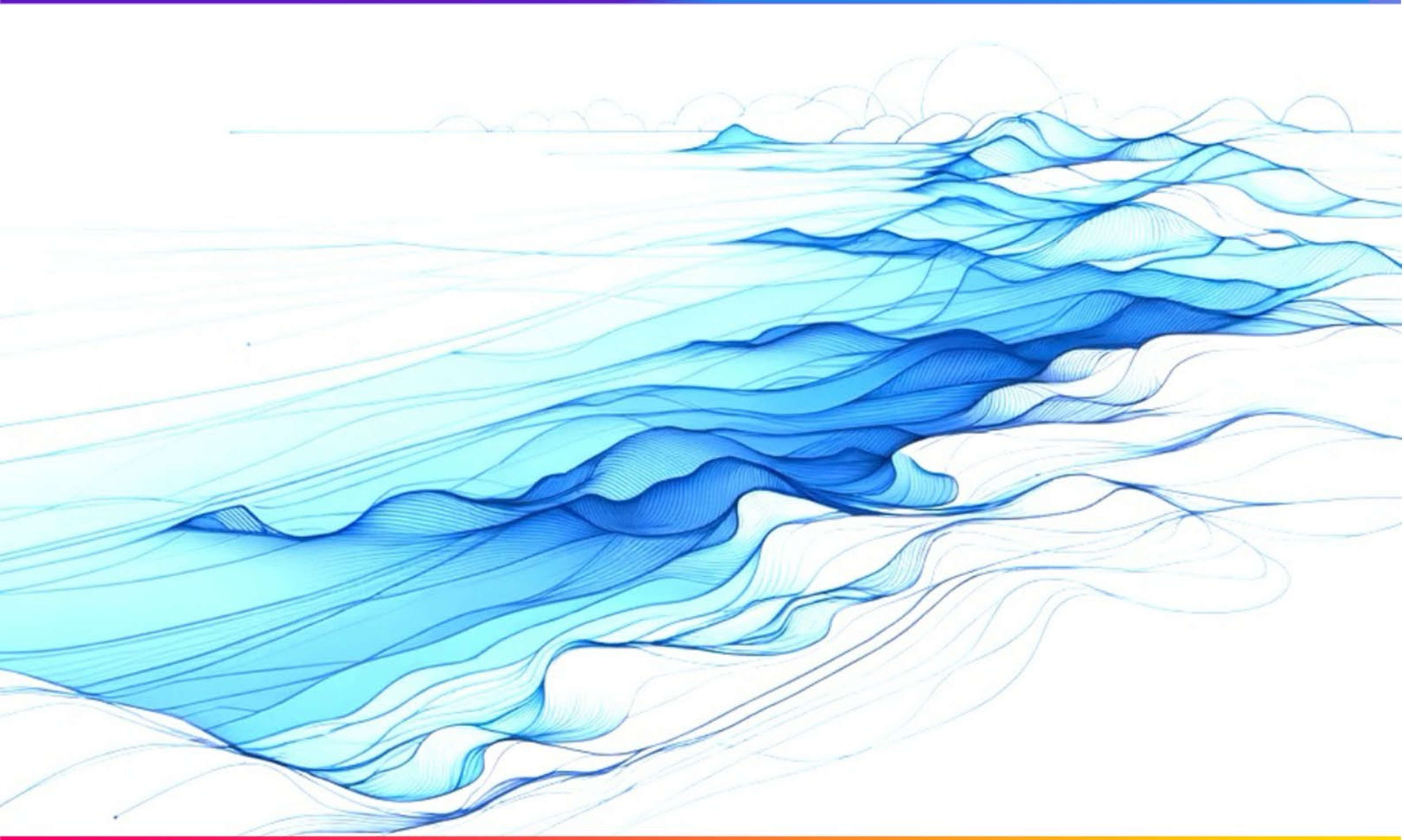

REGIA MSS

Environment Plan

Public

June 2024

[Video Instructions for Navigating Environment Plan]

Executive Summary

The Regia Marine Seismic Survey (**Regia MSS**) Environment Plan (**EP**) is a detailed document that explains how the environmental management approach taken by CGG Geophysical Services Pty Ltd (**CGG**) complies with the prevailing regulatory requirements. The regulations allow the National Offshore Petroleum Safety and Environmental Management Authority (**NOPSEMA**) to permit the Regia MSS. CGG is seeking such permission to carry out the activity as specified in this document and its appendices.

CGG propose to undertake a three-dimensional (**3D**) marine seismic survey in the Otway Basin, in Commonwealth waters offshore from Victoria. The activity aims to gather data on the structure and composition of geological formations for the purpose of identifying petroleum resources.

The EP has been uniquely structured to address feedback related to the digestion of large and complicated environmental approval documents presented by titleholders. Further, the content is slightly more educational than a typical EP because many of the consultations revealed a need to fully describe the regulatory requirements, share NOPSEMA guidance, and explain environmental management concepts such as reducing impacts and risks to as low as reasonably practicable (**ALARP**) and to an acceptable level.

By having a concise EP document and extended, comprehensive appendices, CGG aims to simplify the assessment processes for NOPSEMA, the public, and relevant persons. For NOPSEMA, areas of contention or focus are more easily accessible through the shorter, separate appendices, rather than reviewing a long singular document. For the public, this format is easier to digest, encouraging more readers, inviting more public comment, and potentially helping to identify more relevant persons. For relevant persons identified in preparation of this Environment Plan, the parts of the EP addressing their functions, interests or activities and subsequent objections, feedback and claims are located more quickly and easily through the specific appendices.

A significant feature of the preparation of this EP was the consultation process initiated by CGG on February 4, 2023. This process involved engaging with over 900 community members, relevant persons, environmental experts, government agencies, and regulatory bodies. The objective was to incorporate diverse perspectives and concerns into the plan, ensuring that the design of the survey and the mitigation of its adverse effects are well-informed and community inclusive. A public comment period on this EP received 14,879 submissions. Within those submission there were 653 unique submission and 905 specific claims considered as inputs into the environmental management planning process.

The EP has two parts. The first part discusses the specific criteria that must be met to gain acceptance from NOPSEMA. It focuses on demonstrating that the criteria for acceptance have been met. The second part of the EP covers the content requirements specified in the Regulations. These are the component parts of an environmental impact and risk assessment, and it covers aspects such as marine wildlife protection, pollution control, sound reduction, and emergency response protocols. The second part also explains how CGG will ensure the effective implementation of the EP. This includes regular environmental audits, feedback mechanisms, and adaptive management practices to address any deviations from the predicted levels of impact and risk.

Overall, the Regia MSS EP represents a contemporary, proactive, and inclusive approach to environmental management. It showcases CGG's commitment to sustainability, community engagement, and adherence to stringent environmental standards, setting a comprehensive framework for conducting environmentally responsible marine surveys.

Document Structure and Map

This document has been structured to show the evolution of the content over time, in consultation with relevant persons and the broader community. The structure shown in Figure F1-1 is hyperlinked and bookmarked so it can be accessed to easily navigate the EP. Video instructions are available to further assist readers in navigating the EP and can be found here.

Regia MSS Environment Plan

Document Map and Outline of the Environmental Assessment Process

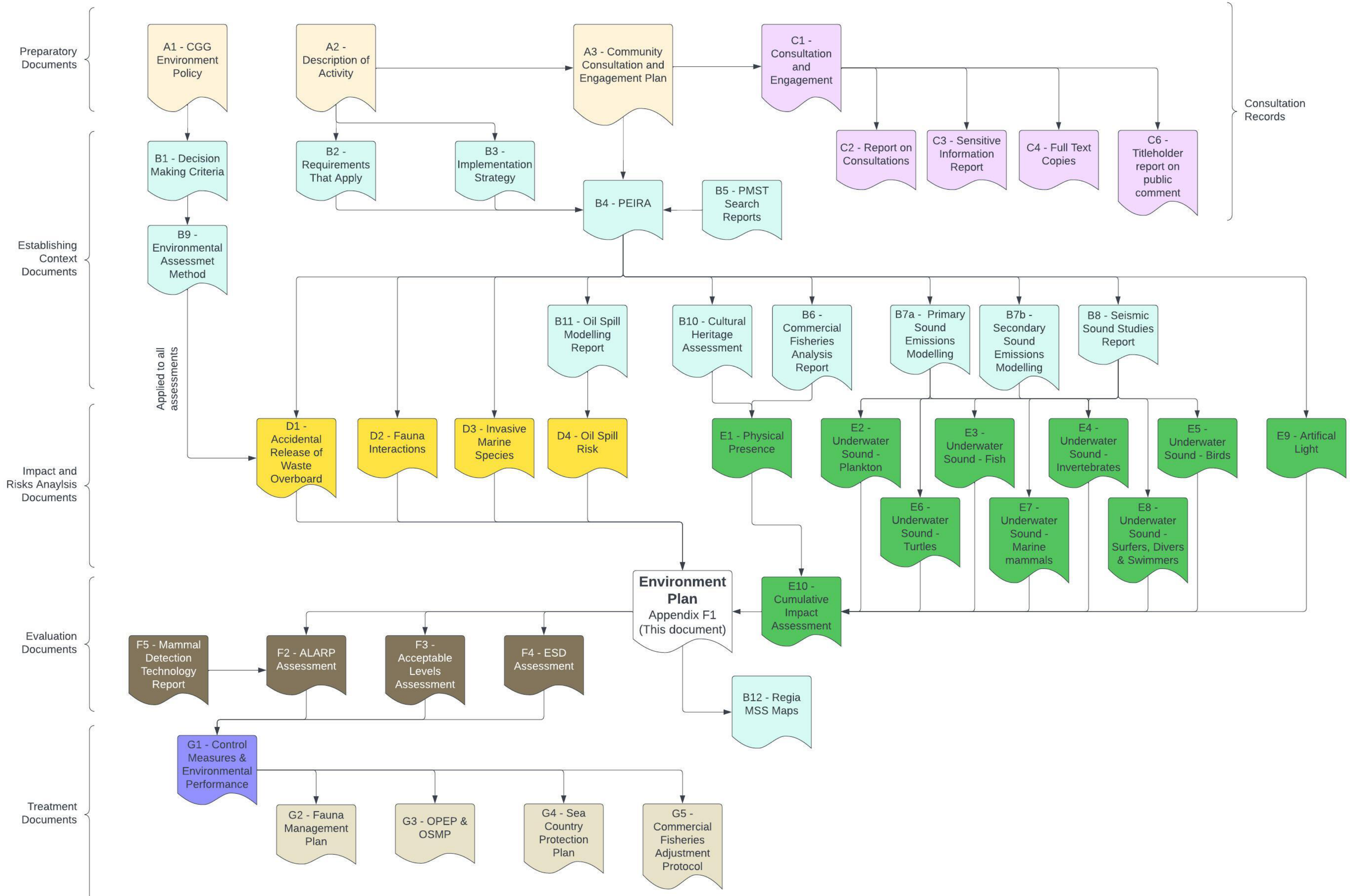

Figure F1-1 - Regia MSS Environment Plan Document Map

Table of Contents

1 Introduction

Welcome to the Regia Marine Seismic Survey (**Regia MSS**) Environment Plan (**EP**). This document is made to adhere to the guidelines and regulations set forth for environment management in the *Offshore Petroleum and Greenhouse Gas Storage (*Environment*) Regulations 2023* (**the Regulations**). To enhance clarity and understanding this EP is divided into two distinct parts.

1.1 Part 1: Criteria for Acceptance of an Environment Plan

The first part is dedicated to addressing the criteria for acceptance of an EP. This section of the EP explicitly seeks to address the NOPSEMA Decision-Making Guideline (N-04750-GL1721). This part underscores the critical nature of these criteria as the backbone of regulatory assessment, ensuring that environmental impacts and risks are not merely identified but also rigorously mitigated and managed in accordance with the highest standards of environmental protection and sustainability.

The narrative within this part respects the separate yet interdependent roles of the titleholder and the regulator. It is incumbent upon the titleholder to demonstrate, with exacting precision and thorough documentation, the compliance of their EP (and ultimately the petroleum activity) with each specified criterion. This demonstration must encompass detailed evidence and a robust justification of the strategies employed, adhering to the principle that the burden of proof lies squarely with the titleholder.

In contrast, the regulator's role is executed through a lens of critical evaluation and verification. The regulator will rigorously test the titleholder's assertions, ensuring that the EP not only meets the letter of the law but also embodies the spirit of environmental stewardship and responsibility. This process is fundamental in maintaining the integrity of the regulatory framework, ensuring that compliance is not a mere formality but a substantive demonstration of environmental stewardship.

1.2 Part 2: Contents of Environment Plan

The second part is dedicated to meet the content requirements of an EP as stipulated by Regulations 20 to 24. This part is significant because it lays out the foundational aspects of the EP, ensuring that all activities are systematically assessed and managed in accordance with recognised standards. In this case, ISO AS/NZS 31000 is adapted into the environmental assessment process contained in Appendix B9.

In this section of the document, we delve into each regulation in detail, starting with the overarching purpose of the EP, the environmental assessment process, and the implementation strategy. We also cover the crucial aspects of documenting the titleholder's details and additional information necessary for a comprehensive EP.

Significantly, throughout this part, there are references to numerous documents that substantiate our claims of meeting each regulation's specific requirements in detail. These documents were published on the Regia MSS Consultation Hub and have been available for comment from the public, in some cases for more than 8 months. These documents provide additional depth and context to this EP, showcasing the comprehensive approach to environmental stewardship and compliance. By doing so, we ensure that every aspect of this EP is not only in line with the regulatory framework but is also supported by relevant and authoritative documentation.

This structured approach is aligned with the 'plan – do – check – act' cycle of systematic environmental management, emphasising our commitment to a holistic and sustainable approach to environmental stewardship. It enables readers to grasp the intricate components of the EP, ensuring clarity and a focused understanding of each aspect's relevance and interconnectivity.

1.3 Why This Two-Part Structure is Necessary

This structure acknowledges that there has been an environmental assessment process undertaken by CGG Geophysical Services Pty Ltd (**CGG**), over several months, with numerous studies, reports, and analysis' which supported that process. The compilation of these studies into one document becomes unmanageable for the public to digest, particularly in a 30-day public comment period. Therefore, this EP functions in the same way as an environmental impact statement would and provides information about the environmental assessment process undertaken, with signposts to further information relevant to a reader's interests.

Further, the rationale for splitting the EP into these two parts with a series of supporting appendices enhances:

- **Clarity and Focus**: By separating the content requirements from the acceptance criteria, we enable readers to concentrate on specific aspects of the EP without being overwhelmed by its entirety.
- **Plainness**: This division allows for a more structured and systematic approach to understanding the EP. Each part addresses distinct yet interrelated components, making the information more digestible and accessible.
- **Targeted Implementation**: The split facilitates a targeted approach towards both the creation and review of the EP. Readers can align their efforts more effectively by understanding the nuances of what the plan entails and how it is evaluated.
- **Compliance and Beyond**: While compliance with regulations is paramount, this structure also underscores our commitment to going beyond mere compliance. It demonstrates our dedication to environmental excellence and sustainable practices.

The structure of the EP is such that maps are used sparingly in the text only where they contribute to the logical flow of information. The full collection of supporting maps can be found in Appendix B12 and we advise readers to open the EP twice so that maps may be sighted as and when your own logical flow desires a spatial representation of what is being described.

In conclusion, this two-part structure of the EP is not just a compliance-driven choice but a strategic approach to ensure that our environmental planning is both comprehensive and easily understandable. It reflects our commitment to transparency, excellence in environmental management, and our unwavering dedication to a sustainable future.

2 Purpose of the Environment Plan

CGG propose to undertake a three-dimensional (**3D**) marine seismic survey in the Otway Basin, in Commonwealth waters offshore from Victoria. Hereafter, this activity will be referred to as the Regia MSS. The Regia MSS provided for in this EP is proposed to be carried out within the Operation Area defined in Appendix A2 and shown in Figure F1-2. This EP allows for the activity to be undertaken during a near 5-year period, between 1 April 2024 (subject to acceptance of this EP by NOPSEMA) and 31 December 2028.

This EP has been prepared to ensure the Regia MSS is planned and undertaken in accordance with CGG's Health, Safety and Environment Policy (HSE Policy), which can be found at Appendix A1. The EP has also been prepared to comply with the requirements of the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (**OPGGS Act**) and the Regulations.

2.1 Purpose and Objectives

In accordance with the requirements of the Regulations, the purpose of this EP is to demonstrate that the Regia MSS will be caried out in a manner:

- consistent with the principles of ecologically sustainable development set out in Section 3A of the EPBC Act; and
- by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable; and
- by which the environmental impacts and risks of the activity will be of an acceptable level.

This includes assessing the environmental impacts and risks to the environmental values and sensitivities within the receiving environment, including people and communities, and the social, economic, and cultural features of that environment.

Preparation of this EP has resulted in the adoption of controls measures and operational procedures to be implemented to reduce the potential adverse environmental impacts and risks associated with the Regia MSS to ALARP and to acceptable levels.

Environmental performance is covered in this EP to ensure that the control measures adopted in this EP are effective throughout the duration of the EP. The objective of the proposed activity is to provide a 3D data coverage and improved subsurface imaging within the Otway Basin. The new 3D data will provide an improved understanding of the subsurface, which to-date has been limited to 2D data coverage. Ultimately the new data will provide improved confidence in mapping major geological structures aiding in the identification and de-risking of petroleum prospectively across the active source area (**ASA**).

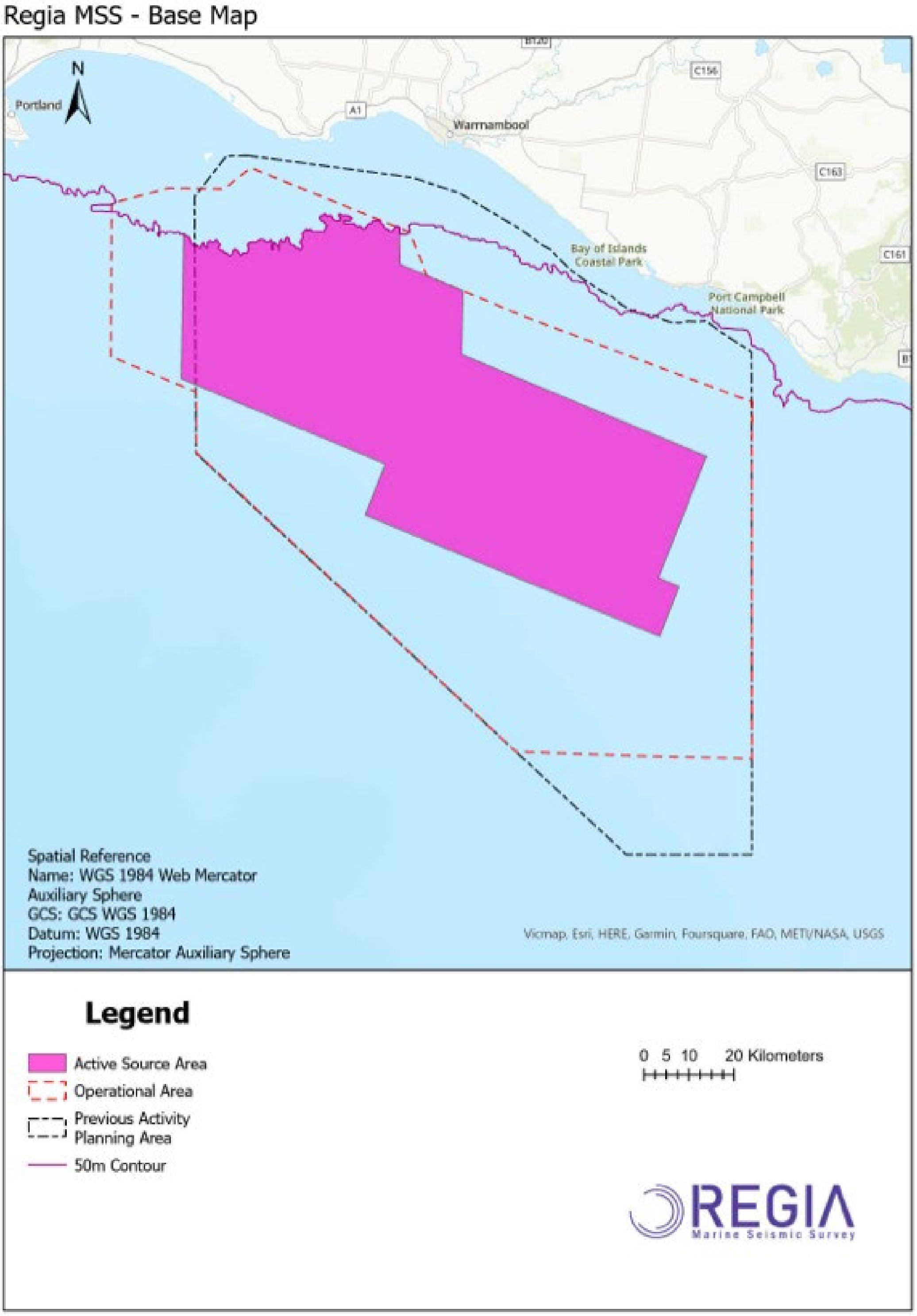

Figure F1-2 - Base Map: Proposed Operational Area and Active Source Area (MAP-REG-EPM-040)

2.2 Scope of the Environment Plan

The scope of this EP addresses the petroleum activity – a marine seismic survey - and associated activities as described in Appendix A2. Of relevance, the scope of this EP covers 3D seismic data acquisition and associated line turns, run-ins, run-outs, seismic testing, and support activities within the defined Operational Area (**OA**). The petroleum activity is defined as commencing at the point when the seismic vessel is within the defined OA and the source is deployed, until the seismic source has been retrieved and the seismic vessel departed from the OA, following completion of the survey. The scope of this EP does not include the periods when the seismic vessel or support vessels are not within the OA, such as during maintenance activities outside of the OA, port calls, crew changes, inclement weather avoidance, or vessel mobilisation/demobilisation to/from the OA. During these periods the project vessels are deemed to be operating under the Commonwealth Navigation Act 2012 and are not managed within this EP.

2.3 Structure and Organisation of the Environment Plan

This EP has been developed in accordance with the environmental assessment process detailed in Appendix B9 and in parallel to the consultation process detailed in Appendix A3, which was adapted as per Appendix C1. For readers wishing to appreciate the entire EP, the document map in Figure F1-1 shows the links between appendices and the flow in which they were prepared. If reading this EP in full, CGG recommends reading within the workflows shown by the arrows. Each document that supports this EP was prepared and published at the appropriate step (See Appendix C1, Table C1-6).

Reference to Regulations and Sections within those Regulations are for the *Offshore Petroleum and Greenhouse Gas Storage* (Environment) *Regulations* 2023, unless otherwise stated.

Table F1-1 - Documents published within each process step.

Assessment Process Step	Documents Published	Appendix
Preparation of the EP	CGG Environmental Policy	A1
	Description of Activity	A2
	Community Consultation and Engagement Plan	A3
Establish the Context	Decision-Making Criteria	B1
	Requirements that Apply	B2
	Implementation Strategy	B3
	Preliminary Environmental Impact and Risk Assessment	B4
	PMST Search Reports	B5
	Commercial Fisheries Analysis Report	B6
	Initial Modelling Report – Sound Emissions	B7a
	Secondary Modelling Report – Sound Emissions	B7b
	Seismic Sound Studies Report	B8
	Environmental Assessment Method	B9
	Biosis Otway Exploration Cultural Heritage Desktop Assessment	B10
	Oil Spill Modelling Assessment	B11
	Regia MSS Maps	B12
Risk Analyses	Accidental Release of Waste Overboard	D1
	Fauna Interactions	D2
	Invasive Marine Species	D3
	Oil Pollution	D4
Impact Analyses	Physical Presence	E1
	Underwater Sound - Plankton	E2
	Underwater Sound - Fish	E3
	Underwater Sound - Birds	E4
	Underwater Sound - Invertebrates	E5
	Underwater Sound - Turtles	E6
	Underwater Sound – Surfers, Divers and Swimmers	E7
	Underwater Sound – Marine Mammals	E8
	Artificial Light	E9
	Cumulative Impacts	E10
Impact and Risk Evaluation	Environment Plan (this document)	F1
	ALARP Assesment	F2
	Acceptability Assessment	F3
	ESD Assessment	F4
	Mammal Detection Report	F5
Impact and Risk Treatment	Environmental Performance	G1
	Fauna Management Plan	G2
	Oil Pollution Emergency Plan and Operational and Scientific Monitoring Plan	G3
	Sea Country Protection Plan	G4
	Commercial Fisheries Adjustment Protocol	G5
Consultation	Relevant Persons Consultation Chapter	C1
	Report on Consultations	C2
	Consultation Materials – Superseeded, now found in C2	C5
	Titleholders Report on Public Comment	C6

Regia MSS EP Part 1: Criteria for Acceptance of an Environment Plan

3 Objectives and Scope

Part 1 of the EP is a comprehensive justification for why CGG believes that NOPSEMA can be reasonably satisfied that the Regia MSS EP meets the criteria for acceptance set out in Section 34. This part is an evaluation of whether reasonable person charged with assessing the EP should be reasonably satisfied that each of the criteria in Section 34 have been met.

A key feature of this part is the discussion on the application of the term 'reasonably satisfied' in the context of NOPSEMA's decision-making process. This consideration reveals the balance between objective assessment and subjective judgment, demonstrating how CGG has applied discretion in its environmental assessment process, considering the unique environmental, social, and economic contexts of the Regia MSS. Furthermore, this part provides insights into how CGG interpreted and adhered to these criteria to achieve regulatory compliance because it has been written as part of the evaluation step in the environmental assessment process.

Throughout this part, the public and relevant persons will gain a clearer understanding of the regulatory landscape, the role of discretion in environmental assessments, and the responsibilities of titleholders in aligning their operations with these regulatory standards.

4 Public Comment

NOPSEMA invited comments on the Regia MSS EP at midnight on 25 January 2024 for a period of thirty days. 14,848 comments were received from a single petition email with embedded unique claims from submitters. A further 51 submissions were received through the NOPSEMA portal. Once the public comment period closed, NOPSEMA gave CGG a copy of the comments as per Section 30(2). CGG has considered each of the submissions made and, where appropriate, made modifications to the EP.

CGG has given NOPSEMA a written statement responding in general terms to the comments and indicated where any modifications to the EP were made in response to the comments. This written statement has been given to NOPSEMA separately to the EP to facilitate publication under Section 30(5).

The written statement is extensive, reflecting the large number of comments received. Therefore, CGG has prepared Appendix C6 as a summary of the full written statement for inclusion in the EP so that inputs from the public comment process can be shown to have directly contributed to the EP. Further, each relevant Appendix of this EP has been reviewed considering the comments and a new section added to show how relevant comments have been incorporated into the EP. Table F1-2 shows how the Matters raised during public comment have been incorporated into the EP in this document.

Whilst this additional work is not explicitly requirement of the Regulations, CGG believes it demonstrates our commitment to transparency and inclusivity. It also aims to assist NOPSEMA because all comments received must be considered (Section 30(6)) in deciding whether to accept the EP under Section 33.

Table F1-2 - List of changes arising from public comment matters

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Impacts to juvenile seals	M30	Updates have been made to EP Appendix E7 Section 6.4, Section 8), and EP F1 (Environmental Plan)
Matter: Displacement of Deen Maar and Portland seal colonies	M31	CGG has made updates to EP Appendix E 7 Sections 4.1, 6.4, 7, and 8., and EP Appendix F1 (Environmental Plan).
Matter: Operational Buffer around Deen Maar	M32	CGG has made updates to EP Appendix E7 Sections 6.4, 7 and 8, and EP Appendix F1 (Environmental Plan).
Matter: Insufficient mitigation measures for seals and sea lions	M33	CGG has made updates to EP Appendix E7 Sections 6.4, 7 and 8 EP Appendix F1 (Environmental Plan).
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

5 Overview of the Criteria for Acceptance

Section 34, as interpreted in NOPSEMA's Decision-Making Guidelines, represents a comprehensive set of criteria that are vital to the environmental management and regulatory compliance of offshore petroleum activities. This section forms the bedrock upon which NOPSEMA assesses whether the environmental impacts and risks of a proposed activity are permissible and in line with both the Regulations and the broader principles of Ecologically Sustainable Development (**ESD**).

In Section 33, the standard of 'reasonably satisfied' that the criteria for acceptance have been met ensures that NOPSEMA's decisions are based on substantial evidence, comprehensive risk assessments, and a rigorous evaluation process. The decisions must also align with the principles of ESD, which are an object of the Regulations.

The application of 'reasonably satisfied' in regulatory practice is also informed by the precautionary principle, which posits that a lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation when there are threats of serious or irreversible damage. This principle, which is a key component of ESD, influences the standard of proof by mandating a cautious approach when potential risks to the environment are not fully understood.

The standard of being 'reasonably satisfied' represents a specialised threshold of belief, shaped by legal precedents and the principles of ESD, which guides NOPSEMA's acceptance of EPs. It necessitates a high degree of confidence in the environmental management and risk mitigation measures outlined in the EP, ensuring that the activities it covers will not result in unacceptable environmental harm.

The criteria for acceptance of an EP are essential for several reasons:

- **Standardisation:** They provide a standardised framework for environmental assessment, ensuring that all titleholders adhere to a consistent set of expectations.
- **Protection:** These criteria are designed to protect the marine environment by ensuring that activities do not proceed unless their impacts and risks are reduced to ALARP and to an acceptable level.
- **Transparency:** They create transparency in decision-making processes, offering a clear basis for NOPSEMA's evaluations and decisions.
- **Accountability:** Titleholders are held accountable for the environmental impacts and risks of their activities, where the burden of proof is place on the titleholder with clear requirements for documentation and evidence.
- **Continuous Improvement:** The criteria encourage continual improvement in environmental performance by requiring that impacts and risks are managed and reassessed over time.

Titleholders and NOPSEMA utilise the criteria for acceptance of an EP differently. CGG has used these criteria as a guideline to prepare this EP and prepare to carry out the activity. The criteria informed the environmental assessments, the selection of control measures, and the development of environmental management strategies. CGG has the duty to demonstrate compliance with these criteria in their EP submissions.

For the regulatory body, these criteria form the basis for assessing and accepting an EP. NOPSEMA assesses the adequacy of the titleholder's environmental impact and risk assessments, the effectiveness of their environmental management strategies, and the overall suitability of the EP for the proposed activity.

The application of the criteria for acceptance within the EP assessment process is a nuanced exercise that extends beyond a mere tick-box approach. While Section 34 provides criteria against which an EP must be assessed, the language used within the regulatory framework inherently allows for a certain degree of discretion in decision-making.

Within the parameters of the legislation, NOPSEMA's decision-making process is guided by principles of administrative decision-making that permit a holistic and flexible approach to assessing, and accepting, an EP. The term 'reasonably satisfied' suggests that NOPSEMA must consider the entirety of the situation, including the environmental setting, the predicted impacts and risks, and the mitigation, monitoring, and management measures proposed by CGG. It acknowledges that environmental assessments are complex and multifaceted, often requiring judgment calls based on professional expertise, scientific evidence, and best practice standards in environmental management. This subjective aspect of Section 34 is critical for several reasons:

- **Contextual Evaluation:** It allows consideration of specific contexts of each proposed activity, recognising that environmental settings vary and that a one-size-fits-all approach may not be appropriate for all cases.
- **Adaptive Management:** Discretion in decision-making supports adaptive management practices. As new information becomes available or as situations evolve, assessment can adjust, accordingly, ensuring that EP decisions remain relevant and effective.
- **Quality of Judgement:** The discretionary language ensures that decision-making is not just about compliance but also about the quality of judgment and reasoning behind how environmental impacts and risks are proposed to be managed.
- **Community Confidence:** By moving away from a rigid checklist, NOPSEMA and titleholders can address relevant person concerns more effectively, ensuring that decisions are made with an understanding of the complexities involved and the potential for varying interpretations of risk and impact.
- **Continual Improvement:** Decision-making discretion facilitates continual improvement, as titleholders are encouraged to not only meet minimum standards but to also strive for best practice in environmental management, reflecting an ongoing commitment to reducing environmental impacts and risks.

The importance of regulatory criteria like Section 34 lies not only in their role as standards but also in their function as tools for informed, flexible, and adaptive decision-making. This approach is integral to the environmental assessment process, allowing for a balance between the predictability necessary for business operations and the flexibility needed to manage diverse environmental scenarios.

6 Detailed Assessment of Each Criterion

There follows a discussion of the facts and reasons that support CGG's belief that each criterion for acceptance of the EP has been met.

6.1 The EP is appropriate for the nature and scale of the activity.

The EP is appropriate to the nature and scale of the activity because it demonstrates a comprehensive understanding of the proposed activity (Appendix A2) and its environmental context. This understanding is evident in Appendices B5, B6, B8 and in the descriptions of the existing environment relevant to each environmental aspect, in the detailed analysis for each environmental aspect arising from the activity (Appendices D1 – D4 and E1 – E9), and in the proposed management of environmental impacts and risks associated with the activity (Appendix G1 – G5).

In the impact and risk analysis carried out, CGG has ensured that the relevant values and sensitivities of the existing environment have been described, using relevant references and information sources. These descriptions have included the social, economic, and cultural features of ecosystems and their constituent parts, the physical resources, qualities and characteristics of locations, places and areas, and the heritage values of places. In doing so it is evident that matters protected under Part 3 of the EPBC Act are adequately described utilising relevant information, including information available on the DCCEEW website such as plans of management, threat abatement plans, threatened species recovery plans and marine bioregional plans.

Therefore, the EP contains a level of rigor, effort, content, and detail that aligns and exceeds the complexity and scale of the proposed operations. It provides robust supporting predictions, analyses, and conclusions about environmental impacts and risks, ensuring that all aspects of the activity's interaction with the environment are thoroughly evaluated and addressed. Each assessment of impacts and risks was scaled commensurate with the magnitude of effect/consequence. This is evidenced in the screening of lower order (negligible) impacts and risks performed in the PEIRA (Appendix B4) and the series of additional studies (e.g. sound modelling report (Appendix B7a and B7b), detection technologies report (Appendix F5) etc.) undertaken for higher order, or more uncertain impacts and risks.

The legislative and other requirements were at forefront of the environmental assessment process and have been considered at every step in that process. This is evidenced in the EP in Appendix B2 which considered the legislative and other requirements in the context of the activity. This is further proven in each environmental analysis (Appendices D1 – D4 and E1 – E9) when the environmental aspects of the activity were the context of considering relevant legislative and other requirements.

The EP has also been scaled in response to feedback from relevant persons as evidenced by additional studies, for example, the additional assessments undertaken of key environmental values and sensitivities in Appendix F3, and dedicated studies relevant to the principles of ESD (Appendix F4), and the reduction of risks to ALARP (Appendix F2).

Furthermore, the EP outlines clear and effective control measures tailored to mitigate identified risks and impacts, indicating that the EP is not only reactive but also proactive in its approach to environmental management. The methodologies and strategies employed in the EP for monitoring, mitigating, and managing environmental impacts are consistent with the latest industry standards and best practices, demonstrating a commitment to environmental stewardship.

In summary, the EP's content reflects a deep level of understanding and response to the environmental impacts and risks arising from the activity, with the control measures employed being suitably scaled and detailed for the nature of the operations.

6.2 The EP demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable.

The EP demonstrates that the environmental impacts and risks of the activity will be reduced to ALARP because it meticulously evaluates all reasonably conceivable control measures, particularly for higher order impacts and risks, and clearly shows the exploration of alternative, additional, or improved control measures (Appendix F2). It details how the assessment of impacts and risks has directly informed the selection of suitable control measures aimed at diminishing either or both effect/consequence or uncertainty/likelihood of the environmental impacts and risks of the activity.

Moreover, the EP provides comprehensive details of each control measure to substantiate their effectiveness in mitigating impacts and/or risks throughout the duration of the EP. Each control measure is evaluated against criteria of functionality, availability, reliability, survivability, independence, and compatibility with other measures, ensuring a multi-faceted approach to risk management, as evidenced in Appendix G1.

Furthermore, the management and mitigation measures delineated within the Regia MSS EP are not arbitrary but are founded on well-established environmental management principles and industry best practice. These measures have been tested and validated in similar contexts (i.e. in other seismic survey EPs), providing a level of confidence in the accuracy of the predictions and confidence in the effectiveness of control measures. Scalability in the adaptive response actions reinforce the robustness of the environmental assessment, as evidenced in Appendix G2.

In terms of economic considerations, Appendix F2 provides a methodical semi-quantitative evaluation process that weighs the environmental benefits of mitigation and management measures against their implementation costs. The methodology for this evaluation is systematic, thoroughly applied, defensible, and reproducible, providing a transparent and rational basis for the design of the activity and the selection of control measures.

Finally, the EP reflects a consultative approach, incorporating and evaluating information gathered from relevant person consultations and public comment. This is evidenced in Appendix G1 where each control measure has been evaluated considering the subject-centred groups it reduced exposure to, and whether an environmental performance standard was adopted because of the consultations, or not. This ensures that the EP is not only comprehensive but also considerate of the insights and concerns of all relevant persons.

6.3 The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level.

Multiple methods have been used to demonstrate that the environmental impacts and risks of the Regia MSS will be of an acceptable level. These are:

1. Comparison of predicted levels of impact and risk to pre-defined acceptable levels.
2. Further assessment of key environmental values and sensitivities.
3. Compliance with the EPBC Act.
4. A search for unacceptable environmental impacts.
5. Consideration of predictive uncertainty.

The subsequent subsections explain why these separate demonstrations provide confidence in the environmental assessment process and the outcome of that process.

6.3.1 Comparisons of acceptable levels of impact and risk to predicted levels.

The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level because CGG defined acceptable levels within a reasonable context that includes internal and external factors, legislative requirements, and industry standards. These acceptable levels of environmental impact and risk are specifically tailored to be appropriate and relevant to the environmental components of the Otway marine estate that may be affected by the activity. The public and relevant persons were given the opportunity to influence the defined acceptable levels.

Additionally, the EP establishes that the acceptable levels are attainable by comparing them to the predicted levels of impact and risk. This comparison is grounded in a methodical approach, ensuring that the process is systematic, thoroughly applied, defensible, and reproducible. The content of Appendices D1 – D4 and E1 – E10 reflect careful consideration of the activity-specific decision-making criteria established for the activity and principles of ESD.

6.3.2 Further assessment of key environmental values and sensitivities

In Appendix F3 we present analysis that reveals the relative impacts of seismic survey activities on key values and sensitivities within the Otway marine environment. These key matters were selected either because of the consultations or because the species has an elevated level of protection under the EPBC Act. The key values and sensitivities further assessed were, in no order:

- **Southern Right Whales** (e.g. Event ID's 653, 3237, 3384, 3697, 3678, Person ID 1163[1])
- **Blue Whales** (e.g. Event ID's 3697, 653, 2901, 3384, and Org 181)
- **Southern Rock Lobster** (e.g. Event ID's ID 2774, 3228, 653, 1742, 2886, 1529, 4107, 1815)
- **Giant Crab** (e.g. Event ID's 653, 1742, 1892)
- **Glass Eels** (e.g. Event ID's 3697, 3237, 3678)
- **Gould's Squid** (e.g. Event ID's 3237, 4107)
- **Pale Octopus** (Octopus pallidus) (Public Comment Matter F11, F12)
- **Blacklip Abalone** (Haliotus rubra) (Event ID's 906, 908, 948, 1742, 2078, 2093, 2095, Public Comment Matter F1, F12, F16, F17)
- **Pink Snapper** (Chrysophrys auratus) (Public Comment Matter F11, F12, F19)
- **King George Whiting** (Sillaginoides punctatus) (Event ID 4355, 4433, Public Comment Matter F12, F14, F19
- **Plankton Communities** (e.g. Event ID's 3697, 3182, 3237, 3384)
- **Commercial Fish Spawning Patterns** (e.g. Event ID's 1529, 2774, 2886)

In each case the assessment focused on the cause-effect pathway of most concern – elevated levels of sound. These assessments systematically evaluate the effects of seismic acoustic disturbances in comparison to other environmental threats and pressures. Our findings suggest that the acoustic signals associated with short-term seismic surveys exhibit minimal and non-significant impacts at population levels when compared to the baseline variability induced by larger-scale environmental processes.

The research included a comprehensive review of the existing peer reviewed literature, grey literature, and feedback from relevant persons. Through this integrative approach, we concluded (in general

[1] See Appendix C3 for sensitive information regarding cultural significant of Koontapool.

terms) that the minor and temporary impacts to populations brought by seismic surveys are often indistinguishable from the pre-existing effects attributed to other large-scale oceanic pressures, such as those from commercial shipping, climatic events, recreational and commercial fishing, and human marine activities.

It was critical to contextualise the scale and duration of impacts associated with seismic activities within the broader scope of anthropogenic and natural influences on marine ecosystems. The discourse within the scientific community predominantly centres on the repercussions of large-scale changes driven by global phenomena — such as climate change, ocean acidification, and overfishing — which are identified as principal factors contributing to irreversible shifts in population dynamics and key ecosystem functions.

Our analysis posits that while the Regia MSS will contribute to the cumulative effects to and within marine environments, the magnitude of their contribution relative to other sources remains immeasurably low. The temporal and spatial extent of seismic-induced disturbances are bounded and often rapidly attenuated, eliminating the likelihood of significant impacts, and ensuring that the formal precautionary trigger of serious or irreversible environmental harm is not met.

6.3.3 Compliance with the EPBC Act

The primary environmental legislation within Australia is the *Environmental Protection and Biodiversity Conservation Act* 2002 (**EPBC Act**). NOPSEMA's authorisation processes have a Part 10 approval applied to offshore petroleum activities as per the NOPSEMA EPBC Act Program. This program ensures that impacts on matters protected under Part 3 of the EPBC Act are not unacceptable.

Matters protected by the EPBC Act that have been considered in this EP include:

- World Heritage properties (see Section 6.6).
- National heritage values of declared National Heritage Places.
- Wetlands of international importance.
- Listed threatened species and ecological communities.
- Listed migratory species.
- Commonwealth marine environment.

Each impact and risk analyses has considered these matters and provides evidence that the proposed activity is not in conflict with any recovery plans or threat abatement plans for listed threatened species or ecological communities. It respects the management plans in place for Commonwealth reserves, such as Australian Marine Parks, and upholds the Australian IUCN Reserve Management Principles. It shows that the activity will not have unacceptable impacts on the values of these protected areas.

Moreover, the EP content confirms that the proposed activity does not contravene any management plans for World Heritage properties, National Heritage places, or Ramsar wetlands. In the absence of specific management plans, the EP shows that all reasonable steps have been taken to ensure consistency with the Australian World Heritage Management Principles, National Heritage Management Principles, Australia Ramsar Management Principles, and Commonwealth Heritage Management Principles.

The EP also demonstrates due regard for relevant policy documents, guidance, bioregional plans, wildlife conservation plans, management plans, gazettal instruments under the EPBC Act, conservation advices', marine bioregional plans, and other pertinent information, including spatial data, available on the DCCEEW website.

6.3.4 Search for potential unacceptable impacts

Conducting a search for potential unacceptable impacts within an ecosystem and considering these in the context of the Regia MSS facilitates the identification and prediction of potential negative effects the activity may have on the environment. If the analyses of each impact and risk arising from the activity is a 'bottom up' approach to assessing impacts, the search for unacceptable impacts is a 'top down' approach because it starts by looking at the highest levels of ecosystem health – biological diversity and ecosystem integrity.

This method of demonstrating levels of impact from the Regia MSS provides a useful alternative perspective on the nature and scale of impacts that complements the detailed analyses of the cause effect pathways arising from the activity. By thoroughly searching for and addressing unacceptable impacts, the environmental assessment process supports a demonstration that the impacts of an activity can be managed to a level that is not detrimental to the maintenance of biological diversity and ecosystem integrity, in other words, will be of an acceptable level.

6.3.5 Consideration of predictive uncertainty

Uncertainty of the extent, severity, and duration of environmental impacts has been systematically considered each phase of the assessment process. In instances where uncertainties exist, the EP does not shy away from acknowledging these gaps in knowledge. Instead, it approaches them with a structured plan to manage and, if necessary, mitigate such uncertainties. This proactive stance not only reflects a commitment to environmental stewardship but also aligns with a precautionary approach to environmental management – a key aspect in the face of scientific uncertainty. Evidence of considering predictive uncertainty is most relevantly presented in each of the impact assessments (Appendices E1 – E9)

Additionally, the EP incorporates and appropriately addresses the information provided during relevant person consultations, ensuring that the views and knowledge of others contributed to the establishment of acceptable levels of impact and risk. This thorough incorporation of diverse inputs and robust evaluation mechanisms provides evidence that all impacts and risks, particularly to protected matters, will be managed to acceptable levels.

6.4 The EP provides for appropriate environmental performance.

Appendix G1 provides for appropriate environmental performance outcomes (**EPO**s), environmental performance standards (**EPS**s), and measurement criteria because there are clear, unambiguous EPOs that are intrinsically linked to acceptable levels of environmental impact and risk (see Annex 3, Appendix G1). The full list of EPO's can be found in Part 2, Section 7.5.

The EPOs are comprehensive, apply to multiple impacts and risks, and ensure that all identified environmental aspects, as well as the cumulative effects on all values and sensitivities that may be affected by the activity, are addressed. The EPOs set within the EP not only reflect achievable levels of environmental performance by CGG, but also adhere to the relevant requirements of the NOPSEMA EPBC Act Program, establishing a standard for management that is both ambitious and attainable. The associated EPSs are directly connected to the control measures and provide clear statements of performance that are not open to misinterpretation.

Furthermore, the EP includes explicit and detailed measurement criteria that can demonstrate whether the desired environmental performance has been achieved. These criteria are designed to confirm that all impacts and risks are maintained at acceptable levels and reduced to ALARP. The EP ensures that the EPOs and EPSs can be easily monitored for compliance, facilitating straightforward oversight and enforcement.

Compliance with established environmental performance standards is a non-negotiable aspect of the Regia MSS EP. The document details rigorous monitoring and enforcement mechanisms that not only track adherence to these standards but also outline clear measures for addressing any deviations. Such a systematic approach to compliance underscores the scientific integrity of the environmental assessments.

Lastly, the EP guarantees that the EPOs, EPSs, and measurement criteria are interlinked and mutually reinforcing, which is crucial for confirming that the predicted level of impact and risk will not exceed the defined acceptable levels. The integration of these components within the EP ensures a cohesive and effective approach to managing environmental performance throughout the duration of the activity.

6.5 The EP includes an appropriate implementation strategy.

The EP includes an appropriate implementation strategy for the Regia MSS because it is grounded in a standardised methodology that CGG has developed and refined over years of successful operations in Australia, as stated in Appendix B3. This implementation strategy is designed to fulfill the specific requirements of Section 22(1), which demands a comprehensive approach to environmental performance management throughout the lifecycle of the activity.

Appendix B3 showcases that for the duration of the Regia MSS, CGG has established specific measures and arrangements to ensure that all environmental impacts and risks are continually identified and reduced to ALARP. Appendix G1 details control measures that are not only effective in mitigating environmental impacts and risks to ALARP and acceptable levels but also demonstrates that the EPOs and EPSs outlined within the EP are capable of consistently being met.

Moreover, the EP includes management systems to effectively implement control measures identified in the impact and risk analyses. These systems are designed to ensure that the implementation of control measures is monitored rigorously, thereby continuously reducing environmental impacts and risks to ALARP over time. The implementation strategy also emphasises the importance of ongoing consultation, both prior to and during the seismic survey, and incorporates a process for monitoring, auditing, and reporting environmental performance relative to the activities conducted under the EP.

An integral component of the Regia MSS EP is its adaptive management framework outlined in the environmental management system (described in Appendix B3). This approach is responsive to new data and changing environmental conditions, allowing for the modification of strategies and actions in an evidence-based manner. This ensures that the environmental management strategies are not static but evolve in line with the best available scientific information.

Additionally, Appendix B3 describes arrangements that are in place to respond to and monitor impacts of oil pollution emergencies, thereby ensuring preparedness for potential environmental incidents. Training protocols to ensure that all employees and contractors have the appropriate competencies are also described.

The EP also reflects a commitment to continuous improvement, considering lessons learned from previous activities and inspection recommendations. This iterative learning approach ensures that the implementation strategy remains dynamic and responsive to changing circumstances and emerging best practices.

In summary, the EP's implementation strategy is appropriate for the Regia MSS due to its systematic, evidence-based approach to environmental management, which aligns with regulatory requirements and reflects CGG's operational experience and commitment to environmental stewardship.

6.6 The activity is not being undertaken in a declared World Heritage property.

The Regia MSS is not planned to occur within the boundaries of any World Heritage Property. This has been confirmed through careful planning and consultation with spatial data and environmental sensitivity maps. The survey's location has been chosen to avoid any overlap with areas designated under the World Heritage Convention, ensuring that there is no direct or indirect impact on the Outstanding Universal Value of any World Heritage site.

6.7 The EP demonstrates that consultation have been carried out and the measures adopted because of the consultations are appropriate.

The EP for the Regia MSS demonstrates compliance with the consultation requirements set out in Section 25 because it includes a thorough consultation process which ensured the effective capture and incorporation of input from all relevant persons.

Moreover, the consultative process described in the EP is indicative of a thorough and inclusive approach to consultation. By ensuring that the views and inputs from a broad spectrum of relevant persons and the public have been actively sought and considered, the assessment reinforces its comprehensive nature and the quality of the resultant environmental planning.

Evidence that the consultation has been carried out in accordance with Section 25 can be found in the Appendices C1 – C4 (noting Appendices C3 and C4 are the sensitive information part of the EP). The activities undertaken in preparation of the EP demonstrate that:

- The consultation process is clearly detailed, ensuring broad and inclusive identification of all ascertainable relevant persons, and published at the commencement of EP preparation.
- The nature of the activity, the description of the environment, and the potential impacts and risks have been thoroughly considered when determining the relevance of the activity to relevant persons.
- Appendix C1 and C2 demonstrate that effective consultation has taken place, providing sufficient information and a reasonable period for relevant persons to respond, thereby facilitating a genuine two-way dialogue.
- The consultation methods employed by CGG were designed to be accessible, providing depth and quality of information with the least burden on relevant persons, offering ample opportunity for response, and genuinely considering relevant person views before final decisions are made.
- Feedback obtained through the consultation process is integrated into the EP, effectively informing the identification of environmental values and sensitivities, and contributing to the assurance that impacts and risks are reduced to ALARP and acceptable levels.
- The EP contains a detailed report and full text copies of all the consultation that includes prescriptive elements as per Section 24(b), providing NOPSEMA with sufficient information to objectively determine that the titleholder’s duty to consult has been adequately discharged.

In summary, these elements collectively illustrate that the EP's consultation process has been conducted with due diligence, ensuring comprehensive relevant person engagement and integration of feedback into the environmental planning process.

CGG's consultation methodology could identify each relevant person by capturing sufficiently broad people and information. Once relevant persons were identified, they were invited to tailored consultation and provided with sufficient information and a reasonable period to consult. This documented process helped CGG to inform the description of the environment and mitigate potential adverse effects of the activity, which is demonstrated throughout Appendix C1, throughout this document, and other supporting documents.

A public comment period occurred and previously identified relevant persons made submissions. These submissions were treated as relevant person correspondence. Any previous and new objections and claims were (re)assessed and CGG provided a response to the relevant person. Changes have been made throughout the EP because of the public comment submission. These changes can be seen at the commencement of each Appendix (where relevant). Further information on the public comment process can be found in Appendix C6 and in the separate Titleholders Report on Public Comment (which is not part of the EP).

6.8 The EP complies with the Act and the Regulations.

To meet the criteria of Section 34(h), the EP has demonstrated that the environmental assessment process carried out has resulted in a proposed activity that is consistent with the objectives of the Environment Regulations, including the principles of ESD (see Appendix F4).

The EP contains sufficient information to address each of the content requirements of sections 20-24 with enough clarity, consistency, and detail commensurate with the nature and scale of the activity. This case has been put forward in the Appendices and has been summarised in this document, particularly in Part 2, Sections 6.1 and 6.3.

The EP acknowledges and commits to the requirements of the OPGGS Act to maintain equipment and property brought into the title area and to remove it when no longer in use.

The EP acknowledges and commits to the requirements of the Regulations to notify reportable incidents and the start and end of an activity.

The EP is developed in a manner that is not inconsistent with the statutory and regulatory requirements, as evidenced by the inclusion of all necessary and relevant information pertaining to the activity and its environmental impacts and risks. This is shown further in Part 2 of this EP.

Regia MSS EP Part 2: Contents of Environment Plan

7 Environmental Assessment

On 4 March 2023, CGG published the proposed environmental assessment method. Appendix B9 provides a comprehensive methodology for assessing environmental impacts and risks associated with offshore petroleum activities like the Regia MSS. It outlines a transparent, consultative approach that incorporates best practices in environmental management, complying with relevant legislation. Key elements include the application of the ISO 31000:2009 Risk Management Framework, relevant person communication and consultation, and detailed impact and risk assessment processes.

The methodology emphasises systematic, evidence-based evaluation of environmental aspects and integrates feedback from relevant persons and communities to inform the EP preparation. This document is pivotal in ensuring that environmental impacts and risks are identified, analysed, and managed effectively, aligning with regulatory requirements and stakeholder expectations.

7.1 Description of the Activity

The activity is a marine seismic survey, focusing on acquiring 3D geophysical data in the Otway Basin, an area with a history of hydrocarbon production. Key elements of the activity include the establishment of Environmental and Activity Planning Areas, stringent adherence to environmental laws, and detailed operational plans. The location of the activity is shown in Figure 1 (MAP-REG-EPM-040) and the coordinates of the active source area polygon are in Table F1-3.

Table F1-3 - Active Source Area Coordinates

Point	Longitude	Latitude
1	141° 57' 14.41069241"" E	38° 32' 22.50000959"" S
2	141° 56' 58.56578522"" E	38° 45' 50.56387531"" S
3	142° 21' 17.82349906"" E	38° 53' 44.87649788"" S
4	142° 18' 56.16477525"" E	38° 58' 29.93829630"" S
5	142° 54' 05.13994651"" E	39° 09' 45.98905126"" S
6	142° 56' 24.56062558"" E	39° 05' 08.10161449"" S
7	142° 53' 56.56021341"" E	39° 04' 18.14945527"" S
8	142° 59' 39.74957304"" E	38° 53' 02.83427710"" S
9	142° 30' 27.33890596"" E	38° 43' 34.52251718"" S
10	142° 30' 38.25785422"" E	38° 37' 39.80496139"" S
11	142° 23' 06.42047622"" E	38° 35' 11.53267500"" S
12	142° 23' 00.53681331"" E	38° 31' 47.35909479"" S
Line	Single line joining Point 1 to Point 12 following the 50m bathymetry contour.	

Appendix A2 presents a comprehensive description of the Regia MSS. This document outlines operational and design envelopes, detailing the timing, location, and nature of the activities. The activity encompasses various aspects such as seismic surveying, streamer and sail line operations, sound source specifications, and support activities, all described with relevant environmental parameters. This comprehensive activity description ensures transparency and rigor in assessing environmental impacts and risks, fulfilling the requirements of Section 21(1).

The activity description does not yet contain a description of the final acquisition area. This is partly due to the unavailability of information within which to finalise the geophysical objectives of the survey. As soon as this information is known an acquisition area will be set which is the full fold area that CGG will seek to acquire. Once set, the area may narrow further the project progresses towards operations and during the activity based on weather and other event that cause a prioritisation of acquisition areas. The absence of a defined acquisition area does not invalidate CGG seeking permission for the Regia MSS because:

- Other activity limitations are in place to constrain the activity.
- A spatial limitation for discharge of the sound source exists – the active source area.
- The impact and risk assessment have been completed on a larger area than the future acquisition area – either the original activity planning area or the active source area (plus justified buffers for each impact and risk).
- CGG have committed to implementing an acquisition area as soon as practicable which will be smaller than the active source area.

It is important to note that Appendix A2 serves as the foundational document for ensuring compliance with Sections 17, 18, and 19. It is the definitive guide for the Regia MSS and should be referred to as the primary source of information. In the event of any discrepancies or contradictions between Appendix A2 and other parts of the EP or its appendices, it is to be noted that such inconsistencies are unintentional. In such cases, Appendix A2 prevails and should be considered the authoritative source for compliance and operational guidance. This approach guarantees consistency and clarity in aligning our activities with the regulatory requirements.

7.1.1 Evolution of the Activity Design

CGG undertook a highly consultative approach to the activity design. It involved publishing early versions of the Description of Activity and refining the areas of geological interest based on relevant person input. CGG published updated versions of Appendix A2 throughout the consultation process, with the earliest version being available on the Consultation Hub since 4 February 2022. There is a revision history included in the document which shows the additions made to the document throughout the environmental assessment and consultation processes.

The evolution of the activity included:

- Initially establishing an activity planning area of 7,755 km^2 abutting the State waters boundary with a 155 km environment planning area shown in Figure F1-3 (MAP-REG-EPM-080).
- An initial preference for a summer acquisition window due to:
    - Better weather which would have meant a shorter survey due to less vessel downtime which reduces physical presence impacts and reduced the overall cost of the survey.

- The initial overlap of the activity planning area including overlap with the (then) Southern Right Whale (SRW) reproductive BIA meaning their absence was required to complete the survey[2].

Following initial community information sessions three overriding themes of concerns relevant to the adverse effects of the activity led to the first set of modifications to the proposed activity. The first theme related to the concerns the local communities had for commercial fishing activities which were understood to focus on shallower waters (Feedback 166, 232). The second theme related to the increased levels of biodiversity found in the region in summer months and the importance of the upwelling events to ecological integrity (Feedback 203). The third theme related to effects from elevated levels of sound to SRW (Feedback 74, 48, 160, 164, 231) (), the Australian fur seal breeding colony at Lady Percy Julia Island / Deen Maar (Feedback 97, 222), () and Pygmy Blue Whales (Feedback 48, 160, 231) ().

[2] Note that the Commonwealth government Conservation Management Plan for SRW was under review during the preparation of the EP and the SRW BIA changed twice on the National Conservation Atlas which contributed to the evolution of the activity design.

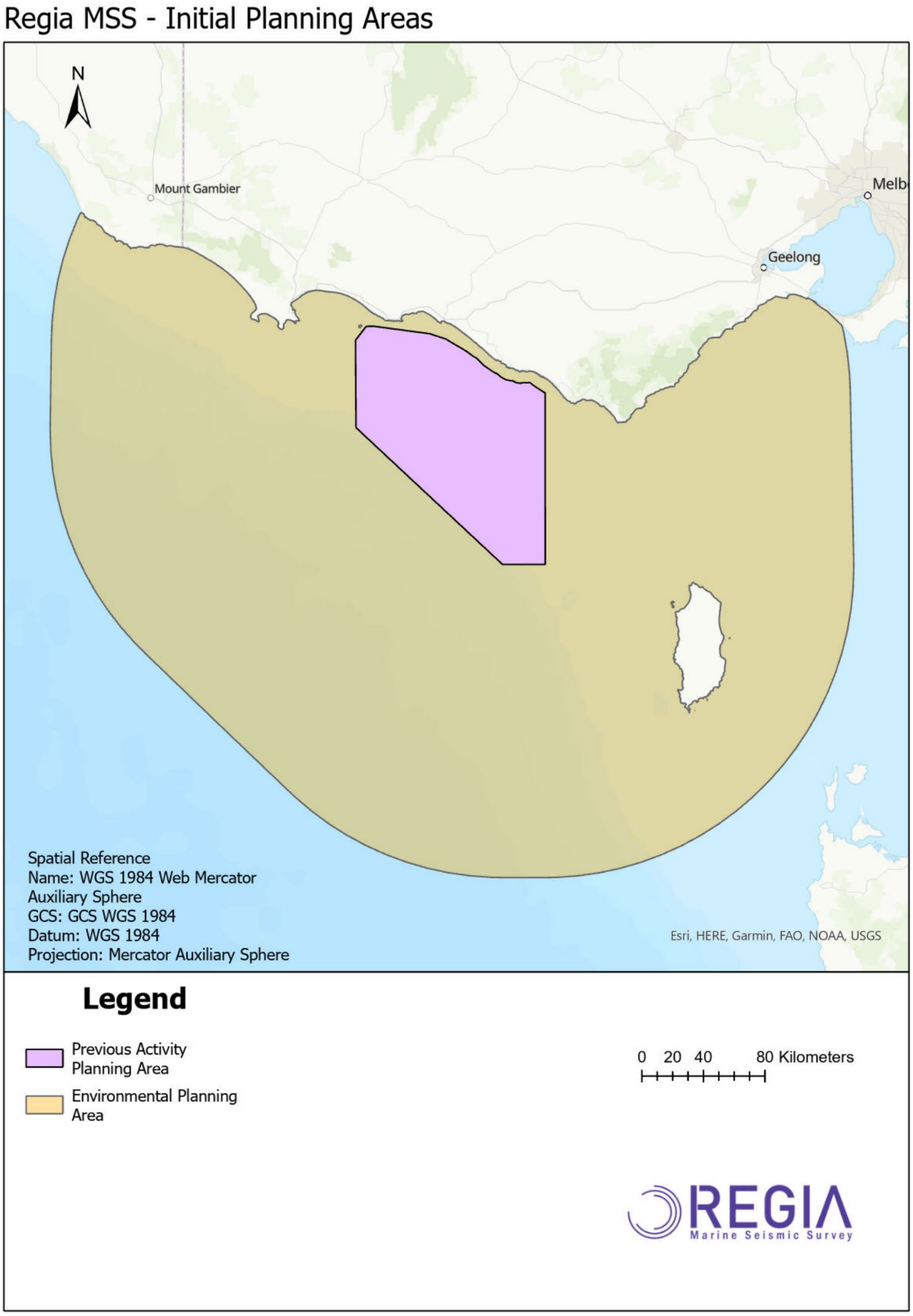

Figure F1-3 - Initial Planning Areas (MAP-REG-EPM-080)

In parallel with the initial community sessions, CGG commissioned initial sound propagation modelling to provide an initial understanding of the effect distances to key locations along the coast and effect distances for relevant grouping of environmental receptors. The initial modelling report can be found at Appendix B7a. After receipt of the initial modelling report, feedback from the community sessions, and correspondence from relevant persons the following changes to the proposed activity were made:

- A spatial activity limitation to exclude waters shallower than 30 m. This was primarily due to concerns for effects on abalone from abalone divers.
- A 10.3 km buffer placed around Lady Percy Julia Island / Deen Maar which is the behavioural effect distance for pinnipeds derived from the modelling report. Note: This buffer has been updated to reflect that the sound source will not be activated within 17 km of Lady Percy Julia Island / Deen Maar. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix B7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. Now, 11.8 km is the furthest distance to behavioural disturbance sound effect criteria for pinnipeds (seals), the increased protections afforded through the 17 km buffer are considered highly conservative to minimise disturbance of breeding seals. *[Paragraph updated in response to Matters M30, M31, M32, M33 and F17]*.
- A change in timing preference to avoid the peak levels of biodiversity expected in the summer months (January/February/March).

With the change in timing for the activity to prefer either an April – June, or September – November window further community sessions were held to communicate the change and further raise awareness about the proposed activity. Relevant person consultation continued throughout 2023 and lead to the following second set of modifications to the activity:

- Consultation with conservation groups and relevant persons revealed that the change in timing of the survey did not adequately address concerns associated with effects to zooplankton, particularly during upwelling events and the values associated with Key Ecological Features (**KEF**s) in the region. This resulted in an activity limitation of no acquisition within 500 m of the Bonney Upwelling KEF, nor the West Tasmanian Canyons KEF.
- Consultation with the Gunditj Mirring Traditional Owners Aboriginal Corporation indicated that *Deen Maar* was a site of cultural importance. CGG noted the 10.3 km buffer already in place and received no confirmation whether this distance was sufficient to manage effects on cultural values. Following this feedback, and further desktop research on cultural values (Appendix B10), CGG committed to no vessels traversing between Deen Maar and the mainland. The buffer around Deen Maar is now 17 km due to the exclusion of acquisition in water shallower than 50 m. *[Paragraph updated in response to F17]*.
- Consultation with Parks Victoria resulted in an activity limitation with no operational activity with 5 km of the Twelve Apostles State Marine Park (Feedback 259).
- Consultation with the Abalone Council of Australia resulted in an activity limitation extending the bathymetry contour activity limitation from no shallower than 30 m to no shallower than 50 m (Feedback 262).
- Consultation with a commercial fisher (Feedback 245) led to an activity limitation to exclude acquisition from fishing blocks G12, G13, H13, and H14, plus a 700 m buffer to protect the target species of the fisher.

The publication of draft impact and risk analyses occurred in September 2023 and there was further feedback provided by relevant persons that led to the following changes to the activity:

- Consultation with commercial fishers, and commercial fishing associations, revealed concerns about the overlap with productive trawl fishing areas in water depths of 200 m to 400 m resulting in an activity limitation of no acquisition deeper than the 200 m bathymetry contour.
- Consultation with a local dive shop/school revealed concerns about sound effect threshold exceedance for divers at known popular dive sites. This has resulted in an activity limitation to ensure that the effect levels to humans are not exceeded at those sites. This feedback also led to an agreement to implement a simultaneous operation (**SIMOPS**) plan for divers in the region.

As a result of consultation with local commercial divers, secondary sound propagation modelling was undertaken [Event ID 3367 & Feedback ID 253]. Popular and frequent dive sites were identified by relevant persons and used as 'receiver' locations in the secondary modelling report to understand offset distances that may be required to protect divers and inform the SIMOPS plan. The secondary modelling also addressed the constraint of the sound source activation to water depths of no shallower than 50 m. Results from this work showed that:

- Offset would be required in the northwest corner of the future acquisition area (Site 1).
- Behavioural sound effect criteria for pinnipeds are now reached at a maximum of 11.8 km (previously 10.3 km) from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted. [Paragraph updated in response to Matter F17].

As foreshadowed to relevant persons during the consultation, the description of activity has been progressively narrowed over time as geological objectives were refined and relevant person feedback was addressed. In total the active source area has been reduced to 39% of the activity planning area and can only narrow further from the current design.

As described in Section 4 above (Public Comment), further changes to the activity design were made because of public comment. Changes to the EP because of this process are described in the Regia MSS: Public Comment Titleholder Report. Each relevant Appendix of this EP has been reviewed considering the comments and a new section added to show how relevant comments have been incorporated into the EP.

7.2 Description of the Environment

For the purposes of the EP summary requirements of Section 35(7) a description of the receiving environment is provided in this document whereas the full descriptions of the environment as required by Section 21(2), and any relevant values and sensitivities as required by Section 21(3), are found in each specific impact and risk analysis for reasons explained in Part 2, Section 7.2.3.

7.2.1 Description of the Receiving Environment

The marine environment off the Otway Coast in Victoria, Australia, presents a remarkable instance of ecological complexity and diversity, encompassing a broad spectrum of biological, physical, and socio-cultural components.

7.2.1.1 Ecosystems and Constituent Parts, Including Human Communities:

The Otway marine ecosystem is characterised by its biodiversity. This region is a habitat for a multitude of species, ranging from microorganisms to larger marine mammals like whales and dolphins. The intricate food webs within this ecosystem are a focus of extensive research, emphasising the interdependence of species. The role of keystone species, such as certain fish and crustaceans, is critical in maintaining the ecological balance. Human communities along the Otway Coast are deeply intertwined with this marine ecosystem. Their livelihoods, predominantly fishing and tourism, are directly linked to the health of the marine environment. There is a growing body of literature exploring the socio-economic dependence of these communities on the marine ecosystem, highlighting the need for sustainable management practices.

7.2.1.2 Natural and Physical Resources:

The Otway region's marine environment encompasses a variety of natural resources, including significant fish stocks and unique benthic habitats, particularly in nearshore waters. This area has high water quality, influencing the health of the marine biota. Geological features such as underwater cliffs, canyons, and sandy substrates contribute to the area's biodiversity by providing habitats and influencing oceanographic processes. The dynamic nature of these physical features, under the influence of both natural and anthropogenic factors, is a subject of ongoing study.

7.2.1.3 Qualities and Characteristics of Locations, Places, and Areas:

The Otway marine environment is distinguished by its unique marine landscapes, which include diverse sponge fields. These areas are not only ecologically important but also contribute to the aesthetic and intrinsic value of the marine landscape. Some locations within this marine environment are recognised as biodiversity hotspots, critical for the conservation of endemic and endangered species.

7.2.1.4 Heritage Value of Places:

The Otway coast holds significant cultural and historical value. Indigenous communities have longstanding connections with this region, with coastal areas often holding traditional and spiritual significance. The presence of historic shipwrecks adds another layer to the region's heritage, making it a site of archaeological and historical interest. Marine Protected Areas within this region not only serve to conserve biodiversity but also help in preserving these cultural and historical values.

7.2.1.5 Social, Economic, and Cultural Features:

The economic framework of the local communities is intrinsically linked to the marine environment. The fishing industry, alongside emerging sectors like marine aquaculture, plays a significant role in the local economy. Petroleum development, including over 80 seismic surveys since the 1960's, has been ever present since the 1990's. The cultural aspect of the marine environment is equally significant. Traditional knowledge and practices related to marine resources are an integral part of the local culture, especially among First Nations groups. Furthermore, the region is a hub for environmental education and research, contributing significantly to our understanding of marine ecosystems and their sustainable management.

In conclusion, the marine environment off the Otway Coast of Victoria, Australia, is a multifaceted ecosystem with significant biological diversity, physical resources, cultural heritage, and socio-economic importance. The interplay of these elements underlines the need for an integrated approach to conservation and management, ensuring the sustainability of both the natural ecosystem and the human communities that depend on it.

7.2.2 Evolution of the Description of the Existing Environment

The description of the existing environment started with establishing an environment planning area (**EPA**) which was derived from the likely largest area of effect from any environmental aspect of a seismic survey – in this case an oil spill. The EPA represents a 150km buffer around the Activity Planning Area, plus a 5km buffer to include coastal sensitivities. The 150km distance was selected as it is conservatively the farthest an oil spill could reach in the unlikely event of an accidental release of marine diesel.

This area was shown on the interactive map on the Consultation Hub and visitors to the site were able to share information on the environmental values and sensitivities they had in the area. There were several environmental values and sensitivities highlighted on the interactive map which can be found in Appendix C2 and remain online. 78 map comments were received in total with the following examples of the community sharing their environmental values and sensitivities:

- One comment identified Logans Beach as south-east Australia's only established SRW nursery.
- Two comments identified Fairy Penguin colonies at coastal locations that the community valued.
- One comment highlighted the cultural values of Sacred Birthing Grounds for the Southern Right Whales and "stood in solidarity with Gunditjmara Traditional Owners of this precious Sea Country."
- One comment identified "The Bonney Upwelling is vital to the survival of local marine species."

These map comments have each been considered in the impact and risk analyses and the environmental assessment process overall. Comments were taken at face value and lead to an increased weighting on environmental protections for the identified environmental components.

In parallel to receiving comments through the website the Preliminary Environmental Impact and Risk Assessment (**PEIRA**) (Appendix B4) identified the basis of the spatial extent of each environmental aspect of the activity. These distances were subsequently used to complete multiple queries of the Protected Matters Search Tool and other databases of environmental values and sensitivities. The PMST reports completed to inform the PEIRA (Appendix B4) and the subsequent analyses (Appendices D1 – D4 and E1 – E10) can be found in Appendix B5. These search reports were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time [In response to Matters: I16 and I17]. These searches will be re-run prior to the activity commencing, and at least once a year, to help determine any changes to environmental knowledge underpinning this EP.

7.2.3 Description of the Existing Environment

The approach adopted for this EP was to integrate the Description of Environment within each impact and risk analyses. This represents a departure from traditional EP presentation methods of a single large chapter describing every receptor within the largest affected area without the context of cause effect pathways or subsequent protection of the described environmental values and sensitivities. Therefore, content that satisfies the requirements of Section 21(2) and Section 21(3) can be found in the impact and risk analyses in Appendices D1 to D4 and E1 to E10.

The benefits of this approach are various, especially for relevant persons:

- **Enhanced Specificity and Relevance:** By embedding the environmental description within each impact and risk analysis, readers gain a more detailed and specific understanding of how the activity may affect the environment. This contextualises the environmental effects, making them more relatable and understandable.
- **Improved Relevant Person Consultation:** This approach makes it easier for a relevant person to self-identify and for CGG to communicate how effects may manifest (i.e. through an identified cause-effect pathway). As a result, consultation becomes more targeted and meaningful, fostering better communication and collaboration.
- **Dynamic Assessments:** Traditional methods often present a static view of the environment. In contrast, this integrated approach allows for a dynamic assessment, reflecting changes in

environmental conditions or activity profiles over time. It was easier for relevant persons to see their input and will be easier for CGG to manage and communicate change over time.

- **Streamlined Documentation:** Instead of navigating through a separate chapter for environmental descriptions, relevant persons can directly access information within each impact and risk analysis. This makes the EP more user-friendly and accessible.
- **Comprehensive Environmental Understanding:** Integrating the environmental description within each assessment ensures that all environmental aspects are considered in relation to specific aspects of the activity, leading to a more accurate environmental understanding where only things affected are analysed.

In summary, this approach enhanced the clarity, relevance, and efficacy of the environmental assessment process, benefiting both the environment and relevant persons involved.

7.3 Requirements that Apply to the Activity

Appendix B2 is a comprehensive compilation of legislative and regulatory requirements relevant to the environmental management of the Regia MSS. It encompasses international conventions, Commonwealth and state legislation, policy statements, and international and industry standards. The document includes a detailed list of these requirements, their relevance to the Regia MSS, and outlines how the proposed activity will adhere to these requirements, demonstrating compliance and a commitment to best practice environmental management. The document is structured to be updated regularly, ensuring the activity remains within the current legal framework.

Appendix B2 was first published during the establishing context step of the environmental assessment process. Publishing the requirements that apply to the environmental management of the activity early in the consultation process is important because it:

- Enhances transparency about the regulatory framework guiding the project.
- Allows the public and relevant persons to understand the compliance landscape and evaluate the activity against these criteria.
- Facilitates informed feedback and meaningful discussion during the consultation.
- Demonstrates the project's commitment to regulatory adherence and best practices.
- Enables early identification and resolution of potential compliance issues.

In preparing Appendices D1-D4 and E1-E9, CGG considered these identified requirements that apply to the activity and has listed all those that were relevant to each cause effect pathway as evidenced in the Annexes of each chapter. So, the legislative and other requirements were used in the environmental impact and risk analyses and references to relevant laws, regulations, conventions, and EBPC Act guidance documents are made throughout these analyses to tie the whole assessment process together and demonstrate how each of these requirements will be met as required by Section 21(4)(b).

CGG believe that the content in each impact and risk analysis, along with Appendix B2, demonstrates our ability to properly identify and meet the requirements because it comprehensively lists relevant legislative and regulatory requirements and:

- Describes the applicability of each requirement to the activity in detail.
- Outlines specific strategies and measures in place to ensure compliance.
- Is constructed with due diligence to reflect the latest legal standards.
- Has been peer-reviewed by legal experts to ensure accuracy.

- Provides a clear, auditable trail of how operational procedures align with regulatory obligations.

7.4 Evaluation of Environmental Impacts and Risks

This section of the EP is dedicated to detailing the compliance with Section 21(5) and Section 21(6), a central part of our environmental management process. Section 21(5) mandates the inclusion of specific content within an EP that details and evaluates all environmental impacts and risks associated with the activity. This section underpins informed decision-making for the protection of the marine environment.

Our approach to section 21(5) is rooted in best-practice methodologies and is aligned with both regulatory requirements and relevant persons expectations. It is an iterative process in theory which can be challenging to deliver in practice. For the Regia MSS EP a decision was taken early in the assessment process to publish all the documents prepared as soon as the drafts were ready. Comments were invited during consultations and the content was used in raising awareness about the environmental aspects of the activity. Relevant persons were furnished with the information in the following incremental and iterative way.

1. Initially CGG commissioned Klarite, an environmental services company with expertise in offshore energy approvals, to prepare the PEIRA (Appendix B4). This document was published in March 2023.
2. Specific study reports to provide detailed identification of the extent, severity, and duration of impacts and risks were commissioned from other expert consultants such as:
   - Millodon Consulting – Commercial fishing history in the area (Appendix B6).
   - JASCO Applied Sciences – Sound Propagation Modelling (Appendix B7a & B7b)
   - S2 Services – Seismic Sound Studies Report (Appendix B8).
3. Drafts of the full impact and risk assessments were prepared by a combination of expert consultants and published as soon as they were complete (Appendices D1 – D4 and E1 to E10). Note that Appendix E10 – Cumulative Impact Assessment was prepared in response to requests from relevant persons and will be published alongside submission of the EP for public comment.

7.4.1 Details of the environmental impacts and risks of the activity

The regulatory requirement to ‘detail’ impacts and risks is interpreted in NOPSEMA guidance (N-04750-GN1344) to mean both the identification and analysis of impacts and risks. The identification of environmental impacts and risks was completed in the PEIRA. Subsequently, CGG commissioned dedicated analyses to cover each environmental impact and risk. Both these steps are described in more detail below and the full reports are appended to this EP.

7.4.1.1 Preliminary Environmental Impact and Risk Assessment

The PEIRA (Appendix B4) was the first document published about environmental impacts and risks from the Regia MSS. The PEIRA was published to provide initial information to relevant persons during the consultation process. Publishing the PEIRA allowed relevant persons to understand the cause effect pathways created by the Regia MSS and hence, be able to identify how they may be affected, or where to ask for more information.

The PEIRA identified the following planned environmental aspects that can lead to environmental impacts from the activity.

- Artificial light
- Physical presence
- Underwater sound
- Atmospheric emissions
- Planned discharges.

The PEIRA also identified the following unplanned environmental aspects that can lead to environmental risks from the activity.

- Accidental release of fuel
- Accidental release of materials or waste overboard
- Introduction of marine pest species
- Collisions with marine fauna

Benthic disturbance was considered in the PEIRA, and it was concluded that if there is no anchoring during the activity there is no pathway for the activity to result in changes to benthic habitats.

Having identified relevant environmental aspects of the activity and providing an initial estimate of the likely extent and duration of the aspect, the PEIRA performed a screening of these aspects with components of the environment because not all environmental aspects interact with an identified component part of the environment. A table from the PEIRA is replicated below at Table F1-4. With these steps complete, there were now justified boundaries established to be able to undertake the full impact and risk analyses.

Table F1-4 - Screening of Environmental Aspects against the Components of the Environment

		Environmental Aspects								
		Artificial Light	Physical Presence	Underwater Sound	Atmospheric Emissions	Planned Discharges	Accidental Release of Fuel	Accidental Release of Materials or Waste Overboard	Introduction of marine pest species	Collisions with marine fauna
Environment Component										
Physical Environment	Air Quality				✓					
	Ambient Light	✓								
	Ambient Sound			✓						
	Climate				✓					
	Sediment Quality						✓			
	Water Quality					✓	✓	✓		
	Benthic Assemblages			✓			✓	✓	✓	
	Coastal Habitats and Communities				✓		✓			

Environment Component		Artificial Light	Physical Presence	Underwater Sound	Atmospheric Emissions	Planned Discharges	Accidental Release of Fuel	Accidental Release of Materials or Waste Overboard	Introduction of marine pest species	Collisions with marine fauna
		Environmental Aspects								
Ecological Environment[3]	Plankton	✓		✓	✓	✓	✓			
	Invertebrates	✓		✓	✓	✓	✓		✓	
	Fish	✓	✓	✓	✓	✓	✓	✓		✓
	Birds	✓	✓	✓	✓	✓	✓	✓		
	Marine Reptiles	✓	✓	✓	✓	✓	✓	✓		✓
	Marine Mammals	✓	✓	✓	✓	✓	✓	✓		✓
Human Environment	Coastal Development	✓					✓			
	Commercial Fishing and Aquaculture		✓				✓	✓	✓	
	Diving		✓	✓			✓		✓	
	Indigenous Culture		✓				✓	✓		
	Marine Industries		✓				✓			
	Marine Protected Areas[4]		✓				✓	✓		
	Marine Tourism		✓				✓			
	Recreational Fishing		✓				✓		✓	

The PEIRA also completed the impact assessment requirements for this EP when initial assessment indicated that the levels of impact (the combination of effect and uncertainty) were negligible and low resulting in a preliminary outcome that no further assessment was required. Justification for not carrying through these impacts is provided in the PEIRA.

Similarly, the PEIRA also completed risk assessments required for this EP when initial assessment indicated the level of risk (the combination of probability and consequence) were rare and negligible resulting in a preliminary outcome that no further assessment was required. Justification for not carrying through these risks is provided in the PEIRA.

[3] Ecological environment includes the presence of a listed threatened species or listed threatened ecological community, the presence of a listed migratory species, any values and sensitivities that exist in, or in relation to, part or all a Commonwealth marine area, or Commonwealth land.

[4] Marine Protected Areas includes the National Heritage values of a National Heritage place and the ecological character of a declared Ramsar wetland. The activity is not being undertaken in any part of a declared World Heritage property.

The PEIRA concluded that the identified environmental impacts (Table F1-5) and identified environmental risks (Table F1-6) will be carried through to the full assessment and will be refined based on further assessment and consultation.

Table F1-5 - Planned environmental aspects requiring full assessment (PEIRA - Appendix B4)

Environmental Aspect	Environmental Impact	Preliminary Outcome
Artificial Light	Change in ambient light	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
Underwater Sound	Change in ambient sound	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
	Change in hearing capacity	Quantitative assessment
	Change in physical condition	Quantitative assessment
Physical Presence	Change in functions, interests, or activities	Quantitative assessment

Table F1-6 - Unplanned environmental aspects requiring full assessment (PEIRA - Appendix B4)

Environmental Aspect	Environmental Risk	Preliminary Outcome
Accidental Release of Fuel	Change in water quality	Low
	Change in sediment quality	Low
	Change in ecosystem dynamics	Low
	Change in physical condition	Low
	Change in fauna behaviour	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Introduction Of Marine Pest Species	Change in ecosystem dynamics	Moderate
	Change to functions, interests, or activities	Moderate
Accidental Release of Materials or Waste Overboard	Change in physical condition	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Collisions With Marine Fauna	Change in physical condition	Moderate

The following recommendations were made for CGG to consider, each of which was accepted:

1. Commission independent underwater sound modelling to understand the effect thresholds and distances for specific receptors within the Environment Planning Area.
2. Split the full assessment of underwater sound into two components for impulsive and continuous sound sources.
3. Review the NERA Reference Case 2018:1003 Consequence analysis of an accidental release of diesel and regionally relevant spill models from similar worst-case events to determine the applicability of the NERA Reference Case and, subsequently, the need for activity specific spill modelling.

Having identified the environmental impacts and risks that require full assessment, CGG commissioned various consultants to undertake the environmental assessments. The analyses in Appendices D1 to D4 and E1 to E10 were completed between April 2023 and July 2023. Each was published and relevant persons informed through a project update. The project updates included an explicit invitation for relevant persons, and other readers, to provide input into the assessment process. A copy of this invitation can be found in Annex 1. There now follows a summary of each environmental aspect analysed.

7.4.1.2 Planned discharges (PEIRA)

Impacts from planned discharges from project vessels was assessed as negligible within the PEIRA and, with the legislative requirements in Australia met, would be adequately managed by CGG's marine assurance system. There is no discernible difference between the planned discharges of CGG's project vessels and the hundreds of other vessels that utilise this area all year round, all of which must comply with stringent international conventions and Australian maritime laws, including Marine Orders.

7.4.1.3 Atmospheric emissions (PEIRA)

Impacts from atmospheric emissions from project vessels was assessed as negligible within the PEIRA and, with the legislative requirements in Australia met, would be adequately managed by CGG's marine assurance system. Like planned discharges, there is no discernible difference between the atmospheric emissions of CGG's project vessels and the hundreds of other vessels that utilise this area all year around.

7.4.1.4 Physical presence (Appendix E1)

Appendix E1 details the impacts from the physical presence of vessels and towed equipment and their potential interference with people and communities who use, or have a connection to, the marine environment. It includes consideration of human environmental components such as commercial fishing, indigenous culture, and marine industries, and outlines the predicted level of impact the Regia MSS may have.

The physical presence of the project vessels became a key focus area for CGG based on relevant persons consultations, summarised as follows:

- Commercial fishers identified that interference with their activities would have a detrimental effect of their business and financial interests and a comprehensive adjustment protocol will be adopted for the survey, as per industry standards.
- Conservation managers highlighted the values of marine parks (both State and Commonwealth), and appropriate buffers were established around those parks that were to the satisfaction of those agencies.
- We are aware that there are cultural values held by Traditional Owners in the area that project vessels may interfere with, and a Sea Country Protection Program is in place to provide the opportunity for Traditional Owners to co-design and co-implement a program of work to protect these values.

More information on the consultations with these groups, and others, can be found in Appendix C1.

The best measures for minimising interference with other marine users are to adapt the activity design to cater for reasonable requests for avoidance. CGG notes that some level of interference is permitted by Section 280 of the OPGGS Act. However, there is a limitation in this clause that the interference must not be to a greater extent than is necessary for the reasonable exercise of the rights and performance of CGG's duties. This facilitates a mutual marine use policy whereby other marine users and CGG must compromise on use of the marine environment.

After extensive re-design of the survey, following feedback from relevant persons (mostly commercial fishers), the activity was limited to within the 50m and 200m bathymetry contours and the active source area has shrunk to 39% of the original activity planning area (from 7,755 km^2 to 3,041 km^2). The depth limitations significantly reduce the overlap with productive fishing grounds.

Overall, the document concludes that the impacts from the physical presence of the survey equipment are considered minor, temporary, and largely avoidable with planned mitigation measures. These include on-water communications, optimised vessel usage, and compensation processes for any potential financial loss to marine users, ensuring that environmental management measures are in line with legislative and industry standards.

7.4.1.5 Underwater sound (Appendices E2 – E8)

CGG commissioned independent studies on the effects of seismic survey sound emissions on the environment prior to completing the analysis found in Appendices E2 to E8. These studies were critical in recognition that underwater sound assessments are historically one of the higher order impacts for seismic survey environment plans.

The first study used to inform the analysis were a numerical modelling report to establish the most appropriate sound exposure thresholds and effect level distances. This study focused on a highly prospective area that was critical to meeting the geological objectives of the study. The second study was a similar modelling report that examined new survey plans in response to relevant persons consultation. In particular, the new modelling tested the effect on reducing the size of the active source area and also limited the depth of the survey to no shallower than 50 m. The modelling was undertaken for sail lines as shallow as 49 m (MSL) so the output can be viewed as representing a small level of precaution to the environmental impact analyses.

The third study was a literature review of relevant peer reviewed papers in relation to the effects of sound on various environmental components. Both studies were published as soon as CGG received them, and they were used to support the provision of sufficient information to relevant persons.

The subsequent series of impact analyses of elevated levels of sound found that there were no major or catastrophic levels of effect identified to any environmental component. The effects to different species ranged from no effect, through to some effect levels that were ranked as moderate, meaning additional management and mitigation measures are required to ensure impacts are of an acceptable level.

The most important findings about predicted effects within these reports are that with the management and mitigation measures adopted by CGG:

- There may be permanent sub-lethal effects to some Southern Rock Lobsters within 711 m of the sound source that may increase affected individuals' exposure to predation, however this increased exposure to predation is insignificant in the context of a population resilient to a minimum ~30% reduction in adult lobsters every year (this statement is further examined and justified in Appendix E10 and Appendix F3).
- There may be permanent mortal injury to zooplankton within 220 m of the sound source, but this is considered insignificant in the context of total population levels of zooplankton, very high levels of naturally occurring mortality, and the avoidance of major upwelling locations where there may be higher densities or abundance (this statement is extensively examined and justified in Appendix F3).

The analyses also considered the uncertainty in the predictions of impact and found that after the application of quantitative modelling from an independent expert there was generally low levels of uncertainty in the predictions of impact. However, the following findings arose where the level of uncertainty was rated as medium, meaning there are still gaps or uncertainties:

- There was a range of literature considered in the analysis of effects to zooplankton and relevant person concern about the effect criteria used not being the most conservative.
- There is a paucity of data and information on the effects on the early life-cycle stages of species associated with the upwelling events in the region.
- There is a paucity of data and information on indirect impacts if disturbance to either Southern Right Whales and Pygmy Blue Whales occurred and an absence of long-term monitoring data of the effects of seismic given the recovery of the species in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The impacts associated with elevated levels of sound were also some of the most frequently raised concerns of relevant persons about the adverse effects of the activity. Given these findings, CGG undertook additional assessment to put the effects of seismic surveys in context with other pressures on these species. These studies can be found in Appendix F3.

7.4.1.6 Artificial light (Appendix E9)

Appendix E9 details the regulations and management plans in place to mitigate the impact of artificial light emissions from marine vessels on wildlife, including marine turtles, seabirds, and migratory shorebirds. Compliance with the Navigation Act 2012 and associated Marine Order 30 ensures that navigation lighting on vessels meets international standards for preventing collisions at sea. The National Light Pollution Guidelines for Wildlife mandate best practice lighting design to minimise light pollution and require environmental impact assessments for artificial light that could affect wildlife. These guidelines ensure that light emissions do not disrupt wildlife within important habitats and allow for critical behaviours such as foraging, reproduction, and dispersal.

For seabirds, the Wildlife Conservation Plan for Seabirds addresses the management of light pollution effects on breeding and roosting areas, with a focus on preventing disruption to seabird activities. The Vessel Lighting Management Plan is highlighted as a key measure to keep light emissions at levels that do not disturb seabird habitats, ensuring that seabird populations are not adversely affected by artificial light from vessels.

Regarding migratory shorebirds, the document cites the Wildlife Conservation Plan for Migratory Shorebirds and the EPBC Act Policy Statement 3.21. These guidelines require that development processes consider areas important to migratory shorebirds and provide strategies to avoid significant impacts on these species. The Vessel Lighting Management Plan is implemented to ensure that light emissions do not lead to a substantial reduction in migratory shorebird numbers.

The overall impact of light emissions is rated as low concern because the project vessels will be indistinguishable from any other vessels in the area. The comprehensive assessments and mitigations, which include controlled light levels and management plans ensuring that light does not disrupt or displace wildlife from important habitats or affect their critical behaviours is over and above the standards for any other transient vessels in the area with similar levels of impact.

7.4.1.7 Accidental release of materials or waste overboard (Appendix D1)

Appendix D1 addresses the potential environmental impacts associated with the accidental release of materials or waste overboard, evaluating the risks and management measures in line with the principles of ESD and the EPBC Act Management Plans and Recovery Plans. The EP predicts that the potential for injury or mortality to marine fauna due to entanglement or ingestion of marine debris is low, with a consequence that may occur to an individual but is unlikely to affect species populations or ecosystems. This assessment considers Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which has prohibited the discharge of plastic into the sea since 1988 and all types of garbage since 2013.

The risk of an accidental release of materials or waste is considered unlikely and, if it were to occur, it would be a one-off event with minimal impact. All vessels used for the Regia MSS will comply with the MARPOL requirements, ensuring no solid waste discharge to the marine environment. Additional waste management measures, such as the use of covered containers to prevent windblown waste, further mitigate the potential for waste loss overboard.

In terms of the functions, interests, or activities of other users, the risk as minor, with a low likelihood of occurrence and an overall medium risk level. Control measures such as the CGG Marine Assurance System and specific waste management requirements will be adopted to ensure no waste material is disposed of overboard, with all vessels required to have a Garbage Management Plan. In the event of an accidental release of materials or waste, procedures are in place for the immediate retrieval of materials and notification of relevant authorities.

The EP asserts that the predicted level of impact from an accidental release of materials or waste remains below the defined acceptable level, affirming that the risks to biological, ecological, economic, and cultural features are temporary, reversible, and of low intensity. It emphasises that all reasonably practicable measures have been adopted to reduce environmental impacts and risks, ensuring that the implementation strategy will effectively manage any potential risk.

Additionally, the EP incorporates feedback from the consultation process to address the concerns of relevant persons. For example, assurances have been made that activities at sea will not increase rubbish washing up onshore, addressing the concerns of local tourism operators and environmental groups. The EP also details that the views of the public have been considered in the impact and risk assessment, with no public comments received in relation to an accidental release of materials or waste to date.

Overall, Appendix D1 demonstrates a comprehensive approach to managing the risks associated with the release of materials or waste overboard, aligning with regulatory requirements and demonstrating a commitment to environmental protection and sustainable practices.

7.4.1.8 Collisions with marine fauna (Appendix D2)

Appendix D2 details the risk analysis for potential collisions with marine fauna due to survey operations. It sought expert feedback to refine these assessments, emphasising accuracy, environmental values, scientific literature, legislation, and additional mitigation measures. The risk of collisions or entrapments with marine animals is considered in the context of legal requirements and operational measures, with details on specific marine species expected to be found in the area.

Management strategies are in place to mitigate this risk. Measures include design modifications to equipment (adoption of turtle guards), regulated vessel speeds, the presence of marine fauna observers, and adherence to Policy Statement 2.1. The document asserts that the predicted impacts from vessel operations are unlikely and restricted to individual animals. There is no affect to populations or the overall health of the marine ecosystem.

The risk of collision with marine fauna is low. Crews keep a lookout for marine fauna, and the vessel operates at a slow speed to give animals time to move away. When the sound source is active it is more likely that marine fauna will navigate away from the sound rather than toward it. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05]. The Regia MSS has been designed to avoid known areas of high animal concentrations, especially during sensitive times such as migration or breeding seasons.

7.4.1.9 Introduction of marine pest species (Appendix D3)

Appendix D3 provides a detailed analysis of the potential introduction of marine pest species associated with seismic survey activities. It delves into the various ways marine pests might be introduced, notably focusing on vessels used in the Regia Marine Seismic Survey. The introduction risk is attributed to factors such as the discharge of ballast water containing foreign species and the translocation of species through biofouling on vessel hulls or in-water equipment like source arrays and streamers. The document further explores the duration and extent of this risk, indicating that the potential for introducing marine pests exists within the Activity Planning Area over a period of 90 days while activities are undertaken.

Additionally, the assessment touches on the legislative and other requirements governing marine pests, with an appendix detailing these legalities and compliance strategies. A notable inclusion is the PEIRA, which establishes a cause-effect pathway for the potential introduction of marine pests because of the survey activities.

Conclusively, the document rates the risk of introducing marine pest species due to these activities as medium. This rating underscores the importance of vigilance and the implementation of effective measures to mitigate this environmental concern, highlighting the need for a careful balance between operational objectives and ecological conservation. The IMS risk assessment procedure adopted by CGG is a comprehensive approach to meeting and exceeding the requirements of the Biosecurity Act 2015 which is consistent with industry best practice.

7.4.1.10 Accidental release of fuel (Appendix D4)

Appendix D4 provides a comprehensive risk assessment concerning the potential loss of containment and subsequent oil spill scenarios associated with the seismic survey operations. Contained within this document is a detailed summary that includes an analysis of the aspects and mechanisms of potential loss of containment, the extent and duration of such events, and the relevant legislative requirements that govern the survey's operations. A cause-effect pathway is delineated, clarifying how an incident might unfold and the potential consequences thereof.

Crucially, the document assesses the existing environment where the Regia MSS is to be conducted, anticipating the consequences on various environmental receptors including water and sediment quality, benthic assemblages, coastal habitats and communities, plankton, invertebrates, fish populations, birds, marine reptiles, and marine mammals. Additionally, it considers the effects on coastal developments, Indigenous culture, commercial fisheries, the seaweed industry, and other marine industries.

The risk assessment predicts the levels of risk to these environmental receptors, establishing criteria for sensitivity and has predicted level of risk to be medium. This is mainly due to the rare likelihood of a spill event occurring based on the absence of any reported collision of a seismic vessel leading to an oil spill in Australia. This is further supported by the adoption of the vessel bunkering procedure, the marine assurance system, and the comprehensive oil pollution emergency plan (OPEP) and operational and scientific monitoring program (OSMP) as means for reducing the consequences of a spill.

7.4.1.11 Summary of impact and risk analysis

The environmental impact and risk analysis were structured to systematically capture this part of the environmental assessment process for the environmental aspects of the activity identified by the PEIRA. The structure included:

- An outline of the aspect being assessed.
- A description of how the aspect occurs and its extent and duration.

- The legislative and other requirements that apply.
- A cause-effect pathway analysis.
- An overview of the existing environment that may be affected by the activity.
- Predicted levels of impact and a comparison with defined acceptable levels.
- Identification of mitigation and management measures.
- Document control information and references.
- Appendices with detailed legislative and other requirements.

These elements collectively form a thorough environmental assessment, providing a clear pathway from the Description of Activity (Appendix A2) through to the environmental performance required of CGG (Appendix G1). They are sufficient because they:

- **Follow a Recognised Framework:** The analysis utilise a methodology aligned with international standards and regulatory frameworks, ensuring robustness and completeness.
- **Are Comprehensive:** CGG have addressed all relevant environmental aspects and their potential impacts or risks, from minor to significant.
- **Incorporate Best Available Information:** Used the latest and most relevant scientific data and relevant person input for assessments.
- **Ensures Transparency:** Clearly documents all steps, from scoping to conclusion, allowing for relevant person review and verification.
- **Define Mitigation Measures:** The documents each proposes effective mitigation and management measures for identified impacts or risks.
- **Meet Legal Requirements:** Aligns with legislative and regulatory obligations, ensuring compliance.
- **Facilitate Decision Making:** Provides a clear basis for informed decision making by CGG, regulators, and other stakeholders.

Each analysis has been publicly available since September 2023. Whilst there have been general comments raised about the analyses, there have been no direct comments received related to the matters upon which CGG invited feedback with the exceptions discussed below.

During consultation there was some criticism that the environmental assessments were inadequate because they did not consider cumulative effect properly and bifurcated the aspects of the activity rather than consider them holistically (Event ID 3697). CGG considered that cumulative impacts were properly considered because the existing environment step in each analysis was carried out considering the existing and future pressures on the environment. However, CGG also recognised it was opaque how current and reasonably foreseeable activities had been considered. This lead CGG to work with other titleholders known to be proposing petroleum activities in the region to prepare a Cumulative Impact Assessment which was published on submission for public comment (Appendix E10).

CGG also received criticism about the bifurcation of the assessment by considering each environmental aspect in isolation. CGG acknowledges that the process and format of the assessments lead to relevant persons who had concerns about specific receptors (Event ID 3697) would not be able to get a holistic picture of the effects on that receptor easily. This lead CGG to complete additional evaluation of higher order environmental values and sensitivities so that effects could be considered more holistically (Appendix F3). Similarly, relevant persons looking for holistic assessments of the activity's consistency with the principles of ESD (Event ID 3697) would have an equally troubling time given this assessment was done against each environmental aspect. This lead

CGG to commission a separate evaluative document looking at the consistency of the decision-making process used in preparation of the EP with the principles of ESD (Appendix F4).

7.4.2 Evaluation of all the environmental impacts and risks

There are three main stages of the evaluation that occurred in sequence during the consultation process. The first stage of the evaluation of all environmental impacts and risks started with CGG publishing its Decision-Making Criteria (Appendix B1). The purpose of the Decision-Making Criteria provides the defined acceptable levels against which the (future) predictions of impact and risk will be compared. In the format shown in Table F1-7, they are used in the structured process of evaluating each environmental aspect.

The criteria, or justifiable variations on them, have been used by CGG in recently accepted EP's (Gippsland MSS) and in other current EP's (Sauropod MSS). They are like the criteria applied in most EP's accepted by NOPSEMA and were assessed to be appropriate in the context of the Regia MSS. The Regia MSS Decision-Making Criteria document was hosted on the Regia MSS Consultation Hub for 61 days between 1 May 2023 and 30 June 2023, during the 'analysis' phase of the environmental assessment and prior to the evaluation phase. This was done to ensure that relevant persons had the opportunity to comment on them prior to CGG applying the criteria in the impact and risk analyses.

Relevant persons were invited to comment on the appropriateness of the criteria and had an opportunity to influence CGG's application of the criteria to the environmental assessment process (Appendix B9). Awareness was raised about this opportunity and the importance of inputting at webinars, in 1-on-1 meetings, community meetings, and on social media (Appendix C1 & C2). Despite this, no comments were received through the Consultation Hub, nor in any subsequent meetings.

The second phase of the evaluation of all environmental impacts and risks was to use the decision-making criteria in the draft impact and risk analyses. Each of the fourteen analyses dutifully carried out this process and each presents a comparison of the predicted levels of risk against the defined acceptable levels. In doing so, CGG has complied with the expectations of NOPSEMA's Decision-Making Guidelines (N-04750-GL1721).

Table F1-7 - Defined Acceptable Levels of Impact and Risk

Category	**Defined Acceptable Level for the Regia MSS Impacts and Risks**
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.
	The impact and risk assessments are based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.
Economic	Affected persons will not be worse off because of the activity.
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.

Category	Defined Acceptable Level for the Regia MSS Impacts and Risks
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.
	The views of the public have been considered in the impact and risk assessment.

The analyses must be appropriate to the nature and scale of the activity (Section 21(5)(b)) and the analysis completed in Appendices D1 – D4 and E1 – E10 are appropriate because they are:

- **Comprehensive:** They cover all environmental aspects, and all environmental components including air, water, land, flora, fauna, and human health including the social, economic, and cultural features of these.
- **Systematic:** They follow a structured methodology to identified environmental impacts and risks.
- **Transparent:** Clearly document the assessment process and findings for relevant person review and they have been publicly available for months prior to submission.
- **Precautionary:** Each analysis applies caution in uncertainty, preferring preventative measures and properly applying the hierarchy of controls concept.
- **Adaptable:** The analysis will be maintained in a 'live' status throughout the duration of the EP so to enable the incorporation of new data and adjust management and mitigation measures as needed.
- **Properly scaled:** There has been greater effort applied to analysis of impacts and risks with lower predictive confidence and higher effect/consequence meaning the EP has prioritised actions based on the severity of impacts and risks.
- **Sustainability Focus:** Each analysis shows that actions meet current needs without compromising future generations.
- **Legally Sound:** Comply with relevant laws and regulations.
- **Ethical:** Address the social and cultural impacts on local communities.

The analyses completed have credibility because they incorporated peer-reviewed scientific literature, utilised high-quality and verifiable data, employed rigorous and established scientific methodologies, ensured the reproducibility of results, and maintained transparency regarding methods and data sources used. It also exercises objectivity, avoiding any conflicts of interest by using qualified external experts, and follows international standards for environmental impact assessments. Comprehensive documentation throughout the assessment process further underpins its scientific integrity.

The conclusion from the four risk analyses (Table F1-8) and ten impact analyses (Table F1-9) provided a series of ratings in accordance with the environmental assessment process (Appendix B9).

Table F1-8 - Summary of Risk Assessment Outcomes of the Environmental Assessment Process

Appendix Ref	Predicted level of Consequence	Likelihood	Predicted level of Risk
D1 – Accidental Release of Waste Overboard	Minor	Unlikely	Medium
D2 – Fauna Interactions	Major	Rare	Medium
D3 – Invasive Marine Species	Major	Rare	Low
D4 – Oil Spill Risk	Moderate	Rare	Medium

Table F1-9 -Summary of Impact Assessment Outcomes of the Environmental Assessment Process

Appendix Ref.	Predicted level of Effect	Uncertainty	Predicted level of Impact
E1 – Physical Presence	Moderate	Low	Medium
E2 – Underwater Sound - Plankton	Minor	Low	Low
E3 – Underwater Sound – Fish	Minor	Medium	Medium
E4 – Underwater Sound – Invertebrates	Minor	Medium	Medium
E5 – Underwater Sound – Birds	Minor	Medium	Medium
E6 – Underwater Sound – Turtles	Minor	Low	Low
E7 – Underwater Sound – Marine Mammals	Moderate	High	High
E8 – Underwater Sound – Surfers, Divers, & Swimmers	Negligible	Low	Low
E9 – Artificial Light	Minor	Low	Low

The third and final stage of evaluating all environmental impacts and risks is to consider them holistically from the activity. To achieve this CGG, decided to wait to commence these assessments until it believed all relevant persons had received sufficient information and a reasonable period to share their assessments of how their functions, interests, and activities may be affected by the Regia MSS. This allowed for relevant persons to input into the evaluation step with information, feedback, objections, and claims. CGG was subsequently able to make properly informed decisions. CGG notes that many titleholders use the UKOOA Risk Decision Framework and in this framework each impact and risk would have been assessed using decision context 'C', the most inclusive of societal values.

So, following the commencement of inviting objections and claims from relevant persons CGG began the evaluation steps of the environmental management process (Appendix B9). To reiterate, the evaluation of all the environmental impacts and risks is considered in the CGG environmental assessment process to be a holistic assessment about whether the collective set of all the impacts or all the risks have been managed to below an acceptable level and reduced to ALARP.

The evaluation documents originally intend to be completed by CGG were:

- Appendix F1 – An assessment whether the EP meets each criterion for acceptance (this document).
- Appendix F2 – A more detailed assessment of whether the activity can be carried out in a manner by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable.
- Appendix F3 – A more detailed assessment of whether the activity can be carried out in a manner by which the environmental impacts and risks of the activity will be of an acceptable level.

As per the earlier commentary, an additional evaluative document was added to the decision-making part of the process because of the consultations:

- Appendix F4 – A more detailed assessment of whether the activity can be carried out in a manner consistent with the principles of ecologically sustainable development set out in section 3A of the EPBC Act.

These documents are appended as part of the EP and make the demonstrations required by Section 34, which is discussed in detail in Part 1 of this EP.

7.4.3 Details of the control measures

Sections 21(5)(c) requires the EP to include details of the control measures that will be used to reduce the impacts and risks of the activity to as low as reasonably practicable and an acceptable level. The control measures adopted for the Regia MSS to achieve this are listed below and the full details are presented in Appendix G1.

1. **M#02: Consultation Management System (CMS):** CMS organizes efficient consultation processes throughout the activity lifecycle, including identifying, engaging, and responding to relevant persons.
    - **Activity Communications Plan:** Part of CMS, CLP informs relevant persons and communities about activity progress, with the Environment Advisor ensuring communication adherence.
    - **Fisheries Liaison Officer (FLO):** A CGG representative that can discuss the status of the Regia MSS operations with fishers and assists with Adjustment Protocol claims.
2. **M#03: Fauna Management System:** Focuses on protecting marine fauna, especially Southern Right Whales and Blue Whales, during Regia MSS through various surveillance and impact minimisation methods.
    - **Fauna Management Plan (FMP):** The FMP offers guidance for on-water actions and shoreside support to protect marine fauna, ensuring compliance with EPO's.
    - **Fauna Detectors:** The system employs Marine Fauna Observers, Passive Acoustic Monitoring Operators, and Acoustic Detection Monitoring Operators on multiple platforms in multiply locations for identifying and minimising impacts on marine fauna.
    - **Fixed Buoy Acoustic Detection:** Fixed buoys, equipped for real-time whale detection, are tested for reliability in detecting low-frequency whales.
    - **Aerial Surveillance:** Complements other methods for detecting whales, focusing on movements of Southern Right Whales and Blue Whales in specific areas.
    - **Expert Panel:** Independent experts in whale species assist CGG in dynamic survey situations to achieve EPO's, with details in the FMP.
3. **M#04: Marine Assurance System:** Ensures compliance with maritime regulations and includes vessel contractor assessments and biofouling controls to meet EP requirements.
    - **Project Vessels and Gear:** Includes various vessels equipped with environmental protection gear and procedures, ensuring navigational safety and environmental compliance.
    - **IMS Risk Assessment Procedure:** Assesses vessels and equipment for environmental risks in line with international and national standards.

- **Vessel Bunkering Procedure:** Ensures best practices and standards in bunkering operations at sea.

4. **M#05: Sail Line Plan:** Procedural control for contractor activities, including technical and spatial data to comply with CGG specifications and activity limitations (M#01).
5. **M#06: Sea Country Protection Program (SCPP):** Aims to identify and protect cultural heritage values, inviting co-design and co-implementation by First Nations peoples.
6. **M#07: Adjustment Protocol for Commercial Marine Users:** Manages unavoidable interference with fishing activities, outlining principles for negotiation and response.
7. **M#08: Oil Pollution Emergency Plans:** Comprehensive plans for addressing oil spill incidents, aligning with national preparedness and response systems.
8. **M#09: Acquire Seismic on Paper (ASOP):** A pre-operational workshop for CGG, its contractors, and technical staff to collaborate to identify risks and improvements.
9. **M#10: Company Site Representatives:** CGG assigns onboard representatives for Quality Control, Health and Safety, and Environmental Advice, ensuring compliance with EP and the survey contract.

7.5 Environmental Performance Outcomes and Standards

Appendix G1 details the control measures and environmental performance required for the Regia MSS to reduce environmental impacts and risks to ALARP and acceptable levels. It includes consultation outcomes and was updated throughout the consultation process. A significant update was undertaken after most objections and claims had been received to show the measures adopted because of the consultations. Appendix G1 was published when the EP was submitted for public comment on the Consultation Hub. Prior to public comments the initial set of management and mitigation measures were published in the impact and risk analysis documents.

Appendix G1 sets out management and mitigation measures which should be interpreted as self-imposed conditions or limitation of acceptance. These are framed as environmental performance required of the activity. An EPO is a measurable level of performance required for the management of environmental aspects of the activity to ensure that environmental impacts and risks of the activity will be of an acceptable level. The EPOs for the Regia MSS, informed by the defined acceptable levels, and against which the performance of CGG in protecting the environment is to be measured, are:

EPO 1. To ensure effective communication and engagement with relevant persons and local communities throughout the activity's lifecycle, fostering transparency, understanding, and responsiveness to their needs and concerns.

EPO 2. No death or injury to fauna, including listed threatened or migratory species, from the activity.

EPO 3. Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area.

EPO 4. Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.

EPO 5. No introduction of a known or potential invasive marine species.

EPO 6. To guarantee that all contracted vessels strictly adhere to international and national maritime regulations, including MARPOL, COLREGS, and specific Marine Orders.

EPO 7. To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment.

EPO 8. To establish and maintain a framework for Sea Country protection that manages the interaction of the activity with First Nations cultural values and sensitivities.

EPO 9. Interference with other marine users is of no greater extent than is necessary for the exercise of right conferred by the titles granted.

EPO 10. To establish and maintain an effective Oil Pollution Emergency Plan (OPEP) that ensures swift and efficient response to oil spill incidents, minimizing environmental harm, protecting sensitive ecosystems, and safeguarding human health and safety.

EPO 11. To align all staff and contractors involved in the activity to ensure environmental protections implemented in this EP can and will be met.

The full list of EPSs for the control measures listed in Section 7.4.3 are provided in Appendix G1 along with detailed measurement criteria that CGG will use to determine whether each environmental performance outcome and environmental performance standard is being met.

8 Implementation Strategy for Environment Plan

Appendix B3 details CGG's approach for environmental management of the Regia MSS in accordance with Section 22. Appendix B3 was published as part of the 'establishing the context' step in the assessment process. Publishing this document early in the assessment process was essential as it provided the community with a clear understanding of the company's management systems in practice, especially in relation to each sub-clause of Section 22.

8.1 Environmental Management System

Appendix B3 contains a description of the Environmental Management System (EMS) designed to ensure that CGG's activities, specifically for the Regia MSS, are conducted in an environmentally responsible manner. That includes specific measures to be used to ensure that, for the duration of the activity:

- the environmental impacts and risks of the activity continue to be identified and reduced to a level that is as low as reasonably practicable.
- control measures in Section 7.4.3 (and Appendix G1) are effective in reducing the environmental impacts and risks of the activity to as low as reasonably practicable and an acceptable level.
- environmental performance outcomes and environmental performance standards in the environment plan are being met.

The EMS encompasses a structured framework for managing environmental responsibilities, facilitating compliance with legal and other requirements, and achieving continuous improvement in environmental performance. The system includes mechanisms for identifying environmental aspects and impacts, setting objectives and targets, and monitoring and reviewing performance to mitigate environmental risks effectively.

8.2 Roles and Responsibilities

Appendix B3 establishes a clear chain of command, setting out the roles and responsibilities of employees and contractors in relation to the implementation, management, and review of the EP. There are also specific measures to ensure that each employee or contractor working on, or in connection with, the activity is aware of the employee's or contractor's responsibilities in relation to the EP, including during emergencies or potential emergencies, and has the appropriate competencies and training.

Key roles include the Environmental Manager, who ensures compliance with environmental standards; the Operations Manager, responsible for daily activity management; and the HSE Advisor, who advises on health, safety, and environmental matters. During the survey, the Survey Manager and Party Chief play crucial roles in implementing the EMS on-the-water, with specific duties in overseeing operational adherence to environmental protocols and immediate response actions.

8.3 Monitoring and Reporting Requirements

Appendix B3 provides for meeting the requirements of Section 22(5) and is sufficient because CGG's approach to environmental performance management hinges on several key elements:

- **Comprehensive Monitoring and Recording:** CGG's strategy likely includes rigorous monitoring and recording practices that capture a wide range of environmental data. This continuous collection of information is vital to understand the real-time impact of activities and to ensure environmental performance outcomes and standards are met.

- **Regular Audits:** Periodic audits provide an additional layer of scrutiny, helping to identify any discrepancies between the planned environmental management practices and those carried out. Audits are a cornerstone of any robust environmental management system, enabling the detection of potential non-conformances before they escalate.
- **Management of Non-conformance:** When non-conformances are identified, CGG's strategy probably defines clear processes for addressing them. This includes corrective actions to mitigate any environmental impact and preventive measures to ensure the same issues do not recur.
- **Review and Continuous Improvement:** The strategy must include regular reviews of environmental performance against the outcomes and standards set in the environment plan. These reviews feed into a cycle of continuous improvement, ensuring that the strategy evolves and adapts to new information or changes in the operational environment.
- **Alignment with Regulations and Standards:** CGG's implementation strategy is designed to align with relevant environmental regulations and industry standards, providing a framework that supports compliance and environmental protection.
- **Relevant Person Involvement:** By incorporating feedback into monitoring and review processes, CGG ensures that the strategy is responsive to the concerns of all relevant interested persons, which is critical for maintaining social license to operate.
- **Transparency:** Adequate reporting mechanisms likely ensure transparency in CGG's operations, which is essential for building trust with regulators, relevant persons, and the public.

These elements collectively ensure that CGG's implementation strategy for environmental performance is proactive, responsive, and in line with best practices, thereby meeting the intended outcomes and standards in the environment plan.

Similarly, the sufficiency of CGG's monitoring and maintaining quantitative records of emissions and discharges as part of an environmental management system lies in its ability to:

- **Ensure Accountability:** Quantitative records provide concrete evidence of performance against environmental standards. This data is essential for verifying compliance and demonstrating accountability in environmental management.
- **Enable Impact Assessment:** The records allow for an accurate assessment of the actual versus predicted environmental impacts. This is crucial in determining whether the environmental performance outcomes and standards in the environment plan are being met.
- **Facilitate Decision Making:** Quantitative data on emissions and discharges support informed decision-making. It enables the identification of trends, potential areas of improvement, and the effectiveness of mitigation measures.
- **Support Transparency:** Detailed records of emissions and discharges contribute to transparency, enabling relevant interested persons to assess the environmental performance of the operations themselves.
- **Comply with Regulatory Requirements:** Regulators require precise records to ensure that operations are within the allowed environmental limits. Such records are often a regulatory requirement, and their sufficiency ensures legal compliance.
- **Aid Continuous Improvement:** Quantitative records are a benchmark for continuous improvement. By analysing the data, the company can identify opportunities for reducing its environmental footprint and enhancing its environmental performance.

Monitoring and record-keeping of emissions and discharges are foundational to a robust environmental management system, ensuring environmental performance outcomes and standards are being met efficiently and effectively.

Appendix B3 states when CGG will report to NOPSEMA in relation to its environmental performance for the activity and the interval between reports is not more than 12 months.

8.4 Emergency Response Planning and Testing

The OPEP is mentioned in Appendix B3 but is provided in its complete form in Appendix G3. The arrangements for responding to and monitoring environmental pollution as outlined in the OPEP & OSMP document demonstrate adequacy by establishing comprehensive, systematic processes for handling potential oil and chemical spill emergencies. The document details initial response actions, specific notification procedures, and the roles and responsibilities of key personnel in addressing spills. Moreover, it integrates the Operational and Scientific Monitoring Plans, which are designed to effectively manage and mitigate oil pollution incidents and ensure compliance with regulatory obligations.

The plans include a tiered response protocol that scales according to the severity of the spill, leveraging resources from the National Plan for Maritime Environmental Emergencies to maximise response capabilities. The OPEP has been shared with the Victorian and Tasmanian Control Agencies during the consultation process and feedback from those groups has been incorporated. The OPEP was published on the Consultation Hub for transparency and comment.

There are provisions in Appendix B3 for the testing of oil pollution emergency response arrangement and they are appropriate because they:

- Align with industry best practices and standards.
- Are designed to realistically simulate operational conditions.
- Are regularly reviewed and updated based on operational feedback and incidents.
- Ensure that all equipment and response protocols are effective and can be reliably deployed in actual events.
- Examine the effectiveness of response arrangements against the objectives of testing.
- Include mechanisms to address any recommendations arising from tests.

8.5 Ongoing Consultation

The arrangements for ongoing consultation as detailed Appendix B3 are appropriate due to the structured and inclusive approach they adopt. These arrangements are designed to comply with Section 22(15) which stipulates that the implementation strategy must include ongoing consultation with relevant authorities and other relevant interested persons or organisations.

The key reasons for the appropriateness of these provisions show:

- **Inclusive Engagement:** By committing to consult with relevant authorities of the Commonwealth, State, or Territory, as well as other interested persons or organisations, the strategy ensures that all relevant interested persons with a potential interest are considered.
- **Continuity of Consultation:** The provisions for ongoing consultation beyond the initial acceptance phase, during the planning, and throughout the execution of the activity, ensures that relevant interested persons are engaged and informed at all stages of the project. This

continuous engagement allows for adaptive management in response to concerns and evolving project dynamics.

And in relation to emergency conditions because:

- **Real-time Identification of High Priority Areas:** The strategy involves identifying high priority protection areas within the Environment that May Be Affected (EMBA) in real-time, which allows for immediate attention to sensitive areas and the ability to quickly adapt strategies in response to emerging issues.
- **Monitoring Methodologies:** Specifying monitoring methodologies within the Operational and Scientific Monitoring Program (OSMP) provides transparency about how environmental monitoring will be conducted, enabling stakeholders to understand and trust the monitoring process.
- **Situational Awareness:** The strategy is designed to provide situational awareness, assisting in the planning and execution of emergency responses, which minimises environmental harm and aids in recovery efforts.
- **Recovery Assessments:** By providing for both short-term and long-term environmental damage and recovery assessments, the strategy demonstrates a commitment to understanding and mitigating the full spectrum of potential environmental impacts.

Overall, the ongoing consultation provisions reflect a commitment to transparent, inclusive, and adaptive environmental management, which is critical to maintain trust and to safeguard the environmental integrity of the project.

9 Details of Titleholder and Nominated Liaison

As required by Section 23, the details for the titleholder are:

- CGG Services (Australia) Pty Ltd
- Level 1, 1 Ord Street, West Perth WA 6005
- Telephone: +61 8 9214 6200
- ACN: 081 777 755

And the details for the CCG's nominated liaison for the activity are:

- Paul Rheinberg
- Level 1, 1 Ord Street, West Perth WA 6005
- Telephone: +61 8 9214 6200
- contact@regiamss.com.au

If there is a change in the titleholder, the titleholder's nominated liaison person or a change in the contact details for the titleholder or liaison person, CGG will notify NOPSEMA and provide the updated details (as described in Appendix B3).

10 Other Information in the Environment Plan

10.1 CGG Corporate Environmental Policy

Section 24(a) requires that the EP must contain a statement of CGG's corporate environmental policy. CGG has two policies that are relevant to this section which are listed below and can be found at Appendix A1:

- Environmental, Social & Governance Policy
- Health, Safety & Environment Policy

These documents were considered as foundational to the Regia MSS EP and to the consultation process. Therefore, CGG published these policies on the Regia Consultation Hub at the commencement of the consultation process so that community members and relevant persons had line of sight to the policies that governed CGG's employees, contractors, and site visitors.

10.2 Consultation Report

Section 25(g) has two requirements for titleholders, that Division 2.2A consultation is complete prior to completeness check and that appropriate measures are adopted considering those consultations. The Act and Regulations do not define what constitutes consultation for the purposes of Division 2.2A and subsequently 25(g) and in this absence, CGG fulfilled consultation obligations subjectively based on the circumstances and characteristics of the relevant persons affected.

Beginning on 4 February 2023, CGG commenced consultation in preparation of the Regia MSS Environment Plan. The overarching goal of consultation was to identify as many relevant persons as possible and provide them with sufficient information to help inform the protection of the environment. The consultation process was designed in the context of the objects of the Environment Regulations and is consistent with the principles of ESD, reduces environmental impacts risks to ALARP and an acceptable level. Full details of how CGG aligned consultation with the principles of ESD can be found in Appendix F4.

Very broadly, the consultation process involved the following steps:

1. Identifying the legislative and regulatory requirements.
2. Incorporating other guidelines and resources into the planning stage.
3. Creating a community consultation and engagement plan.
4. Identifying *each*[5] relevant person through a broad capture of people and information.
5. Providing identified relevant persons with sufficient information to make an informed decision on the potential impacts of Regia MSS on their functions, interests and activities.
6. Allowing a reasonable period for consultation.
7. Giving relevant persons appropriate feedback.
8. Assessing the merit of any objections, claims or feedback relevant persons had, and where appropriate incorporating this into the EP.
9. Keeping confidential records of all communications with relevant persons.
10. Having appropriate ongoing consultation procedures in place in the implementation strategy.

[5] The requirement that the titleholder "must consult with each" relevant person is a requirement to consult with each and every relevant person. The text of reg 11A, including the multiple references made to "each relevant person" make that requirement clear." Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No 2) [2022] FCA 1121 at [81]. Although CGG recognises some RP's may remain unidentified for reasons discussed in Appendix C1, the methodology employed was reasonably capable of discharging this obligation.

The complete details of these steps are expanded on in Appendix C1 (Consultation Chapter) and full supporting documentation can be found in Appendices C2, C3, and C4.

In January 2024, CGG completed consultation in the preparation of the Environment Plan. The valuable information provided by relevant persons was consolidated and reviewed to ensure it was accurately reflected and accommodated for in the EP before submission to NOPSEMA for public comment.

CGG will continue to communicate throughout completeness check and public comment. Once the Environment Plan is accepted, the appropriate ongoing consultation procedures outlined in Appendix B3 will ensure relevant persons remain up to date and informed throughout the life of the project.

In accordance with Section 24(b), this EP contains a report on all consultations between CGG and any relevant person. Table F1-10 shows concordance with the section requirement and the location of the contents in this EP.

Table F1-10 - Concordance table of content meeting the requirements of Section 24(b)

Regulatory Requirements	Location in the EP
A summary of each response made by a relevant person.	**Appendix C2** This document is structured in two parts. The first part is organised by each person consulted, either as an individaul, or as a representative of an organisation. The second part is organised by each organisation or authority consulted. Each consultation was given a unique identifying 'Event ID' which is listed in Appendix C2. The details of each Event have been reported and the summary can be found in the furthest right column of the report, under each persons or organisation.
An assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates.	**Appendix C2** Each objection or claim raised by a relevant person was logged in the Consultation Management System. The system requires that an assessment of the merits of each objection or claim is made. This enabled reporting against indivduals that raised the objection or claim, as well as reporting in a consolidated list of objections and claims. Appendix C2 presents both reports; by person or organisation, and in a consolidated format.
A statement of the titleholder's response, or proposed response, if any, to each objection or claim	**Appendix C2** For each objection and claim entered into the Consultation Management System, CGG was required to make a statement of response. This included the consideration of adopting measures because of the consultations (meaning because of the objection or claim.
A copy of the full text of any response by a relevant person.	**Appendix C4** The full text copies of each Event sent by CGG to relevant persons are included for context as well as the full text copies of any response by a relevant person. This attachment is structured as a repeat of Appendix C2, only with the inclusion of the full text copies of every Event.

Regulatory Requirements	Location in the EP
Consultation materials	**Appendix C2** This details the materials used during consultations to provide sufficient information to relevant persons. CGG prepared summary documents that it believed would be useful and on request from relevant persons. Documents requested were also published on the Consultation Hub. This appendix also includes all evidence of awareness raising activities through traditional and social media.

The consultation report is supplemented by Appendix C3 which is a sensitive part of the EP and must not be published. Appendix C4 is similarly a sensitive part of the EP and must not be published.

10.3 Details of all Reportable Incidents

A 'reportable incident' is defined as an incident related to the activity that has caused or has the potential to cause moderate to significant environmental damage. As required by Section 24(c), the following information details the scenarios that could meet this definition during the Regia MSS:

Table F1-11 - Details of reportable incidents

Scenario	Details of reportable incidents
Impact on marine fauna	Any incident leading to the disturbance of a blue whale from its foraging area or injury to a southern right whale or blue whale due to the acoustic output will be considered a reportable incident.
Exceedence of permitted sound levels	When undertaking the activity, CGG will be verifying the sound levels emitted. Exceedence of the levels that have been predicted may give rise to unacceptable impacts on protected species. As such any exceedances of permitted sound levels may lead to a reportable incident
Seabed disturbances	The activity does not include anchoring and has eliminated the assessment of physical disturbances to the seabed on that basis. Therefore any anchoring, or other distrubance to the seabed could significantly alter benthic habitats will be subject to reporting.
Oil spills	Accidental releases of hazardous substances or marine diesel from survey vessels will be reportable.
Effects on protected areas	The activity does not overlap any protected areas. Therefore, any activities inadvertently impacting marine protected areas or sensitive ecological zones will be promptly reported.
Unplanned interference with fishing and navigation	There may be some interference with fishing and navigation on the water, however, with the control measures in place interference should be avoidable. Therefore, if there are any unplanned interferences that materially disrupt local fishing or navigation, they will be reported in accordance with Section 24(c).
Boundary violations	Conducting activities outside of permitted zones, impacting unassessed environments, is reportable. Strict navigational controls and continuous tracking of survey vessels will prevent such incidents.

In accordance with Section 24(c) and detailed within the Implementation Strategy document, CGG Services (Australia) Pty Ltd is obliged to notify the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) of any recordable and reportable incidents. Recordable incidents are those that breach an Environmental Performance Outcome (EPO), or Environmental Performance Standard (EPS) set in the EP that are not reportable incidents, while reportable incidents are those that have caused or have the potential to cause moderate to significant environmental damage.

When such incidents occur, they are to be reported by the Client Site Representative to the relevant government agency within the specified timeframe. Following the notification of an incident, an investigation is conducted, and the findings are communicated to all pertinent personnel. Documentation of both recordable and reportable incidents is managed by the CGG Technical Operations Manager and includes details of the incident, immediate actions taken, and corrective actions implemented to prevent recurrence. This process ensures that all incidents are appropriately logged and reviewed, with a view to continuous improvement. The specific requirements for the reporting and recording of incidents are outlined in Table 1 of Appendix B3.

11 EP Summary

This document functions as the EP Summary required by Section 35(7). Table F1-12 is a concordance table with the requirements of this section and this document.

Table F1-12 - EP Summary Concordance Table

Section 35(7)	EP Summary Content Location
The location of the activity.	Part 1, Section 7.1
A description of the receiving environment.	Part 1, Section 7.2.1
A description of the activity.	Part 1, Section 7.1
Details of environmental impacts and risks of the activity.	Part 1, Section 7.4.1
A summary of the control measures for the activity.	Part 1, Section 7.4.3
A summary of the arrangements for ongoing monitoring of the titleholder's environmental performance.	Part 1, Section 8.3
A summary of the response arrangements in the oil pollution emergency plan.	Part 1, Section 8.4
Details of consultation already undertaken, and plans for ongoing consultation.	Part 1, Section 10.2, and Section 8.5
Details of the titleholder's nominated liaison for the activity.	Part 1, Section 0

12 Revision History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	12 December 2023	MS/SR/LB/AE	Document drafted.
0.1	22 December 2023	LT/PR	Review by CGG
1	4 January 2024	MS	Updated and reviewed, published for public comment.
2	9 June 2024	AH/CT/MS	Updated following public comment. Incorporated passage of time amendments.

List of Tables

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Annex 1

Copy of invitation to readers of the draft environmental assessments

Dear Reader,

The Regia MSS Environment team is seeking your insights, experience, and expertise as we look to refine the impact assessments for the Regia MSS Environment Plan. These documents are the result of careful research, analysis, and the dedicated pursuit of informed decision-making. Any environmental assessment process is improved by thoughtful critique, suggestions, and feedback to ensure these assessments are as comprehensive, robust, and accurate as possible.

Your unique perspectives and areas of expertise could shed light on facets that we might have overlooked or underestimated. Whether it's a detail that seems off, an argument that could be further strengthened, or an area that needs more clarity, we want to hear from you. No point is too small, and no comment is insignificant. Each one will contribute significantly to the improvement of these assessments.

This document has been prepared as a draft for consultation. It forms the basis of the Environment Plan that will be submitted to NOPSEMA. It will be amended based on feedback received and any subsequent research required.

An intended purpose if the document is to provide detail on an environmental aspect to assist in the provision of sufficient information for relevant persons during the consultation process. The Regia MSS team is specifically looking for the following types of feedback:

- *The accuracy of the described environment that may be affected.*
- *Any omissions of environmental values and sensitivities relevant to the environmental aspect.*
- *Any errors or omissions of scientific/peer reviewed literature that should be considered.*
- *Any errors or omissions of relevant legislation or documents of standing that should be considered.*
- *Any further mitigation or management measures that should be considered.*

For relevant persons, we are also seeking objections or claims about the impact or risk described may affect you. To assist us resolving any objections or claims you may have, we ask that your feedback includes a short preamble about your functions, interests, or activities and a clear statement about how the proposed activity/aspect may affect you.

This document should be read in the context of the Description of Activity and the Preliminary Environmental Impact and Risk Assessment available in the document library on the Regia MSS website (www.regiamss.com.au) which constitute initial information for individuals or organisations to determine whether they are a relevant person.

MS Word versions of the document are available for relevant persons on request. A summary of this information is available on request. Should you wish to discuss the content with a member of the Regia MSS Environment Team please submit a request to contact@regiamss.com.au. Feedback should be emailed to this address.

Thank you in advance for your time and attention. We look forward to receiving your insightful feedback, and we are excited about the improvements in environmental outcomes we can bring to these assessments together.

Regards,

Regia MSS Environment Team

Care+Protect
WHAT MATTERS

ENVIRONMENTAL, SOCIAL & GOVERNANCE (ESG) POLICY

Purpose

We believe that the health of the environment and climate as well as operating in a socially and ethical responsible way are moral obligations and critical to the continued and improved well-being of people and communities globally, as well as the sustainability of the company. Therefore, all of us at CGG have a duty to do our part in making continued significant progress in these areas.

Scope

This policy applies to CGG in all its operations as well as contractors and site visitors within CGG's prevailing influence.

Responsibility

As one of our values, responsibility is in the core of everything we do. CGG is committed managing the potentially negative impacts of its operations, mitigating and minimizing them as far as possible, while acting as a positive influence on our stakeholders:

- We act responsibly and ethically and abide by all applicable laws and regulations, providing our employees and contractors with guidance and support to enable compliance.
- We will always have a precautionary approach towards challenges, taking the time to assess risks and manage the potential impacts of our operations.
- We use our prevailing influence with service providers and suppliers to support the continuous improvement of their ESG performance.

Environment

We are committed to measure and reduce our carbon footprint across all levels of our value chain:

- We report environmental data across our operations, measuring and monitoring the Carbon Footprint.
- We are committed to reaching carbon neutrality by 2050 in scopes 1 & 2 of the Greenhouse Gas Protocol.
- We aim to improve the Power Usage Efficiency (PUE) of our data centers.
- We commit to increase the low-carbon content of our energy supply mix.
- We encourage and support local internal initiatives supporting our 2030-2050 carbon neutrality ambitions.
- We work with our Supply Chain to improve their ESG performance.
- We develop and offer products & services enabling environmentally sustainable activities.

Social

Our key aim is to be an exemplary company for all our stakeholders:

- We strengthen our work environment and our culture around diversity and inclusion.
- We ensure our work environment enables the engagement and development of our employees and attracts the best talents.
- We act as a positive influence for our employees, suppliers, and communities.
- We maintain a robust HSE-Operating Management System which is built around and complies with recognized International and Industry standards and supports our ESG commitments.

Governance

Our aim is to set the highest standards of governance which shall guide our operations and ensure the highest level of compliance & ethics are applied in the way we conduct our business.

Sophie ZURQUIYAH
Chief Executive Officer

Date: June 2022 - **Review Period:** 24 months

Care+Protect
WHAT MATTERS

HSE POLICY

Purpose

This policy broadly outlines our commitments to Health, Safety, Environment (HSE) . Our corporate policies, governance, and values as a whole act to drive and assure that CGG remains a healthy, safe, and environmentally conscious company that can sustain the needs of its present demands without compromising needs of the future generations.

HSE principles are integrated into our risk management, business planning and processes. We believe that all incidents are preventable and strive for zero harm to our people, the environment and the communities in which we operate.

Scope

This policy applies to all employees, contractors and site visitors within CGG.

Compliance

We recognize all International Labor Organization conventions and laws and comply with all national and industry HSE regulations.

We contribute to advancing industry standards and seek to establish and apply best practice.

Our HSE Principles

CGG provides a healthy, safe, inclusive and environmentally conscious workplace whilst promoting awareness of workplace hazards.

We protect our employees, contractors and assets from criminal, hostile and malicious acts.

We monitor the health of our employees and promote wellbeing.

We are committed to promoting a working environment that is free from illicit substances and tobacco use.

We apply eco-design principles and mitigation to prevent and remediate harmful effects on the environment.

We respect and promote human rights and maintain mutually beneficial relationships with local communities.

Leadership, Commitment & Responsibilities

The commitment and cooperation of all employees and contractors is essential, including the right and obligation to stop work and intervene.

Willful breach of CGG's 'Rules to Live By' will not be tolerated.

Line management are responsible for implementing this policy, setting relevant HSE objectives and ensuring resources are in place to achieve them.

The HSE OMS

Our Health, Safety, Security, Environment Operating Management System (HSE-OMS) provides a framework for company-wide integrated approach to Risk and Opportunity Management.

Our HSE-OMS is built around and complies with recognized International and Industry standards.

Stakeholders

CGG selects partners and contractors who acknowledge and comply with our HSE Principles whilst supporting them in fulfilling those responsibilities.

We openly engage and dialogue on HSE with our main stakeholders and publicly disclose our performance

Sophie ZURQUIYAH
Chief Executive Officer

Date: June 2022 - **Review Period:** 24 months

REGIA
Marine Seismic Survey

Description of Activity

Appendix A2: REG-EP-002-A2

Rev 4

May 2024

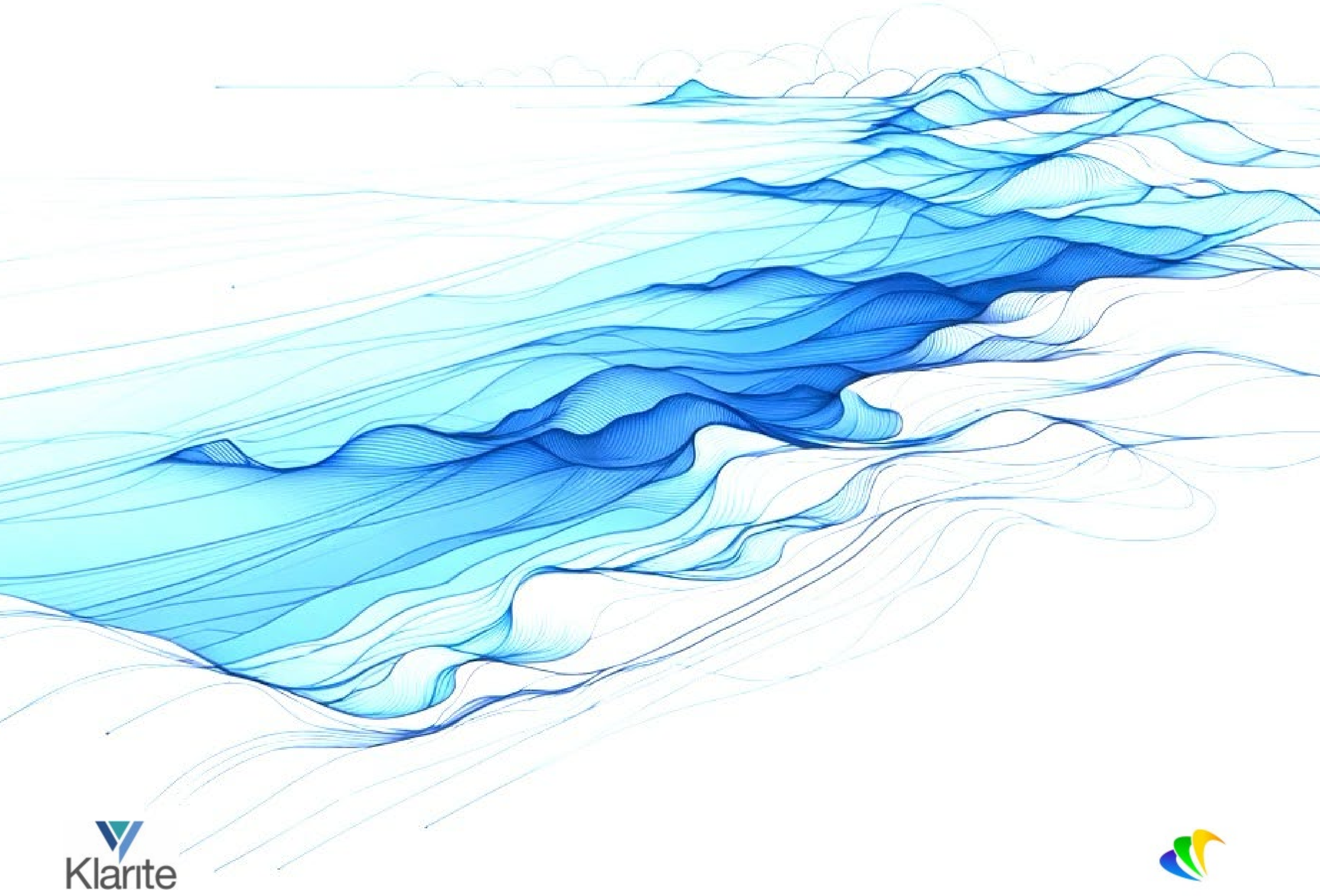

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Table of Contents

1 Introduction

This Description of Activity has been prepared by CGG Services (Australia) Pty Ltd (**CGG**) in its environmental management of the Regia Marine Seismic Survey (**Regia MSS**). This is the content of the Environment Plan (**EP**) that will be submitted to meet the requirements of Section 21(1) of the *Offshore Petroleum and Greenhouse Gas Storage (*Environment*) Regulations* 2023 (the Regulations).

1.1 Purpose

The purpose of this document is to provide a comprehensive description of the activity including the following:

a) the location or locations of the activity.
b) general details of the construction and layout of any facility.
c) an outline of the operational details of the activity and proposed timetables.
d) any additional information relevant to consideration of environmental impacts and risks of the activity.

1.2 Overview

To commence the preparation of the EP for the Regia MSS an Environmental Planning Area was established to frame the initial studies and community consultation effort. Within that area an Activity Planning Area was established to frame the maximum geographical limits of the activity. The Environmental Planning Area and Activity Planning Area are shown in Figure A2-1. The Activity Planning Area coordinates are recorded in Table A2-1 and Figure A2-2.

The Environmental Planning Area was set at 155 km around the Activity Planning Area. This distance has been selected using professional judgement and a review of previous oil spill risk assessments for similar activities in the region (Appendix B11). Further justifying the distance, the NERA Reference Case: Consequences analysis of an accidental release of diesel (NERA 2018) found that diesel spills under 700m^3 were reliably predicted to disperse within this distance.

1.3 Environmental Regulations and Guidelines

The primary legislation governing the Regia MSS is the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (the Act) and the Regulations. There are numerous additional laws, regulations, and guidelines that apply requirements to the Regia MSS activity. These can be found in Appendix B2 and their relevance to each environmental aspect is considered in each assessment (Appendices D1- D4 and E1 – E10). Any legislative requirements discussed in this document if they are relevant to the management of environmental impacts and risks.

The following terms are used in this document and are defined in the Regulations:

> A **petroleum activity** or **activity** means operation or works in an offshore area undertaken for the purpose of: (a) exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or (b) discharging an obligation imposed on a petroleum titleholder under the Act or a legislative instrument under the Act.

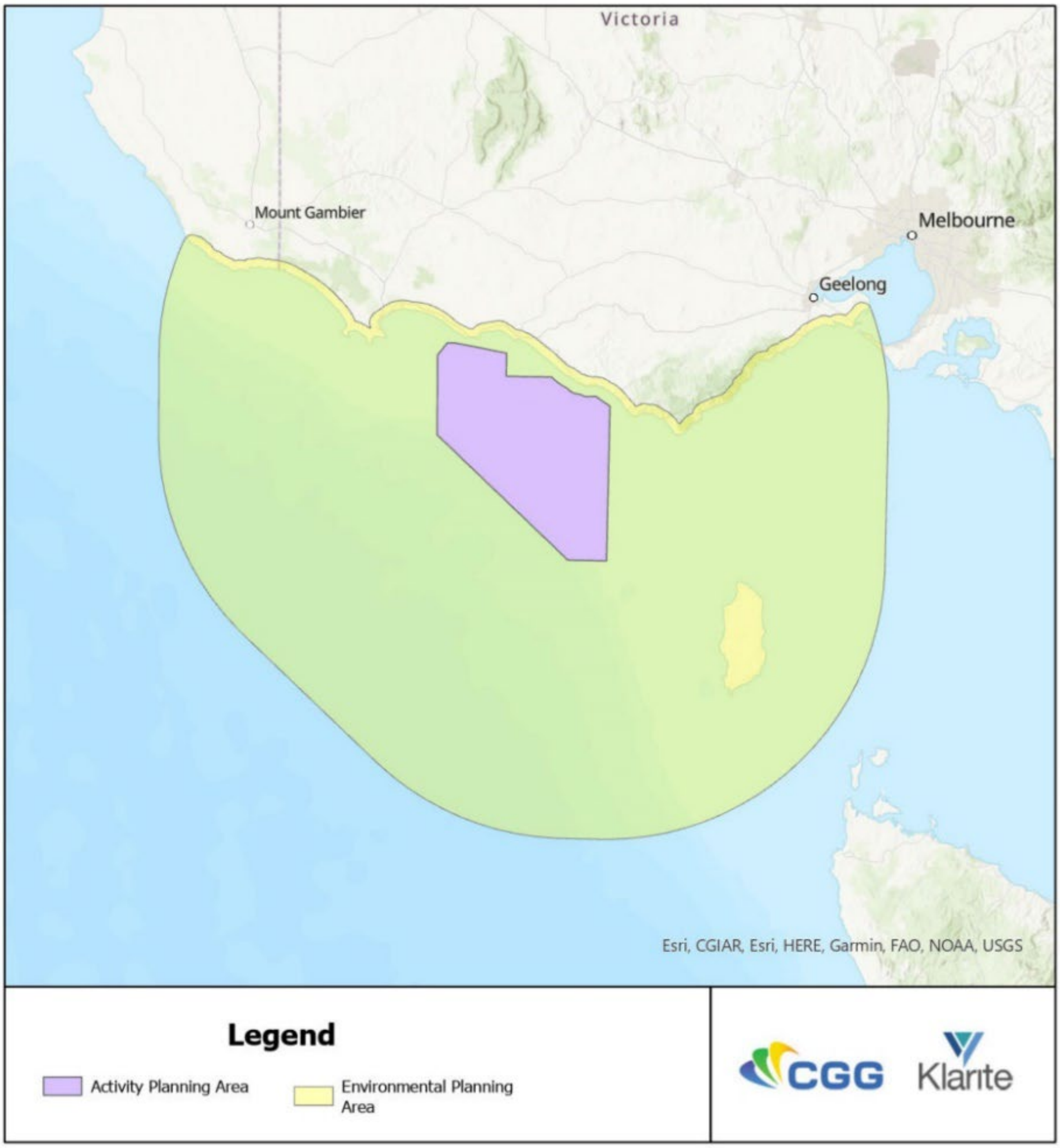


Figure A2-1 - Regia MSS Environmental Planning Area and Activity Planning Area

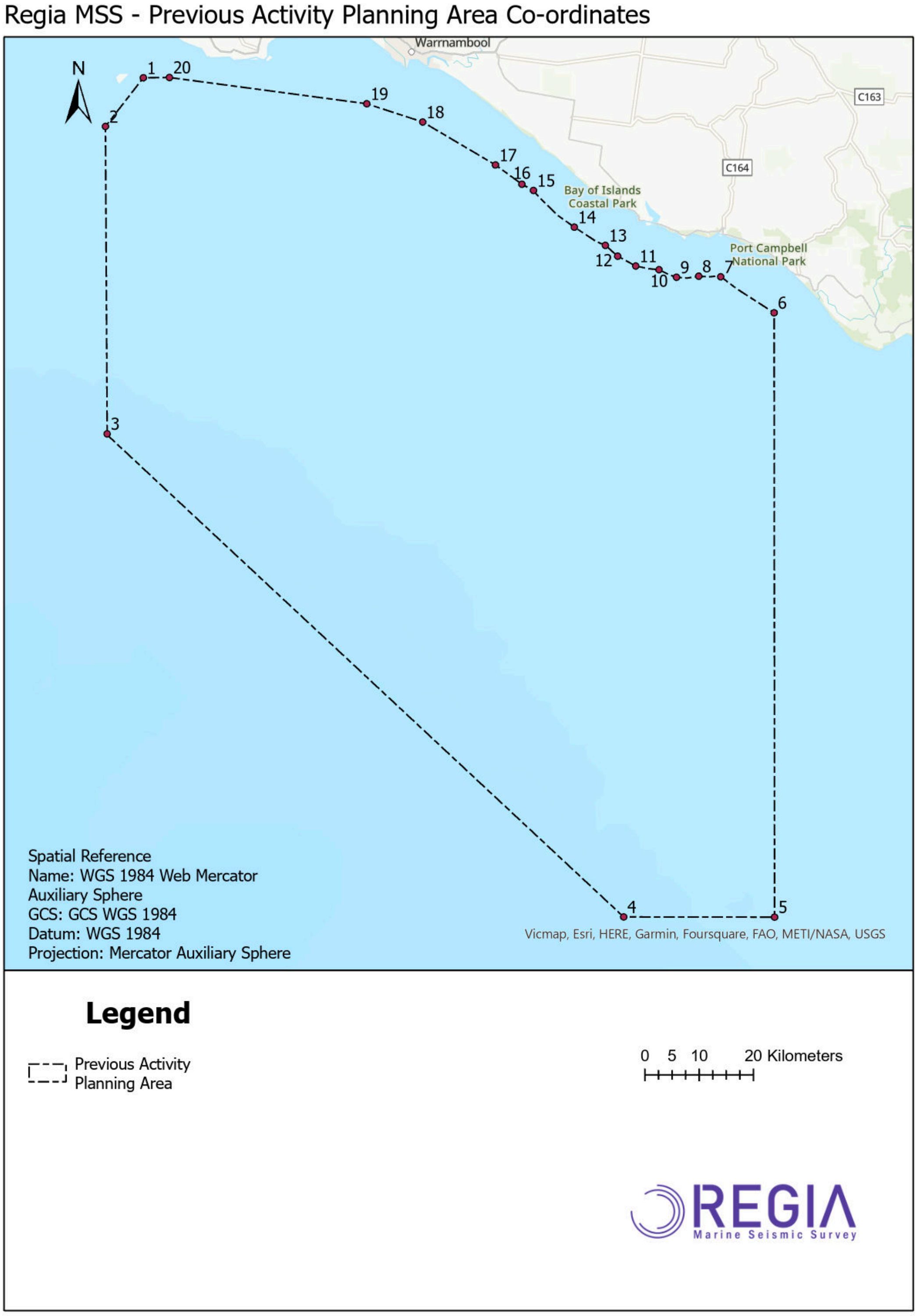


Figure A2-2 - Activity Planning Area Coordinates

Table A2-1 –Activity Planning Area Coordinates

Point	Longitude	Latitude
1	142° 02' 21.45593522” E	38° 25' 04.26056480” S
2	141° 58' 35.39330539” E	38° 28' 51.53116539” S
3	141° 58' 45.51609119” E	38° 52' 42.45350650” S
4	142° 50' 05.33731959” E	39° 29' 54.73405589” S
5	143° 05' 05.17959740” E	39° 29' 55.55982434” S
6	143° 05' 02.55949558” E	38° 43' 19.91372453” S
7	142° 59' 44.10474244” E	38° 40' 32.26457724” S
8	142° 57' 32.96925291” E	38° 40' 29.33294536” S
9	142° 55' 20.41399799” E	38° 40' 34.62305483” S
10	142° 53' 36.01524735” E	38° 39' 59.24899533” S
11	142° 51' 17.00630319” E	38° 39' 42.09987555” S
12	142° 49' 29.74030372” E	38° 38' 56.21829395” S
13	142° 48' 16.24122659” E	38° 38' 05.86132316” S
14	142° 45' 11.35030216” E	38° 36' 41.06108820” S
15	142° 41' 07.59478471” E	38° 33' 50.05350742” S
16	142° 39' 58.59838323” E	38° 33' 21.00044963” S
17	142° 37' 20.80923458” E	38° 31' 50.94761971” S
18	142° 30' 07.20986599” E	38° 28' 30.73250045” S
19	142° 24' 33.61806230” E	38° 27' 05.60993427” S
20	142° 04' 56.91157014” E	38° 25' 02.85324205” S

2 Assessment Input

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table A2-2 shows how this feedback has been incorporated into the environmental assessments.

Table A2-2 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
A yacht race is held every Saturday. A different yacht race occurs every Easter. Course may be up to 4nm offshore.	3	Notification to vessel contractor of race occurrence and location. Note: no overlap with race expected.
Email received detailing the negative impact on marine life and climate.	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted.
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement various activity limitations captured in Section 4.
Received levels of sound at coastal areas must be below 145 dB re 1 μ Pa	231	CGG have agree to limit the activity in this way and commissioned a second sound propagation modelling report to confirm the distances. Note: a simultaneous operation plan is still required with divers in the area.
Issues with seismic on the local fishing stock and does not believe that retirement of quota was a fair means of compensation.	245	No vessel movements with 700 m of fishing blocks G12, G13, H13, and H14.
Concerned about the impact of the project on the Twelve Apostles Marine Park.	237, 259	No vessel movements within 5 km of the Twelve Apostles State Marine Park.
Submission requesting preference for survey to start in shallower area and work towards deeper, outer continental shelf areas.	848	CGG agreed to acquisition lines acquired working from shallow lines to deep lines if the survey period is during the April to June period. Reversely, if the survey period is between September to November, the acquisition plan will be to acquire deep lines to shallow lines.

2.1 Public Comment

Table A2-3 shows how the Matters raised during public comment have been incorporated into the EP in this document.

Table A2-3 - List of changes arising from public comment matters

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, and G1.).

3 Description of Activity

3.1 Purpose and Need

The Otway Basin has been producing hydrocarbons since the 1990's and has seen the discovery of several gas fields. Since that time, seismic acquisition and processing technologies have advanced dramatically. The Regia MSS aims to survey areas where 3D geophysical data has not been acquired previously or applying new technologies to overlapping areas of existing 3D data, to improve our understanding of the geophysics of the area. Exploration for new gas reserves has been identified by the Labour Government's Future Gas Strategy[1] as necessary to meet predicted gas supply shortfalls and the Otway basin is explicitly mentioned as a possible source of additional domestic supply.

3.2 Project Design, Location and Timing

Two envelopes define the limits of the activity. A design envelope, which is the broadest timing and location of the activity, and an operating envelope which narrows the timing and location of activities. These envelopes changed during the environmental assessment. The nature of any change and the reasons for it were communicated through the online Regia MSS Consultation Hub and through consultation, where relevant.

3.2.1 Design Envelope

The activity commences in two stages: operations and acquisition. The seismic and support vessels will conduct a few days of operational movements to deploy and test the equipment. This may occur within the operational area or adjacent to it. Operations start when the vessels enter the operational area and end when the vessels leave the operational area. Acquisition starts when the sound source is discharged at full power for the first time and ends when the sound source is discharged at full power for the final time. The following parameters set the timings within the design envelope:

Table A2-4 - Design envelope parameters

Parameter	Details
Earliest start date (operations)	00:01 AEST on 1 April 2024
Earliest start date (acquisition)	00:01 AEST on 5 April 2024
Latest finish date (acquisition)	23:59 AEST on 20 October 2028
Latest finish date (operations)	23:59 AEST on 31 October 2028
Night-time operations	Yes

[1] https://www.industry.gov.au/sites/default/files/2024-05/future-gas-strategy.pdf

3.2.2 Operating Envelope

Acquisition may occur 24 hours a day over consecutive days, or at unspecified intervals due to time for equipment deployment, weather delays, fauna instigated shutdowns, contractor downtime, line turns, and equipment retrieval. The following parameters set the operating envelope:

Table A2-5 - Operating envelope parameters

Parameter	Details
Maximum days (operations)	90 continuous days
Maximum days (acquisition)	60 days
Maximum sail line distance	1,700 km

3.3 Outline of the Operational Details of the Activity

The activity is the acquisition of geophysical data (a seismic survey) and any other activities (support activities) required to support acquisition, carried out within the operational area prior to and after acquisition.

3.4 Location of Activities

There are several progressively smaller areas within the **Activity Planning Area** that govern the various component parts of the activity, these are describe below and shown in Figure A2-3igure A2-4:

- **Operational Area**: an area within the Activity Planning Area in which survey vessel activities other than actively operating the seismic source will be conducted, such as line turns, equipment maintenance and deployment/recovery, crew change and resupply.
- **Active Source Area**: an area within the Operational Area in which the sound source is active. This area is used to complete data acquisition along sail lines. Line runouts and run-ins occur within this area. There may also be occasional source testing at, or below, full capacity.
- **Survey Acquisition Area**: the primary target area for the survey and the area in which seismic data will be recorded.

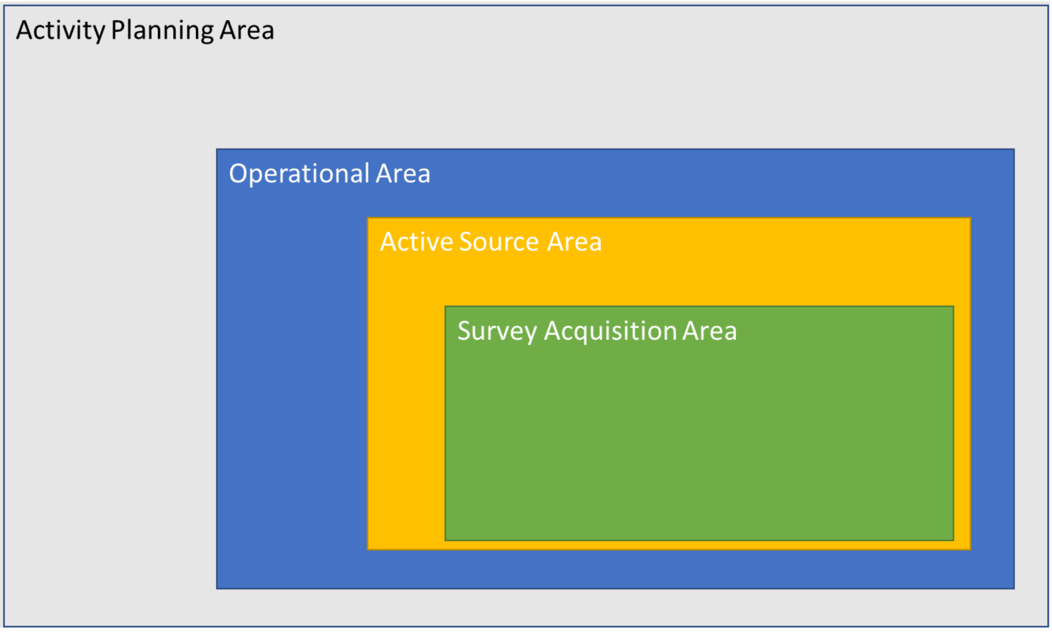


Figure A2-3 - Relevant Activity Areas

3.4.1 Operational Area

The operational area for the Regia MSS has been refined through consultation and throughout the environmental assessment process. In May 2023, it was decided that the operational area needed to extend westward to meet geophysical objectives of acquiring full data up to the boundary of petroleum title Vic/P79. This required an extension to the operational area beyond the activity planning area. This change was communicated at community sessions throughout May and in the May newsletter. The final coordinates for the operational area are shown in Table A2-6able A2-4 and Figure A2-4ure A2-5.

3.4.2 Active Source Area

The active source area for the Regia MSS has been reduced through consultation and thorough environmental assessment. Like the operational area, in May 2023, it was decided that the active source area needed to extend westward to meet geophysical objectives. This required an extension to the active source area up to the western edge of the activity planning area. This change was communicated at community sessions throughout May and in the May newsletter. The final coordinates for the operational area are shown in Table A2-7able A2-5 and Figure A2-5 A2-6.

3.4.3 Survey Acquisition Area

The survey acquisition area is yet to be defined though it will be fully within the active source area.

Figure A2-4 - Operational Area Coordinates

Table A2-6 - Operational Area Coordinates

Point	Longitude	Latitude
1	142° 05' 16.36731454” E	38° 26' 10.85543250” S
2	142° 26' 16.51574318” E	38° 36' 13.94860129” S
3	143° 05' 09.69318434” E	38° 48' 00.14571285” S
4	143° 05' 04.67882903” E	39° 21' 03.62327244” S
5	142° 36' 52.94914954” E	39° 20' 23.41884832” S
6	142° 24' 07.50000104” E	38° 32' 15.00000770” S
7	141° 58' 45.51609119” E	38° 52' 42.45350650” S
8	141° 58' 45.97159093” E	38° 47' 04.71440775” S
9	141° 48' 33.17463405” E	38° 43' 44.91246252” S
10	141° 48' 37.63265552” E	38° 29' 30.29365786” S
11	141° 55' 22.91787843” E	38° 28' 04.95447531” S
12	142° 02' 04.26170745” E	38° 28' 09.17227542” S

Table A2-7 - Active Source Area Coordinates

Point	Longitude	Latitude
1	141° 57' 14.41069241” E	38° 32' 22.50000959” S
2	141° 56' 58.56578522” E	38° 45' 50.56387531” S
3	142° 21' 17.82349906” E	38° 53' 44.87649788” S
4	142° 18' 56.16477525” E	38° 58' 29.93829630” S
5	142° 54' 05.13994651” E	39° 09' 45.98905126” S
6	142° 56' 24.56062558” E	39° 05' 08.10161449” S
7	142° 53' 56.56021341” E	39° 04' 18.14945527” S
8	142° 59' 39.74957304” E	38° 53' 02.83427710” S
9	142° 30' 27.33890596” E	38° 43' 34.52251718” S
10	142° 30' 38.25785422” E	38° 37' 39.80496139” S
11	142° 23' 06.42047622” E	38° 35' 11.53267500” S
12	142° 23' 00.53681331” E	38° 31' 47.35909479” S
Line	Single line joining Point 1 to Point 12 following the 50m bathymetry contour (MSL).	

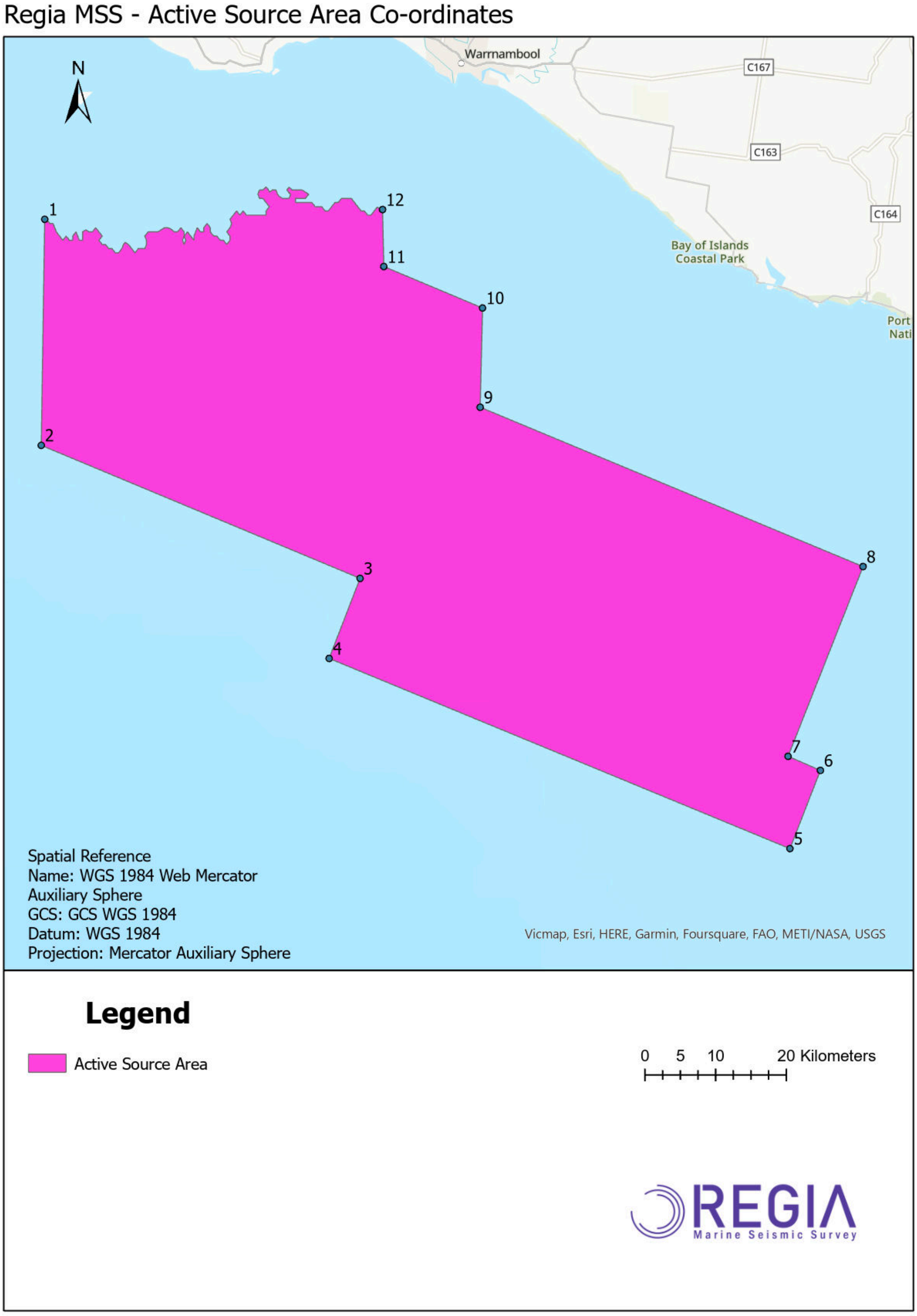


Figure A2-5 - Active Source Area Coordinates

3.5 Seismic Survey

Seismic surveying is a widely used exploration method to define and analyse subsurface geological structures in the marine environment. Seismic surveying uses a technique that directs acoustic energy into subsurface geological structures from equipment deployed from a specifically design survey vessel. This activity is called a marine seismic survey (MSS) and includes the towing of a sound source and multiple streamers along sail lines, day, and night.

3.5.1 Streamers and Sail Lines

The survey vessel will tow streamers back and forth through a (currently undefined) acquisition area along a series of sail lines within the Activity Planning Area. The streamers contain sound sensors that detect the pressure and velocity of sound levels reflected from the geophysical structures being targeted. TableA2- 8able A2-6 provides relevant environmental management details about the streamers and sail lines. The survey may be carried out in sections and the sail lines can be acquired in any order allowing flexibility for the activities to adapt to environmental features and occurrences such as marine mammal observations.

TableA2- 8: Environmentally Relevant Details for Streamers and Sail Lines

Parameter	Details	Environmentally relevant information
Maximum number of streamers	14	Using more streamers lessens the acquisition time. The highest number of streamers will be used that meet geophysical objectives of the survey and vessel recording capability.
Maximum length	8,100 m	The streamers will trail behind the survey vessel and present a hazard to navigation and marine fauna.
Maximum depth below sea surface	25 m	
Average and maximum streamer horizontal separation	100 m (average) 200 m (maximum)	Separation distance will be maximised whilst meeting survey objectives and vessel capability to lower the acquisition time. Streamer fanning will be used to increase the swath width at the end of the streamer array to minimise the need for in-fill lines.
Streamer type	Solid or gel core	The streamers are made of a solid core construction, with either a solid foam core or a solid gel core used for internal ballast.
Maximum number of sail lines in the racetrack survey design	Unknown	Number of sail lines will be minimised to reduce acquisition time.
Likely sail line orientation	North-west to South-east	Decreases acquisition time and decreases sound levels received at mainland Victoria due to increased sound profile forward and aft of the sound source.
Minimum line separations	500 m	Separation distance will be maximised whilst still meeting geophysical objectives.

3.5.2 Sound Source

The survey vessel will acquire the seismic data by towing three acoustic source arrays with three sources per array operating alternatively, one array discharging as the others recompress. Details about the sound source that are relevant to environmental management are provided in Table A2-9. These details provide the basis upon which predictions of sound levels and attenuation in the marine environment can be made.

Table A2-9: Environmentally relevant details of the sound source

Parameter	Details	Environmentally relevant information
Number of source arrays	Three	
Maximum tow depth	8 m	
Frequency range	0-200 Hz	
Low-power mode	50 cui	Used during line turns to minimise impacts. Used to transit between survey lines anywhere in the Operational Area. Used to manage impacts to flocks of foraging seabirds observed within 500 m of the survey vessel.
Maximum total volume	2,820 cui	Minimised to achieve survey objectives.
Maximum operating pressure	2000 psi	Minimised to achieve survey objectives.
Shot point interval	12.5m	Minimised to achieve survey objectives.
Towing speed	3-6 knots	

The sound source will be towed along a series of adjacent and parallel sail lines in a 'racetrack' like pattern. At the end of the first line, the vessel will turn in a wide arc to position itself for another parallel line in the opposite direction, offset by several kilometres from the previous line. The vessel will then turn again to position itself to return in the original direction along a third parallel line, offset from the first line. This pattern is repeated in the survey acquisition area until the required coverage is completed.

To obtain full coverage of the eventual acquisition area the seismic source must remain at full power for at least half a streamer length prior to the vessel turn. This 'run out' of the acquisition area occurs each time the vessel ends an acquisition sequence and occurs entirely within an active source area. Once outside the active source area, the source is turned to low-power mode to complete the turn. Then, during the 'run in' to the acquisition area, soft-start procedures are implemented for a minimum of 30 minutes, which begins with the operation of the single smallest air chamber in the array and then the gradual ramp-up to include additional air chambers until the source is at full power for the commencement of full power acquisition at the acquisition area boundary.

The source may be operated for short durations elsewhere in the operational area for maintenance and testing. These activities are infrequent and typically involve intermittent discharge of individual air chambers.

3.6 Support Activities

Support activities include:

- Survey vessel when the sound source is not active.
- Support vessel operations for safety, resupply, staff transfers, and maritime observations.
- Aviation operations for staff transfers and resupply.

In the unlikely event of an emergency additional vessels and aircraft may be deployed to assist the response efforts.

3.6.1 Vessels

The survey will be conducted using a purpose-built seismic survey vessel. Its purpose is to tow the sound source and streamers along the sail lines. The survey vessel will have a small on-board workboat, which may be launched to assist with equipment deployment and retrieval, or to carry out streamer maintenance activities. The survey vessel will also have a fast rescue craft (FRC) on-board. Environmentally relevant details of the survey vessel are included in Table A2-10.

Table A2-10: Environmentally Relevant Details of the Survey Vessel

Parameter	Details	Environmentally relevant information
Vessel length	90 – 130 m	Potential for interference with other marine users, inform expected sound source.
Total crew accommodation	70 people	Accommodating crew results in the discharge of sewage, greywater, reverse osmosis brine from water treatment, and food wastes.
Vessel class	1A1	This class has two fully independent propulsion systems providing redundancy in the event of loss of steerage.
Endurance at sea	32 days	Refuelling, crew transfers, bulk transfers of chemicals, waste, and supplies will occur during the activity.
Largest fuel tank size	257.4 m^3	Results in a worse-case credible oil spill risk in event of a vessel collision.
Dynamic positioning	No	Informs expected level and sound source of continuous sound from vessels.
Propulsion and power	Main engines, generators, and bow thrusters.	Results in discharges of cooling water and bilge water.
Vessel lighting – navigation	Minimum for safe navigation.	Mandatory indication of the 'restricted ability to manoeuvre.'
Vessel lighting – safe work	Minimum for safe work.	The working deck areas will be lit as required to provide for safe work.

At least two (2), and no more than three (3) support vessels, comprising a 'supply vessel' and at least one or two smaller 'escort vessel(s)', will accompany the survey vessel to provide logistical, safety and equipment management duties. At least one vessel will be rigged and capable of towing the survey vessel in the case of an emergency. The support vessels will mobilise to and from the mainland to undertake re-supply, refuelling and other support functions for the activity.

The support vessels may be required to leave the operational area to respond to unplanned events such as retrieval of accidentally over boarded floating objects, or communicating with a third-party vessel, or for other logistical and safety reasons. The support vessels transit between the port and the activity approximately once every two weeks.

In addition, there will be one (1) spotter vessel as part of the marine spread dedicated to marine fauna observation. It will be used near the survey vessel and tasked as required by the prevailing circumstances to improve marine fauna detection capabilities.

3.6.2 Aircraft

Aircraft maybe used for crew changes, critical equipment supply, surveillance and emergency response uses. Aircraft includes helicopters, fixed wing planes, and drones. Helicopter operations occur as needed which is approximately once every 3-4 weeks.

4 Additional information relevant to consideration of environmental impacts and risks of the activity

Following consultation with relevant persons, and completion of the environmental assessments, the following activity limitations have been adopted. These activity limitations have been referred to throughout the impact and risk analyses and are collectively referred to as M#01 – Activity Limitations.

Activity Limitations Relevant to Species Protection

1) No discharge of the sound source in the Southern Right Whale reproduction biologically important area (**BIA**) at any time.
2) No discharge of the sound source within 15 km of the Southern Right Whale reproduction BIA or Habitat Critical to Survival (**HCTS**) while Southern Right Whales are present in the BIA and HCTS.[2]
3) Only discharge the sound source in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway.[3]
4) No discharge of the sound source within 17 km of Lady Percy Julia Island / Deen Maar. [4, 5] [Sentence updated in response to Matter F17].
5) Data acquisition will follow a 130-degree orientation.[6]
6) The MSS acquisition lines will be acquired working from:
   - Shallow lines to deep lines if the survey period is during the April to June period.[7]
   - Deep lines to shallow lines if the survey period is between September to November.[8]

Activity Limitations Relevant to Protected Areas

7) No discharge of the sound source within a Key Ecological Feature.[9]
8) No vessel movements within 5 km of the Twelve Apostles State Marine Park. [10]

[2] 15 km is based on 14.2 km is the furthest distance to sound effect criteria for Southern Right Whales from the secondary sound propagation modelling report (Appendix B7b).
[3] Specific criteria for 'low numbers' can be found in Appendix G2.
[4] 17 km is based on the furthest distance from the Active Source Area to Deen Maar. It also covers relevant effects to other values such as pinnipeds and divers.
[5] Adoption of the 50 m depth limitation results in no discharge of the sound source within ~17 km of Deen Maar.
[6] This aligns with the modelled approach to minimize environmental impact to zooplankton.
[7] Measure adopted on request from relevant person to minimise interference with Southern Bluefin Tuna (Event ID 4370).
[8] Measure designed to mitigate interactions with Blue Whales who might traverse the intended MSS area as they move towards their summer feeding grounds recognising historical feeding patterns and timing.
[9] Two KEFs were identified within the Environment Planning Area, the Bonney Upwelling KEF, and the West Tasmanian Canyons KEF.
[10] 5 km is based on a reasonable buffer to reduce IMS risks to the park values following consultation with Parks Victoria.

Activity Limitations Relevant to Cultural Sensitivities

9) Project vessels will not traverse between Lady Percy Julia Island / Deen Maar and the mainland.
10) No vessel movements within 5 km of the Twelve Apostles State Marine Park. [11]

Activity Limitations Relevant to Marine User Interactions

11) No vessel movement within 4 nautical miles of the coast, except in case of emergency. [12]
12) No vessel movements with 700 m of fishing blocks G12, G13, H13, and H14.[13]
13) No discharge of the sound source at full power;
    - in water depths of less than 50 m.
    - from locations which result in an exceed of the safety criteria for recreational divers and swimmers along the coastline. [Sentence has been updated in response to Matter F17].
14) Received levels of sound at coastal areas must be below 145 dB re 1 μPa.
15) No discharge of the sound source at full power in water depths of greater than 200 m.
16) Minimise vessel movements in water depths of greater than 200 m to avoid trawling activities.

Activity Limitations Relevant to Compliance

17) No anchoring permitted within the operational area.
18) No discharge of the sound source outside of the active source area except for when during line turns or if transiting between sail lines anywhere in the operational area when the sound source will be at low power.[14]
19) No discharge of the sound source in January, February, or March.
20) Seismic and support vessels will operate at no more than 5 knots during acquisition.

Activity Limitations Relevant to Cumulative Impacts

21) The industry standard control of 40 km separation distance between operating seismic sources will be applied.
22) CGG and TGS have agreed not to acquire their surveys simultaneously.

[11] 5 km is based on a reasonable buffer to reduce effects on Sea Country values of the park.
[12] This limitation ensures no overlap with local yacht races (Feedback 3).
[13] 700m is based on the no effect distance for invertebrates, the target species of the fisher in these blocks.
[14] As requested by the Director of National Parks (Feedback 231).

5 Document Control

Table A2-11 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	24 March 2023	MS	Initial version taken from Activity Overview flyer which was published 1.2.23.
0.1	29 March 2023	LT/PR	Review by CGG
0.2	30 March 2023	MS	Updated following CGG review
1.0	31 March 2023	MS	Published on Regia MSS Consultation Hub website
1.1	30 June 2023	MS	Updated following consultation to include commitments for activity limitations (not published).
1.2	14 September 2023	MS	Updated following completion of impact and risk assessments to add further activity limitations. Also added the proposed active source area and operational area (not published).
1.3	26 September 2023	PR/LT	CGG Review.
2.0	30 September 2023	MS	Published on Regia MSS website.
2.1	31 October 2023	MS	Updates to include refined activity limitations following consultation.
3.0	29 December 2023	MS	Reviewed following updates to Appendices D1 – D4 and E1 – E10. Preparation for submission to NOPSEMA for public comment.
4.0	11 May 2024	MS	Additional activity limitations added because of passage of time, new literature, public comments, and revision of the EP. Also added spotter vessel to marine spread.

Community Consultation and Engagement Plan

January 2023

Contents

Definitions and Abbreviations

Term	Definition
Activities	In reference to consultation with a relevant person, activities are a thing a person or group does/is already doing.
ALARP	As Low As Reasonable Practicable
CCEP	Community Consultation and Engagement Plan
EIA	Environmental Impact Assessment
EMBA	Environment that May Be Affected
EP	Environment Plan
ERA	Environmental Risk Assessment
Function	In reference to consultation with a relevant person, functions are a role that is performed or something to be exercised.
Interests	In reference to consultation with a relevant person, interests are any interest above that of the public.
MSS	Marine Seismic Survey
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OSMP	Operational and Scientific Monitoring Plan
Petroleum activity	means operations or works in an offshore area undertaken for the purpose of exercising a right conferred on a petroleum titleholder under the OPGGS Act by a petroleum title
Relevant person	A person specified under Division 2.2A of the Regulations
The Regulations	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023
Work Program	CGG's activities proposed to be carried out to meet our corporate objectives

Introduction

CGG is seeking to gather geological information about potential hydrocarbon deposits in the Otway basin in the Commonwealth offshore area. CGG has started the design of a marine seismic survey (MSS) to be called the Regia Marine Seismic Survey (Regia MSS). As part of operating in Australia, CGG recognises the need to introduce ourselves to local communities, build relationships and earn our social licence to operate. We are also required to undertake consultation in preparation of environmental approvals called an Environment Plan (EP). This Community Consultation and Engagement Plan (CCEP) is a key pillar for CGG in describing how we will undertake our consultation activities in Australia.

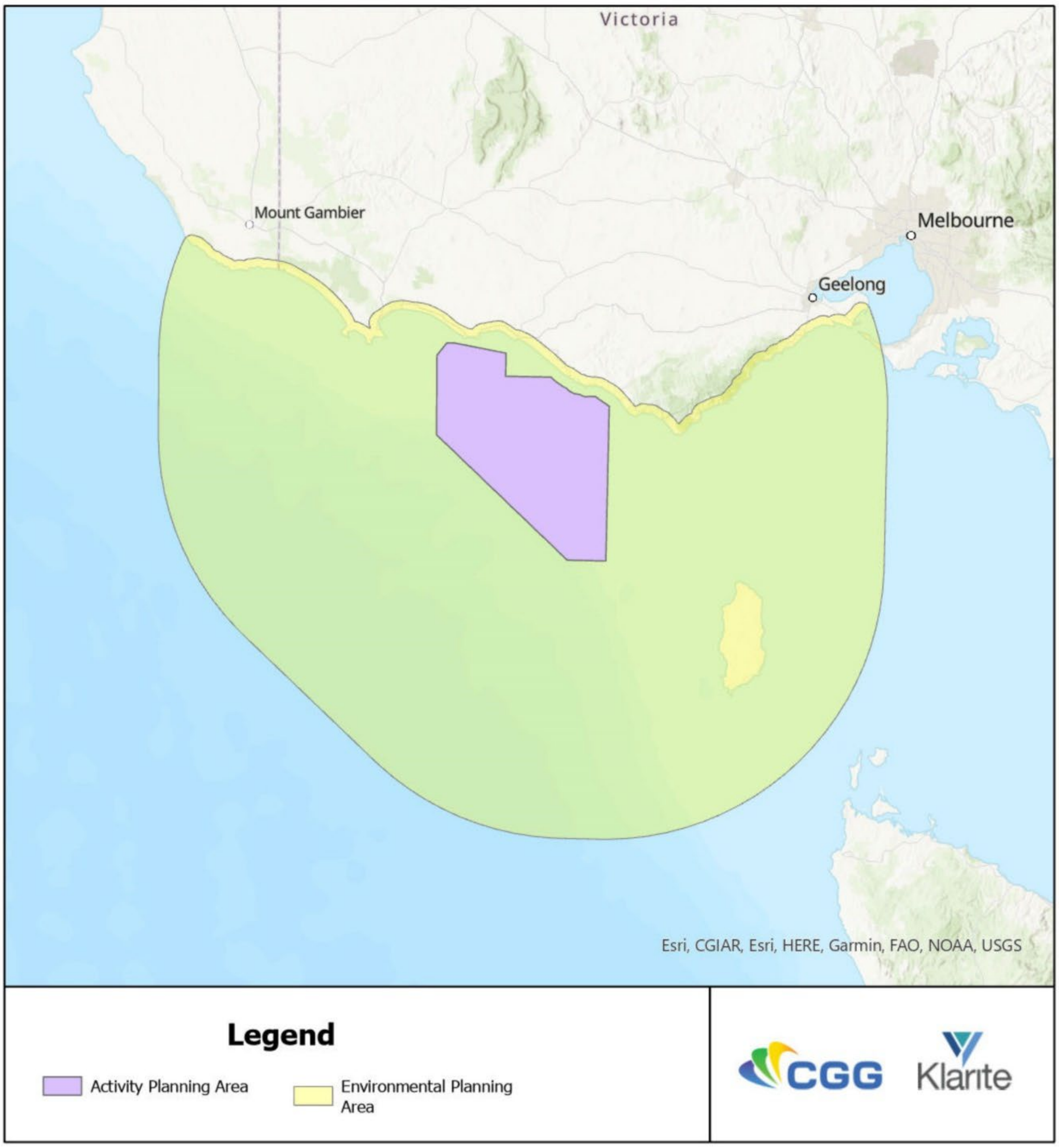


Figure A3-1 – Current boundaries of the Regia MSS

Scope

This document covers community consultation and engagement in the broadest meaning of those terms. It does not cover elected officials. The scope of the CCEP is to describe the process CGG will use to progress and document consultation and engagement activities in relation to the Regia MSS Environment Plan (EP).

This document is prepared as part of the EP and will be submitted to NOPSEMA for assessment. It is published at the commencement of the preparation of the EP to share our community consultation and engagement activities and support effective consultation.

Aim and Objectives

The aim of CGG's consultation efforts is to ensure that the activity is planned and executed in a way that respects the rights, interests and concerns of all relevant persons and that it is socially and environmentally responsible.

The objectives of CGG's consultation efforts are to:

- Identify all relevant persons who may be affected by the activity.
- Assist in providing sufficient information and time to allow relevant people to make an informed assessment of the potential consequences on their functions, interests and activities.
- Gather knowledge about the environmental values, sensitivities and social and cultural features of the areas in which we intend to operate.
- Elicit feedback from the community and address any objections and claims of relevant persons that may arise.
- Establish information flows between CGG and relevant persons.
- Help identify, and consider, important environmental characteristics or mitigation opportunities presented by relevant persons.
- Ensure that the magnitude and significance of impacts have been properly assessed.

Outcomes

There are three target outcomes for the community consultation and engagement activities.

1. Improved predictive quality of environmental impact and risk assessments.
2. Earn and maintain social licence to operate in Australia.
3. Perform the consultations as required by local Australian environmental law in a timely manner.

Background and Context

Legislation and Other Requirements

The *Offshore Petroleum and Greenhouse Gas Storage Act 2006*(OPGGS Act) and the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (the Regulations) are the prevailing legislation that govern how CGG is required to engage in offshore petroleum activities. There is a requirement for CGG to have an Environment Plan (EP) accepted by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA).

The Regulations mandate a consultation process that CGG must carry out in preparation of an EP. In December 2022, the Federal Court of Australia considered the consultation parts of the Regulations in a landmark judgement[1]. The findings of the Federal Court have been incorporated into this CCEP. Other guidelines considered in the preparation of this CCEP are included in the References.

Acceptable Levels of Environmental Impact and Risk

Section 280 of the OPGGS Act requires that a titleholder must carry on its activities in a manner that does not interfere with navigation, fishing, conservation of the resources of the sea and seabed, exploration for, recovery of or conveyance of a mineral, construction or operation of a pipeline, offshore infrastructure activities, or the enjoyment of native title rights and interests, or other lawful activities to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the titleholder. One of the objectives of the Regulations is that petroleum activities must be carried out in a manner by which the environmental impacts and risks will be of an acceptable level. Importantly, these clauses implement Australian government policy about mutual marine use and a policy that recognises the offshore petroleum industry is not a no impact industry.

This plan uses these clauses to govern our public engagement and relevant persons consultation processes including consultation activities and decision making. Acceptable levels of environmental impact and risk are context specific, so they are established in the preparation of each individual Environment Plan. However, generally, the following levels of environmental impact and risk are of an acceptable level.

- No person, organisation, or authority is worse-off because of offshore petroleum activities.
- Environmental impacts that are short-term, temporary, and recoverable.
- Environmental risks have consequences that are preventable and effectively managed.

These general statements will be refined through the planning process to become defined acceptable levels of environmental impact and risk that will be activity-specific and developed during consultation in the preparation of the Environment Plan.

Engagement and Consultation Principles

This document is prepared in accordance with ISO 31001, which stipulates consultation as integral to all stages of risk management. When we engage with external authorities, organisations, or persons the following principles guide our work. We recognise that effective consultation requires the fostering of relationships, a clear and co-designed process and the identification of substantive issues. The following principles apply to these three preconditions for effective consultation and in all our activities.

1. Open: Being honest, open and direct in our engagement with relevant persons.
2. Inclusive: Hearing people and listening to understand. We want to be easy to talk to.

[1] Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193

3. Collaborative: Encourage people to be part of the engagement and work towards minimising impacts on each other.
4. Respectful: Valuing the knowledge and experience of people. Grateful for people's time and input.
5. Meaningful: Ensuring that our communication can be reciprocal, timely and empowering.

Relevant Persons Identification

Identification of potentially affected communities is the critical first step in being able to successfully manage and address the concerns and issues of groups, organizations, or individuals who may be affected by or impact the Work Program. The community can be disaggregated in many ways and a person can reveal themselves within the community differently. CGG is proactive in its identification activities, which are undertaken when we commence the preparation of the EP. Identification activities are ongoing while we prepare the EP, and when it is in-force, with increased efforts in preparation of an EP.

Categorising the people within the community is a useful way to group and plan engagement activities that are fit-for-purpose for those groups. The legislation uses four main categories: the public, authorities, organisations and persons. The Regulations create a distinction between the public and *relevant persons* (authorities, organizations and persons) who are mandatory consultees in the preparation of each EP. CGG will adopt these categories for its activities.

Consultation with the Public

CGG will facilitate two streams of activities. One stream of activities relates to public engagement and the other relates to consultation with relevant persons. Both streams commence with the publication of a dedicated activity-specific website. Comments raised through the website will be taken to be submitted by members of the public. The website will go live on 1 February 2023 and end when the EP is no longer in force. After 5 months, on 30 June 2023, both streams will pause while the EP is prepared for submission to NOPSEMA.

Running these two streams of consultation supports the broadest search for relevant persons, who are a subset of the public. It also allows support to non-relevant persons, or persons who opt out of the formal consultation process, to engage with our activities in a way that works for them. The two streams of relevant persons consultation and public engagement are shown in Figure A3-2 below.

An activity specific website will be a central repository of information about the activity which will allow the public to raise concerns, share location-based information, and provide feedback to CGG regardless of whether they meet the definition of being a relevant person. This includes the provision of initial information to the public sufficient to allow a person to self-identify as a relevant person. Persons who contribute to the preparation of the EP through the website will be providing information directly into the EIA and ERA processes that are being carried out in parallel to the engagement activities. Commenting through the website does not qualify as a relevant person and they will be encouraged to undertake a consultation survey to determine if they are a relevant person.

The public is a broader group of people than those who can be identified as relevant persons. Without proactive action from CGG, the first time the public are made aware of the activity in the EP is too late for relevant persons to self-identify as someone who may be affected by our activities. Therefore, CGG will publish notices in print media, social media, in local radio adverts, and online to:

- Notify the public of the commencement of the preparation of an EP.
- Encourage relevant persons to self-identify to be consulted with.
- Notify the public of the commencement of the consultation process.
- Encourage people concerned to visit the website.

In addition to CGG's public engagement activities the Regulations provide a mechanism for the public to make comment on each EP for seismic activity. This mechanism allows the public to comment directly to the regulator with their views about the proposed activity. The public comment period occurs upon submission of the EP.

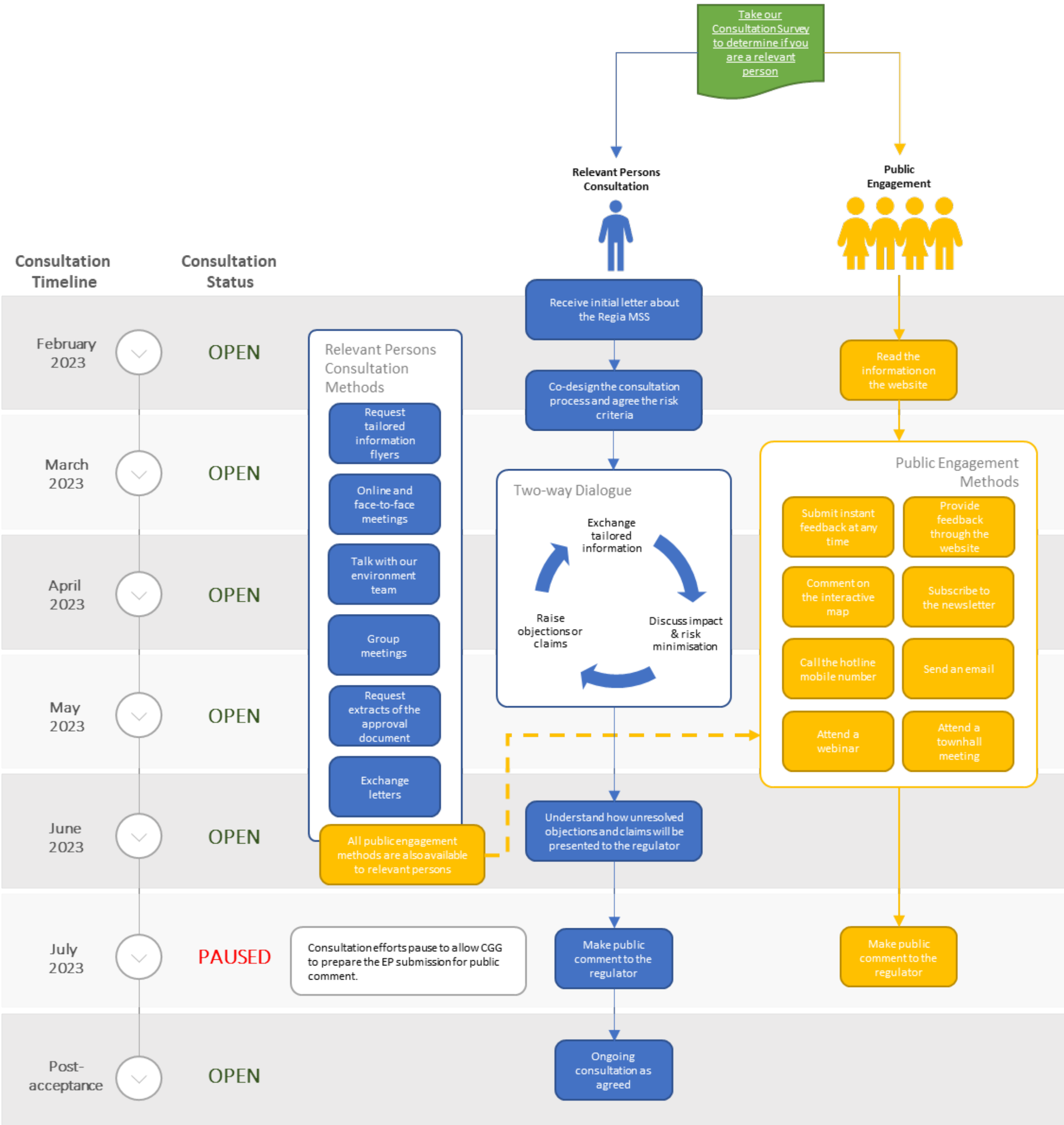


Figure A3-2 - Regia MSS Consultation Activities

Relevant Persons: Authorities, Organisations and Persons

The steps above will not be solely relied upon to identify all relevant persons. CGG will be proactive in pursuing relevant persons and providing the opportunity for each of them to be consulted as per the regulated process. To discharge our legislated obligation, CGG must tell the authority, person, or organisation that they have been identified as a relevant person and that the subsequent consultation effort is being undertaken as per the prescribed process and we are obligated to expressly advise them of titleholder obligations for consultation.

Identification of relevant persons

CGG uses the following methods to find authorities, organisations and persons who may be affected by our activities.

1. **Contact government agencies and organizations:** Relevant government agencies may have information about individuals and organizations that may be affected by the activity.
2. **Consult with local community groups:** Reach out to local community groups, such as those focused on environmental conservation or fishing, as they may have members whose interests or activities could be affected by the activity.
3. **Consult with local Indigenous groups:** Indigenous groups may have specific cultural or spiritual interests and activities that could be affected by the activity, it's important to consult with them and ensure their rights and beliefs are respected.
4. **Conduct online research:** We will search for news articles or press releases about similar activities in the area and identify individuals or organizations that were mentioned.
5. **Advertise in Local Newspapers and on Local Radio stations:** Advertising in local newspapers or on local radio stations to notify the public about the planned activity and ask for any persons with specific interests or activities that may be affected by the activity to come forward.
6. **Contact industry associations:** We will reach out to industry associations related to fishing, shipping and oil and gas exploration in the area, as they may have members whose interests or activities could be affected by the activity.
7. **Contact local businesses:** We will reach out to local businesses, such as tour operators or accommodation providers, as they may have customers whose interests or activities could be affected by the activity.
8. **Contact local educational institutions:** We will reach out to local educational institutions, such as universities or research centres, as they may have researchers or students whose interests or activities could be affected by the activity.
9. **Use social media:** We will use social media to find relevant persons by searching for hashtags or keywords related to the activity, following local organizations or groups in the area and reaching out to people who have commented on or shared posts about similar activities.
10. **Conduct a survey:** We will conduct a survey to reach out to a wide range of people and gather information about their interests and activities that may be affected by the activity.
11. **Attend local community events:** We will search for local community events that may be appropriate for CGG to participate in and engage with aggregations of people, some of whom may be affected by the activity.

In addition to the above methods, we have an online survey available for anyone to determine if they are entitled to consultation with us as a relevant person or if they should engage with us as a member of the public. The survey will remain live throughout the preparation of the EP, the public comment period and throughout NOPSEMA's assessment.

Authorities

Authorities are relevant to each of CGG activities within its Work Program. Each Department or Agency has been identified through online searches, expert advice, review of legislation and review of previous EPs adjacent to the title. Some authorities have published specific guidelines on how they wish to be consulted as relevant persons under the Regulations. These have been hyperlinked in the lists below.

Australian Commonwealth Agencies

NOPSEMA Guideline GL1887 identifies the following government agencies as relevant persons as they have responsibilities within the Commonwealth marine area.

- Australian Fisheries Management Authority (AFMA)
- Australian Maritime Safety Authority (AMSA)
- Department of Agriculture, Fisheries and Forestry (DAFF)
  - Fisheries
  - Biosecurity (vessels)
  - Biosecurity (marine pests)
- Department of Climate Change, Energy, the Environment and Water (DEECCW)
  - Australian Antarctic Division (AAD)
  - Underwater Cultural Heritage
  - Sea Dumping
- Department of Defence (DoD)
  - Australian Hydrographic Office (AHO)
- Department of Foreign Affairs and Trade (DFAT)[2]
- Director of National Parks (DNP)

The full list[3] of Commonwealth agencies will be reviewed to find additional Commonwealth agencies. The following agencies were identified as relevant persons:

- Australian Communications and Media Authority (ACMA)
- Commonwealth Fisheries Association (CFA)
- National Native Title Tribunal (NNTT)
- Maritime Border Command (MBC)

Victorian Government Agencies

The full list[4] of Victorian agencies will be reviewed to find relevant persons. The following agencies will be contacted to determine whether they are relevant persons.

- Victorian Fisheries Authority
- Heritage Council Victoria
- Heritage Victoria
- Department of Energy, Environment and Climate Action
- Department of Health
- Department of Jobs, Skills, Industry and Regions
- Department of Transport and Planning
- Business Victoria
- Energy Victoria
- Environment Protection Authority
- Local Government Victoria
- Parks Victoria
- Ports Victoria
- Victorian Aboriginal Heritage Council

People and Organisations

The Regulations specify that relevant persons include people or organizations whose functions, interests and activities may be affected by the petroleum activity. The Federal Court of Australia helped to define these terms in the appeal decision of Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No 2) [2022] FCA 1121.

[2] Not a relevant person as the proposed activity does not cross into or impact on waters outside of Australia's maritime jurisdiction.
[3] Full list of Commonwealth agencies can be found here https://www.directory.gov.au/departments-and-agencies
[4] Full list of Victorian agencies can be found here https://www.vic.gov.au/victorian-government-organisations

CGG has grouped people and organisations into subject-centred categories because this allows for tailoring identification, communication and engagement strategies to each category. An additional benefit is that the search for one member of a group can often lead to the discovery of additional members of that group. The following subject-centred groups have been identified in the preparation of this plan. A person could be associated with more than one of these groups while it is more likely that an organisation will associate with just one.

Subject-centred Groupings

Commerce	Tourism operators	Traditional Owners	Port users
Petroleum titleholders	Commercial fishers	Recreational fishers	Native title land councils
Conservation groups	Fishing associations	Commercial shipping	Local councils
Educational bodies	Other marine users	Ports and harbours	Heritage groups

The search for persons or organizations who are relevant persons starts as a global public search because the definitions of functions, interests and activities are not geographically constrained. However, certain groups, such as other marine users, are likely to be proximate to the activity.

We assume that there will be more relevant persons proximate to the activity and therefore consultation efforts will be greater in these locales. However, the subject-centred approach allows identification of relevant persons to be tailored within that group allowing global searches to be carried out where this is more likely to reveal relevant persons.

Identification of relevant persons by subject-centred groups

The identification of persons or organizations within the subject-centred groups will be tailored and will evolve as engagement within these groups is carried out. In all cases each person contacted will be asked to support in the identification of relevant persons and encouraged to share information about the petroleum activity and how to contact us.

Information about each of these subject-centred groups that supports the identification of relevant persons can be found in materials published by the DCCEEW under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) including:

- **Plans of Management:** including for World and National Heritage places, Ramsar wetlands, Australian marine parks, Commonwealth reserves and Commonwealth Heritage places.
- **Recovery Plans:** for listed threatened species and ecological communities.
- **Policy Statements:** including significance impact guidelines and industry specific guidelines.
- **Other material:** including management principles, online databases, factsheets and other publications.

Tourism operators

To identify tourism operators the following searches will be performed:

- Online searches for marine tours and recreational experiences such as marine mammal observations, diving and thrill-seeking experiences.
- Request to Tourism Australia and Tourism Victoria to query any databases of local businesses along the coastline within the socio-economic risk EMBA.
- Enquiry with local Chambers of Commerce to identify marine based tourism operators in the region.
- Search for upcoming marine-based community or sporting events.

Traditional Owners

To identify Traditional Owners the following searches will be performed:

- Visit the local government authority websites (the shire or municipal council) who often include an acknowledgement of the local traditional owners.

- State and territory government websites also include information about traditional owners in their jurisdictions, especially in the context of information about local offices.
- Search online for states' and territories' Aboriginal and Torres Strait Islander consultative bodies, which themselves might offer advice.
- Contact land councils representing the local Aboriginal or Torres Strait Islander communities.
- Online searches for Native Title groups and corporations on the Prescribed Bodies Corporate website.
- Register searches on the National Native Title Tribunal website.
- Geospatial searches by completing the forms here on the National Native Title Tribunal website.

Note that any person with Native Title claims of any standing will be categorised as a relevant person.

Port users

To identify port users the following searches will be performed:

- Contact made with relevant harbourmaster to enquire about frequent users.
- Online searches for businesses located at wharves in regional ports.

Petroleum titleholders

To identify petroleum titleholders the following searches will be performed:

- Use the NEATS database to find titles and titleholders within the EMBA.
- Use the NOPSEMA EP database to find other titleholders with activities.
- Subscribe to the NOPSEMA EP submissions pages for all activities in Victoria.

Commercial fishers

To identify commercial fishers the following searches will be performed:

- https://www.fish.wa.gov.au/Sustainability-and-Environment/Fisheries-Science/Stock-assessment-and-data-analysis/Pages/Making-a-data-request.aspxRequest data from the Victorian Fisheries Authority to understand historical fishing activity within the EMBA.
- Visit local ports to find local fishers who operate in the area.

Recreational fishers

To identify recreational fishers the following searches will be performed.

- Engagement with recreational fishing associations to use newsletters/circulars or websites.
- Request contact details for license holders.
- Request to engage with advisory bodies or reference groups to establish the best approach to identify relevant persons.

Native title land councils

To identify native title land councils the following searches will be performed:

- Seek contact details of land councils from the National Native Title Council.

Conservation groups

To identify conservation groups the following searches will be performed:

- Review of previously submitted EPs on the NOPSEMA website.
- Online searches for conservation groups with interests in similar activities.
- Online searches for new articles and current campaigns related to similar activities.

Fishing associations

To identify fishing associations the following tasks and searches will be performed:

- Identify the target species within the EMBA through online research.
- Ask the peak fishing association to identify other species-specific associations.
- Request contact details for license holders.

Other marine users

To identify other marine users the following searches will be performed:

- Online searches for groups who use or have a connection to the marine environment. This search will focus on marine users proximate to the EMBA.

Commercial shipping

To identify commercial shipping entities the following searches will be performed:

- Contact made with relevant harbourmasters and shipping agents to enquire about frequent users.
- Online searches for businesses located at wharves in regional ports.

Local councils

To identify local councils, shires and cities, the following searches will be performed:

- Search the Victorian Electoral Commission database for councils, shires and cities proximate to the activity.

Educational bodies

To identify educational and research bodies the following searches will be performed:

- Contact the Department of Education to identify relevant institutions and research programs.
- Contact the universities to identify any relevant research programs.

Note: for this category the exposure thresholds for monitoring of potential impacts of the activity will be used rather than the socio-economic thresholds because this is more relevant to the likely activities of research institutions.

Commerce

To identify commercial entities the following searches will be performed:

- Contact the local Chamber of Commerce to identify local marine-based businesses.
- Online searches for news articles or press releases about marine-based businesses in the area.

Ports and harbours

To identify ports and harbours (including boat ramps) the following searches will be performed:

- Review of automatic information system (AIS) data of vessel activities along the coast to establish frequented ports.
- Review the Victorian boat ramp database.
- Contact local councils, cities and shires for listing of local boat ramps and users.

Heritage groups

To identify heritage groups the following searches will be performed:

- Contact Victorian heritage organisations to identify other relevant persons.
- Query the Australian Heritage Database.
- Query the Australasian Underwater Cultural Heritage Database.

Each of the relevant persons identification searches will be re-run at least quarterly while the EP is in-force and at least once a month before the activity commences.

The Consultation Framework

A framework of consultation stages will be implemented, within which there is flexibility to tailor the consultation to subject-centred groups and individual needs. This includes the provision of initial information to the public sufficient to allow a person to self-identify as a relevant person. The early engagement of relevant persons will provide the clarity of the consultation process required to underpin effective consultation. Further, early engagements with relevant persons enable discussions about the expectations a relevant person may have about the type and level of detail of information required through the process. The framework has been designed to align with ISO 31001 in that it should be iterative throughout its numerous stages as per Table A3-2.

This consultation framework covers both public engagement and consultation with relevant persons. The timeframes show when certain information is intended to be made available to the public. Consultation with relevant persons will occur within the overall timeframe, subject to any variations required after co-design of the consultation process.

Table A3-1 - Consultation framework and schedule

Stage	Purpose	Information to Publish	~Timing
0	To prepare the engagement and consultation activities		7 months pre-submission
1	To introduce the activity and this consultation plan and seek input into the co-design of the consultation processes.	- Community Consultation and Engagement Plan - Description of Activity - EIA and ERA processes and assessment criteria	5 months pre-submission
2	To provide the environmental context to the activities and information to relevant persons and the public.	- Legislative Requirements - Implementation Strategy - Preliminary EIA	4 months pre-submission
3	To provide the environmental analysis undertaken to predict the levels of impact and risk that the environment is exposed to.	- Predicted levels of impact - Predicted levels of risk - Independent reports (e.g., noise modelling, oil spill modelling)	3 months pre-submission
4	To provide the evaluation of and control measures adopted for the environmental impacts and risks including how relevant persons' feedback has been incorporated.	- Full EIA - Full ERA - Treatment and Management Plans (e.g., OPEP, OSMP)	2 months pre-submission
5	To provide an opportunity for relevant persons to raise objections or claims about any adverse impact on their functions, interests and activities.	- Notice of the consultation process complete and ongoing	1 month pre-submission
6	To complete the consultation records for first submission of the EP.		0 months pre-submission
7	To provide updates during the assessment process including the feedback provided by NOPSEMA and the way in which the titleholder is addressing the matters raised	- NOPSEMA letters to the titleholder - Latest versions of the submitted/resubmitted EP	During the assessment process
8	To provide updates on the activity and the monitoring of environmental impacts and risks	- Activity commencement and cessation notifications - Ongoing notifications to commercial fishers and other marine users - Environmental incident reports (recordable and reportable incidents)	Prior to and during the activity

Undertaking a petroleum activity is a complex task that requires extensive planning, integration of many component parts and detailed risk management. To deliver the activity successfully an integrated schedule governs the timing of all activities including the preparation of EP's and the conduct of the consultation required. This framework caters for some flexibility in the community engagement and consultation activities. This is recognised in the first stage of the framework, which encourages relevant persons to influence the design of the subsequent processes and activities. This framework acknowledges that consultation activities cannot be 'one-size-fits-all' and there is an obligation to adapt our consultation activities to what we hear from the community and relevant persons.

However, like all businesses, we must operate within a schedule. Therefore, each stage of the framework has an indicative timeframe of one month for each of the stages to occur. This equates to a 5-month consultation process run in parallel with the preparation of the EP. This timeframe is considered reasonable given that at each stage within the framework the public and relevant persons, will be able to have full access to the documents that underpin the environmental assessments as they are prepared. As will be shown later in this plan, the community will be able to make comment on those documents and engage in the process to the extent that they want to, either as a relevant person or as a member of the public.

Reasonable Period for the Consultation

CGG is required to provide a 'reasonable period' to relevant persons once they have received 'sufficient information' to make an informed assessment of the potential consequences of the activity on their functions, interests and activities. Whilst the framework is adaptable to what we hear from relevant persons the minimum definition of a 'reasonable period' will be:

- At least 5-months from the notice of commencement of the consultation process.
- At least 30-days following the provision of sufficient information to the relevant person.

Sufficient Information

Information provided must be sufficient to allow an informed assessment of the possible consequences of the activity on the functions, interests, or activities of the relevant person. What constitutes sufficient information as part of a consultation process will differ depending on the relevant person(s). The information provided to relevant persons will consider:

- the functions, interests, or activities of the relevant person.
- the environmental impacts and risks that may affect them.
- the degree to which a relevant person is affected.

The overarching consultation framework and its schedule will remain as the base case for the consultation effort. However, the specific processes applied to relevant persons will need to be defined in collaboration with those persons for the EP. The type, format and level of detail of information necessary is likely to vary for different relevant persons depending on the above factors. However, CGG recognises that for some relevant persons there may never be enough information for them to assess how they may be affected (i.e., in the case of a general objection to the activity). Therefore, the framework has been designed in such a way that the entire contents of the EP will be made available for the public (and therefore to all relevant persons) for a minimum of 30 days prior to first submission of the EP. This design implies that sufficient information is, at least, the full EP contents that will be put before the regulator upon which they will decide whether to accept or refuse to accept the EP.

Notwithstanding the above commitment to publish the full draft EP prior to submission, CGG will undertake the consultation processes and activities without relying on this measure as the way sufficient information will be provided to relevant persons. We recognise that generic information flyers, targeted electronic mailouts and links to a webpage will not be considered sufficient. We will endeavour to tailor the information we provide in a convenient and digestible format that respects the needs and activities of each relevant person. The exact method of communicating sufficient information cannot be determined without talking to relevant persons. However, CGG has a variety of communication methods available to use such as in-person meetings, phone calls, email, letters, social media, public meetings and newsletters.

Engagement and Consultation Activities

Best practice consultation includes an element of co-design of consultation processes. This means that detailed planning in advance of talking to relevant persons is somewhat limited as the needs of the relevant person would not have been taken into consideration. However, this does not remove the need for a preferred consultation and engagement plan to be developed. Rather, it means that the engagement and consultation activities need to be adapted in response to circumstances.

Consultation Methodology

Once a relevant person is identified, consultation will be undertaken in line with the International Association for Public Participation IAP2 spectrum (IAP2 Spectrum), which is considered best practice for stakeholder engagement. Table A3-3 shows how the IAP2 Spectrum aligns with our consultation efforts on specific goals. It links the communication channels available to CGG to the IAP2 Spectrum and assesses the effectiveness of consultation methods. The assessment of effectiveness of a communication channel included consideration of the following:

- Accessibility to the channel.
- Accessibility of information.
- Depth and quality of information able to be communicated.
- Least burden on the person.
- Opportunity to respond to the information.
- Ability to show genuine consideration of the views prior to a decision.

Table A3-2 – Consultation goals, channels and assessment of effectiveness

Relevant IAP2 Spectrum element	Consultation goal	Consultation channels	Assessment of effectiveness
Inform	To provide balanced and objective information to assist persons in understanding the problems, alternatives and/or solutions. To seek and further understand the environmental values and sensitivities in the EMBA.	Activity specific website. Activity information flyers. Print media notices. Mandated public comment process.	The methods adopted cover a wide range of persons and provide specific information about the CGG activity and its environmental impacts and risks. As an exploration EP, the full EP is available for public exhibition prior to submission to NOPSEMA for assessment, which provides the opportunity for the public to provide feedback directly to NOPSEMA.
Consult	To obtain specific feedback on analysis, alternatives and/or decisions from potentially relevant persons.	Exchange of letters/emails. Informal discussions. Activity update flyers.	Adapting consultation processes so that they are fit-for-purpose and tailored to the relevant person and/or provided updates to specific information as the activity definition is developed.

Relevant IAP2 Spectrum element	Consultation goal	Consultation channels	Assessment of effectiveness
Involve	To work directly with relevant persons throughout the process to ensure that their functions, interests and activities are consistently understood, considered and addressed.	Phone calls. Online meetings. Face-to-face meetings.	The methods adopted in this category are targeted and support the provision of detailed and tailored information to allow informed assessment of the possible consequences of the CGG activity on the relevant persons' specific functions, interests or activities and building of one-on-one relationships.
Collaborate	To partner with the public in each aspect of our decision making including the development of alternatives and the identification of the preferred solutions.	Dual consultation process for the public and relevant persons. Participatory decision making.	The dual consultation processes allow anyone to engage as they prefer to. Both processes will directly influence the design of the activity, its environmental management measures and the decision about whether the activity is environmentally acceptable.
Empower	To provide the opportunity to co-design the consultation process and directly influence the final design of the activity.	Final decisions are placed in the hands of an independent regulator.	CGG will accept the decision of NOPSEMA about whether it has done enough to demonstrate that the requirements of the Regulations have been met.

Consultation with Relevant Persons Process Flowchart

Relevant persons may reveal themselves at any time in the preparation of an EP, during the activity, or after the activity is finished. As a result, the flowchart in Appendix A governs how each relevant persons will be treated irrespective of the stage within the framework.

Consultation Activities and Tasks

The following tables identify all the activities and the tasks that will be carried out in preparation of an EP and provides guidance for how these activities should be completed. The Regulations require that all consultation activities are specific to the EP.

The consultation and engagement activities that CGG is prepared to undertake are listed below and are expanded on in the following tables. This CCEP must be adaptable to the needs of relevant persons therefore not all activities listed below will take place, rather this is a list of activities that CGG is prepared to undertake should the need be identified. The 'triggers' in each of the corresponding tables provide guidance to when the activity and tasks may be implemented. Other circumstances may trigger the activity. If the consultation activity will occur the trigger is captured as '*Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters*.'

- Establish an activity-specific online presence (Table A3-4)
- Public notices in print and social media and on radio (Table A3-5)
- Publication of information flyers (Table A3-6)
- Written correspondence (Table A3-7)
- Phone calls (Table A3-8)
- Online meetings (Table A3-9)
- Face-to-face meetings (Table A3-10)
- Group meetings (Table A3-11)
- Webinars (Table A3-12)
- Establish a consultation reference group (Table A3-13)
- Community meetings (Table A3-14)
- Public notices at prominent locations (Table A3-15)
- CGG activity news subscription service (Table A3-16)
- Maintain a telephone hotline service (Table A3-17)

In addition to these measures the website will have a link to provide instant feedback in a prominent location for anyone to provide feedback directly to our environment team.

Table A3-3 - Establish an activity-specific online presence

Consultation Activity	Establish an activity-specific online presence					
Purpose	The purpose of this activity is to establish a central place for all activity specific information that needs to be easily accessible to as many people as possible at any time during the consultation process and during the activity. The website will function as the single source of truth for information provided to the community and be a place for the community to provide feedback. Social media activity sites will act to direct traffic to the website.					
Triggers	Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
0	Build an activity-specific webpage and social media activity pages.	N/A	All	Minimum of 7 months prior to EP submission	Surrender of title	Once
1	Publish the details of the proposed activity and the consultation process going forward	Authorities, Organizations and People	All	Minimum of 6 months prior to EP submission	Surrender of title	Year-round
2	Interactive map: Create a place for people to provide location-based feedback on the proposed activity	Authorities, Organizations and People	All	Minimum of 5 months prior to EP submission	Acceptance of the EP	Year-round
2	Issues comment board: create a page for anyone to raise specific concerns and comment on them	Authorities, Organizations and People	All	Minimum of 5 months prior to EP submission	End of the activity	Year-round
2	Community survey: seeking information on the environment that may be affected	Authorities, Organizations and People	All	Minimum of 5 months prior to EP submission	End of stage 4	Once
4	Community survey: provide a form for people to raise objections and claims	Authorities, Organizations and People	All	Minimum of 3 months prior to EP submission	End of stage 4	Once

Table A3-4 - Public notices in print and social media and on radio

Consultation Activity	Public notices in print and social media and on radio					
Purpose	The purpose of these activities is to increase awareness of the petroleum activity and direct interested persons to the website. Notices are to be placed in local, regional and other relevant print media. Notices and updates are also printed on social media platforms LinkedIn and Facebook. Subject-centered groups may have their own newsletters or print communication methods that should be used, if possible, to communicate within those groups.					
Triggers	Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters. Upon significant changes to the petroleum activity.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
1	Notices in local papers, on social media platforms (LinkedIn, Facebook, Instagram) and on local radio (3RPC Community Radio, ABC Local Radio 3SWR) notifying of the activity, the consultation process and the way to "self-identify".	Persons	All	Start of phase 1	End of phase 5	Monthly
1	Notices in regional papers (Portland Observer, Geelong Advertiser, Warrnambool Standard) notifying of the activity, the consultation process and the way to "self-identify".	Persons, Organizations	Marine Users	Start of phase 1	End of phase 5	Monthly
1	Notice in national papers (The Australian, The Age) notifying of the activity, the consultation process and the way to "self-identify".	Persons, Organizations	All	Start of phase 1	-	Once
5	Notices in local, regional and national newspapers and on social media inviting objections or claims on the proposed activity and its environmental management.	All	All	Start of phase 4	-	Once
8	Notices in local, regional and national newspapers and social media informing the outcome of the NOPSEMA assessment and, if accepted, inviting self-identification as a relevant person at any time.	All	All	Upon final decision by NOPSEMA	-	Once

Table A3-5 – Information flyers

Consultation Activity	Information flyers					
Purpose	Short summary flyers containing activity specific context about the petroleum activity, its environmental aspects and its potential environmental impacts and risks will be produced for distribution alongside other consultation activities and tasks. They will be accessible through the website and appended to correspondence as necessary. If a relevant person requests more information, or the information in a different form, subject-specific flyers will be created to further tailor the information to the subject-centered group. For example, if fishers request information about impacts on their target species a tailored flyer will be produced.					
Triggers	Upon completion of EP content Upon request through consultation					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
0	Flyer: Description of activity, consultation framework, and risk framework	All	All	Start of phase 1	-	Once
1	Flyers: Environmental aspects	All	All	Start of phase 1	-	Once
Any	Prepare flyers as per requests for information from relevant persons	Organizations, Persons	Marine Users	Start of phase 1	End of the activity	On request

Table A3-6 – Written correspondence

Consultation Activity	Written correspondence					
Purpose	To provide formal consultation between the titleholder and a relevant person. Written correspondence is useful to initiate consultation with authorities and organizations					
Triggers	Upon identification of a relevant person					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
1	Communicate with all identified authorities and organizations to commence the consultation process. Focus of the letter/email is to notify the commencement of the preparation of the EP and invite co-design of the consultation process.	Authorities, Organizations	Petroleum titleholders, educational bodies, fishing associations, local councils, ports and harbors, heritage groups, native title land councils and Traditional Owners.	Start of Stage 1	-	Once
1	Communicate with all identified fishers to commence the consultation process. Focus of the letter/email is to notify the commencement of the preparation of the EP and invite co-design of the consultation process.	Persons	Fishers	Start of Stage 1	-	Once
All	Continue the consultation processes as agreed.	All	All	-	-	Once
2	Request input on the environmental values and sensitivities within the EMBA through the interactive map on the website.	All	All	Start of Stage 2	-	Once
5	Written notice that the draft EP is available online and request any residual objections or claims that haven't been addressed by the consultation process to date.	All	All	Start of stage 5	Start of Stage 6	Once

Table A3-7 – Phone calls

Consultation Activity	Phone calls					
Purpose	To supplement written correspondence to assist in delivering the message effectively and build relationships with the receiver. Cold calls are not part of this activity and are not supported as an effective method of commencing consultation.					
Triggers	After written correspondence has been sent. To arrange other consultation activities.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
1-5, 7 & 8	Call relevant persons to confirm receipt of correspondence and offer the opportunity to ask any questions.	All	All	One week after correspondence sent	-	Once

Table A3-8 – One-on-one online meetings

Consultation Activity	One-on-one online meetings					
Purpose	As many of the decision makers for CGG are not in Victoria online meetings with relevant persons are the preferred method of meeting with relevant persons. With attendees' permission they can be transcribed for ease of record keeping. It is likely that meetings will follow some form of written correspondence. Like all meetings, the agenda and frequency of meetings will be specific to the needs of the relevant person.					
Triggers	Upon request from a relevant person. To assist in delving deeper into the substantive issues of a relevant person. To resolve objections or claims that cannot be easily managed.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
2-5, 7 & 8	Online meetings to be held, if triggered, with a clear agenda communicated and agreed beforehand.	All	All	As needed	-	On requests or as agreed

Table A3-9 – Face-to-face in person meetings

Consultation Activity	Face-to-face in person meetings					
Purpose	Face-to-face meetings are the preferred means of building relationships with relevant persons.					
Triggers	Relevant person requests a face-to-face meeting During CGG staff visits to Victoria. If other consultation activities have failed to resolve substantive issues					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Completion Date	Start Date	Frequency
2-5, 7 & 8	Face-to-face meetings to be held, if triggered, with a clear agenda communicated and agreed beforehand.	All	All	As needed	-	On requests or as agreed

Table A3-10 – In person group meetings

Consultation Activity	In person group meetings					
Purpose	In person group meetings can be useful to communicate the same messages and content to multiple relevant persons at the same time and allow for deeper debate on the substantive issues that affect the whole group. A group meeting might be effective if there are multiple representatives of a relevant organization where it is more efficient to meeting collectively rather than with each representative individually.					
Triggers	On request from an organization. On request from more than 10 relevant persons in the same subject-centered group.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
2—5, 7 & 8	Organize a meeting at a convenient location for relevant persons.	All	All	As needed	-	On request or as agreed.

Table A3-11 – Webinars

Consultation Activity	Webinars					
Purpose	Hosted periodically online, these open briefings are available to anyone who registers to attend i.e., the public and relevant persons. The purpose is to communicate the consultation process, provide instruction on how to determine if you are a relevant person, seek input and local knowledge and build trust in the community.					
Triggers	Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
2-5, 7 & 8	Host an online webinar specific to the activity that anyone can register to attend.	All (and the public)	All	-	-	Monthly

Table A3-12 – Establish a consultation reference group

Consultation Activity	Establish a consultation reference group					
Purpose	A consultation reference group is designed to provide CGG with input into decision making within the consultation framework, the consultation methodology and the consultation processes. It is designed as a consultative group across the activities within the Work Program. It would meet regularly throughout the Work Program to provide feedback to CGG on its consultation efforts and how they can be improved.					
Triggers	If the co-design consultation processes reveal themselves to be ineffective. If there are trade-offs between relevant persons that may need community input to resolve.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
2	Offer relevant persons who are directly affected by the activities the opportunity to be part of a consultation reference group.	Authorities, Organizations	Commercial Fishers, Native Title Land Councils, Local Councils, Conservation Groups, fishing associations and Traditional Owners	As needed	-	As defined by the group

Table A3-13 – Community briefings

Consultation Activity	Community briefings					
Purpose	These are open forums held at relevant locations proximate to the location of the activity to engage the local communities in the Work Program. They are designed to facilitate relationship building with the public and relevant persons within those locales.					
Triggers	If the environmental assessment identifies significant impacts or risks that cannot be avoided.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
3, 4, or 5	Undertake a roadshow of community briefings at strategic locations with appointments for anyone to come and meet the CGG team and discuss their concerns.	Persons	Recreational fishers, Traditional Owners, Port users, other marine users.	As needed	-	Once in the Work Program

Table A3-14 – Public notices at prominent locations

Consultation Activity	Public notices at prominent locations					
Purpose	These notices can be targeted to relevant subject-centered groups in places they may receive other notices or messages.					
Triggers	If other activities have identified relevant persons but their identity cannot be shared, for example, if fishing records show activity but because of confidentiality either the exact location fished, or the fisher, cannot be identified through other means. If other activities have identified that relevant persons may have been inadvertently missed. If this activity is requested by associations or other relevant persons.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
1 & 4	Public notices to be placed on the notice boards at local post offices, boat ramps, public houses and local councils about the stage of consultation we are at.	Persons	Traditional owners (fishers), commercial fishers, recreational fishers, tourism operators and other marine users.	Start of the stage	-	Once per stage
8	Public notices to be placed at locations defined as useful by relevant persons.	Persons	Traditional owners (fishers), commercial fishers, recreational fishers, tourism operators and other marine users.	Start of the stage	-	Once

Table A3-15 – CGG activity news subscription service

Consultation Activity	CGG activity news subscription service					
Purpose	Any person will be able to subscribe to a newsletter that will outline the latest information on CGG's full Work Program including the status of the activities and the status of the EP.					
Triggers	Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
All	Short 2-page max newsletters will update all subscribers about the status of the Work Program, the activities and the approvals.	All	All	Start of stage 1	End of activity	Monthly

Table A3-16 – Maintain a telephone hotline service.

Consultation Activity	Maintain a telephone hotline service					
Purpose	Any person will be able to contact this service to find out about the activity from a member of the EP development team who is familiar with the activity and environmental management requirements.					
Triggers	Upon the decision to seek environmental approvals for a petroleum activity in Australian Commonwealth waters.					
Implementation						
Framework Stage	Task	Relevant Person Category	Target Group(s)	Start Date	Completion Date	Frequency
All	Maintain a telephone hotline service.	All	All	Start of phase 1	End of the activity	Ongoing

Coordination of Activities

All consultation and engagement activities will be coordinated by the CGG Consultation Team, who are also responsible for updating this plan and communicating the change to internal stakeholders and, where relevant, external audiences.

Assessment of Merit of Objections or Claims

Feedback of any type will be welcomed throughout the consultation process. If received through our public engagement activities, it will be documented in the website management system and is considered in the preparation of the EP. If feedback is received through our relevant persons consultation activities, it will be recorded in our consultation management system and forms part of the EP.

Listening to feedback and attempting to understand the substantive issues is the first step in mitigating them. The process in Appendix A will be applied to assess the merit of objections and claims received from relevant persons. It is preferred that this process take place in meetings rather than through written correspondence, though this may not always be possible.

An assessment of merit of each objection or claim will be carried out by CGG with external experts as needed. A relevant person's objection or claim has higher merit when one or more of the following criteria is met:

- The objection or claim is relevant to environmental management of the activity.
- The objection or claim is relevant to the persons functions, interests, and activities.
- The objection or claim can be resolved through the adoption of additional control measures, an activity design variation/limitation, or through changes to the implementation strategy for the EP.

An objection or claim may be resolved by providing more information and/or adopting one of the three main types of 'measures' which can be adopted because of the consultations:

1. Control measures (with associated environmental performance outcomes and standards)
2. Activity design variations/limitations applied within the activity description.
3. Inclusions within the Implementation Strategy of the EP.

Despite our best efforts to resolve all objections and claims we understand that relevant persons may not agree with our treatment of their objection or claim. In such circumstances the consultation processes can continue provided that the relevant person has received a response about our assessment of their objections and claims and is aware how our respective views will be presented to NOPSEMA.

Ongoing Consultation

Section 22(15) of the Regulations requires ongoing consultation to be incorporated into the Implementation Strategy of the EP. This CCEP will form part of the Implementation Strategy of the EP. CGG will continue to search for relevant persons before, during and after all our activities up until the EP has ended or expired. CGG will continue the discourse with relevant persons and organisations after this time to maintain relationships for future activities. In addition, CGG will keep relevant persons up to date with the status of the title by sending periodic public notifications and correspondence to all relevant persons who have not explicitly requested that communications cease.

CGG acknowledges that relevant persons may have decided not to engage in the consultation processes but may reconsider that decision at any time. As such, CGG will continue to provide notifications to relevant persons if they haven't specifically requested to be excluded from the consultation processes. CGG will apply the same consultation processes that applied in preparation of the EP for the duration of the activity.

Post-EP acceptance, key milestones that will trigger further consultation with relevant persons include:

- Availability of the accepted EP on the NOPSEMA website.
- Notification prior to activity commencement (the notification period varies from one day to five weeks pre-activity depending on the relevant person).
- Completion of activity (between one and 10 days, depending on the relevant person).
- Any reportable incidents.
- If there is a change to the CGG activity scope that would affect the relevant person in a new or different manner to that which has been discussed.

Communication of changes

CGG acknowledges that changes to activities based on knowledge underpinning the environmental impact and risk assessments occur from time to time. In the event of such a change that affects a relevant person's functions, interests, or activities, CGG will complete an assessment that includes provision of information to affected relevant persons in respect of the change and consideration of their feedback.

As required by the Regulations, CGG shall assess the merits of any new claims or objections made by a relevant person because of the change that may have an adverse impact on their functions, interests, or activities. If the claim has merit, where appropriate, CGG will modify the management of the activity.

CGG will seek to finalise its determination of the merits of any claim or objection received before the activity starts, and if after commencement, within 1 week of receipt and undertake any resulting management of change actions as soon as practicable, but preferably within that timeframe. The assessment of merit and any resulting management of change actions will be shared with the concerned relevant persons. For objections and claims that do not require a change in management of the activity, CGG will respond to relevant persons providing reasoning and supporting information (as relevant) to support CGG's conclusions. This may include an outline of the options/controls explored to mitigate the degree to which the person may be affected and/or a demonstration that the impact or risk in question has been reduced to ALARP and acceptable levels.

Any claims or objections raised by relevant persons after submission of the EP will be assessed for merit and a response provided. If a change to the CGG activity or controls adopted during the CGG activities occurs because of relevant persons consultation, the change will be managed in accordance with the processes outlined in the EP.

Monitoring

Effectiveness of Consultation

It is CGG's intention to consult effectively in preparation of the EP, during the activity and throughout the tenure of the title. The effectiveness of our consultation will be determined in the following ways:

- **Responsiveness**: We will have effectively consulted when we have reached out to relevant persons, listened to their concerns and taken appropriate actions to address those concerns.
- **Two-way communication**: Consultation is an ongoing process of two-way communication, not just providing information. Effective consultation is when we have actively listened to the views and concerns of relevant persons and taken them into account in our decision making.
- **Inclusion**: We will have effectively consulted when we can show we have reached out to a diverse range of people, including those who may be particularly affected by the activity.
- **Timing**: We have effectively consulted when we have reached out to relevant persons early in the planning process, throughout the preparation of the EP and throughout the duration of the activity.
- **Transparency**: We have effectively consulted when we can show we have provided relevant persons with accurate and transparent information about the activity and have been open and honest in our communication.
- **Feedback**: We have effectively consulted when we have received feedback from relevant persons and have taken appropriate actions to address their concerns.
- **Compliance**: We have effectively consulted when we have followed all relevant laws and regulations related to consultation, such as ensuring that the rights of all persons are respected.

Records Management

Engagement and consultation activities with relevant persons will be logged by the person who carried out the activity in the consultation management system.

Key Performance Indicators

The following key performance indicators will be monitored to judge the effectiveness of this CCEP, the consultation processes and the consultation activities.

1. Numbers of relevant persons start high and begin to lower indicating that our identification processes are working.
2. Relevant persons are responded to within 24 hours, acknowledging receipt of a correspondence.
3. Relevant persons have a considered response from CGG within 14 days of receiving correspondence.
4. Website visits on issues decline as control measures are adopted and the activity design changed in response to relevant person concerns.
5. The EP is submitted to NOPSEMA with no outstanding issues from relevant persons.

References

The following requirements and guidance have been followed during the consultation process:

The OPGGS(E) Regulations

NOPSEMA policies, guidance, and information papers, including:

PL1347 - Environment plan assessment policy (19 May 2020).

GL1721 - Environment plan decision making (10 June 2021).

GL1887 - Consultation with Commonwealth agencies with responsibilities in the marine area (3 July 2020).

GN1344 - Environment plan content requirements (11 September 2020).

GN1488 - Oil pollution risk management (7 July 2021).

GN1785 - Petroleum activities and Australian marine parks (3 June 2020).

GN1847 - Responding to public comment on environment plans (11 September 2020).

Other relevant guidance, including:

- AIATSIS Engaging with Traditional Owners Guidance: fpicsnapshot2020.pdf (aiatsis.gov.au)

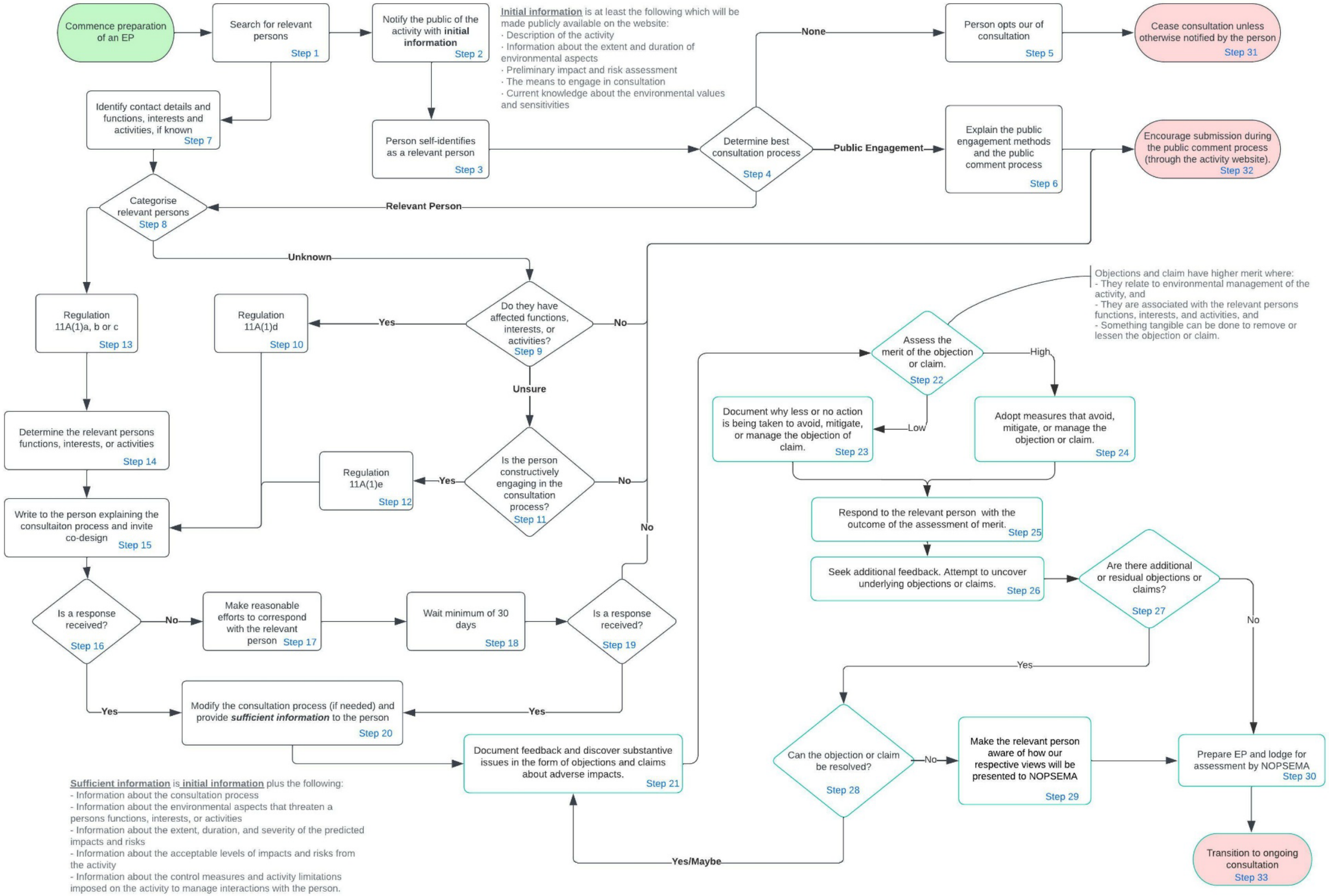
Revision History

Change History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	24 March 2023	MS	Initial version
0.1		LT/PR	Review by CGG
0.2		MS	Updated following CGG review
1.0	31 March 2023	MS	Published on Regia MSS Consultation Hub website

Appendix A

Consultation Process



REGIA
Marine Seismic Survey

Decision-Making Criteria in the Environmental Assessment Process

Appendix B1: REG-EP-004-B1

Rev 2

January 2024

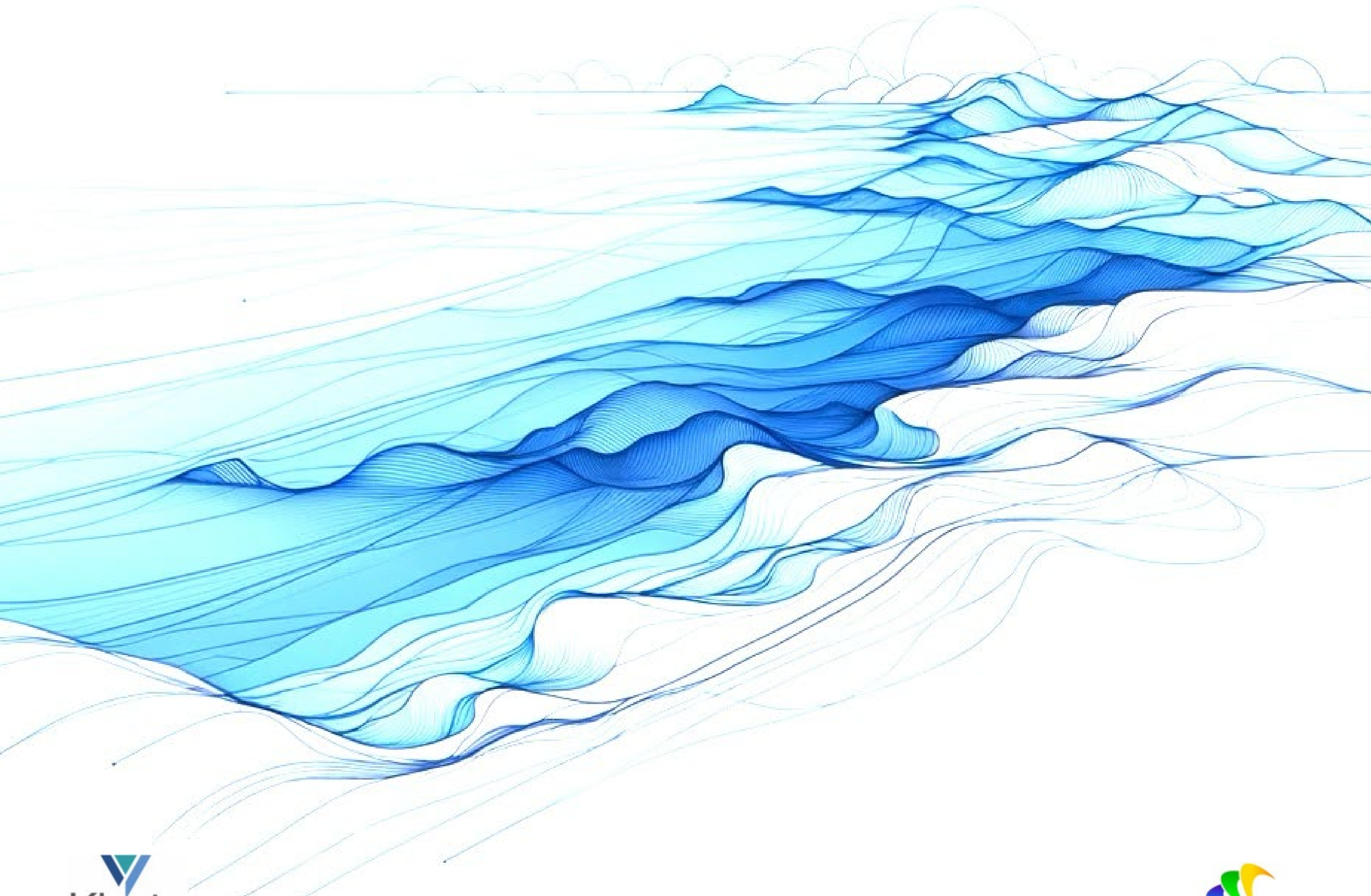


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Table of Contents

1 Introduction and Purpose

This Decision-Making Criteria (**DMC**) document has been prepared to support CGG Services (Australia) Pty Ltd (**CGG**) in its environmental management of the Regia Marine Seismic Survey (**Regia MSS**). The DMC follows a standardised methodology for identifying environmental impacts and risks from offshore petroleum activities and determining their relative significance.

This document aims to:

- Communicate the basis for the decision-making criteria that CGG will apply in its environmental assessment of the Regia MSS.
- Explain the process for determining how the activity is to be managed to ensure these decision-making criteria will be met throughout the duration of the activity.
- Determine how the principles of ecologically sustainable development (**ESD**) as set out in section 3A of the Environment Protection and Biodiversity Conservation Act (**EPBC Act**) will be integrated into the impact and risk assessment process and management of the activity.
- Propose acceptable levels of environmental impact and risk to support consultation with relevant persons.
- Introduce the concept of managing environmental impacts and risks to As Low As Reasonably Practicable (**ALARP**).

This document will be updated over time because of the consultations and throughout the environmental assessments.

2 Aspect Specific Relevant Person Objections and Claims

These DMC were published in May for a period of 60 days and relevant persons, and the community, were invited to provide input into their quality and form. The consultation sought involve people who may be affected by the activity to improve the predictive quality of the assessments.

No feedback on the DMC document or the criteria themselves was received despite promotion of the importance of these documents at community information sessions, webinars, and during consultation activities (See Appendix C1). The lack of comment has not been used to assume relevant persons tacitly agree with these criteria. Notwithstanding, the criteria were derived from industry standards and from previously accepted Environment Plan thus giving them sufficient credibility to be used for this activity.

3 Legislation

3.1.1 Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023

The objectives of the *Offshore Petroleum and Greenhouse Gas (*Environment*) Regulations 2023* (**the Regulations**) are to ensure that any petroleum activity carried out in an offshore area is carried out in a manner consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act. Additionally, these activities must be carried out in a manner by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable, while also ensuring that any environmental impacts and risks are of an acceptable level.

These objectives are critical to the protection of the marine environment and marine ecosystems from potential pollution, degradation, and other negative impacts associated with offshore petroleum activities. The principles of ecologically sustainable development promote the responsible use of natural resources and emphasize the need to consider the long-term impacts of human activities on the environment.

Reducing the environmental impacts and risks associated with offshore petroleum activities to as low as reasonably practicable is an important aspect of responsible and sustainable business practices in the offshore petroleum industry. This involves identifying potential environmental impacts and risks associated with an activity, implementing measures to minimize those impacts and risks, and continually monitoring and evaluating the effectiveness of those measures.

Ensuring that residual environmental impacts and risks are of an acceptable level is also critical to protecting the marine environment and marine ecosystems. This involves defining acceptable levels, such as effect level thresholds for specific receptors and ensuring that the environmental impacts and risks associated with an activity do not exceed those levels/thresholds.

3.1.2 Section 3A of the EPBC Act

The principles of ecologically sustainable development (ESD) in Section 3A of the EPBC Act refer to a set of guidelines aimed at promoting responsible environmental stewardship and sustainable use of natural resources. Table 1 describes the six principles of ESD outlined in the EPBC Act and explains how they will be met by the environmental impact and risk assessment process for the Regia MSS.

By adhering to these principles, decision-makers can promote sustainable development practices that consider both environmental and economic factors, ensure the conservation of biodiversity and ecological integrity, and engage with affected communities in transparent decision-making processes. These principles are critical to promoting a sustainable future that balances economic development with the protection and preservation of the environment.

Table B1-1 - Application of the Principles of ESD to the Environmental Impact and Risk Assessment Process

Principle of ESD	Application to the Environmental Impact and Risk Assessment Process
Integration Principle: Decision-making processes should effectively integrate both long-term and short-term economic, environmental, social, and equitable considerations.	This principle is addressed by defining acceptable levels of impact and risk for biological, ecological, social and economic features of the environment which are compared against the predicted levels of impact and risk. This principle is inherently met through the environmental impact and risk assessment as it requires consideration of long-term and short-term economic, environmental, social, and equitable considerations based on: Consultation with relevant persons. Environmental requirements including legislation, conservation advice, recovery plans and management plans.
Precautionary principle: If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.	The precautionary principle will be applied in the presence of scientific uncertainty for all levels of impacts and risks, not just those of serious or irreversible environmental damage. At the conclusion of each impact and risk assessment a level of predictive uncertainty is assigned. If there is residual uncertainty this will be assessed, and measures implemented to either remove the uncertainty or apply the precautionary principle. Activities where environmental damage is temporary / reversible, small scale, and/or low intensity is deemed to be of an acceptable level.
Intergenerational principle: That the present generation should ensure that the health, diversity, and productivity of the	The acceptable level of impact and risk will be set to ensure impacts and risks do not result in serious or irreversible environmental damage, thus ensuring the health, diversity

Principle of ESD	Application to the Environmental Impact and Risk Assessment Process
environment is maintained or enhanced for the benefit of future generations.	and productivity of the environment is maintained or enhanced for the benefit of future generations.
Biodiversity principle: The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making.	The EP must demonstrate the activity is not inconsistent with a recovery plan or threat abatement plan for a listed threatened species or ecological communities, or a management plan for an Australian Marine Park or Ramsar Wetland. This means that the acceptable level of impact and risk will be consistent with these plans which aim to ensure biological diversity and ecological integrity is maintained.
Valuation principle: Improved valuation, pricing and incentive mechanisms should be promoted.	The application of measures provides for CCG as the titleholder, to bear the cost of environmental management for the activity to ensure that the environmental impacts and risks are reduced to ALARP and are of an acceptable level. The ALARP assessment inherently balances the economic cost against environmental benefit.
Transparency principle: Decision-making should be transparent and involve the participation of potentially affected communities and stakeholders.	By publishing this document as part of our consultation activities we aim to meet this principle. This document will be used throughout our consultation effort and is available in the Regia MSS Consultation Hub (www.regiamss.com.au).

4 Decision-Making Criteria in the Environmental Assessment Process

Assessing environmental impacts and risks involves comparing the predicted levels of impact and risk against the pre-defined acceptable levels for each environmental impact and risk. This comparison is done considering typical (best practice) measures. If the predicted level of impact or risk is greater than the defined acceptable level, further measures or changes to the activity are required to ensure the environmental impact or risk can be managed to the defined acceptable level.

Once the defined acceptable level is met, an evaluation is done to identify if there are additional measures that would further reduce the environmental impact or risk to ALARP. The evaluation relies on demonstrating that further potential measures would require a disproportionate level of cost/effort to reduce the level of impact or risk. If this cannot be demonstrated, then the measure is required to be adopted.

The process for applying measures to meet the acceptable level and to be ALARP is shown in Figure B1-1.

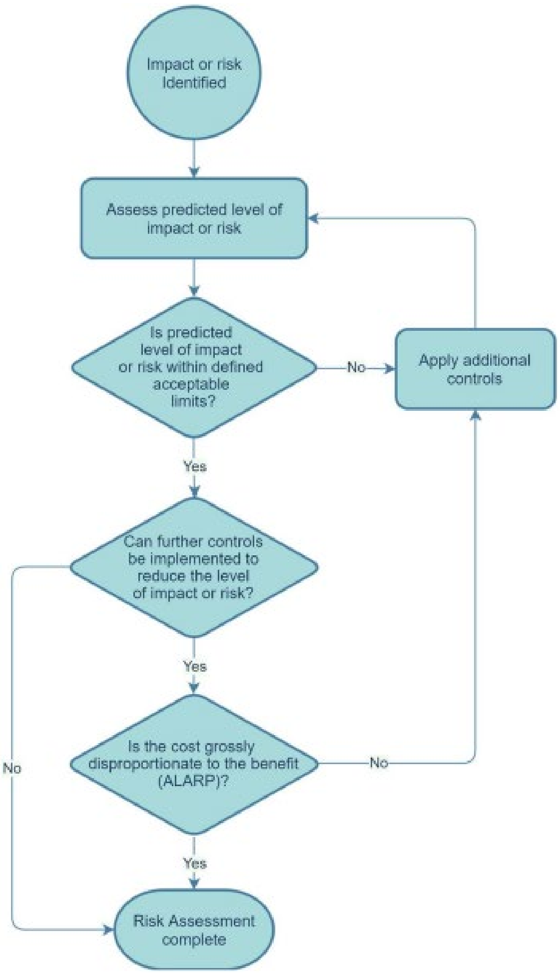


Figure B1-1 - Process for Applying Measures to Meet the Acceptable Level and ALARP

5 Defining Acceptable Levels of Impact and Risk

An 'acceptable level' is the specified amount of environmental impact and risk that an activity may have, which is consistent with all relevant principles and does not compromise the protection objectives of the environment.

To define the acceptable level for each impact and risk there are five areas of context to be considered:

1. **Principles of ESD:** Activities are to be carried out in a manner consistent with the ESD principles set out in Section 3A of the EPBC Act.
2. **Environmental context:** Consideration of the biological, ecological, economic, and cultural features relevant to the activity.
3. **Legislative context:** Management of the activity is consistent with legislation and other requirements including relevant policy documents, guidance, bioregional plans, wildlife conservation plans, management plans, gazettal instruments under the EPBC Act, conservation advice, and marine bioregional plans.
4. **Company (Internal) Context:** Management of the activity is consistent with the CGG impact and risk assessment process and implementation strategy.
5. **External Context:** Relevant persons' objections or claims have been assessed, responded to and controls adopted for objections and claims which have merit.

Based on these contexts, the statements in Table B1-2 have been proposed by CGG as being the defined acceptable levels of impact and risk for the Regia MSS.

Table B1-2 - Defined Acceptable Levels of Impact and Risk

Category	Defined Acceptable Level for the Regia MSS Impacts and Risks
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.
	The impact and risk assessments are based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.
Economic	Affected persons will not be worse off because of the activity.
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.
	The views of the public have been considered in the impact and risk assessment.

A tabulated process will be followed for each impact and risk assessment. Each impact and risk assessment applies a standard method of comparing the predicted level of impact and risk against the defined acceptable level. Where there is uncertainty in the prediction that results in the possibility for unacceptable impacts the uncertainty will be identified and managed.

6 Demonstrating ALARP

As detailed in Figure 1, environmental impacts and risks are reduced to ALARP after the defined acceptable level of impact or risk has been reached. Further consideration of measures is undertaken and CGG demonstrates impacts and risks are reduced to ALARP when the cost and effort required to further reduce risk is grossly disproportionate to the benefit gained. Part of this demonstration includes a systematic process of considering alternative, additional or improved control measures and performance standards. Justification for control measures or improved performance standards that have been rejected is also provided.

This consideration of control measures to reduce impacts and risks will be made after the environmental assessments have been completed.

7 Document Control

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	2 March 2023	MS	Initial version
0.1	26 March 2023	SJ	Peer review
0.2	30 March 2023	LT/PR	Review by CGG
0.3	31 March 2023	MS	Updated following CGG review
1.0	31 March 2023	MS	Published on Regia MSS Consultation Hub website
1.1	15 December 2023	MS	Updated formatting and consistency with rest of EP ready for submission.
2	4 January 2024	MS	Published ready for submission.

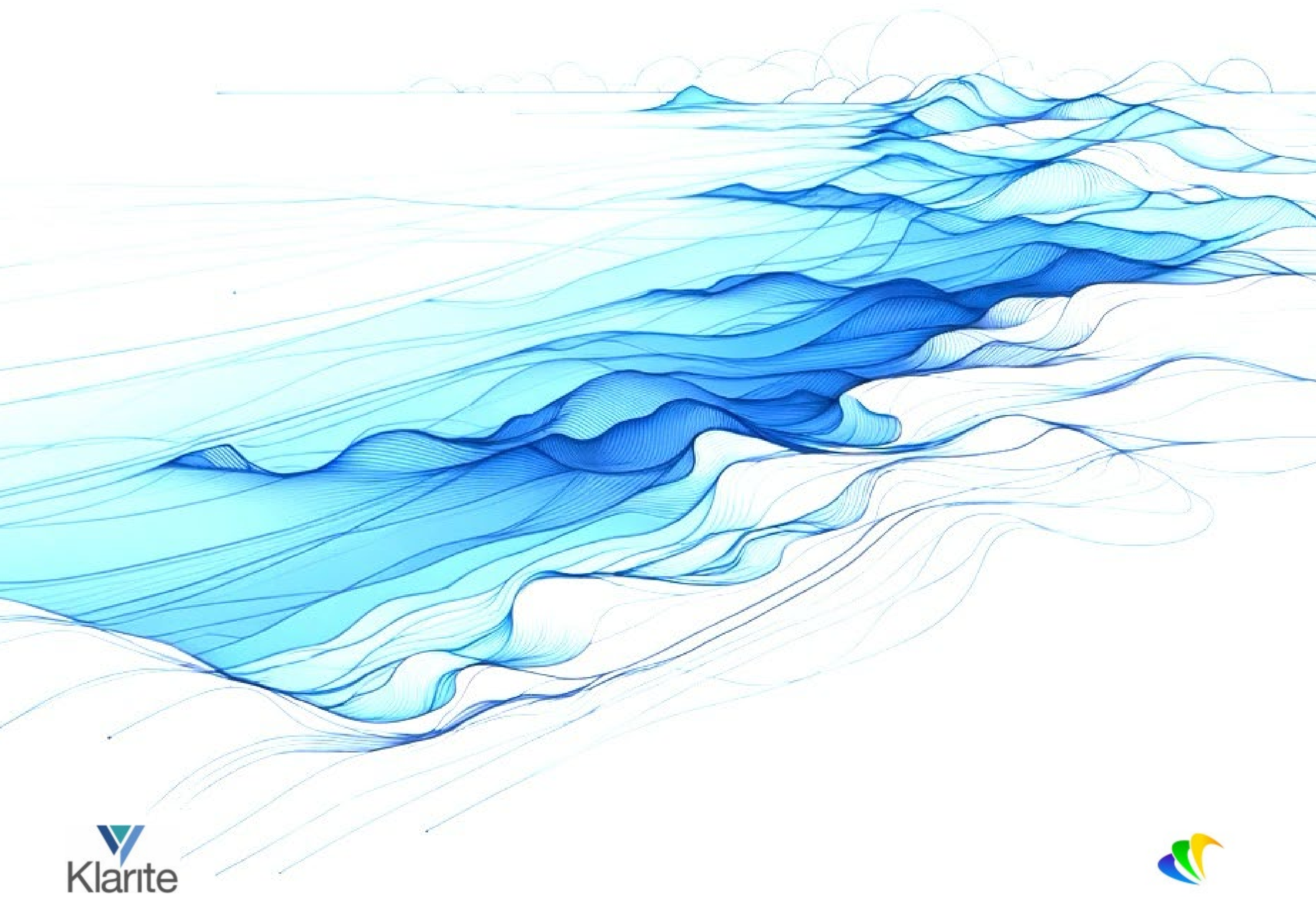
REGIA
Marine Seismic Survey

Legislation and Other Requirements Relevant to the Environmental Management of the Activity

Appendix B2: REG-EP-005-B2

Rev 2

January 2023



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1 Introduction

This document outlines the legislation and other requirements that have been identified and considered relevant to the environmental management to the Regia Marine Seismic Survey (Regia MSS) and provides an overview of the regulatory framework in which the proposed activity must operate.

The impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) demonstrate how the requirements identified as relevant to the Regia MSS will be met throughout the activity.

This document will be updated over time to reflect changes to the regulatory framework, including the introduction of new and updates to existing legislation and other requirements. These changes will be reviewed against the impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) and where appropriate these documents will be updated to include details about how the new or updated legislation and other requirements will be met throughout the activity. A register is provided at the end of the document to record changes to the document.

1.1 Background

The legislation that governs offshore activities in Australian waters are designed to ensure the protection and preservation of the marine environment and the sustainability of its resources.

The process used to identify legislation and other requirements that apply to the environmental management of the proposed activity involved a comprehensive review of legislation, policies, guidelines, and advice at the Commonwealth and State (Victorian and Tasmanian) levels. This was initially done in March 2023 based on the Activity Planning Area which was within Commonwealth waters and the Environmental Planning Area which is within Commonwealth, Victorian and Tasmanian (King Island) waters. Since then, the Operational Area has been defined and supersedes the Activity Planning Area. The Operational Area, like the Activity Planning Area, is totally within Commonwealth waters. A review of this document was undertaken in January 2024 to identify any new or changes to legislation and other requirements applicable to the Operational Area.

Environment Plans previously submitted and accepted by NOPSEMA were used to validate the process.

1.2 Purpose

This document aims to provide a comprehensive overview of the legislation and other requirements that currently apply to environmental management of the proposed activity. Were legislation and other requirements were identified to be relevant to the Regia MSS the impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) demonstrate how they will be met throughout the activity.

By complying with all applicable legislation and other requirements and updating this document as needed, the proposed activity can be carried out in an environmentally responsible and sustainable manner.

The following concepts have been identified in the NOPSEMA guidelines and form the structure of this document:

- Compliance with legislation and other requirements.
- Best practice environmental management.
- Application of the precautionary principle.
- Adaptive management approach.
- Relevant person consultation.
- Monitoring and reporting.

1.3 EBPC Act Streamlining

In 2014, the Commonwealth government amended the *Environmental Protection and Biodiversity Conservation* (EPBC) *Act* to streamline environmental approvals for offshore petroleum activities under the *Offshore Petroleum and Greenhouse Gas Storage* (OPGGS) *Act*. This amendment allows for the OPGGS (Environment) Regulations to be used as the primary mechanism for environmental assessment and approval under the EPBC Act for offshore petroleum activities. As a result, NOPSEMA is now responsible for assessing the environmental impact of proposed offshore petroleum activities and ensuring compliance with the EPBC Act and associated policies, guidelines, and advices.

In conducting their assessment, NOPSEMA is required to have regard to a range of documents under the EPBC Act, including threatened species and ecological communities' lists, conservation advices, recovery plans, conservation agreements, and management plans (Available on the Department of Climate Change, Energy, the Environment and Water (DCCEEW)). This requirement ensures that the potential impacts of the proposed activity on the environment are assessed and managed in accordance with the regulatory framework for environmental protection in Australian waters.

- Threatened species and ecological communities' lists: These are lists of species and ecological communities that are listed as threatened under the EPBC Act 1999. The list is maintained under the EPBC Regulations 2000. These lists are used to identify and manage potential impacts of the proposed activity on these species and communities.
- Conservation advice: These documents provide information about the ecology and conservation status of listed threatened species and ecological communities. They are issued under the EPBC Act 1999 and provide guidance on the management of potential impacts of the proposed activity on these species and communities.
- Recovery plans: These plans set out the actions necessary to recover listed threatened species and ecological communities. Recovery plans are prepared under the EPBC Act 1999 and provide guidance on how the potential impacts of the proposed activity on these species and communities can be managed.
- Conservation agreements: These are voluntary agreements between the Commonwealth government and landholders or other stakeholders for the conservation and management of threatened species and ecological communities. Conservation agreements are made under the EPBC Act 1999 and the EPBC Regulations 2000. Conservation agreements can provide additional guidance on the management of potential impacts of the proposed activity on these species and communities.
- Management plans: These are plans that set out the objectives and actions for the management of protected areas, such as National Parks or Marine Parks. Management plans are made under various pieces of legislation, including the EPBC Act 1999, the National Parks and Wildlife Conservation Act 1975, and the Environment Protection and Biodiversity Conservation Regulations 2000. Management plans can provide guidance on how the potential impacts of the proposed activity on these areas can be managed.

In summary, each type of EPBC Act document provides guidance on how to manage potential impacts of the proposed activity on the environment. They help to ensure that the proposed activity is carried out in a way that is consistent with the regulatory framework for environmental protection in Australian waters, as set out in various pieces of legislation and other requirements.

2 Compliance with Legislation and Other Requirements

The proposed activity must comply with all relevant legislation and other requirements. The legislative and other requirements relevant to the environmental management of the proposed activity have been identified and are described in Annex 1 of this document.

The proposed activity will be designed to comply with these legislative and requirements. Any changes to the proposed activity that may impact compliance with these legislative and other requirements will be assessed and managed through the Management of Change Process described in the Implementation Strategy (Appendix B3).

3 Principles of Ecologically Sustainable Development

We have completed a dedicated assessment of the Regia MSS EP preparation process for consistency with the principles of ecologically sustainable development. This can be found in Appendix F4.

4 Relevant Person Consultation

Relevant persons consultation with relevant authorities is an important part of the management of the proposed activity in accordance with the applicable legislation. The consultation with the relevant authorities ensures the proper application of legislative and other requirements that apply to the environmental management of the activity. Details of the consultation with relevant authorities can be found in Relevant Person Consultation (Appendix C1 to C5).

5 Legislative and Other Requirements Identified and Considered

5.1 International Conventions

Table B2-1 - International Conventions

Instrument	**Relevant to Regia MSS (Yes/No)**	**Description of Relevance to Environmental Management of the Activity**
Agreement on the Conservation of Albatrosses and Petrels (ACAP)	Yes	ACAP is a multilateral agreement which seeks to conserve listed albatrosses, petrels and shearwaters by coordinating international activity to mitigate known threats to their populations. Albatrosses, petrels and shearwaters are protected under the Environment Protection and Biodiversity Conservation Act 1999.
China-Australia Migratory Bird Agreement (CAMBA)	Yes	This agreements provides for the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships. Birds listed in the annex of this agreement are required to be listed as migratory species under the Environment Protection and Biodiversity Conservation Act 1999.
Convention on Biological Diversity (CBD)	Yes	The CBD aims to conserve biodiversity, sustainably use its components, and share the benefits from the use of genetic resources. Seismic surveys may impact marine biodiversity through noise pollution or other means, so it is important to consider the potential impacts on biodiversity during the survey. In Australia, the CBD has been given effect by the Environment Protection and Biodiversity Conservation Act 1999.
Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR)	No	The goal of this convention is to preserve marine life and environmental integrity in and near Antarctica. It was established in large part to concerns that an increase in krill catches in the Southern Ocean could have a serious impact on populations of other marine life which are dependent upon krill for food.
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	Yes	The Conn Convention aims to conserve terrestrial, aquatic and avian migratory species throughout their range. Marine seismic surveys may impact migratory species such as whales or dolphins, so it is important to consider potential impacts during the survey. In Australia, the CMS has been given effect by the Environment Protection and Biodiversity Conservation Act 1999.
Convention on the International Regulations for Preventing Collisions at Sea (COLREG)	Yes	COLREG establishes the navigation rules to be followed by ships and other vessels at sea to prevent collisions between two or more vessels. Seismic surveys may involve the use of vessels that must comply with the safety standards set out in this convention. In Australia, COLREG is implemented through the Navigation Act 2012.
International Convention on Civil Liability for Oil Pollution Damage (CLC)	Yes	The CLC aims to ensure that victims of oil pollution are compensated for the damage caused. Seismic surveys may involve the use of vessels that carry oil or other pollutants, so it is important to consider the potential for oil spills during the survey. In Australia, the CLC is implemented through the Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008.
International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFS)	Yes	The AFS convention aims to prohibit the use of harmful anti-fouling systems on ships, which can release toxic substances into the marine environment. Seismic surveys may involve the use of vessels that must comply with the regulations of this convention. In Australia, the convention is implemented through the Protection of the Sea (Harmful Anti-fouling Systems) Act 2006.

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
International Convention on Load Lines (LL)	Yes	The convention pertains specifically to a ship's load line (also referred to as the "waterline"), a marking of the highest point on a ship's hull that can safely meet the surface of the water; a ship that is loaded to the point where its load line is underwater and no longer visible has exceeded its draft and is in danger because its capacity has been exceeded. In Australia, this requirement is implemented through the Navigation Act 2012.
International Convention for the Control and Management of Ships' Ballast Water and Sediments	Yes	The convention is a 2004 international maritime treaty which requires signatory flag states to ensure that ships flagged by them comply with standards and procedures for the management and control of ships' ballast water and sediments. In Australia, the convention is implemented through the Biosecurity Act 2015 and associated regulations.
International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC)	Yes	The OPRC convention aims to establish an international framework for preparedness and response to marine oil pollution incidents. Seismic surveys may increase the risk of oil spills due to the use of vessels carrying fuel or other pollutants, so it is important to have a plan in place to respond to any potential spills. In Australia, the convention is implemented through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.
International Convention for the Prevention of Pollution from Ships (MARPOL)	Yes	This convention regulates the discharge of pollutants from ships into the sea, including discharges of oil, chemicals, sewage and garbage. Marine seismic surveys may involve the use of vessels that must comply with the regulations of this convention. In Australia, the convention is implemented through the Protection of the Sea (Prevention of Pollution from Ships) Act 1983.
International Convention for the Safety of Life at Sea (SOLAS)	Yes	SOLAS establishes minimum safety standards for ships, including requirements for equipment, construction, and operation. Seismic surveys may involve the use of vessels that must comply with the safety standards set out in this convention. In Australia, SOLAS is implemented through the Navigation Act 2012.
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW)	Yes	STCW sets the standards of competence and certification for seafarers internationally. Seismic surveys may involve the use of vessels that must comply with the training and certification standards set out in this convention. In Australia, STCW is implemented through the Navigation Act 2012.
Japan-Australia Migratory Bird Agreement (JAMBA)	Yes	This agreement provides for the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships. Birds listed in the annex of this agreement are required to be listed as migratory species under the Environment Protection and Biodiversity Conservation Act 1999.
Minamata Convention on Mercury	No	The Minamata Convention on Mercury is an international treaty that seeks to protect human health and the environment from anthropogenic (caused by humans) emissions and releases of mercury and mercury compounds. No mercury emissions are predicted associated with the seismic survey.
Montreal Protocol on Substances that Deplete the Ozone Layer (the Montreal Protocol)	Yes	This protocol controls the production and import of chemicals that deplete the ozone layer. In Australia, the protocol is implemented through the Ozone Protection and Synthetic Greenhouse Gas Management Act 1989.

Instrument	**Relevant to Regia MSS (Yes/No)**	**Description of Relevance to Environmental Management of the Activity**
Ramsar Convention on Wetlands (Ramsar Convention)	Yes	The Ramsar Convention encourages the designation of sites containing representative, rare or unique wetlands, or wetlands that are important for conserving biological diversity. Once designated, these sites are added to the Convention's List of Wetlands of International Importance and become known as Ramsar sites. Wetlands of International Importance are managed under the Environment Protection and Biodiversity Conservation Act 1999.
Republic of Korea-Australia Migratory Bird Agreement (CAMBA)	Yes	This agreements provides for the protection and conservation of migratory birds and their important habitats, protection from take or trade except under limited circumstances, the exchange of information, and building cooperative relationships. Birds listed in the annex of this agreement are required to be listed as migratory species under the Environment Protection and Biodiversity Conservation Act 1999.
United Nations Convention on the Law of the Sea (UNCLOS)	Yes	UNCLOS provides the legal framework for all activities in the ocean, including marine seismic surveys. The convention establishes the rights and responsibilities of states in their use of the world's oceans, establishing guidelines for businesses and governments to operate within maritime boundaries. In Australia, UNCLOS has been given effect by the Seas and Submerged Lands Act 1973.
UNESCO 2001 Convention for the Protection of the Underwater Cultural Heritage (UNESCO 20021 Convention)	Yes	The Convention aims to protect underwater cultural heritage to assist countries in managing and preserving their unique underwater cultural heritage. The Convention defines underwater cultural heritage as all traces of human existence having cultural, historical or archaeological character which have been partially or totally underwater, periodically or continuously for at least 100 years. It does not include installations still in operation such as submarine cables or piers, jetties and wharves that have been utilised with the last 100 years., In this convention has been given effect by the Underwater Cultural Heritage Act 2018.

5.2 Legislative Requirements

5.2.1 Commonwealth

Table B2-2 - Commonwealth Legislation

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	Yes	The act provides for the protection and conservation of Aboriginal and Torres Strait Islander heritage in Commonwealth waters, including those that may be impacted by seismic surveys.
Australian Maritime Safety Authority Act 1990	Yes	The act establishes the Australian Maritime Safety Authority (AMSA), which is responsible for ensuring the safety of vessels and seafarers, including those associated with seismic surveys.
Antarctic Treaty (Environment Protection) Act 1980	Yes	The act provides for the protection and conservation of the Antarctic environment, including those that may be impacted by seismic surveys.
Biosecurity Act 2015 (Biosecurity Act)	Yes	The act provides a framework for managing biosecurity risks associated with the import and export of goods and vessels, which may be associated with seismic surveys.
Biosecurity Regulations 2016	Yes	The regulations provide additional guidance on the management of biosecurity risks associated with the import and export of goods and vessels, which may be associated with seismic surveys.
Biosecurity Amendment (Biofouling Management) Regulations 2021	Yes	The regulations require operators of all vessels, including those associated with seismic surveys, to provide information on biofouling management practices prior to arriving in Australia.
Climate Change Act 2022	Yes	This Act sets out Australia's greenhouse gas emissions reduction targets. The Minister must prepare an annual climate change statement. The Climate Change Authority is to give the Minister advice that relates to the preparation of an annual climate change statement.
Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	Yes	The act regulates activities that may have a significant impact on the environment, including seismic surveys, and requires that these activities are assessed and approved before they can be carried out.
EPBC Act Regulations 2000	Yes	The regulations provide additional guidance on the assessment and approval process for activities that may have a significant impact on the environment, including seismic surveys. They also provide distances and actions to be taken when interacting with cetaceans for vessels and aircraft, which may be associated with seismic surveys.
Environment Protection (Sea Dumping Act) 1981	No	The act regulates the dumping of waste at sea, which will not occur for the Regia MSS.
Fisheries Management Act 1991	Yes	The Fisheries Management Act 1991 establishes the legislative framework for the sustainable use and conservation of fisheries resources, and for the management of fishing activities by commercial, recreational, and Indigenous fishers. The act provides for the setting of total allowable catches, fishing

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
		quotas, and other management measures, as well as the regulation of fishing gear, fishing methods, and fishing licenses.
Fisheries Management Regulations 2009	Yes	The Fisheries Management Regulations 2009 provide more detailed regulations for the implementation of the Fisheries Management Act 1991, including provisions for monitoring, compliance, and enforcement of fisheries management measures. The regulations set out requirements for the reporting of fishing activities, the monitoring of fishing vessels, and the handling of fish and other seafood products.
Hazardous Waste (Regulation of Exports and Imports) Act 1989	No	The act regulates the import and export of hazardous waste, which will not occur for the Regia MSS.
Marine Order 21 (Safety and Emergency Arrangements)	Yes	The marine order provides guidance on the safety and emergency arrangements for vessels, which may be associated with seismic surveys.
Marine Orders Part 27 (Safety of Navigation and Radio Equipment)	Yes	The marine order provides guidance on the safety of navigation and radio equipment for vessels, which may be associated with seismic surveys.
Marine Order 30 (Prevention of Collisions)	Yes	The marine order provides guidance on the prevention of collisions between vessels, including those associated with seismic surveys.
Marine Order 31 SOLAS and non-SOLAS certification	Yes	The marine order provides guidance on the survey, certification and maintenance of certificates for regulated Australian vessels and certification of foreign vessels, which may be associated with seismic surveys.
Marine Order 70 (Seafarer Certification)	Yes	The marine order provides guidance on the certification of seafarers, including those associated with seismic surveys.
Marine Order 71 (Masters and Deck Officers)	Yes	The marine order provides guidance on the certification and training of masters and deck officers for vessels, including those associated with seismic surveys.
Marine Order 72 (Engineer Officers)	Yes	The marine order provides guidance on the certification and training of engineer officers for vessels, including those associated with seismic surveys.
Marine Order 91 - Marine pollution prevention - oil	Yes	Marine Order 91 sets out the requirements for the prevention of marine pollution by oil from ships in Australian waters. The order establishes procedures for reporting, investigating, and responding to pollution incidents, as well as measures for the clean-up and disposal of spilled pollutants. It also sets out the requirements for pollution emergency plans, contingency planning, and pollution response equipment and training.
Marine Order 93 - Marine pollution prevention - noxious liquid substances	Yes	Marine Order 93 sets out the requirements for the prevention of marine pollution from liquids and chemicals in Australian waters, including measures to prevent spills, leaks, and discharges of noxious liquids from ships. The order establishes procedures for reporting, investigating, and responding to noxious liquid pollution incidents, as well as measures for the clean-up and disposal of spilled noxious liquids. It also sets out the requirements for noxious liquids pollution emergency plans, contingency planning, and pollution response equipment and training.

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Marine order 94—Marine pollution prevention – packaged harmful substances	Yes	Marine Order 94 sets out the requirements for the prevention of marine pollution from packaged harmful substances in Australian waters, including management of harmful substances in packaged form, washing substances overboard and notifying and reporting an incident.
Marine Order 95 - Marine pollution prevention - garbage	Yes	Marine Order 95 sets out the requirements for the prevention of marine pollution from garbage in Australian waters, including measures to prevent the discharge of garbage from ships. The order establishes procedures for the storage, processing, and disposal of garbage, as well as the requirements for garbage management plans and records.
Marine Order 96 - Marine pollution prevention - sewage	Yes	Marine Order 96 sets out the requirements for the prevention of marine pollution from sewage in Australian waters, including measures to prevent the discharge of untreated sewage from ships. The order establishes requirements for the design and operation of sewage treatment systems on board ships, as well as the requirements for sewage management plans and records.
Marine Order 97 - Marine pollution prevention - air	Yes	Marine Order 97 sets out the requirements for the prevention of air pollution from ships in Australian waters, including measures to reduce emissions of pollutants from ships' engines and boilers. The order establishes requirements for the use of low-sulphur fuels and the installation of emission control systems on board ships.
Marine Order 98 - Marine pollution prevention - antifouling systems	Yes	Marine Order 98 sets out the requirements for the use of antifouling solutions on ships in Australian waters. The order establishes restrictions on the use of certain types of antifouling coatings, as well as requirements for the management of hull cleaning and maintenance.
National Environmental Protection Measures (Implementation) Act 1998	No	The act provides a framework for the implementation of national environmental protection measures, which were not identified to be relevant to the Regia MSS.
National Greenhouse and Energy Reporting Act (NGER Act)	No	The Act establishes a national framework for reporting and disseminating information about greenhouse gas emissions, energy production, and energy consumption. The Act applies to facilities that meet certain thresholds for greenhouse gas emissions, energy production, and energy consumption, including some offshore petroleum facilities. The Regia MSS will not trigger the reporting requirements of the Act.
Native Title Act 1993	Yes	The main objects of this Act are: to provide for the recognition and protection of native title; and to establish ways in which future dealings affecting native title may proceed and to set standards for those dealings; and to establish a mechanism for determining claims to native title; and to provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title. Native title may be associated with seismic surveys.
Navigation Act 2012	Yes	The act regulates the safety and navigation of vessels, which may be associated with seismic surveys.

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)	Yes	The act provides a regulatory framework for offshore petroleum and greenhouse gas storage activities, which includes seismic surveys.
Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023	Yes	The regulations provide additional guidance on the environmental impact assessment process for offshore petroleum and greenhouse gas storage activities, including seismic surveys. The Regia MSS will not occur in Victorian State waters.
Ozone Protection and Synthetic Greenhouse Gas Management Act 1989	Yes	The act regulates the import, export, manufacture, and use of ozone-depleting substances (ODSs) and synthetic greenhouse gases (SGGs) in Australia. The act establishes a framework for the phase-out of ODSs and the reduction of SGG emissions, in order to protect the ozone layer and mitigate climate change. The act provides for the licensing of persons involved in the handling of ODSs and SGGs, as well as the regulation of equipment containing these substances. It also establishes penalties for non-compliance with the regulations under the act.
Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008	Yes	The Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008 is a Commonwealth legislation that provides for civil liability and compensation for damages caused by oil spills from ships' bunkers in Australian waters. The act establishes a regime for the liability of the shipowner and the right to compensation of the affected parties, including the cost of clean-up and restoration of the environment. The act also provides for the limitation of liability of the shipowner in certain circumstances.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	Yes	The act regulates the prevention of pollution from ships, which may be associated with the transportation of personnel and equipment during seismic surveys.
Protection of the Sea (Harmful Antifouling Systems) Act 2006	Yes	The act regulates the use of antifouling systems, which may be used on vessels associated with seismic surveys.
Underwater Cultural Heritage Act 2019	Yes	The act provides for the protection of underwater cultural heritage, which may be affected by the activities associated with seismic surveys.

5.2.2 Victorian Legislation

Table B2-3 - Victorian Legislation

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Aboriginal Heritage Act 2006	Yes	This Act provides for the protection of Aboriginal cultural heritage in Victoria, including Aboriginal cultural heritage that may be affected by the operation of seismic surveys.
Aboriginal Heritage Regulations 2018	Yes	The Regulations give effect to the Aboriginal Heritage Act. The Regulations prescribe standards, set out the circumstances in which a Cultural Heritage Management Plans should be prepared, including where Aboriginal cultural heritage may be affected by the operation of seismic surveys.
Climate Change Act 2017	Yes	This Act provides Victoria with the legislative foundation to manage climate change risks, maximise the opportunities that arise from decisive action, and drive transition to a climate-resilient community and economy with net-zero emissions by 2050.
Emergency Management Act 2013	Yes	This act provides for the management of emergencies, including natural disasters and other incidents that threaten public safety, health or welfare. It establishes a framework for emergency management at the federal, state and local levels, and sets out the roles and responsibilities of emergency management agencies.
Environment Protection Act 2017	Yes	The act regulates the prevention and management of pollution and waste, including those generated by seismic surveys, and provides for the protection of the environment and human health.
Flora and Fauna Guarantee Act 1988 (FFG Act)	Yes	The act provides for the conservation of flora and fauna, including marine species that may be affected by the operation of seismic surveys.
Heritage Act 1995	Yes	This act provides for the protection and conservation of historic places, objects, shipwrecks and archaeological sites in state areas and waters, including those that may be affected by the operation of seismic surveys.
Marine and Coastal Act 2018	Yes	The act provides a framework for the management of marine and coastal environments in Victoria, including the assessment and management of environmental impacts of activities such as seismic surveys.
Marine (Drug, Alcohol and Pollution) Act 1988	Yes	This act regulates the use of drugs and alcohol by seafarers and provides measures for preventing marine pollution. It aims to promote safety and protect the marine environment from the harmful effects of pollution caused by ships.
Marine Safety Act 2010	Yes	This act provides for safe marine operations in Victoria State waters, including imposing safety duties on owners, managers and designers of vessels, marine infrastructure and marine safety equipment; marine safety workers, masters and passengers on vessels; regulation and management of vessel use and navigation in Victorian State waters.
National Parks Act 1975	Yes	This act establishes a framework for the protection and management of national parks in Australia. It provides for the conservation of natural and cultural resources, the provision of recreational opportunities, and the management of park use.
Offshore Petroleum and Greenhouse Gas Storage Act 2010	No	The act applies to petroleum operations within three nautical miles of the Victorian coast and address licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations.

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Pollution of Waters by Oil and Noxious Substances Act 1986 (POWBONS)	Yes	This act provides measures for preventing, controlling and cleaning up pollution caused by oil and other noxious substances in Australian waters. It aims to reduce the risk of damage to the environment and protect public health and safety.
Seafood Safety Act 2003	Yes	This act regulates the production, processing, and sale of seafood in Victoria, Australia. It sets standards for food safety and ensures that seafood products are safe for human consumption.
Wildlife Act 1975	Yes	This act provides for the conservation and management of wildlife in Victoria, Australia. It regulates the hunting and trapping of wildlife, establishes protected areas for wildlife, and provides for the protection of threatened and endangered species.
Wildlife (Marine Mammals) Regulations 2009	Yes	The regulations provide guidance on the management and protection of marine mammals, which may be affected by the underwater noise generated by seismic surveys.

5.2.3 Tasmanian Legislation

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Aboriginal Heritage Act 1975	Yes	The act is the primary legislation for the protection of Aboriginal cultural heritage in Tasmania,
Environmental Management and Pollution Control Act 1994	Yes	The act regulates the management and control of pollution, including those generated by seismic surveys, and provides for the protection and conservation of the environment and human health in Tasmania.
Historic Cultural Heritage Act 1995	Yes	The act was developed to ensure the historic places that are of importance to the whole of Tasmania are recognised, protected, and managed effectively as part of the Resource Management and Planning System, including the assessment and management of environmental impacts of activities such as seismic surveys.
Living Marine Resources Management Act 1995	Yes	The act regulates the management and conservation of living marine resources in Tasmania, including the assessment and management of environmental impacts of activities such as seismic surveys.
Marine Farming Planning Act 1995	Yes	The act provides a framework for the planning, management, and development of marine farming activities in Tasmania, including the assessment and management of environmental impacts of activities such as seismic surveys.
Marine Farming Planning Regulations 2016	Yes	The regulations provide detailed guidance on the management and regulation of marine farming activities in Tasmania, including the assessment and management of environmental impacts of activities such as seismic surveys.
Marine-related Incidents (MARPOL Implementation) Act 2020	Yes	This act deals specifically with discharges of oil and other pollutants from ships, including those associated with seismic surveys.
Marine and Safety Authority Act 1997	Yes	The act provides for the safety of vessels and seafarers in Tasmania, including those associated with seismic surveys.
National Parks and Reserves Management Act 2002	Yes	The act provides for the management of parks and reserves based on management objectives of each class of reserve, declaration and management of Marine Protected Areas (marine reserves), including those that may be impacted by seismic surveys.

5.3 Other Requirements

5.3.1 Policy Statements

Table B2-4 - Policy Statement

Instrument	**Relevant to Regia MSS (Yes/No)**	**Description of Relevance to Environmental Management of the Activity**
Australian Ballast Water Management Requirements	Yes	The requirements provide guidance on how vessel operators should manage ballast water when operating within Australian seas to comply with the Biosecurity Act 2015, including those conducting a marine seismic survey. They align to the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004.
Australia Biofouling Management Requirements	Yes	The requirements set out vessel operator obligations for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas, including those conducting a marine seismic survey.
Australian National Guidelines for Whale and Dolphin Watching 2017	No	The guidelines provide guidance on the responsible watching of whales and dolphins. Applicable requirements relevant to seismic surveys are applied via the Environment Protection and Biodiversity Conservation Regulations 2000 Part 8.
EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance	Yes	The policy statement provides guidance on the assessment and management of activities that may have a significant impact on matters of national environmental significance, including marine habitats and species.
EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (2008)	Yes	The policy statement provides guidance on how to minimise the impact of seismic surveys on whale populations, which may be affected by underwater noise and disturbance caused by these activities.
EPBC Act Policy Statement 3.21 - Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species	Yes	The policy statement provides guidance on how to minimise the impact of seismic surveys on migratory shorebirds, which may be affected by the disturbance caused by these activities.
Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Biofouling Guidelines)	Yes	Provide a globally consistent approach to the management of biofouling, which may be associated with seismic surveys.
Marine Pest Plan 2018–2023: National Strategic Plan for Marine Pest Biosecurity	Yes	The plan outlines a coordinated approach to building Australia's capabilities to manage the threat of marine pests over the next five years. It represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
		minimise their potential harm to marine industries, communities and the environment, which may be associated with seismic surveys.
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009	Yes	The guidance provides a framework for managing the biofouling of vessels, which may be associated with seismic surveys.
National Light Pollution Guidelines for Wildlife 2023	Yes	The guidelines provide guidance on the management of light pollution, which may affect marine species, including those affected by seismic surveys.
National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna	Yes	The strategy provides guidance on reducing the risk of vessel strikes on cetaceans and other marine megafauna, which may be affected by the operation of vessels associated with seismic surveys.
Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia’s Coasts and Ocean	Yes	The plan provides national guidance on action to prevent and mitigate the impacts of harmful marine debris on vertebrate marine life, which may be affected by the operation of vessels associated with seismic surveys.
Victorian Coastal Council Strategic Plan	Yes	The strategic plan provides guidance on the management of coastal environments in Victoria, including the management of environmental impacts of activities such as seismic surveys.
Victorian Coastal Strategy	Yes	The strategy provides a framework for the management of the Victorian coast, including the protection and conservation of marine environments that may be impacted by seismic surveys.
Victorian Marine and Coastal Discovery Centre Guidelines	Yes	The guidelines provide guidance on the responsible interaction with marine environments, including the operation of vessels associated with seismic surveys.
Victorian Marine and Coastal Policy 2020	Yes	The policy provides guidance on the sustainable use and management of marine and coastal environments in Victoria, including the management of environmental impacts of activities such as seismic surveys.
Victorian Marine Mammal Emergency Response Plan	Yes	The emergency response plan provides guidance on the response to marine mammal strandings and incidents, which may be associated with the operation of vessels associated with seismic surveys.
Victorian Marine National Parks and Sanctuaries Management Plan	Yes	The management plan provides guidance on the management of marine national parks and sanctuaries in Victoria, including the protection and conservation of marine environments that may be impacted by seismic surveys.
Victorian Marine Pest Management Strategy	Yes	The strategy provides guidance on the management of marine pests, which may be associated with the operation of vessels associated with seismic surveys.
Marine and Coastal Policy 2020	Yes	The policy provides guidance on the sustainable use and management of marine and coastal environments in Tasmania, including the assessment and management of environmental impacts of activities such as seismic surveys.
Tasmanian Marine Bioregional Plan	Yes	The plan provides guidance on the management and conservation of marine ecosystems and species in Tasmania, including those that may be impacted by seismic surveys.

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
Tasmanian Marine Wildlife Code of Practice	Yes	The code provides guidance on the responsible interaction with marine wildlife, including the operation of vessels associated with seismic surveys.

5.3.2 Management Plans

Management Plans have been identified and described in the impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) which also demonstrate how the requirements relevant to the Regia MSS will be met.

5.3.3 Species Recovery Plans

Species Recovery Plans have been identified and described in the impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) which also demonstrate how the requirements relevant to the Regia MSS will be met.

5.3.4 Conservation Advice

Conservation Advice have been identified and described in the impact and risk analysis documents (Appendix D1 to D4 and E1 to E10) which also demonstrate how the requirements relevant to the Regia MSS will be met.

5.3.5 International and Industry Standards

Table B2-5 - International and Industry Standards

Instrument	Relevant to Regia MSS (Yes/No)	Description of Relevance to Environmental Management of the Activity
AS/NZS 4360:2004 Risk Management	Yes	The standard provides guidance on the management of risk associated with the activities associated with seismic surveys.
AS/NZS ISO HB 203:2012 Managing Environment Related Risk	Yes	The handbook provides guidance on managing environment-related risks associated with activities, including seismic surveys.
AS/NZS ISO 31000:2018 Risk Management	Yes	The standard provides guidance on the management of risk associated with the activities associated with seismic surveys.
International Association of Geophysical Contractors (IAGC) Environment Manual for Worldwide Geophysical Operations (2013)	Yes	Provides guidance on the management of risk associated with the activities associated with seismic surveys.
Recommended monitoring and mitigation measures for cetaceans during marine seismic survey geophysical operations (2017)	Yes	Provides recommendations on applying mitigation measures for cetaceans during seismic surveys.
Technical Guidance for Assessing the Effects of Anthropogenic Hearing (NOAA 2018)	Yes	The guidance provides guidance on assessing the effects of anthropogenic hearing on marine mammals, which may be affected by the underwater noise generated by seismic surveys.

6 Document Control

Table B2-6 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	24 March 2023	MS	Initial version
0.1	25 March 2023	LT/PR	Review by CGG
0.2	31 March 2023	MS	Updated following CGG review
1.0	31 March 2023	MS	Published on Regia MSS Consultation Hub website
2.0	1 January 2024	SJ	Updated for EP Submission to NOPSEMA

REGIA
Marine Seismic Survey

Implementation Strategy

Appendix B3: REG-EP-006-B3

Rev 3

May 2024

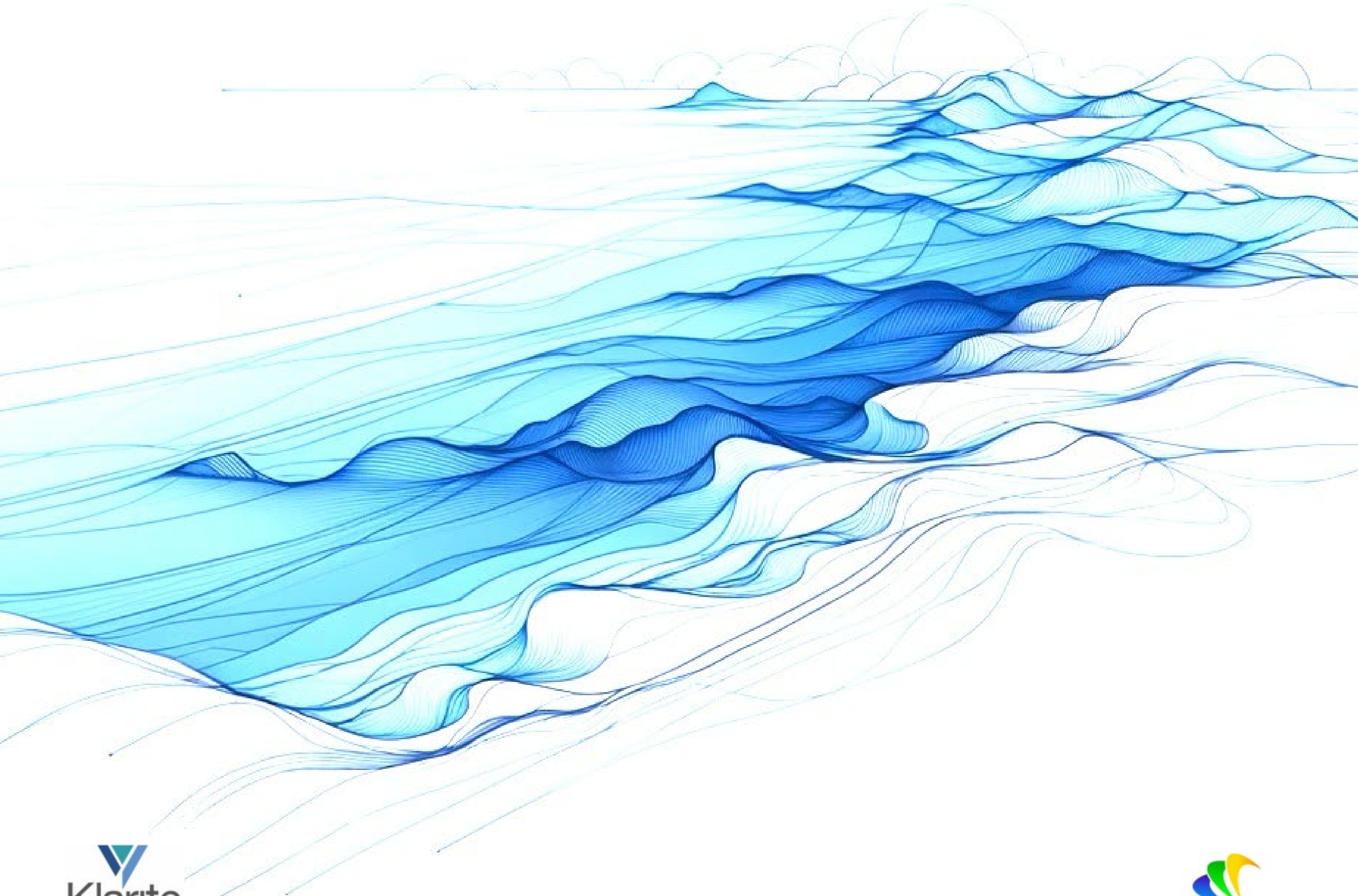

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Table of Contents

1 Introduction

This document has been prepared to support CGG Services (Australia) Pty Ltd (**CGG**) in its environmental management of the Regia Marine Seismic Survey (**Regia MSS**). The Implementation Strategy follows a standardised methodology for monitoring and managing environmental performance of offshore petroleum activities and has been developed by CGG over many years of successfully operating in Australia without major incidents.

2 Purpose

This document aims to communicate the basis for environmental performance monitoring and management before, during and after the proposed Regia MSS. It is structured to align with the prescribed content of an implementation strategy as per Section 22 of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (**the Regulations**).

3 Section 22(1): Implementation Strategy

This implementation strategy has been developed to comply with the requirements of Section 22(1) of the Regulations and describes the specific measures and arrangements that will be implemented for the duration of the activity to ensure that:

- All environmental impacts and risks of the activity will be continually identified and reduced to a level that is as low as reasonably practicable (**ALARP**).
- Management and mitigation measures detailed in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels.
- Environmental performance outcomes and standards set out in the environment plan (**EP**) are met.
- Arrangements are in place to respond to, and monitor impacts of, oil pollution emergencies.
- Consultation is maintained throughout the activity as appropriate.

The implementation strategy outlines a systematic approach that describes:

- The management systems by which the management and mitigation measures identified in the impact and risk assessment will be implemented.
- The implementation of management and mitigation measures will be monitored to ensure environmental risks continue to be managed to ALARP.
- The ongoing consultation process prior to and during the activity.
- Monitoring, auditing, and reporting of environmental performance for activities carried out under the EP.
- Arrangements in place to respond to, and monitor impacts of, oil pollution emergencies.

The implementation strategy for this EP has considered lessons learnt from the implementation of previous campaigns and inspection recommendations.

4 Section 22(2): Environmental Management System

The Regia MSS will be conducted under the framework of the CGG Environment Policy (Appendix A1), CGG Environmental Management Procedure, CGG Health, Safety, Environment and Social Responsibility Operating Management System (**HSE-OMS**) and the survey and support vessel's HSE Management System.

The activity will also operate under an activity specific HSE Plan that CGG, and the vessel operators will develop together. The HSE Plan is a tailored document that ensures CGG's environmental management standards and intended environmental performance outcomes are achieved at an operational level throughout the activity. The HSE Plan identifies and enables the selected seismic and support vessels contractor's own procedures to be utilised where appropriate, for example, for specific vessel operational control measures. At all times, however, the seismic and vessel contractors will be required as a minimum to comply with all relevant requirements of CGG's HSE policies and standards. As described in CGG Environment Management Procedure, the HSE Plan will incorporate regulatory and EP requirements including procedures for the following:

- Emergency response.
- Waste management.
- Hazardous materials and handling.
- Fuel/oil spills.
- Bunkering.
- Light.

The seismic and vessel contractor's HSE documentation will be reviewed for compliance with the relevant requirements described in this EP prior to the commencement of the activity. In the event of a gap between the existing plans and procedures and the requirements of this EP, a bridging document will be developed to ensure all control measures are adequately covered in the implementation of the EP and the hierarchy of control established.

4.1 Management of Change Process

The primary purpose of managing change is to reevaluate the predicted levels of environmental impacts and risks and perform an updated assessment of whether the decision-making criteria are still met. This is the assessment of whether a change can be managed such that the activity continues to manage environmental impacts and risks to as low as reasonably practicable and to an acceptable level.

The following activities will trigger a management of change (**MoC**) process:

- A new scope (e.g., timing, location, or changes to operational details such as vessel type, equipment, processes, or procedures), which has the potential to impact on the environment not assessed for environmental impact previously or authorised in existing management plans and procedures.
- Change to the existing activity, scope, equipment, process, or procedures, which have the potential to impact on the environment or interface with an environmental receptor (responsibility of the CGG Technical Operations Manager).
- Changes in the external environment managed and monitored by the CGG Technical Operations Manager.
- Provision of new information that differs to that included in this EP, such as:
    - Potential changes in scientific knowledge regarding impacts and risks from seismic activities
    - New environmental sensitivities within or adjacent to the survey area

- Issue of new regulatory requirements (e.g., Australian Marine Parks (**AMP**) Management Plans).
- Identification of Key Ecological Features (**KEF**s), threatened or migratory species or critical habitats or biologically important areas (**BIA**s) not identified in the EP.
- Identification of new stakeholder objections or claims that are assessed to have merit.

- Non-conformances (audits, inspections, etc.) which identify management and mitigation measures may no longer manage environmental impact/risk to ALARP or acceptable criteria. Non-conformances are monitored by the Environmental Officer.
- Incidents which identify new or increased impacts and risks arising from activities not previously identified in the accepted EP. Incidents are monitored by the Environmental Officer.

Any change relevant to environmental management of the activity shall be directed to the CGG Technical Operations Manager and Environment Officer for initial assessment. The change shall be assessed for environmental impact/risk in accordance with the CGG Risk Management and MoC Process and any implications determined for the environment and associated regulatory document revisions.

Additional management and mitigation measures identified as part of the MoC that avoid, minimise, limit, or mitigate environmental impacts and risks will be captured in the relevant documents and the change to those documents recorded. Changes to any management and mitigation measure being relied on for the management of environmental impacts and risks will require a reassessment of whether the impact or risk being considered remains of an acceptable level and reduced to ALARP. The appropriateness of the environmental performance outcomes (**EPO**s) and environmental performance standards (**EPS**s) set for the activity will also be reassessed. For changes identified in the impact and risk assessment process, if relevant persons' interests, activities, or functions are affected by the change, they will be advised, and feedback invited on the proposed change.

Any new information, changes or updates considered via the MoC process will also be considered against Section 39 of the Regulations, to determine if resubmission of the EP to NOPSEMA is required. Consideration of the triggers for resubmission will occur after the MoC has been completed and will either result in a major revision (meaning a resubmission to NOPSEMA is required) or a minor revision.

Major revisions to the Environment Plan can arise from many circumstances including but not limited to:

- Before commencement of a new activity.
- Before the commencement of any significant modification or new stage of the activity that is not provided for in the accepted ep.
- Before or, as soon as practicable after the occurrence of any significant new or significant increase in environmental impact or risk, including a series of new or increased impacts or risks.
- If there is a change in titleholder that will result in a change in the way the environmental impacts and risks of an activity are managed.
- If the updated predictions of environmental impacts or risks exceed or may exceed the defined acceptable levels of impacts or risks in the in-force environment plan.
- If the assumptions made in the in-force environment plan about the predicted levels of environmental impacts or risks or defined acceptable levels are proven incorrect/inaccurate.
- In the event of legislative change driven by new case law.
- Requirements relevant to the activity or environmental feature being considered.

Minor revisions to the Environment Plan are likely to include:

- Administrative changes that are identified during operation of the Environment Plan (e.g. document references, contact details, etc.)

- A review of the activity/change and the environmental impacts and risks of the activity/change does not trigger a requirement for revision under the Regulations (Section 39 and Section 40).
- An improvement to a level of environmental performance.

Where amendments are made to the accepted EP/OPEP via the CGG MoC process, revisions made will be justified, tracked and a comprehensive record of the revision kept for each change. This includes all risk assessments associated with MoC activities.

4.2 Management of Knowledge Process

Copies of the following documents will be always available to all staff and contractors on each vessel.

- CGG HSE Plan.
- Environmental Conformance Register.
- Emergency Response Procedures.
- HSE Management Procedures.
- Hazard Management Procedures.
- SOPEP and OPEP.
- The EP.

4.2.1 Pre-survey Knowledge Assessment

At least eight weeks prior to the survey commencement, the CGG Technical Project Manager shall undertake pre-survey knowledge assessment that will review and consider the following as a minimum:

- Community and relevant person notification requirements.
- New issues or concerns raised by relevant persons.
- Changes to relevant legislation or regulatory guidelines.
- Existing information in relation to any component of the receiving environment (including BIAs, AMPs).
- Search the NOPSEMA website and consult with any new titleholders to determine the presence of other seismic operations overlapping the proposed activity.
- Changes to commercial fishery licence areas, fishery status, current fishing effort and licence holders overlapping the Regia MSS Environment Planning Area based on:
  - Status reports and available data sources such as FRDC, IMAS for fisheries and aquatic resources.
  - Information provided directly by fishers, VFA, and AFMA through the relevant person consultation process.
  - Fishing locations.
  - Spawning information relevant to key indicator species.
- Newly available scientific literature.
- New acoustic source technology and justification for or against its implementation.
- Confirmation of emergency (oil spill) contacts.

If new information regarding the receiving environment relevant to the activity is present, then a management of change assessment will be carried out.

4.3 Management of Communications Process

Any modification to the assumptions or basis of the EP that arise because of the implementation of the Environmental Management System will be communicated using the Chain of Command. This includes timely notification of any modifications to the EP because of managing change, knowledge, or adverse weather.

The seismic and vessel contractors will be responsible for keeping its workforce informed about environmental issues. The Party Chief acts as a focal point for personnel to raise environmental issues, and consults/involves all personnel in the following:

- Issues associated with the implementation of the EP.
- Any proposed changes to equipment, systems, or methods of operation of plant, where these may have environmental implications.
- Any proposals associated with continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.
- Regular HSE meetings will be held on the seismic vessel. The issues discussed and actions taken will be recorded. The minutes of each meeting, including action items from the meetings, will be made available to all personnel.

Other forms of internal communication include toolbox meetings, which occur before every critical or unfamiliar job. This meeting includes all personnel involved in the task and will include aspects such as spill prevention requirements, etc.

The Report on Consultations (Appendix C1 and C2) documents all commitments made to relevant persons in relation to notifications about the activity and the progress of the survey.

4.4 Management of Adverse Weather Process

It is the duty of the Vessel Master to act as the focal point for all actions and communications with regards to any emergency, including response to adverse weather or sea state, to safeguard his vessel, all personnel on board and environment.

During adverse weather the Survey and Support Vessel Masters are responsible for:

- Ensuring the safety of all personnel on board.
- Monitoring all available weather forecasts and predictions.
- Initiating the vessel safety management system, vessel HSE procedures and/or vessel ERP.
- Keeping the Party Chief and CGG Site Representative fully informed of the prevailing situation and intended action to be taken.
- Assessing and maintaining security, watertight integrity and stability of vessel.
- Proceeding to identified shelter location(s) as appropriate.
- Other appropriate responsibilities shall be taken into consideration as dictated by the situation.

In addition to in-vessel VHF Marine Radio Weather Services, daily weather forecasting from a designated weather forecast will be provided (if available) to monitor weather within the Operational Area over the duration of the survey.

Should poor/bad weather be imminent/encountered, the Vessel Master shall implement weather monitoring to assess conditions on site. The amount of monitoring and subsequent action would be dependent on the severity of the bad weather front and resulting actions will comply with the seismic contractor's procedure for Severe Weather Monitoring.

The CGG Technical Operations Manager shall ensure adequate weather forecasting is available at an increased frequency as the severity escalates.

4.5 Contractor and Supplier Management Process

Seismic and vessel contractors considered for the Regia MSS will be assessed against, and meet the following criteria:

- Compliance with all statutory requirements.
- Have an acceptable HSEQ performance record in undertaking seismic activities.
- Provide evidence of resources and competency in the services to be provided.
- Services, procedures, and vessel hardware comply with the requirements of this EP.
- Any equipment to be used in the provision of survey services meets regulatory requirements, is fit-for-purpose and has all equipment, testing and verification certificates.
- Specific requirements, which need to be assessed at tender evaluation stage include the acoustic source is confirmed to be 2,820 in^3 or less.
- Specific requirements, which need to be assessed at tender evaluation stage include a preference to select vessels:
    - Whereby refuelling at sea is not required.
    - That are double bottomed.
    - That have double walled fuel tanks.
- Specific requirements that need to be assessed prior to vessel mobilisation include all vessels transiting to the Otway must be assessed for biofouling risk and have the relevant biosecurity clearance.

Prior to the survey, CGG will undertake an audit/inspection of each vessel as detailed in Section 4.7.

4.6 Chain of Command

A clear chain of command for the shore-based and vessel-based roles relating to the Regia MSS is provided in Figure B3-1. Upon contract award, and during evaluation of the contractor's management system, specific on-board positions will be identified who are responsible for specific management and mitigation measure implementation.

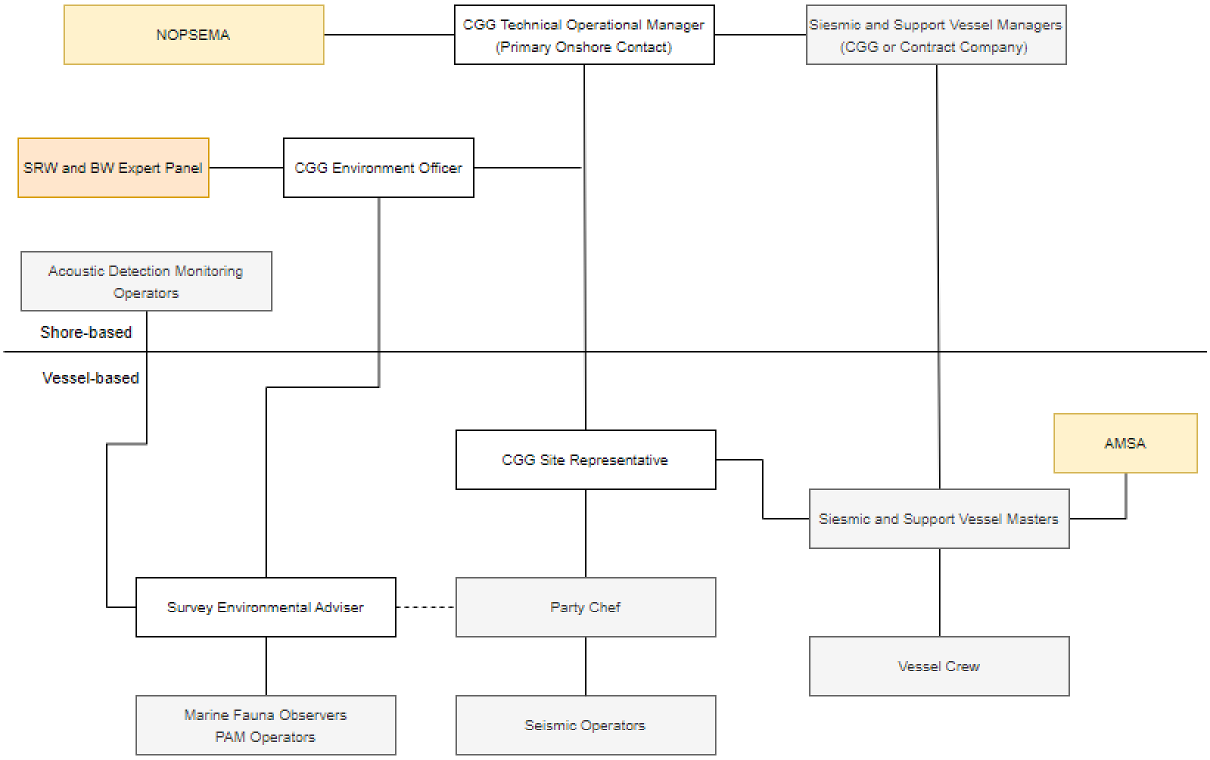

Figure B3-1 – Regia MSS Organisation Structure

4.7 Roles and Responsibilities

The roles and responsibilities for personnel involved in this activity in relation to implementation, management, and review of this EP, including during emergencies or potential emergencies are described in Table B3-1. Emergencies or potential emergencies are defined in this section to be any breach, or potential breach of a requirement of the EP as well as the responsibilities in emergency response. Roles and responsibilities as they relate specifically to oil spill response are detailed in the Oil Pollution Emergency Plan (**OPEP**) which is available in Appendix G3.

Table B3-1 - Regia MSS Roles and Responsibilities

Role	Responsibilities in relation to the implementation, management, and review of the EP	Responsibilities during emergencies or potential emergencies
CGG Technical Operations Manager (Primary Shore-based Contact)	Ensure the activity is undertaken as per the performance outcomes of the EP. Provide sufficient resources to implement management and mitigation measures to achieve the performance outcomes of the EP. At least eight weeks prior to the survey commencement undertake a pre-survey edge assessment as per Section 4.2. With the support of the CGG Environment Officer, ensure that ongoing monitoring for potential changes that may have a bearing on the EP are undertaken. Liaise with regulatory authorities as required. Review results of conformance audits conducted during the program and make recommendations where required. Ensure that the activity specific induction is completed by all project personnel. Initiate the end of activity review with the seismic contractor and document lessons learnt.	Commit resources to facilitate an emergency response strategy in the event of an incident. Manage the CGG emergency response strategy in the event of an incident. Notify NOPSEMA of any spills in Commonwealth waters. Ensure environmental incident reporting meets regulatory requirements. Ensure that all incidents are reported in accordance with Section 22(7).

Role	Responsibilities in relation to the implementation, management, and review of the EP	Responsibilities during emergencies or potential emergencies
CGG Environment Officer	Provide support to the CGG Technical Operations Manager to ensure the activity is undertaken as per the performance outcomes of the EP. Review the seismic and vessel contractor's HSE documentation for compliance with the relevant requirements described in this EP prior to the commencement of the activity. Ensure that ongoing monitoring for potential changes that may have a bearing on the EP are undertaken. Review the EP as necessary and manage change in accordance with the MoC process. Develop the Environmental Conformance Register for the activity, detailing the environmental commitments, performance outcomes and standards and measurement criteria in the EP. Monitor, maintain and advise the CGG Technical Operations Manager of the status of the Corrective Action Register. Coordinate the Expert Panel as part of the Fauna Management Plan. Provided support and advice to the offshore SEA. Liaise with regulatory authorities as required. Monitor and close out corrective actions raised from environmental inspections/audits or incidents. Review results of conformance audits conducted during the program and make recommendations where required. Ensure that the activity specific induction covers the requirements in the EP including the Fauna Management Plan. Prepare the EP Performance/Compliance Report and submit to NOPSEMA.	Manage any oil spill monitoring requirements as per the OSMP. Identify high priority protection areas.

<table>
<tr><th>Role</th><th>Responsibilities in relation to the implementation, management, and review of the EP</th><th>Responsibilities during emergencies or potential emergencies</th></tr>
<tr><td>Seismic and Support Vessel Managers (CGG or Contractor Company)</td><td>Responsible for the overall HSE performance of the vessel against the legislative requirements and any additional commitment made in the EP.
Ensure vessel conformance with all company standards, policies and procedures and the EP.
Participate in audits.
Ensure that all relevant QHSE documentation is in place for the vessel, according to the company’s QHSE Management System requirements.
If contractor’s HSE documentation is not compliant with the relevant requirements described in this EP develop a bridging document to ensure all management and mitigation controls are covered.</td><td>Ensuring major incidents (Lost Time Injury and/or Hi-Potential or above) are thoroughly investigated, root cause analyses performed, corrective actions completed, logged and closed out.
Timely communication of emergencies or potential emergencies within the Chain of Command.</td></tr>
<tr><td>CGG Site Representative (Primary Vessel-based Contact)</td><td>Facilitate clear communications between the CGG Technical Operations Manager, Party Chief and Vessel Masters.
Ensure all personnel have received the activity specific inductions.
Ensure day-to-day activities are monitored for conformance against this EP and the outcomes are reported to the CGG Technical Operations Manager
Monitor and report on the conformance of all EP commitments through observations and assessments of performance against the measurement criteria.
Assist with review, investigation and reporting of all environmental incidents and ensure they are reported to the CGG Technical Operations Manager. Ensure appropriate levels of incident investigation are undertaken and corrective actions from incidents are tracked to completion on behalf of CGG.
Ensure incidents are fully investigated and corrective actions monitored to close-out.
Ensure data and records are collected for the Post-survey Environmental Performance Report (PEPR).
Assist the CGG Technical Operations Manager in the preparation of the PEPR.
Liaise with the CGG Technical Operations Manager in the event of a change in the activity and updates the EP in accordance with the requirements of the Regulations.
Perform MMO duties when the dedicated MMO is unable to, such as during short break periods.</td><td>Immediately alert the CGG Technical Operations Manager of any changes in operations, which could impact negatively on environmental performance or for changes in operation, which alter the environmental risk profile of the activity.
Immediately notify the CGG Technical Operations Manager of any incidents/activities arising from seismic operations that are likely to have a negative impact on the performance outcomes detailed in this EP.
Collate information for monthly recordable incident report and providing information to the CGG Technical Operations Manager.</td></tr>
</table>

Role	Responsibilities in relation to the implementation, management, and review of the EP	Responsibilities during emergencies or potential emergencies
Party Chief	Ensure safe execution of all operations carried out by the seismic crew aboard the survey vessel. Ensure the seismic operations are conducted in accordance with this EP. Ensure that the documents specified in the management of knowledge are available aboard. Ensure the control measures adopted within this EP relating to operation of the seismic source are implemented to minimise potential environmental impacts resulting from seismic acquisition (e.g., pre-watch, soft-start procedures, stop-work procedures) Ensure equipment used on site is inspected before use and as required during survey. With assistance from others, inspect and maintain equipment, including environmental equipment. Maintain all statutory test and inspection documentation for the marine equipment. Provide a daily log of activities and environmental incidents to the CGG Site Representative. Ensure compliance with all aspects of HSE reporting and for investigations of all incidents and near misses.	Immediately notify the CGG Site Representative of any incidents/activities arising from seismic operations that are likely to have a negative impact on the performance outcomes detailed in this EP.

Role	Responsibilities in relation to the implementation, management, and review of the EP	Responsibilities during emergencies or potential emergencies
Survey Environmental Advisor (SEA)	Coordinate the implementation of the Fauna Management Plan offshore and provide advice to the Party Chief on actions to be taken. Provide support to the CGG Site Representative to ensure all offshore personnel have receive the activity specific induction. Monitor the implementation of the environmental performance standards on the survey and support vessels. Ensure environmental inspections/audits are undertaken as per Section 6. Assist with review, investigation and reporting of environmental incidents. Assist in preparation of external regulatory reports required for the survey, in line with environmental approval requirements and the CGG HSE incident reporting procedures. Prepare a report of the overall environmental performance upon completion of the survey, including the results of audits and any incidents, and forward to the Environmental Officer. Collate data for the EP Performance/Compliance Report	
Seismic and Support Masters	Responsible for the overall HSE performance of the vessel against the legislative requirements and any applicable controls in the EP. Ensure the safe execution of all operations of the vessel. Ensure vessel audits, inspections, emergency drills, training, HSE and inductions are undertaken. Ensure maintenance of equipment and records meet legislative requirements. Support the CGG Site Representative in ensuring that all relevant HSE documents are understood and adhered to. Establish and maintain radio contact with other vessels in the Operational Area and adjacent waters.	Notify AMSA, CGG Site Representative and Vessel Manager in the event of a notifiable oil spill. Implement the vessel's SOPEP and OPEP procedures in the event of an oil spill, including first response to an incident using the resources immediately available to the vessel. Immediately notify the CGG Site Representative of any incidents/activities arising from vessel operations that are likely to have a negative impact on the performance outcomes detailed in this EP.

Role	Responsibilities in relation to the implementation, management, and review of the EP	Responsibilities during emergencies or potential emergencies
Seismic Operators **Vessel Crew**	Conduct activities in a professional and safe manner with attention to good housekeeping procedures and work practices. Undertake Regia MSS induction. Immediately report any incidents to the Survey Vessel Master or Party Chief. Encourage improvement in environmental performance wherever possible. Report any marine fauna sightings to the SEA.	
Marine Fauna Observers (MMO) **PAM Operators** **Acoustic Detection Monitoring Operators**	As per Fauna Management Plan.	NA
SRW and BW Expert Panel	As per Fauna Management Plan.	NA

4.8 Emergency Response

CGG's emergency preparedness and response arrangements will be included within the Project HSE Plan. In addition, the seismic and support vessels will be expected to have a vessel-specific Emergency Response Plan (**ERP**) and SOPEP. These documents will be reviewed by CGG to ensure they meet the requirements for emergency and oil spill response specified within this EP. As the Regia MSS is vessel-based, it is considered appropriate that operational response to an emergency would be handled by CGG using their existing emergency response procedures and the vessel-specific ERP and SOPEP. The ERP, SOPEP and OPEP will be tested prior to the commencement of the survey as detailed in Section 10.1.

CGG reviews specific activities, equipment, and workplaces to identify possible emergency situations that may arise. CGG would ensure that any subcontracted vessel operator has established systems to ensure emergency plans are developed, implemented, and maintained and that these plans address those incidents that are reasonably foreseeable. Information that is considered when identifying potential emergency situations include the following:

- Results of hazard identification and impact/risk assessments.
- Legal requirements.
- Previous incident (including accident) and emergency experience.
- Emergency situations known to have occurred in similar organisations.
- Information related to accident and/or incident investigations posted on the websites of regulators or emergency response agencies.
- The Project HSE Plan contains instructions for vessel emergency, medical emergency, search and rescue, reportable incidents, incident notification and contact information to ensure that:

- All potential emergencies are identified.
- Emergency response plans are documented, accessible and clearly communicated.
- Roles and responsibilities are clearly defined.
- Adequate equipment, facilities and trained personnel are available to respond to emergency situations to mitigate adverse consequences.
- Inspection and testing of critical emergency equipment is performed.
- Emergency drills and exercises are conducted to assess emergency response capacity and capabilities.
- Lessons learned are communicated to the appropriate people.

5 Section 22(4): Awareness of EP Responsibilities

5.1 Activity Specific Inductions

All personnel involved with the Regia MSS will be given an activity-specific environmental induction prior to commencing work. This induction will cover environmental responsibilities relevant to the duties and responsibilities of the roles including:

- Environmental sensitivities and conservation values in the EP Area.
- Environmental impacts and risks associated with the activity.
- Waste management and chemical management procedures (including the vessel Garbage Management Plan).
- Emergency response and spill management procedures outlined in the OPEP and vessel SOPEP.
- Procedures for marine fauna interactions as per the Fauna Management Plan.
- Roles and environmental responsibilities of key personnel on board the survey and support vessels.
- The importance of following procedures and using company processes (JSAs etc.) to identify environmental risks and mitigation measures.
- Environmental performance outcomes, standards, and measurement criteria to be complied with under the EP.
- Procedures for reporting environmental hazards, incidents, near misses and opportunities for improvement.
- Opportunities for employee communication and participation.
- Relevant plans and procedures (CGG, seismic and support vessel contractor owned), including where they can be obtained on board the vessels.

A record of the induction will be retained by CGG's Technical Operations Manager with the endorsement of personnel who attended. All personnel are required to sign an attendance sheet to confirm their participation in and understanding of the induction. If a contractor is used, they will conduct their own company and vessel-specific inductions independently and in addition to the activity-specific HSE induction.

5.2 Competency and Ongoing Awareness

It is ultimately CGG's responsibility to ensure all employees and contractors comply with the requirements of the CGG corporate HSE Policy and that the personnel are suitably trained and competent in their respective roles.

CGG will ensure the marine crew are trained and competent to undertake their respective activities on board the vessel. All marine personnel will be qualified in accordance with the International Convention on Standards of Training Certification and Watch Keeping for Seafarers (STCW95).

CGG will ensure marine fauna observers (**MFO**s), passive acoustic monitoring (**PAM**) operators and acoustic detection monitoring (**ADM**) operators are trained and competent as per the Fauna Management Plan.

The following activities will serve to reinforce and maintain ongoing environmental awareness of vessel personnel for the Regia MSS. Records will be produced for each of these meetings:

- Project kick-off meeting: Held at the start of the activity and reviews the contractual and HSE specifications for the activity, the scope of work, vessel specific HSE plans, environmental outcomes, performance standards and measurement criteria within this EP.

- Daily progress meetings (on board): Review all survey operations and incidents of the previous day, actions are recorded within the daily progress report.
- Toolbox meetings: Attended by all personnel involved in a specific operation (i.e. operations involving major hazards and/or involving more than one person). This meeting reviews the activity and reinforces the adoption of control measures within this EP to prevent adverse environmental and safety impacts. Recorded within the daily progress report.

All personnel will be encouraged to communicate any concerns, suggest improvements to the control measures implemented for any task or operation during the activity and comment on any proposed changes to equipment, systems, or methods of operation of equipment, where these may have HSE implications. Opportunities for personnel (including management, relevant contractors and MMOs) to participate in improving the management of environmental risks during the activity include:

- At the time of the induction.
- During daily toolbox and pre-start meetings at the commencement of each shift and prior to commencing a new task (e.g. recovery of streamer).
- Identification of hazards based on incident and near miss reporting.
- Providing suggestions for improvements to the CGG Site Representative at any time.

CGG crew and contractors (including all vessel personnel) will be provided information on employee communication and participation during the project environmental induction prior to commencing the activity.

6 Section 22(5): Managing Environmental Performance

6.1 Monitoring of Environmental Performance

CGG will monitor the performance of the management and mitigation controls during the activity in line with the HSE Plan and CGG Environment Management document. Environmental performance during the survey will be reviewed to ensure that:

- EPOs and EPSs are being met, reviewed and where necessary amended (to continue to reduce the environmental impacts and risks of the activity to ALARP).
- Potential non-conformances and opportunities for continuous improvement are identified and corrective actions implemented.
- All environmental monitoring requirements have been met before completing the activity.

6.2 Recording of Environmental Performance

CGG will develop and maintain an electronic Environmental Conformance Register for the activity, which details the environmental management and mitigation controls, performance outcomes and standards and measurement criteria in the EP. The Environmental Conformance Register is an audit tool to be used before and during the activity to demonstrate conformance of the activity with the EP.

A summary of the environmental management and mitigation controls, performance outcomes and standards and measurement criteria in the EP will be distributed aboard the survey and support vessels, and implementation of the environmental performance standards will be monitored by the Survey Environmental Advisor.

6.3 Audits and Inspections

Post acceptance of the EP, conformance will be monitored on an at least quarterly basis by the CGG Site Representative, or delegate, via audits and inspections, as well as through the commitments under the Management of Risk, Management of Change, and Management of Knowledge parts of this Implementation Strategy.

Prior to the survey, CGG will undertake a vessel audit/inspection to:

- Confirm that the vessel management systems are consistent with the management and mitigation controls detailed in the in-force EP.
- Review of the risk of IMS, potentially including an inspection to confirm that the vessel does not pose an unacceptable risk of IMS.
- Audit the on-board spill response capability against the vessels SOPEP or equivalent and relevant management and mitigation controls in this EP, to verify spill preparedness.
- Ensure that the relevant documents that support implementation of the management and mitigation controls in the EP are accessible and have been communicated to the contractor and vessel crew.

During the activity, conformance will be monitored on an at least fortnightly basis by the CGG Site Representative, or delegate, via audits and inspections during the activity. Conformance auditing or inspection while the EP is in-force will be based on the Environmental Conformance Register and will target the following:

- Conformance with regulatory requirements detailed in the accepted EP.
- Management strategies and procedures to ensure EPOs and EPSs are being implemented, monitored, measured, and evaluated.
- Emissions and discharges are being monitored, measured, and documented.

6.4 Review of Environmental Performance

The following arrangements will be established to review the environmental performance of the activity:

- Inspections of the vessels will be carried out before and during the survey to ensure that procedures and equipment for managing routine discharges and emissions are in place to enable conformance with the EP.
- The performance of key equipment as described in this EP (i.e., oil-in-water separator) will be checked to ensure ongoing reduction of risks and impacts to ALARP, and any potential issues (i.e. observations of poor operating condition/performance or non-conformances) are continually monitored and raised as soon as practicable.
- Records of inspections against EP requirements are documented in the Environmental Conformance Register.

6.5 Management of Non-Conformance

Non-conformances and opportunities for improvement will be identified and corrective actions will be tracked to completion utilising Environment Conformance Register. Corrective actions will specify the remedial action required to fix the breach and prevent its reoccurrence and is delegated to the person deemed most appropriate to fulfil the action. Where more immediacy is required, non-compliances will be communicated to relevant personnel immediately and responded to as soon as possible. CGG will carry forward any areas of non-conformance identified during its previous activities for consideration in future seismic activities to assist with continuous improvement in environmental management.

Non-conformances may necessitate a management of change and/or a management of knowledge process to be implemented.

An end of activity review will be jointly conducted by CGG and the seismic contractor during a post-survey meeting. The purpose of this meeting is to enable the review of management and mitigation strategies implemented during the activity. It includes reviews of performance, incident investigations, audits and field activity to identify actions for future seismic surveys, which can be implemented on a continuous improvement basis. The end of survey HSE Review will include a 'Lessons Learnt' section to facilitate incorporation of any recommended improvement actions in future seismic activities.

7 Section 22(6): Monitoring of Emissions and Discharges

7.1 Monitoring Emissions and Discharges

In accordance with the Regulations the titleholder shall record emissions and discharges for the duration of the activity. Discharges associated with a survey will be limited to those allowed for under maritime law. Therefore, all discharges will be recorded and controlled in accordance with maritime monitoring and recording requirements. Any non-compliance with discharge requirements will be included in the monthly recordable incident report to NOPSEMA.

8 Section 22(7): Environmental Performance Reporting

8.1 Regulatory Reporting

CGG will submit an environmental performance report to NOPSEMA within three months of survey completion. CGG will publish the same environmental performance report at the same time as submission to NOPSEMA on the Regia MSS Consultation Hub.

8.2 Notifications and Reporting

Under Sections 24(c) and 47 of the Regulations, CGG is required to notify NOPSEMA of any recordable (an incident arising from the activity that breaches an EPO or EPS in the EP that applies to the activity that is not a reportable incident) and reportable (an incident arising from the activity that has caused, or has the potential to cause, moderate to significant environmental damage) incident within a specified timeframe. Environmental incidents will be reported to the relevant government agency by the CGG Site Representative. The requirements for reporting and recording incidents are outlined in Table B3-2.

Following any recordable or reportable incident, CGG will undertake an incident investigation and this information will be communicated to all relevant personnel. All recordable and reportable incidents will be documented by the CGG Technical Operations Manager and will include details of the event, immediate action taken to control the situation, and corrective actions to prevent re-occurrence. The CGG Technical Operations Manager and CGG Site Representative will follow up actions taken to ensure that the corrective actions have been taken to close it out. When planning future activities, CGG will review the reportable and recordable incidents that have occurred previously to incorporate any lessons learned as part of CGG's continual improvement process.

Table B3-2 - Notification Requirements

Requirement	Timing	Contact
Recordable Incidents		
As a minimum, the written monthly recordable incident report must include a description of: All recordable incidents which occurred during the calendar month All material facts and circumstances concerning the incidents that the operator knows or can reasonably find out. Any actions taken to avoid or mitigate any adverse environmental impacts of the incident. Corrective actions that have been taken, or may be taken, to prevent a repeat of similar incidents occurring.	As soon as possible but before the fifteenth day of the following calendar month.	NOPSEMA - submissions@nopsema.gov.au
Verbal Notifications		

<table>
<tr><th>Requirement</th><th>Timing</th><th>Contact</th></tr>
<tr><td>Vessel-sourced spill in Commonwealth waters.</td><td>Within one hour</td><td>JRCC Australia:
Phone: +61 2 6230 6811 or 1800 641 792
Facsimile: +61 02 6230 6868</td></tr>
<tr><td>Reportable incidents include, but are not limited to, those that have been identified through the risk assessment process as having an inherent impact consequence of ‘significant’, ‘major’ or ‘critical’, or at a minimum, the following incidents:
A level 2 spill incident
Vessel strike / entrapment or entanglement with listed marine fauna.
IMS Introduction.
The notification must contain:
All material facts and circumstances concerning the incident.
Any action taken to avoid or mitigate the adverse environmental impact of the incident.
The corrective action that has been taken or is proposed to be taken to stop, control or remedy the reportable incident.
This must be followed by a written record of notification ASAP after notification. This written notification must also be supplied to the NOPTA and DEECA (Vic) for Commonwealth water incidents.</td><td>Within two hours</td><td>Verbal:
NOPSEMA – Phone 1300 674 472
DEECA (Vic) – 0419 597 010

Written notifications:
NOPSEMA – submissions@nopsema.gov.au
DEECA – marine.pollution@ecodev.vic.gov.au
NOPTA – reporting@nopta.gov.au</td></tr>
<tr><td>If an oil pollution incident occurs within or approaches an AMP, or where an oil spill response action must be taken within an AMP, the Director of National Parks (DNP) must be contacted immediately. Information which must be provided within that notification includes:
Titleholder details
Time and location of the incident (including AMP likely to be affected)
Proposed response arrangements as per OPEP
Confirmation of providing access to the relevant monitoring and evaluation reports when available
Contact details of the emergency coordinator.</td><td>As soon as possible and prior to response action being taken, as far as reasonably practicable</td><td>Verbal:
Director of Marine Parks – 0419 293 465 (24hr Marine Compliance Officer)
Written Notification:
marine.compliance@environment.gov.au</td></tr>
<tr><td>Notify DCCEEW of any death or injury of a listed threatened species; all cetacean species; listed migratory species or listed marine species.</td><td>Within seven days</td><td>Phone: +61 2 6274 111
Phone: 1800 803 772
Email: EPBC.Permits@environment.gov.au</td></tr>
<tr><td colspan="3">Written Incident Reports</td></tr>
<tr><td>Verbal notification of a reportable incident to NOPSEMA (Commonwealth waters) must be followed by a written report. As a minimum, the written incident report will include:</td><td>Within three days of notification of</td><td>NOPSEMA - submissions@nopsema.gov.au
NOPTA – reporting@nopta.gov.au</td></tr>
</table>

Requirement	Timing	Contact
The incident and all material facts and circumstances concerning the incident. Actions taken to avoid or mitigate any adverse environmental impacts. The corrective actions that have been taken, or may be taken, to prevent a recurrence of the incident. The action that has been taken or is proposed to be taken to prevent a similar incident occurring in the future.	incident (NOPSEMA) Within seven days after submission to NOPSEMA (NOPTA).	
Vessel strike with cetacean is reported to the DCCEEW.	Within 72 hours of incident	Upload information to: https://data.marinemammals.gov.au/report/shipstrike
Heritage Notifications		
Heritage Victoria must be notified in accordance with s80 of the Heritage Act 2017 (Vic) or under Underwater Cultural Heritage Act 2018 (Cth). A further notification must be given to the Minister as per s40 of the Underwater Cultural Heritage Act 2018 (Cth).	As soon as practicable.	Email: heritage.victoria@delwp.vic.gov.au Phone 03 7022 6390

8.3 External Routine Notification and Reporting Requirements

Review of statutory and stakeholder requirements with respect to routine external notification and reporting is provided in Table B3-3. These actions are the responsibility of the CGG Technical Operations Manager (or delegate).

Table B3-3 - External Routine Notification and Reporting Requirements

Requirement	Timing	Contact
Routine Performance Reporting		
The Regulations - Section 51: Submit an EP Performance/Compliance Report to NOPSEMA. This reports compliance against each of the EPOs and EPSs as outlined in this EP.	Within three months of survey completion.	NOPSEMA - submissions@nopsema.gov.au
Report on the conduct of the survey with any whale sightings. Sightings and survey information is to be recorded within the 'Cetacean Sightings Application' (CSA) software. Upon completion of the survey the information entered into the CSA is to be exported as a text file.	Within two months of activity completion.	Upload information to: https://data.marinemammals.gov.au/csa Text file sent to: sightingsdata@aad.gov.au
EP Accepted and Activity Update		
Notification to all relevant stakeholders advising of EP acceptance and provide an update on survey commencement.	Within ten days of the date the EP has been accepted.	All relevant stakeholders listed in the Consultation Log.
Notification of the establishment of the claims process, the survey timing, and the Adjustment Area	No less than 28 days before activity commencement.	Relevant commercial fishing licence holders and respective peak commercial fishing industry bodies.

Requirement	Timing	Contact
Provision of OPEP to DTP and AMSA following EP acceptance and prior to survey commencement.	Prior to survey commencement.	Contact details listed in Consultation Log.
Survey Commencement		
Notify AHO for Notice to Mariners.	At least four weeks prior to commencement.	AHO - datacentre@hydro.gov.au
Notify NOPSEMA of survey commencement.	At least ten days prior to commencement.	NOPSEMA - submissions@nopsema.gov.au
Notify AMSA for Auscoast Warnings This notification will include when operations start and end, name, callsign and maritime mobile service identity (MMSI), satellite communications details (including inmarsat-c and satellite telephone numbers), area of operation, requested clearance from other vessels and any other information that may contribute to safety at sea.	At least 24-48 hours prior to survey commencement.	JRCC - rccaus@amsa.gov.au Ph: 1800 641 792 or +61 2 6230 6811
Survey Cessation		
Notify AMSA to cease Auscoast Warnings	Upon vessel demobilisation.	JRCC - rccaus@amsa.gov.au Ph: 1800 641 792 or +61 2 6230 6811
Notify NOPSEMA with survey completion date	Within ten days of survey completion.	NOPSEMA - submissions@nopsema.gov.au
End of EP		
Notification of EP completion to NOPSEMA.	End of EP operation.	NOPSEMA - submissions@nopsema.gov.au

9 Sections 22(8), 22(9), & 22(11): Oil Pollution Emergency Plan

9.1 Oil Pollution Emergency Plan

The Oil Pollution Emergency Plan (**OPEP**) is available in Appendix G3.

The OPEP consists of the following:

- Survey / support vessel(s) SOPEPs[1]
- CGG Regia MSS OPEP[2]

These response arrangements are consistent with, and supported by, the:

- National Plan for Maritime Environmental Emergencies (NATPLAN): Australian Maritime Safety Authority (**AMSA**) – has jurisdiction and is the Control Agency for vessel spills, which affect Commonwealth waters.
- State Hazard Plan for Maritime Environmental Emergencies (State Hazard Plan): The Victorian Department of Transport and Planning (**DTP**) is the Control Agency for marine oil spills in Victorian state waters.

The seismic and support vessels (if ≥400 gross tonnes) must have IMO compliant SOPEP, prepared in accordance with IMO guidelines for the development of shipboard oil pollution emergency plans (resolution MEPC.54 (32) as amended by resolution MEPC.86 (44)), include oil spill response arrangements and provisions for testing the SOPEP (oil pollution emergency drills).

CGG will ensure that support vessels under 400 gross tonnes (that are not obligated legislatively to have a SOPEP), do have vessel-specific spill response plans (to an equivalent standard) that cover spill response arrangements. The SOPEP is designed to ensure a rapid and appropriate response to any oil spill and provide practical information required to undertake a rapid, effective response, and reporting procedures in the event of a spill.

[1] Required for vessels ≥400 gross tonnes involved in the survey or equivalent for lesser tonnage vessels that manage the environmental impacts of a spill and vessel-based operational monitoring (agreement OPRC 90)

[2] This document supports the individual vessel-based SOPEPs by detailing the interaction between contractor-related spill response plans and CGG response arrangements.

10 Section 22(12), 22(13) & 22(14): Testing of the Response Arrangements in the Oil Pollution Emergency Plan

10.1 OPEP Testing

The OPEP will be tested:

- Prior to the survey commencing.
- Following any significant amendment of the response arrangements.
- When a new seismic vessel is engaged for the activity.
- Not later than 12 months after the most recent test.

Vessel-based SOPEP tests are undertaken by vessels routinely as per MARPOL Annex I (Section 15) requirements, and drill outcomes reviewed as part of the ongoing monitoring and improvement of emergency response control measures.

A desktop drill of the Regia MSS OPEP, including the vessel SOPEP, will be conducted to assess the effectiveness of the response arrangements. Specifically, the drill will be completed at least 8 weeks prior to carrying out the activity and will test the following:

- Roles and responsibilities of those involved in oil spill response are clear and understood.
- Communication sequence from the vessel master to vessel-contractor onshore management and the Control Agency, including notification of the AMSA JRCC is adequate, current and includes all relevant details.
- Communication between the CGG offshore representative and CGG Technical Project Manager and subsequent notification authorities is adequate and timely.
- Ensures Type 1 operational monitoring such as spill surveillance and tracking is appropriate, understood and practised.
- Equipment and procedures intended for source control on-board the vessels are available for use as outlined in the vessel SOPEP.

The outcomes of the drill will be documented, reviewed and improvements identified (as needed). Should any inadequacies, altered contractual arrangements or improvements to arrangements be identified via testing, these corrective actions will be registered as a non-conformance and the EP/OPEP will be amended for these items via a Management of Change process.

11 Section 22(10): Operational and Scientific Monitoring Program

11.1 Operational and Scientific Monitoring Program

The Regia MSS Operational and Scientific Monitoring Program (OSMP) is available in Appendix G3. The OSMP has the following objectives:

- Identify high priority protection areas within the Environmental Planning Area.
- Specify monitoring methodologies.
- Detail the process CGG will follow to determine the monitoring studies that will be implemented in order to:
    - Provide situational awareness and assist in planning and execution of spill response to minimise environmental harm.
    - Provide for short-term and long-term environmental damage and recovery assessments.

12 Section 22(15): Ongoing Consultation

12.1 Ongoing Consultation

As per the Community Consultation and Engagement Plan, community engagement and relevant persons consultation will be ongoing post-acceptance, as well as during the planning and conduct of the activity.

CGG will continue its practice of hosting an online webinar every month the Environment Plan is in-force. During the consultation in preparation of the Environment Plan CGG has encouraged relevant persons to register for this webinar. Registration for the webinars will remain open while the Environment Plan is in-force. Members of the public may also register for the webinar series. All previous webinars will be accessible on the Regia MSS Consultation Hub and on YouTube. Similarly, there will be a monthly newsletter every month the EP is in-force.

CGG will also communicate to each relevant person by sending notifications at the following key milestones or events:

- At each NOPSEMA decision.
- If the EP is accepted.
- 8 weeks prior to survey commencement.
- Immediately upon completion of the activity.
- In the event of a significant incident (e.g. large fuel spill).
- If the seismic vessel is required to depart the Operational Area to avoid adverse weather (notification will be communicated by the AMSA Joint Rescue Coordination Centre as a navigational safety warning).
- If there is a change to the MSS activity scope that may affect the stakeholder interests, activities or functions.
- If a new or significant increase in potential impact or risk is identified that (after identification of additional control measures to manage those impacts or risks) may affect the relevant persons functions, interests, and activities.

All notifications will include the relevant details of the activity including the activity title, location and contact details.

As a result of providing activity status updates publicly, or because of a change in a person's functions, interests, and activities, CGG acknowledges that new relevant persons may reveal themselves at any time while the EP is in-force. The processes provided in the Community Engagement and Consultation Plan will be implemented if a new relevant person is found.

Similarly, a relevant person may be the source of new information that has resulted in a change to their functions, interests, and activities. This may in turn result in a modified or new objection or claim relevant to the activity. CGG shall assess the merits of any modified or new objections or claims in the same way as outlined in the Community Engagement and Consultation Plan. If the claim has merit, where appropriate, CGG may modify the management of the activity as soon as possible. A management of change process would assess the modification to the management of the activity.

CGG will endeavour to respond to the modified or new objection or claim received while the Environment Plan is in-force within one week of receipt of the new information and the modified or new objection or claim. CGG will undertake any resulting management of change actions as soon as practicable, but preferably within the same time. For objections and claims that do not necessitate a change to the management of the activity nor the Environment Plan, CGG will respond to the relevant person providing reasoning and supporting information (as relevant) to support CGG's conclusions within a month of receiving the new information.

13 Section 22(16): Compliance with the Act, the regulations, and all other environmental legislation

13.1 Record Management

In accordance with Section 52, CGG will store and maintain documents or records relevant to the EP implementation for a period of five years in a way that makes retrieval reasonably practicable.

14 Document Control

Table B3-4 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	10 March 2023	MS	Initial version
0.1	19 March 2023	SJ	Peer review
0.2	23 March 2023	LT/PR	Review by CGG
0.3	2 April 2023	MS	Updated following reviews
1.0	6 April 2023	MS	Published on Regia MSS Consultation Hub website
1.1	20 December 2023	HS	Updated for 2023 regulations and reviewed for consistency with environmental assessments.
1.2	29 December 2023	MS/SJ	Reviewed and finalised for submission.
2	3 January 2024	MS	Published on the consultation hub and ready for submission for public comment.
3	**11 May 2024**	**MS**	**Review post public comment, minor changes only.**

Regia MSS: Preliminary Environmental Impact and Risk Assessment

March 2023

Klarite

Contents

Disclaimer

Introduction

This preliminary environmental impact and risk assessment (PEIRA) has been prepared by Klarite to support CGG Services (Australia) Pty Ltd (CGG) in its environmental management of the Regia Marine Seismic Survey (Regia MSS).

Klarite is an independent professional services firm specialising in environmental management of offshore energy developments. Established in 2017, Klarite has performed environmental impact and risk assessment throughout the offshore marine area in Australia and has years of experience in the offshore regulatory framework.

The PEIRA follows a standardised methodology for identifying environmental impacts and risks from offshore petroleum activities and determining their relative significance.

Purpose

The purpose of this PEIRA is to:

- Identify key environmental values and sensitivities (which include social, economic, and cultural features).
- Perform an initial evaluation of the environmental impacts and risks associated with the Regia MSS to support consultation efforts.

The findings of this assessment will be used to inform project design and decision making, and to identify any necessary mitigation measures and management strategies. The PEIRA will also provide a basis for further study, including the potential for baseline characterisation studies, and investigation as required. This document serves as a starting point for a full environmental assessment, which will be required before the activity can progress through the approvals process.

Environmental Planning Area Description

To commence the PEIRA an Environmental Planning Area was established to frame the initial studies and community consultation effort. Within that area an Activity Planning Area was established to frame the maximum geographical limits of the activity. The Environmental Planning Area and Activity Planning Area are shown in Figure B4-1.

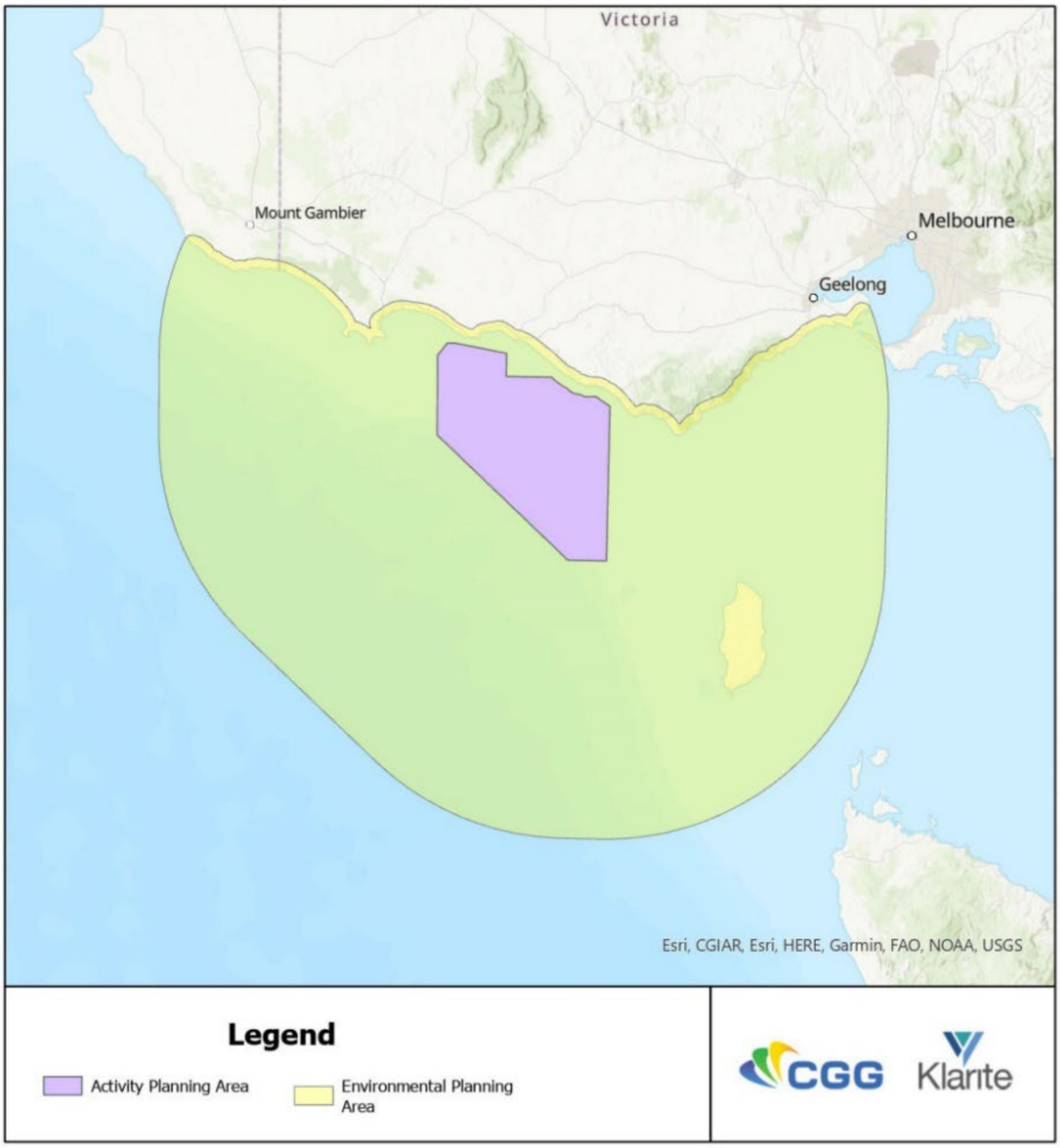

Figure B4-1: Regia MSS Environmental Planning Area and Activity Planning Area

The Environmental Planning Area has been set at 155 km around the Activity Planning Area. This distance has been selected using professional judgement and a review of previous impact and risk assessments for similar activities in the region. Further justifying the distance, the NERA Reference Case: Consequences analysis of an accidental release of diesel (NERA 2018) found that diesel spills under 700m^3 were reliably predicted to disperse within this distance. The Environmental Planning Area will be validated or modified based on recommended within this PEIRA.

Scope of Assessment

This scope of this PEIRA covers the Environmental Planning Area, which includes the Activity Planning Area and the surrounding area that may be affected by the activity. The PEIRA aims to identify and evaluate the impacts and risks of the activity on the:

- physical and biological environment, including air quality, water quality, sediment quality, climate, marine life, and marine habitats; and
- human environment, including marine industries, cultural and indigenous values, recreational activities, tourism, coastal developments, and marine protected areas.

Environmental Regulations and Guidelines

The primary legislation governing the Regia MSS is the *Offshore Petroleum and Greenhouse Gas Storage Act 2006* (the Act) and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (the Regulations).

There are numerous additional laws, regulations, and guidelines that apply requirements to the Regia MSS activity. These are the subject of a separate study being completed by CGG and are only discussed here if they are relevant to the management of environmental impacts and risks.

The following terms are used in this PEIRA and are defined in the Regulations:

A petroleum activity or activity means operation or works in an offshore area undertaken for the purpose of: (a) exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or (b) discharging an obligation imposed on a petroleum titleholder under the Act or a legislative instrument under the Act.

An environmental impact is a change, whether adverse or beneficial, that wholly or partially results from an activity.

The following terms are used in this PEIRA and are defined in various relevant environmental management standards and guidelines:

An environmental aspect is an element of an activity that can interact with the environment.

An environmental risk is the probability and consequence of an unwanted accident.

Methodology

The environmental assessment methodology used in the PEIRA has been developed based on widely adopted best practice and industry standards, primarily AS/NZS ISO 31000:2018: Risk Management – Principles and Guidelines. There are two parts of the methodology, one for environmental impacts and one for environmental risks. Both parts of the assessment are underpinned by a clear description of the activity, data collected in preparation of this document, and the identification of environmental aspects arising from the Regia MSS.

Project Description

Klarite was provided a description of the activity which is available on the Regia MSS Consultation Hub (www.regiamss.com.au).

Data Collection

A review of relevant literature and data sources was undertaken to gather information on the Environmental Planning Area and the baseline environmental conditions. No field surveys were undertaken to collect data given that the marine environment in the Otway region is relatively well understood and the preliminary nature of this PEIRA.

Community consultation for the project has commenced and will provide a valuable source of information on environmental values and sensitivities, as well as the concerns and perspectives of interested parties, including local communities and regulatory agencies. This PEIRA will be published to help inform the community of the environmental aspects of the activity so that their views can be properly reflected in the full environmental assessment.

Information sources accessed to inform this PEIRA are detailed in Table B4-1able B4-1.

Table B4-1: Information Sources Accessed to Inform PEIRA

Information Source	Managed by	Date Accessed
Protected Matters Search Tool https://www.dcceew.gov.au/environment/epbc/protected-matters-search-tool	Department of Climate Change, Energy, the Environment and Water	11 Feb 2023
Species Profile and Threats Database	Department of Climate Change, Energy, the Environment and Water	Feb/Mar 2023
Submarine Cable Map https://www.submarinecablemap.com/	TeleGeography	11 Feb 2023
Victorian Desalination Project https://www.dtf.vic.gov.au/partnerships-victoria-ppp-projects/victorian-desalination-project	Victorian State Government	11 Feb 2023

Impact Assessment Techniques

The impact assessment for the PEIRA consists of a desktop study conducted to evaluate the environmental impacts of the activity on the Environmental Planning Area, based on the data collected during the data collection phase. Professional judgement and good practice have been relied on to complete the PEIRA and recommendations for further studies including modelling, have been made where necessary to support the full environment assessment.

Risk Assessment Techniques

The risk assessment for the PEIRA consists of a desktop study conducted to identify the hazards associated with the activity and analyse the probability and consequence of each hazard to determine the risks associated with the activity. The results of the probability and consequence analysis will be used to characterise the overall risk associated with the activity, and to prioritise mitigation measures and management strategies. Professional judgement and good practice have been relied on to complete the PEIRA and recommendations for further studies, including modelling, have been made where necessary to support the full environmental assessment.

Assessment of Potential Significance

Assessment of potential significance is a key outcome of the PEIRA. It provides context for any additional baseline studies and guides the full environmental impact and risk assessment. Under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), an action (*activity*) will require approval from the Environment Minister if the action has, will have, or is likely to have, a significant impact on a matter of national environmental significance. A 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment, which is impacted, and upon the intensity, duration, magnitude, and geographic extent of the impacts (DAWE 2013).

Treatment of Environmental Impacts and Risks

Throughout the PEIRA (and the subsequent full assessment) there will be mitigation and management measures that will be implemented preparing for, and during, the activity. There are five types of mitigation and management measures as shown below. Where a mitigation or management measure is identified for the Regia MSS from this PEIRA they will be shown within the text to emphasise their importance for environmental management.

Activity Limitation

A measure that constrains, limits or otherwise restricts the activity such that impacts and risks can be avoided, or lessened to at or below acceptable levels.

Control Measure

A system, an item of equipment, a person or a procedure that is used as the basis for management of environmental impacts and risks.

Legislative Requirement

A requirement of law, regulation, or guideline that applies to the activity and is relevant to the environmental management of the activity.

Environmental Performance Standard

A statement of performance required of a control measure

Management System Element

A responsibility, practice, process or resource used to manage an environmental aspect of the activity, including monitoring and review of environmental performance.

Environmental Aspects

Cause Effect Pathways

A cause-effect pathway refers to the chain of events that connects a specific cause to an effect. In the context of environmental impacts and risk assessments, cause-effect pathways describe the relationships between environmental aspects and the impacts or consequences they could have on the environment.

A cause-effect pathway typically starts with the identification of a potential hazard, such as the physical presence of a seismic survey vessel, and then examines the potential pathways by which that hazard could result in an impact, such as the release of pollutants into the water affecting water quality or the generation of underwater sound at levels that can cause harm to marine life.

The identification of cause-effect pathways is an important step in the assessment process, as it allows for a systematic evaluation of the environmental impacts and risks of a proposed activity. It also provides a basis for developing mitigation and management strategies.

Identification

To understand the magnitude, extent and duration of an environmental impact or risk the pathway of each environmental aspect needs to be identified. The following list describes the environmental aspects identified from the Regia MSS activities to date that can lead to environmental impacts.

- Artificial light – the presence of vessels undertaking night-time operations will result in artificial light discharge into the marine environment.
- Physical presence – the presence of components of the activity, such as the physical presence of vessels operating in marine waters may interfere with other marine users.
- Underwater sound – components of the activity will generate impulsive sound and other components will generate continuous sound. Both could affect ecological, economic, or social receptors.
- Atmospheric emissions – vessels used on the activity will generate atmospheric emissions, which could affect ambient physical conditions and ecological receptors.
- Planned discharges – the activity will likely result in planned liquid discharge pathways, such as those typically generated by vessels.

The following list describes the environmental aspects identified in the Regia MSS to date that may lead to environmental risks.

- Accidental release of fuel – whilst undertaking the activity, unplanned events may occur which result in a discharge of marine diesel.
- Accidental release of materials or waste overboard – whilst undertaking the activity, unplanned release of waste, or equipment may occur.
- Introduction of marine pest species – vessels that transit between ports may temporarily harbour invasive marine species that have could be introduced or even establish in foreign places.
- Collisions with marine fauna – vessels have limited manoeuvrability at stages during the activity and may be unable to avoid collisions with marine fauna.

Typical environmental aspects from offshore petroleum activities that were considered and determined to not be relevant to this assessment are listed below.

- Benthic disturbance – there is no pathway for the activity to result in changes to physical receptors, for example disturbance to the seabed, as there will be no anchoring as part of the activity.

Activity Limitation
No anchoring permitted within the activity planning area.

Extent and Duration

Each environmental aspect has a related spatial extent within the Environmental Planning Area. The Regulations require that the Environment Plan must describe the existing environment that may be affected by the activity. Therefore, this PEIRA seeks to identify the appropriate extent and duration of each environmental aspect so that the search for environmental values and sensitivities can be specific to the environmental aspect. Table B4-22B4-2 identifies and justifies the extent and duration of each environmental aspect for the Regia MSS.

Table B4-22: Extent and Duration of Regia MSS Environmental Aspects

Environmental Aspect	Extent	Duration	Justification
Artificial light	Activity Planning Area +20 km	90 days	The National Light Pollution Guidelines (CoA 2020) detail that where there is important habitat for

Environmental Aspect	Extent	Duration	Justification
			listed species that are known to be affected by artificial light within 20 km of a project, species specific impacts should be considered through an Environmental Impact Assessment process. The measurable change in light from ambient conditions is likely to occur at <20 km from the source; but due to difficulties with calculating light intensity in biologically relevant measurements, the distance in CoA (2020) has been used. Once the vessels leave the Activity Planning Area this aspect ceases.
Physical presence	Activity Planning Area	90 days	There will be no activities beyond the Activity Planning Area which will be narrowed to the Operational Area later in the assessment process. The larger area has been used for this PEIRA.
Underwater sound	Underwater sound area	90 days	This is an additional area that varies depending on how sound is received by the receptor. This area will be predicted through qualitative underwater sound modelling.
Atmospheric emissions	Activity Planning Area	90 days	There will be no activities beyond the Activity Planning Area which will be narrowed to the Operational Area later in the assessment process. The larger area has been used for this PEIRA.
Planned discharges	Activity Planning Area	90 days survey duration +1 day	When the survey ends the planned discharges associated with the activity end. Planned discharges are such that after a 24-hour period any impacts would be indistinguishable from other marine activities in the area.
Accidental release of fuel	Environment Planning Area	90 days survey duration +7 days	When the survey ends this aspect ends. If there were an accidental release of fuel the consequences of the release would not be detectable a further 7 days post-incident due to the rapid evaporation and dispersion of the fuel.
Accidental release of materials or waste overboard	Environment Planning Area	90 days	Any buoyant waste released overboard is likely to wash up on shorelines hence why the larger Environment Planning Area has been used. Once the activity ends this aspect is no longer relevant.

Environmental Aspect	Extent	Duration	Justification
Introduction of marine pest species	Activity Planning Area	90 days	The vessel will not be conducting petroleum activities beyond the Activity Planning Area, which will be narrowed to the Operational Area later. Once the activity ends this aspect is no longer relevant.
Collision with marine fauna	Activity Planning Area	90 days survey duration	The vessel will not be conducting petroleum activities beyond the Activity Planning Area, which will be narrowed to the Operational Area later. Once the activity ends this aspect is no longer relevant.

Screening

Not all environmental aspects interact with the identified component parts of the environment. For example, water quality will not be affected by artificial light. Table B4-33B4-3 shows the interactions between each environmental aspects and identified components of the environment. Additional component parts of the environmental may be identified through the consultation process. These will be considered in the full assessment.

Table B4-33: Screening of Environmental Aspects against the Components of the Environment

		Environmental Aspects								
		Artificial Light	Physical Presence	Underwater Sound	Atmospheric Emissions	Planned Discharges	Accidental Release of Fuel	Accidental Release of Materials or Waste Overboard	Introduction of marine pest species	Collisions with marine fauna
Environment Component										
Physical Environment	Air Quality				✓					
	Ambient Light	✓								
	Ambient Sound			✓						
	Climate				✓					
	Sediment Quality						✓			
	Water Quality					✓	✓	✓		
Ecological Environment	Benthic Assemblages			✓			✓	✓	✓	
	Coastal Habitats and Communities				✓		✓			
	Plankton	✓		✓	✓	✓	✓			
	Invertebrates	✓		✓	✓	✓	✓		✓	
	Fish	✓	✓	✓	✓	✓	✓	✓		✓
	Birds	✓	✓	✓	✓	✓	✓	✓		
	Marine Reptiles	✓	✓	✓	✓	✓	✓	✓		✓
	Marine Mammals	✓	✓	✓	✓	✓	✓	✓		✓
Human Environment	Coastal Development	✓					✓			
	Commercial Fishing and Aquaculture		✓				✓	✓	✓	
	Diving		✓	✓			✓		✓	
	Indigenous Culture		✓				✓	✓		
	Marine Industries		✓				✓			
	Marine Protected Areas		✓				✓	✓		
	Marine Tourism		✓				✓			
	Recreational Fishing		✓				✓		✓	

Baseline Environmental Conditions

The baseline environmental conditions identified below are used as a reference point to evaluate the impacts and risks of the Regia MSS. The baseline conditions are also used to determine the significance of the impacts and risks identified in the PEIRA and to identify any necessary mitigation measures and management strategies.

Summary

The marine environment of the offshore Otway Basin, Victoria, Australia, is a diverse and dynamic ecosystem that supports a range of important physical, ecological, and human activities. The Environmental Planning Area encompasses a wide range of habitats, including open ocean, coastal waters, rocky shores, sandy beaches, seagrass beds, and kelp forests. These habitats support a variety of marine species, including fish, crustaceans, molluscs, birds, marine reptiles, marine mammals, and seaweeds. The marine environment also supports a range of human activities, including but not limited to fishing, diving, shipping, and recreation.

Water quality in the Environmental Planning Area is generally good, with relatively low levels of pollutants and relatively high levels of dissolved oxygen. The area is also relatively protected from human impacts, with few major industries or coastal developments in the immediate vicinity. However, the Environmental Planning Area is subject to some environmental stressors, including nutrient runoff, sedimentation, and marine debris.

Physical Environment

The physical environment refers to the non-living natural elements of an ecosystem, including air, water, soil, minerals, and energy from the sun. These elements interact with each other and with living organisms to form a complex system that supports and sustains life.

The physical environment plays a crucial role in shaping the biotic components of an ecosystem, influencing the distribution and diversity of plants, animals, and microorganisms. For example, the availability of water, light, and nutrients determines the types of vegetation that can grow in a particular area, while topography and geology shape the physical structure of the landscape, providing habitats and resources for various species.

Understanding the physical environment is essential for comprehending the functioning of an ecosystem and for developing sustainable management practices that preserve and enhance the ecological, economic, and social values of the environment. The following components of the physical environment are considered in this PEIRA and will be carried through to the full assessments.

- Air Quality
- Ambient Light
- Ambient Sound
- Climate
- Sediment Quality
- Water Quality

Ecological Environment

The ecological environment refers to the living components of an ecosystem, including plants, animals, and microorganisms, as well as their interactions with each other and with the non-living elements of the environment. These interactions form the food webs and nutrient cycles that sustain life and maintain the stability and resilience of the ecosystem.

The ecological environment is shaped by the physical environment, as well as by historical events, such as natural disasters, evolution, and human activities. Biodiversity, or the variety of species and their interactions, is a key feature of the ecological environment, providing the essential functions and services that support human well-being, such as food, medicine, and recreation.

Understanding the ecological environment is important for conserving and restoring biodiversity, preserving the integrity and functioning of ecosystems, and supporting the livelihoods and well-being of people and communities. It involves monitoring and assessing changes in species composition, populations, and interactions, as well as evaluating the impacts of human activities, such as habitat destruction, pollution, and introduction of non-native species, on the ecological environment. The following components of the ecological environment are considered in this PEIRA and will be carried through to the full assessments.

- Benthic Assemblages
- Coast Habitats and Communities
- Plankton
- Invertebrates
- Fish
- Birds
- Marine Reptiles
- Marine Mammals

These components of the ecological environment may include the following matters that must be considered in the full assessments:

- the presence of a listed threatened species or listed threatened ecological community.
- the presence of a listed migratory species.
- any values and sensitivities that exist in, or in relation to, part or all of:
    - a Commonwealth marine area; or
    - Commonwealth land.

Human Environment

The human environment refers to the relationships between people and the environment, including the physical, psychological, social, economic and cultural elements that shape human well-being. It encompasses the communities, economies, and cultures that depend on the environment for their livelihoods, health, and well-being.

In the context of marine areas, the human environment includes coastal developments, fishing and aquaculture industries, tourism and traditional owners who have a close connection to the sea and its resources. The relationship between traditional owners and the sea often involves a deep cultural, spiritual, and economic connection, and they have a unique knowledge and understanding of the marine environment that has been passed down through generations.

Understanding the human environment is critical for developing effective and equitable environmental management strategies that balance the needs of people with the conservation of the environment. It involves considering the social, economic, and cultural values and impacts of environmental change, and engaging with the various stakeholders, including traditional owners, to ensure that their perspectives and needs are incorporated into decision-making processes. The following components of the human environment are considered in this PEIRA and will be carried through to the full assessments.

- Coastal Development
- Commercial Fishing and Aquaculture
- Diving
- Indigenous Culture
- Marine Industries
- Marine Protected Areas
- Marine Tourism
- Recreational Activities

In this list Marine Protected Areas may include the following matters that must be considered in the full assessments:

- the National Heritage values of a National Heritage place.
- the ecological character of a declared Ramsar wetland.

Noting that there is no proposed activity, or part of the activity, being undertaken in any part of a declared World Heritage property.

Environmental Impacts

Environmental impacts are identified and evaluated based on the cause effect pathways that arise from the activity. This PEIRA provides a first pass at evaluating the significance of the environmental impacts to:

- Support community consultation.
- Direct further assessment towards areas of higher impact.
- Inform decision making during the activity design.
- Justify if no further assessment is required for negligible effects.

The evaluation step at this preliminary stage involves using professional judgement to compare the estimated environmental impacts to internal assessment criteria, determining the overall significance of the impacts, and deciding on actions for further assessment.

This impact assessment is designed to facilitate consultation with the community, including government agencies, community groups, and other relevant organisations about the nature and scale of environmental impacts from the activity. This PEIRA will be published, with a summary, on the Regia MSS Consultation Hub (www.regiamss.com.au) and used in consultation with the community.

Environmental Impact Evaluation

At the preliminary stage, environmental impacts are a combination of a subjectively estimated level of effect combined with a subjectively estimated level of uncertainty. The impact assessment methodology is explained in the Environmental Assessment Framework document available on the Regia MSS Consultation Hub. The outcomes of the evaluation are presented in Table B4-4 4B4-4.

Impacts Not Further Assessed

The PEIRA identified four environmental aspects where the environmental impact to some environment components were ranked as having a negligible level of effect. Each identified environmental aspect will be carried through to the full assessment, however, the environment component where the impact was ranked as negligible will not be carried through to the full impact assessment for that environmental aspect. Justification for this decision is provided in the sections below.

Artificial Light

Marine Mammals: Change in fauna behaviour

Artificial light has not been reported to cause a significant behavioural disturbance to marine mammals, despite their often-higher activity levels at night. Results from a previous independent review and assessment of the sensitivity of marine mammals to mining and exploration activities in the Great Australian Bight Marine Park indicate that the consequence of light pollution impacts to marine mammals were insignificant (defined as occasional short-term attraction and/or disruption to marine mammals) (Pidcock, Burton and Lunney, 2003). Therefore, impacts to marine mammals from light emissions are not predicted and have not been evaluated further.

Coastal Development: Change to functions, interests, and activities

The coastline is sparsely populated with no cities (i.e. >100,000 people congregated around an urban centre) located on the coastline. The largest town that may be able to see the mandatory minimum navigational light is Warrnambool at the northwest of the Activity Planning Area. There is a shipping channel through the Activity Planning Area and artificial light produced by the survey at night-time will be no different to artificial light from other marine users navigating at night. Therefore, impacts to coastal developments from light emissions are not predicted and have not been evaluated further.

Atmospheric Emissions

Ecological environment: Change to local air quality, change in climate, change in ecosystem dynamics

Atmospheric emissions have the potential to result in a change in air quality. As a result of a change in ambient air quality, a change in physical condition may occur to benthic assemblages, plankton, invertebrates, fish, marine reptiles, marine mammals and coastal habitats and communities.

Control Measure
Implement the CGG marine assurance system to ensure compliance of contract vessels with MARPOL, COLREGS, and Marine Orders 21, 30, 31, 59 70,71,72, 91, 95, 96, 97, 98.

The use of fuel to power vessel engines, generators and mobile and fixed plant will result in emissions of greenhouse gases (GHG) such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O), along with non-GHG such as sulphur oxides (SO_X) and nitrous oxides (NO_X).

A change in air quality has the potential to result in a change in physical condition. The activity is of a short duration and will only involve up to three vessels. It is a once-off activity. Based on a 2018 seismic survey in Bass Strait, approximately 50 tonnes of fuel were used per day by the vessel spread. This results in the daily emissions of approximately:

- 1.2 tonnes of nitrogen dioxide (NO_X)
- 0.04 tonnes of sulphur dioxide (SO_X)
- 110 tonnes of carbon dioxide (CO_2)

Based on a 90-day survey, it could be expected that 4,500 tonnes of fuel would be used, resulting in similar daily emissions of NO_X, SO_X and CO_2.

Potential receptors above the sea surface within the Environmental Planning Area that may be exposed to reduced air quality include seabirds and marine megafauna that surface for air (e.g., marine mammals and marine turtles). Emissions will be small in quantity and will dissipate quickly into the surrounding atmosphere, therefore any localised reduction in air quality is not expected to result in any measurable effect.

While these emissions add to the GHG load in the atmosphere, which adds to global warming potential, they are relatively small on a state, national and global scale, representing an insignificant contribution to overall GHG emissions. Emissions will be small in quantity and short-term. The emissions from up to three vessels for 90 days will not significantly contribute to climate change.

Therefore, impacts to ecological components of the environment from atmospheric emissions are not predicted and have not been evaluated further.

Table B4-4 4: Preliminary Environmental Impact Evaluation

Environment Component	Environmental Aspect	Environmental Impact	Effect	Uncertainty	Preliminary Outcome
Air Quality	Atmospheric Emissions	Change to local air quality	Negligible	Low	No further assessment
Ambient Light	Artificial Light	Change in ambient light	Minor	Low	Qualitative assessment
Ambient Sound	Underwater Sound	Change in ambient sound	Minor	Low	Qualitative assessment
Climate	Atmospheric Emissions	Change in climate	Negligible	Low	No further assessment
Water Quality	Planned Discharges	Change to water quality	Negligible	Low	No further assessment
Benthic Assemblages	Underwater Sound	Change in physical condition	Negligible	Low	No further assessment
Coastal habitats and communities	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
Plankton	Artificial Light	Change in fauna behaviour	Minor	Low	Qualitative assessment
	Underwater Sound	Change in fauna behaviour	Minor	Low	Qualitative assessment
		Change in physical condition	Minor	Low	Qualitative assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Invertebrates	Artificial Light	Change in fauna behaviour	Minor	Low	Qualitative assessment
	Underwater Sound	Change in fauna behaviour	Minor	Low	Qualitative assessment
		Change in hearing capacity	Negligible	Moderate	Qualitative assessment
		Change in physical condition	Moderate	Low	Qualitative assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Fish	Artificial Light	Change to fauna behaviour	Minor	Low	Qualitative assessment
	Underwater Sound	Change in fauna behaviour	Minor	Low	Qualitative assessment
		Change in hearing capacity	Minor	Low	Qualitative assessment
		Change in physical condition	Minor	Low	Qualitative assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Birds	Artificial Light	Change in fauna behaviour	Minor	Low	Qualitative assessment
	Underwater Sound	Change in fauna behaviour	Negligible	Low	No further assessment

Environment Component	Environmental Aspect	Environmental Impact	Effect	Uncertainty	Preliminary Outcome
		Change in hearing capacity	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Marine Reptiles	Artificial Light	Change in fauna behaviour	Minor	Low	Qualitative assessment
	Underwater Sound	Change in fauna behaviour	Minor	Moderate	Qualitative assessment
		Change in hearing capacity	Minor	Moderate	Qualitative assessment
		Change in physical condition	Minor	Low	Qualitative assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Marine Mammals	Artificial Light	Change in fauna behaviour	Negligible	Low	No further assessment
	Underwater Sound	Change in fauna behaviour	Minor	Moderate	Qualitative assessment
		Change in hearing capacity	Moderate	Moderate	Quantitative assessment
		Change in physical condition	Negligible	Low	No further assessment
	Atmospheric Emissions	Change in ecosystem dynamics	Negligible	Low	No further assessment
	Planned Discharges	Change in fauna behaviour	Negligible	Low	No further assessment
		Change in physical condition	Negligible	Low	No further assessment
Coastal Development	Artificial Light	Change in functions, interests, or activities	Negligible	Low	No further assessment
Commercial Fishing and Aquaculture	Physical Presence	Change in functions, interests, or activities	Moderate	Moderate	Quantitative assessment
Diving	Physical Presence	Change in functions, interests, or activities	Minor	Low	Qualitative assessment
	Underwater Sound	Change in physical condition	Moderate	Moderate	Quantitative assessment
Indigenous Culture	Physical Presence	Change in functions, interests, or activities	Minor	Moderate	Qualitative assessment
Marine industries	Physical Presence	Change in functions, interests, or activities	Minor	Low	Qualitative assessment
Marine Protected Areas	Physical Presence	Change in functions, interests, or activities	Minor	Low	Qualitative assessment
Marine Tourism	Physical Presence	Change in functions, interests, or activities	Minor	Moderate	Qualitative assessment
Recreational Fishing	Physical Presence	Change in functions, interests, or activities	Minor	Low	Qualitative assessment

Planned Discharges

Ecological Environment: Change to water quality, change in fauna behaviour and change in physical condition

Vessel discharges have the potential to result in a change in water quality. As a result of a change in ambient water quality, further impacts may occur to marine fauna, including:

- a change in fauna behaviour
- injury/mortality to fauna

Discharges of organic matter, such as those present in sewage, greywater or food waste can lead to an increase in scavenging behaviour in fauna. Discharges will be localised and temporary as they will be quickly broken down by microbial action and dispersed by wave action and local ocean currents. Sewage solids will be broken down during treatment before being discharged, which will aid the decomposition process. Likewise, under MARPOL, food scraps are required to be macerated to a size small enough to pass through a 25 mm mesh before being discharged.

Control Measure
Implement the CGG marine assurance system to ensure compliance of contract vessels with MARPOL, COLREGS, and Marine Orders 21, 30, 31, 59 70,71,72, 91, 95, 96, 97, 98.

Plankton have a patchy distribution linked to localised and seasonal productivity that produces sporadic bursts in populations (DEWHA 2007). A change in water quality associated with discharges of sewage, greywater or food waste is unlikely to lead to a significant change in plankton distribution at a measurable level and will not result in a change in the viability of the population or ecosystem.

Marine fauna likely to be present within the upper water column are expected to be highly mobile and therefore able to avoid any localised change in ambient water quality. Species with limited mobility (i.e., plankton, fish embryo and larvae) are extremely unlikely to be impacted by any effects of temporary and localised increases in turbidity and low toxicity due to rapid dilution. No significant impacts are expected to plankton species, or on higher trophic levels reliant on plankton abundance.

Levels of contaminants within deck washdown, rainwater and deck drainage are likely to be insignificant. OSPAR (2014) indicates that the predicted no effect concentration (PNEC) for marine organisms exposed to dispersed oil is 70.5 ppb. Due to wave action and ocean currents any low-level contaminants will be quickly diluted and dispersed with no or negligible environmental impact. Shell (2009) conducted modelling that showed discharges of hydrocarbon and other chemical concentrations will be rapidly diluted and expected to be below PNEC within a relatively short time and will meet UNEP (1999) standards within 70m of their discharge.

Bilge water will be treated prior to discharge via an oily water separator with a maximum concentration of 15 ppm oil-in-water being achieved prior to discharge and therefore will have negligible impacts on water quality and hence plankton and marine fauna.

A change in water quality because of routine vessel discharges is unlikely to cause a change in behaviour or a change in physical condition of plankton and marine fauna at a measurable level and will not result in a change in the viability of the population or ecosystem. Therefore, impacts from planned vessel discharges on marine fauna are not predicted and have not been evaluated further.

Underwater Sound

Invertebrates: Change in hearing capacity

Invertebrates detect sound by sensing either the 'particle motion' (Przeslawski et al. 2016a;b; Carroll et al. 2017), through external and/or internal physiological structures such as hairs, statocysts and muscles; or the 'pressure' component (or both) of a sound field in the marine environment. Invertebrate statocysts are the mechanosensory organ equivalent to the inner ear of humans and are responsible for the detection of gravity, position and movement (Day et al. 2020). Because they lack gas-filled bladders, marine invertebrates are unable to detect the pressure changes associated with sound waves (Carroll et al. 2017; Parry & Gason 2006). As no functional cause-effect relationship has been established for a change in hearing, permanent and/or temporary threshold shifts in invertebrates are not predicted and have not been evaluated further. Impacts to statocysts, a balance sensory receptor present in some aquatic invertebrates, are evaluated under 'Fauna injury/mortality'.

Birds: Change in fauna behaviour, hearing capacity and physical condition

Impulsive and continuous underwater sound emissions have the potential to result in a change in ambient sound. As a result of a change in ambient sound, further impacts may occur to birds, including a change in fauna behaviour, hearing capacity and physical condition.

There are no thresholds for underwater sound impacts to seabirds. As such, no modelling can be conducted. The threshold for physiological damage on the auditory system for seabirds is unknown, however most seabirds are generally shallow divers and utilise surface waters where the acoustic signals 'destructively interfere' with the sea surface, resulting in much lower sound exposure compared with deeper waters (Marine Technology Directorate, 1996: cited in SCAR, 2002) and the time of exposure underwater is short.

If individual birds or flocks are present in the Environmental Planning Area during acquisition, vessel movement is expected to temporarily deter them from foraging in the immediate vicinity of the vessel. The uncertainty of underwater sound impacting individuals or a population of any given species during plunge/dive feeding is extremely low. While resting/rafting on the water surface, there is limited potential for seabirds to be affected by the seismic sound due to the limited transmission of sound between the air-water interface. If there is an effect, it is likely to be a startle response, resulting in the bird flying away. Seabirds feed on multiple prey species and have widespread foraging areas. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location. Given their widespread foraging areas (ACAP 2018) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities.

Impacts to shorebird species are not predicted from the activity, given their prey is concentrated within the intertidal zone along the coastline. The little penguin is capable of diving to 72 m but typically dives to 10-20 m. The species is known to generally forage within 20 km of their nesting site during the non-breeding season and 15 km of their nest during the breeding season (October to December) (Australian Wildlife, 2014). The little penguin has a foraging BIA (10 km buffer) around Christmas Island (off the northeast coast of King Island), which is a breeding colony. The Regia Activity Planning Area is more than 25 km from the little penguin BIA. On this basis, encounter rates with little penguin in the Activity Planning Area is considered unlikely. It is inferred that penguins have relatively poor hearing thresholds in the lower frequencies, which is where marine seismic surveys have the most energy (McCauley, 1994). However, Pichegru et al (2017) identified that African penguins switched foraging direction and distance in response to seismic activity but that the response was short-term. As seabirds spend very little time underwater, and shorebirds including the little penguin are located outside of the Activity Planning Area, impacts to birds from underwater sound emissions are not predicted and will not be evaluated further.

Marine Reptiles: Change in hearing capacity; change in physical condition

Underwater sound emissions have the potential to result in a change in ambient sound. As a result of a change in ambient sound, further impacts may occur to marine reptiles, including change in physical condition. The Sound Exposure Guidelines for Fishes and Sea Turtles Guidelines (Popper et al. 2014) details that there is no direct evidence of mortality or potential mortal injury to marine turtles from shipping and continuous sounds. As no functional cause-effect relationship has been established, no change in physical condition is predicted from continuous underwater sound. Studies to date on marine turtles have not identified a change in physical condition as an impact from seismic sound (Nelms 2016, McCauley et al. 2000, Popper et al. 2014). As no functional cause-effect relationship has been established, changes to the physical condition of turtles from seismic sound will not be evaluated further.

Risk Assessment

Environmental risks are identified and evaluated based on the cause effect pathways that arise from the activity. This PEIRA provides a first pass at evaluating the significance of the environmental risk to:

- Support community consultation.
- Direct further assessment towards areas of higher risk.
- Inform decision making during the activity design.
- Justify if no further assessment is required for negligible effects.

The evaluation step at this preliminary stage involves using professional judgement to compare the estimated environmental risks to our corporate criteria, determining the overall significance of the risks, and deciding on actions for further assessment.

This risk assessment is designed to facilitate consultation with the community, including government agencies, community groups, and other relevant organizations about the nature and scale of environmental risks from the activity. This PEIRA will be published, with a summary, on the Regia MSS Consultation Hub (www.regiamss.com.au) and used in consultation with relevant persons.

Environmental Risk Evaluation

At the preliminary stage, environmental risks are assessed on the basis of a combination of an estimated likelihood combined with a subjectively estimated level of consequence. The risk assessment methodology is explained in the Environmental Assessment Framework document available on the activity website. The outcomes of the evaluation are presented in Table B4-55B4-5.

Risks Not Further Assessed

The PEIRA has one environmental aspect where the environmental risks to some environment components are ranked as having a negligible level of effect. Each environmental aspect will be carried through to the full assessment, however, the environment component where the risk is ranked as negligible will not be carried through to the full impact assessment for that environmental aspect. Justification for this decision is provided in the sections below.

Accidental Release of Materials or Waste Overboard

Water Quality: Change in water quality

> **Legislative Requirement**
>
> Marine Order 95: that vessels must have a garbage management plan, placards and maintain a garbage record book. Waste with potential to be windblown shall be stored in covered containers

Loss of materials or waste overboard has the potential to change water quality relied on by marine fauna through ingestion or entanglement. Marine turtles and seabirds are particularly at risk from entanglement. Marine turtles may mistake plastics for food; once ingested, plastics can damage internal tissues and inhibit physiological processes, which can both potentially result in fauna fatality. Floating, non-biodegradable marine debris has been highlighted as a threat to marine turtles, whales, whale sharks, albatrosses and giant petrels in relevant recovery plans and approved conservation advice for those species. Marine debris causing entanglement and ingestion was recognised in 2003 as a key threatening process for marine vertebrates under the EPBC Act leading to the development of the Threat Abatement Plan for the Impacts of Marine Debris on the Vertebrate Wildlife of Australia Coasts and Oceans (DoEE 2018). The recovery plans and approved conservation advice, as well as the threat abatement plan, have specified several recovery actions to help combat this threat. Of relevance to this activity there is a legislative requirement that prevents this type of marine pollution. Marine Order 95 stipulates that vessels must have a garbage management plan, placards and maintain a garbage record book. Waste with potential to be windblown shall be stored in covered containers to minimise the risk of loss to the marine environment. Marine Order 95 gives effect under Australian law to MARPOL Annex VI.

Benthic assemblages: Change in habitat

Loss of equipment or waste has the potential to cause localised seabed disturbance with potential damage to benthic habitats. Given the size of equipment used for a survey, only a relatively small area of the seabed would be disturbed, a maximum of 0.001km^2 based on loss of a streamer that settled on the seabed, though this is unlikely as the streamers will have recovery units. There are no risks to biodiversity or ecosystem function and integrity from any waste that could be lost overboard. Lasting impacts are not predicted as the small area would quickly recover. The consequence to benthic assemblages is ranked as negligible and has not been evaluated further.

Control Measure
Streamers will have recovery units fitted to prevent benthic disturbance in the event of loss.

Table B4-55 – Preliminary environmental risk evaluation

Environment Component	Environmental Aspect	Environmental Risk	Probability	Consequence	Preliminary Outcome
Water Quality	Accidental Release of Fuel	Change in water quality	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change in water quality	Rare	Negligible	Low (Negligible)
Sediment Quality	Accidental Release of Fuel	Change in sediment quality	Rare	Moderate	Low
Benthic Assemblages	Accidental Release of Fuel	Change in ecosystem dynamics	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change in habitat	Rare	Negligible	Low (Negligible)
	Introduction Of Marine Pest Species	Change in ecosystem dynamics	Rare	Severe	Moderate
Plankton	Accidental Release of Fuel	Change in physical condition	Rare	Moderate	Low
Invertebrates	Accidental Release of Fuel	Change in fauna behaviour	Rare	Moderate	Low
		Change in physical condition	Rare	Moderate	Low
	Introduction Of Marine Pest Species	Change in ecosystem dynamics	Rare	Severe	Moderate
Fish	Accidental Release of Fuel	Change in fauna behaviour	Rare	Moderate	Low
		Change in physical condition	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change in physical condition	Rare	Minor	Low
	Collisions With Marine Fauna	Change in physical condition	Rare	Moderate	Low
Birds	Accidental Release of Fuel	Change in fauna behaviour	Rare	Moderate	Low
		Change in physical condition	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change in physical condition	Rare	Minor	Low
Marine Reptiles	Accidental Release of Fuel	Change in physical condition	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change in physical condition	Rare	Minor	Low
	Collisions With Marine Fauna	Change in physical condition	Rare	Moderate	Low
Marine Reptiles	Accidental Release of Fuel	Change in fauna behaviour	Rare	Moderate	Low
	Collisions With Marine Fauna	Change in physical condition	Rare	Moderate	Low
Marine Mammals	Accidental Release of Fuel	Change in fauna behaviour	Rare	Moderate	Low
		Change in physical condition	Rare	Moderate	Low

Environment Component	Environmental Aspect	Environmental Risk	Probability	Consequence	Preliminary Outcome
	Accidental Release of Materials or Waste Overboard	Change in physical condition	Rare	Minor	Low
	Collisions With Marine Fauna	Change in physical condition	Rare	Major	Moderate
Coastal Habitats and Communities	Accidental Release of Fuel	Change in ecosystem dynamics	Rare	Moderate	Low
Commercial Fishing	Accidental Release of Fuel	Change to functions, interests, or activities	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change to functions, interests, or activities	Rare	Minor	Low
	Introduction Of Marine Pest Species	Change to functions, interests, or activities	Rare	Severe	Moderate
Shipping Activity	Accidental Release of Fuel	Change to functions, interests, or activities	Rare	Moderate	Low
Traditional Owners	Accidental Release of Fuel	Change to functions, interests, or activities	Rare	Moderate	Low
		Change in aesthetic value	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change to functions, interests, or activities	Rare	Minor	Low
Coastal Development	Accidental Release of Fuel	Change to functions, interests, or activities	Rare	Moderate	Low
	Accidental Release of Materials or Waste Overboard	Change to functions, interests, or activities	Rare	Moderate	Low
Marine Protected Areas	Accidental Release of Fuel	Change in aesthetic value	Rare	Moderate	Low
	Accidental Release of Materials Or Waste Overboard	Change in aesthetic value	Rare	Minor	Low

Mitigation and Management

This PEIRA considers the residual environmental impacts and risks that occur with the application of legislative requirements as a minimum. Further, industry standards will be applied during the design of the activity, many of which aim to avoid or minimise environmental impacts and risks. Mitigation measures are adopted within the design and implementation of the activity to further reduce environmental impacts and risks. They are typically specific to the environmental setting of the activity may be informed through consultation and may not be defined until the final details of the activity are known.

Mitigation Measures

In determining the mitigation measures included at any stage of the activity, a hierarchy of controls system will be implemented. This is a widely accepted system to classify mitigation measures and promote adoption of the most effective mitigation measures first. The hierarchy, in order of decreasing effectiveness is:

- Elimination/avoidance
- Substitution
- Engineering
- Administrative/ procedural
- Offsetting

In an environmental context, procedural mitigation measures can include further studies which improve the accuracy of predicted impacts and risks, validate assumptions, establish baselines, monitor impacts, or reduce scientific uncertainty.

Management Plans

In the context of this PEIRA, management plans refer to the strategies, procedures, and measures that are put in place to minimise the environmental impacts and risks associated with the activity. They outline how the impacts or risks will be monitored, managed, and mitigated over the course of the activity. Management plans may include measures such as mitigation measures, monitoring programs, emergency response plans, and contingency plans. They aim to ensure that the proposed activity is carried out in an environmentally responsible and sustainable manner. The following management plans are either mandatory or should be considered by CGG based on this PEIRA:

- Oil Pollution Emergency Plan (mandatory)
- Operational & Scientific Monitoring Program (mandatory)
- Marine Mammal Adaptive Management Plan
- On-water Interactions Management Plan

Conclusion and Recommendations

The following identified environmental impacts and risks will be carried through to the full assessment stage and will be refined based on further assessment and consultation.

Environmental Aspect	Environmental Impact	Preliminary Outcome
Artificial Light	Change in ambient light	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
Underwater Sound	Change in ambient sound	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
	Change in hearing capacity	Quantitative assessment
	Change in physical condition	Quantitative assessment
Physical Presence	Change in functions, interests, or activities	Quantitative assessment

Environmental Aspect	Environmental Risk	Preliminary Outcome
Accidental Release of Fuel	Change in water quality	Low
	Change in sediment quality	Low
	Change in ecosystem dynamics	Low
	Change in physical condition	Low
	Change in fauna behaviour	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Introduction Of Marine Pest Species	Change in ecosystem dynamics	Moderate
	Change to functions, interests, or activities	Moderate
Accidental Release of Materials or Waste Overboard	Change in physical condition	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Collisions With Marine Fauna	Change in physical condition	Moderate

The following recommendations are made for CGG to consider:

1. Commission independent underwater sound modelling to understand the effect thresholds and distances for specific receptors within the Environment Planning Area.
2. Split the full assessment of underwater sound into two components for impulsive and continuous sound sources.
3. Review the NERA Reference Case 2018:1003 Consequence analysis of an accidental release of diesel and regionally relevant spill models from similar worst-case events to determine the applicability of the NERA Reference Case and, subsequently, the need for activity specific spill modelling.

This PIERA has not identified any management plans required to be implemented at this stage of the assessment, noting that many environmental impacts and risks have been carried through for full assessment, which is more likely to result in management plan requirements.

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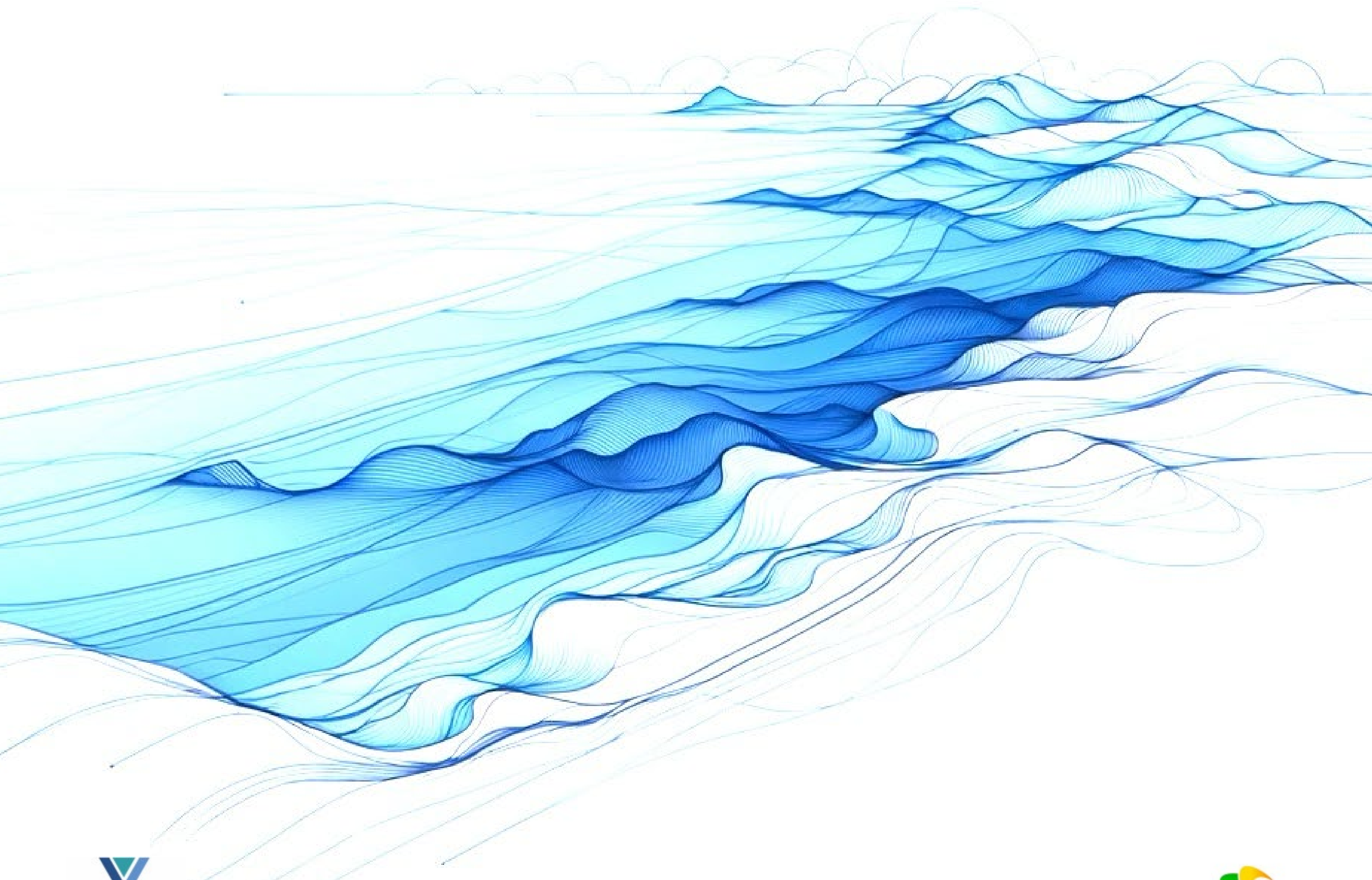
REGIA
Marine Seismic Survey

PMST Reports

Appendix B5: REG-EP-008-B5

Rev 2

May 2024



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1 Introduction

This document includes the Protected Matter Search Tool outputs relevant to various planning areas associated with the Regia MSS. The PMST search tool was initially used to search for environmental values and sensitivities within the Environment Planning Area, with refined searches complete for different aspects buffered around the Activity Planning Area, as defined by the Preliminary Environmental Impact and Risk Assessment (PEIRA).

The searches were performed again prior to Rev 2 submission because the active source area was established as an area narrower than the activity planning area. The passage of time also meant that changes may have occurred in the intervening period between PMST searches.

The searches were then conducted again prior to resubmission (Rev 2) to ensure any changes to species or listings were identified to control for passage of time and in response to Matters: I16 and I17.

This document presents the raw output from the PMST search tool and was used to update the environmental assessment in this Environment Plan. There are eight searches presented in total, of which seven were completed on 23 April 2024 and the eighth on 1 May 2024.

1. Active Source Area.
2. Light Environment that May Be Affected.
3. Operational Area.
4. Underwater Sound for Birds – 50 km.
5. Underwater Sound for Fish – 8 km.
6. Underwater Sound for LF Cetaceans – 44 km.
7. Underwater Sound for Turtle – 6 km.
8. Environment Planning Area

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

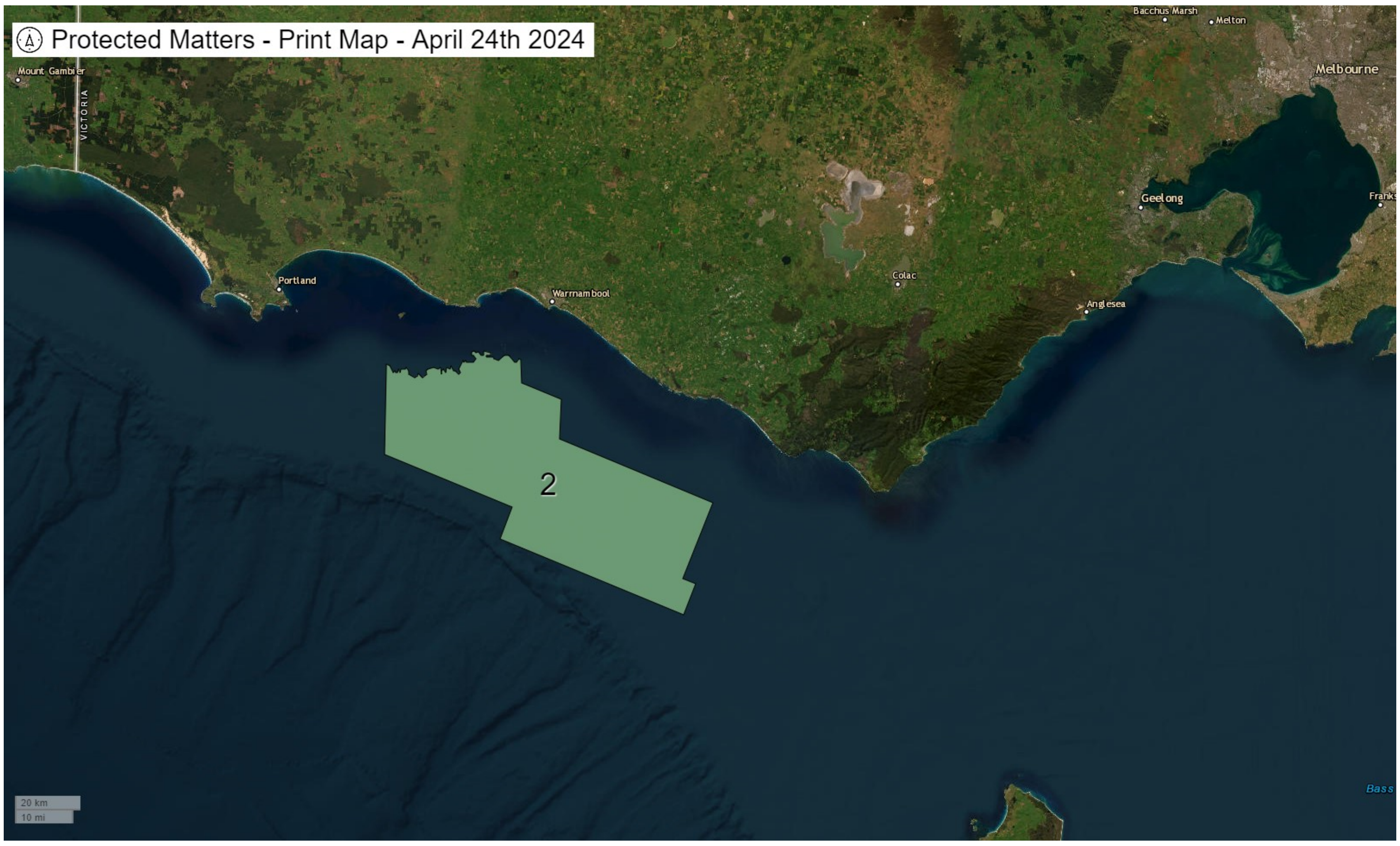

Figure 1: PMST Search Area - Active Source Area

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	41
Listed Migratory Species:	40

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	62
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	32
Key Ecological Features (Marine):	2
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
FISH		
Hoplostethus atlanticus		
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Seriolella brama		
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area
MAMMAL		
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
REPTILE		

Scientific Name	Threatened Category	Presence Text
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Centrophorus uyato		
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea		
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche impavida		
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris		
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini		
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi		
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata		
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area

Migratory Wetlands Species

Scientific Name	Threatened Category	Presence Text
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Vanacampus poecilolaemus		
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri		
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus		
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata		
Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis		
Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Current Scientific Name	Status	Type of Presence
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Spinifex Offshore Surveys	2022/09359		Completed
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval
Otway Development	2002/621	Controlled Action	Post-Approval
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Gas Field Development	2006/2635	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Not controlled action (particular manner)			
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region

Name	Region
Bonney Coast Upwelling	South-east
West Tasmania Canyons	South-east

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur

Scientific Name	Behaviour	Presence
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

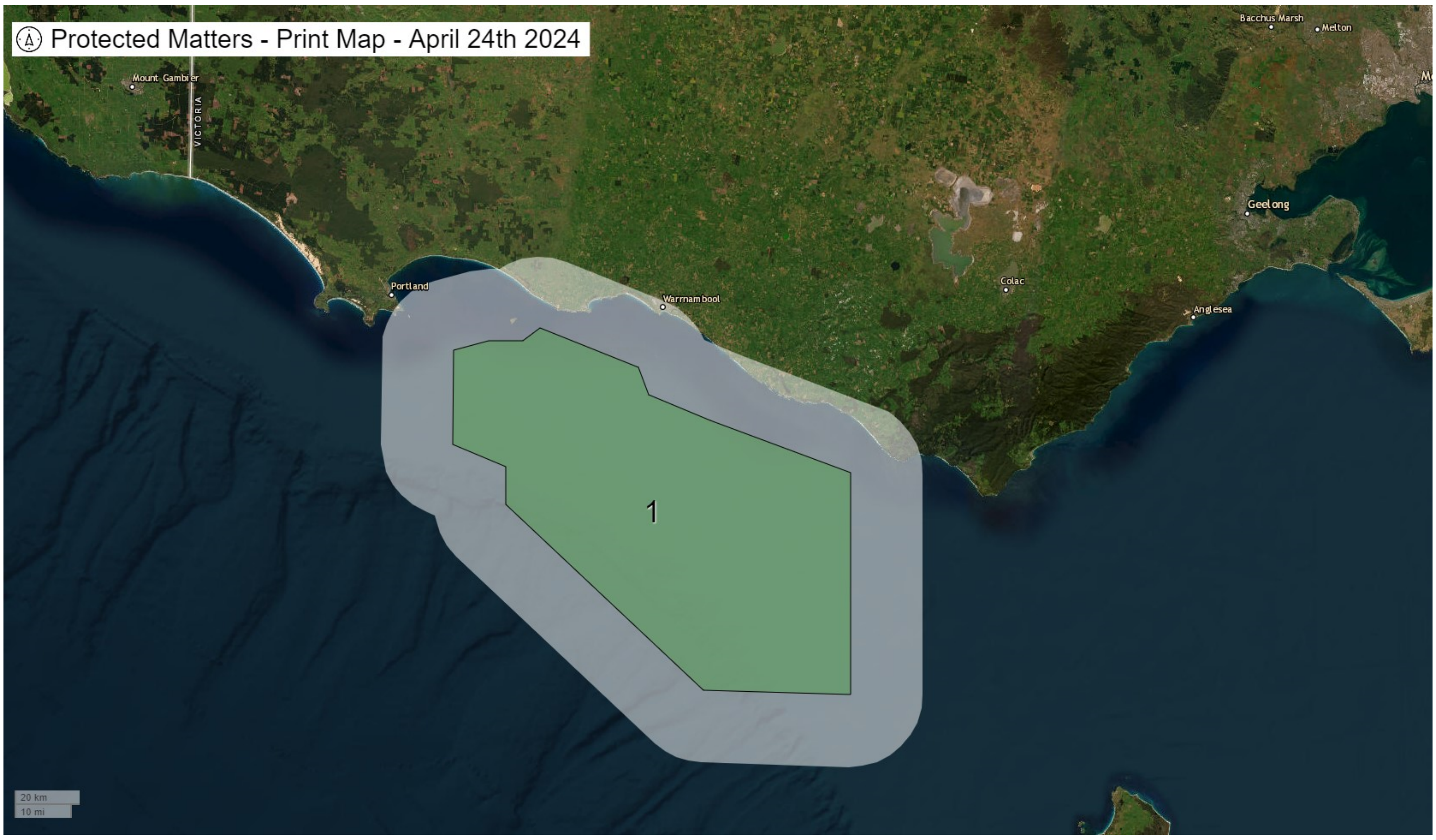

Figure 1: PMST Search Area - Light Environment that May Be Affected (Operational Area + 20km Buffer)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	6
Listed Threatened Species:	99
Listed Migratory Species:	66

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	108
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	19
Regional Forest Agreements:	1
Nationally Important Wetlands:	4
EPBC Act Referrals:	77
Key Ecological Features (Marine):	2
Biologically Important Areas:	22
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In buffer area only

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In feature area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community may occur within area	In buffer area only
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species			[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum			
Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus			
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Climacteris picumnus victoriae			
Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In buffer area only
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
CRUSTACEAN			
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat likely to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
FROG			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Litoria raniformis Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
INSECT			
Synemon plana Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area	In buffer area only
MAMMAL			
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area	In buffer area only
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In buffer area only
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum diversiflorum Gorae Leek-orchid [13210]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum litorale listed as Prasophyllum littorale Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat likely to occur within area	In buffer area only
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In buffer area only
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thelymitra orientalis Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Lissolepis coventryi Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In buffer area only
SHARK			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus			
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus			
Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus			
Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Monarcha melanopsis			
Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In buffer area only
Myiagra cyanoleuca			
Satin Flycatcher [612]		Breeding known to occur within area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba			
Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis			
Red-necked Stint [860]		Roosting known to occur within area	In buffer area only
Charadrius bicinctus			
Double-banded Plover [895]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC	In buffer area only

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In buffer area only
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In buffer area only
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In buffer area only
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In buffer area only
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Morus capensis Cape Gannet [59569]		Breeding known to occur within area	In buffer area only
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In buffer area only
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pelecanoides urinatrix			
Common Diving-Petrel [1018]		Breeding known to occur within area	In buffer area only
Phalacrocorax fuscescens			
Black-faced Cormorant [59660]		Breeding known to occur within area	In buffer area only
Phoebetria fusca			
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pluvialis fulva			
Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Pterodroma mollis			
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Recurvirostra novaehollandiae			
Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Stercorarius antarcticus as Catharacta skua			
Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata			
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalasseus bergii as Sterna bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa brevipes as Heteroscelus brevipes			
Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola			
Wood Sandpiper [829]		Roosting known to occur within area overfly marine area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna			
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis			
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps			
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii			
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Deen Maar	Indigenous Protected Area	VIC	In buffer area only
Goose Lagoon W.R	Natural Features Reserve	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC	In buffer area only
Lake Aringa W.R	Nature Conservation Reserve	VIC	In buffer area only
Latrobe B.R.	Natural Features Reserve	VIC	In buffer area only
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC	In buffer area only
Merri	Marine Sanctuary	VIC	In buffer area only
Port Campbell	National Park	VIC	In buffer area only
Pretty Hill F.R	Nature Conservation Reserve	VIC	In buffer area only
Princetown W.R	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
St Helens F.R	Nature Conservation Reserve	VIC	In buffer area only
The Arches	Marine Sanctuary	VIC	In buffer area only
Tower Hill W.R	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only
Yambuk F.F.R.	Nature Conservation Reserve	VIC	In buffer area only
Yambuk Wetlands N.C.R.	Natural Features Reserve	VIC	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Lower Merri River Wetlands	VIC	In buffer area only
Princetown Wetlands	VIC	In buffer area only
Tower Hill	VIC	In buffer area only
Yambuk Wetlands	VIC	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Cape Winds Offshore Windfarm Geophysical, Geotechnical and Marine Studies	2023/09629		Referral Decision	In buffer area only
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Southern Winds Offshore Wind Project	2022/09435		Assessment	In buffer area only
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed	In buffer area only
Spinifex Offshore Surveys	2022/09359		Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In feature area
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval	In buffer area only
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In feature area
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In feature area
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed	In buffer area only
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In feature area
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In buffer area only
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed	In buffer area only
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed	In buffer area only
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In feature area
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Railway Bridge (H0151) Partial Demolition, Merri River	2010/5534	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2005/2142	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2006/2937	Not Controlled Action	Completed	In buffer area only
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In feature area
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In buffer area only
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
Portland Wave Energy Project	2008/3946	Referral Decision	Completed	In buffer area only
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Referral decision				
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In feature area
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur	In buffer area only
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur	In buffer area only
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

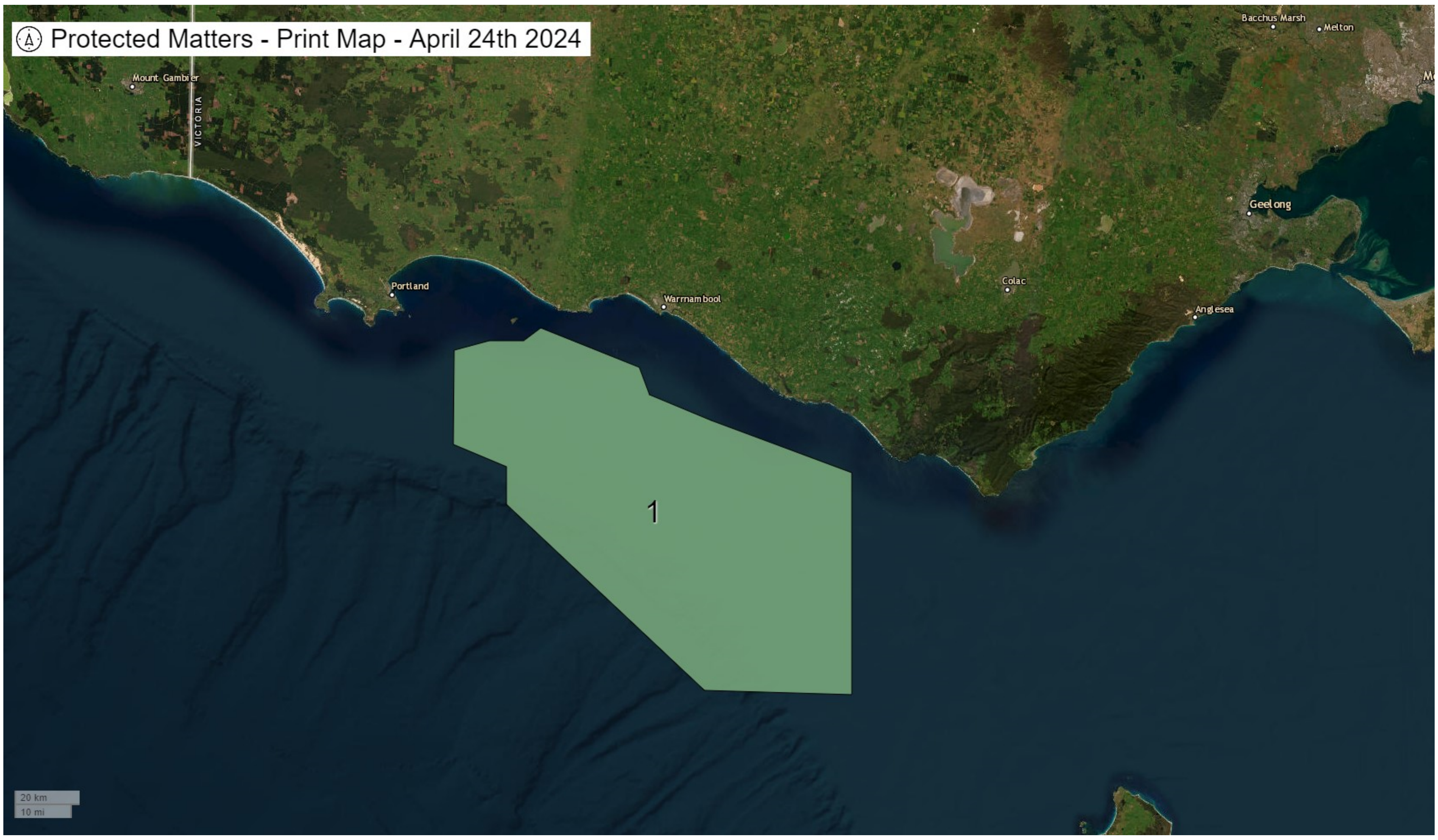

Figure 1: PMST Search Area - Operational Area

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	42
Listed Migratory Species:	40

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	63
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	40
Key Ecological Features (Marine):	2
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
FISH		
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area
MAMMAL		
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
REPTILE		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Centrophorus uyato		
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus		
Sperm Whale [59]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus		
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Numenius madagascariensis		
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Fish		
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		

Current Scientific Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Spinifex Offshore Surveys	2022/09359		Completed
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Otway Development	2002/621	Controlled Action	Post-Approval
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Bonney Coast Upwelling	South-east
West Tasmania Canyons	South-east

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence
Seabirds		

Scientific Name	Behaviour	Presence
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur

Scientific Name	Behaviour	Presence
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

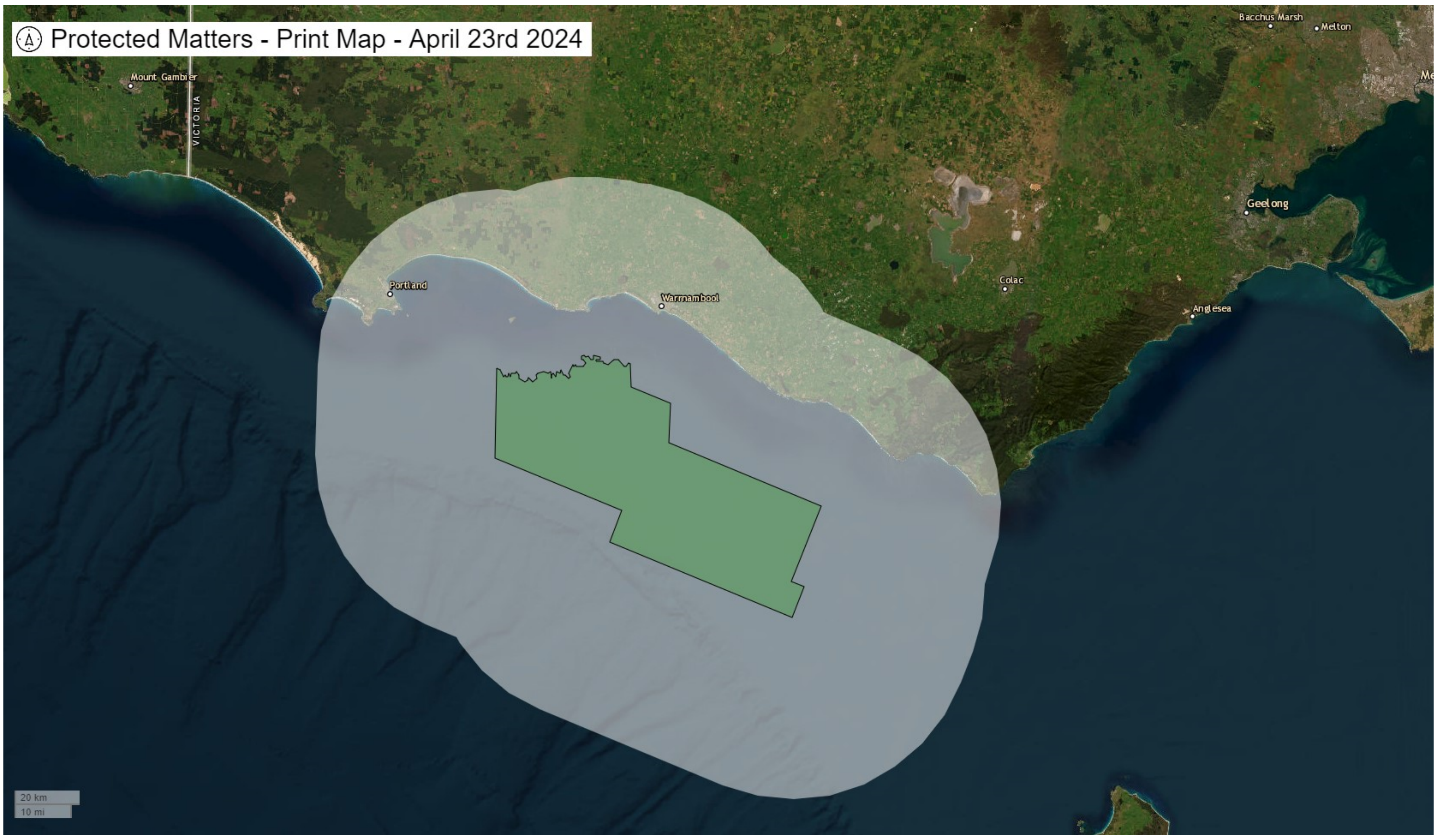

Figure 1: PMST Search Area - Underwater Sound for Birds (Active Source Area + 50km Buffer)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	3
Wetlands of International Importance (Ramsar	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	9
Listed Threatened Species:	115
Listed Migratory Species:	66

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	20
Commonwealth Heritage Places:	None
Listed Marine Species:	110
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	67
Regional Forest Agreements:	1
Nationally Important Wetlands:	8
EPBC Act Referrals:	97
Key Ecological Features (Marine):	2
Biologically Important Areas:	22
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status	Buffer Status
Budj Bim Cultural Landscape	VIC	Declared property	In buffer area only

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In buffer area only
Indigenous			
Budj Bim National Heritage Landscape - Mt Eccles Lake Condah Area	VIC	Listed place	In buffer area only
Budj Bim National Heritage Landscape - Tyrendarra Area	VIC	Listed place	In buffer area only

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity	Buffer Status
Glenelg estuary and discovery bay wetlands	Within 10km of Ramsar site	In buffer area only
Western district lakes	10 - 20km upstream from Ramsar site	In buffer area only

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only

Community Name	Threatened Category	Presence Text	Buffer Status
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In buffer area only
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area	In buffer area only
Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion	Endangered	Community may occur within area	In buffer area only
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Aphelocephala leucopsis			
Southern Whiteface [529]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Botaurus poiciloptilus			
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calyptorhynchus banksii graptogyne South-eastern Red-tailed Black-Cockatoo [25982]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In buffer area only
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
CRUSTACEAN			
Euastacus bispinosus			
Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat known to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus			
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura			
Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prototroctes maraena			
Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
FROG			
Litoria raniformis			
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
INSECT			
Synemon plana			
Golden Sun Moth [25234]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
MAMMAL			
Antechinus minimus maritimus			
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In buffer area only
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isoodon obesulus obesulus			
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only
Mastacomys fuscus mordicus			
Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area	In buffer area only
Miniopterus orianae bassanii			
Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area	In buffer area only
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petauroides volans			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area	In buffer area only
Petaurus australis australis			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In buffer area only
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Astelia australiana Tall Astelia [10851]	Vulnerable	Translocated population known to occur within area	In buffer area only
Caladenia calcicola Limestone Spider-orchid [10065]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Caladenia ornata Ornate Pink Fingers [76213]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Cassinia rugata Wrinkled Cassinia, Wrinkled Dollybush [21885]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area	In buffer area only
Dipodium campanulatum Bell Flower Hyacinth Orchid [55051]	Endangered	Species or species habitat may occur within area	In buffer area only
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lachnagrostis adamsonii Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area	In buffer area only
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pimelea spinescens subsp. spinescens Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Poa sallacustris Salt-lake Tussock-grass [24424]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Prasophyllum diversiflorum Gorae Leek-orchid [13210]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum litorale listed as Prasophyllum littorale Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Rutidosis leptorhynchoides Button Wrinklewort [67251]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Senecio psilocarpus			
Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra epipactoides			
Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In buffer area only
Thelymitra matthewsii			
Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thelymitra orientalis			
Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre			
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
REPTILE			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar			
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Lissolepis coventryi			
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In buffer area only
SHARK			
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Centrophorus uyato			
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus			
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis			
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora			
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans			
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi			
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Macronectes giganteus			
Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli			
Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca			
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons			
Little Tern [82849]		Breeding known to occur within area	In buffer area only
Thalassarche bulleri			
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta			
Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma			
Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus			
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus			
Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Orcinus orca			
Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus			
Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus			
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Monarcha melanopsis			
Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava			
Yellow Wagtail [644]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area	In buffer area only
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - Training Depot, Darts RD 3305 Portland [21019]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21023]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21018]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21010]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21022]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21012]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21013]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21007]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21011]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21016]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21017]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21015]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21014]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21024]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21008]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21009]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21020]	VIC	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - Training Depot, Darts RD 3305 Portland [21021]	VIC	In buffer area only
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC	In buffer area only
Unknown		
Commonwealth Land - [21583]	VIC	In buffer area only

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata			
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In buffer area only
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Arenaria interpres			
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In buffer area only
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In buffer area only
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In buffer area only
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In buffer area only
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Morus capensis Cape Gannet [59569]		Breeding known to occur within area	In buffer area only
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area	In buffer area only
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma mollis			
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Recurvirostra novaehollandiae			
Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In buffer area only
Rhipidura rufifrons			
Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato)			
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Stercorarius antarcticus as Catharacta skua			
Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata			
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons			
Little Tern [82849]		Breeding known to occur within area	In buffer area only
Thalassarche bulleri			
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov.			
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thalasseus bergii as Sterna bergii Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa brevipes as Heteroscelus brevipes Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area overfly marine area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Hippocampus minotaur Bullneck Seahorse [66705]		Species or species habitat may occur within area	In buffer area only
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area	In buffer area only
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Australian Marine Parks		[Resource Information]
Park Name	Zone & IUCN Categories	Buffer Status
Apollo	Multiple Use Zone (IUCN VI)	In buffer area only

Extra Information

State and Territory Reserves			[Resource Information]
Protected Area Name	Reserve Type	State	Buffer Status
Aire River	Heritage River	VIC	In buffer area only
Aire River W.R.	Natural Features Reserve	VIC	In buffer area only
Bats Ridge W.R	Nature Conservation Reserve	VIC	In buffer area only
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Bolwarra H43 B.R.	Natural Features Reserve	VIC	In buffer area only
Bolwarra H44 B.R.	Natural Features Reserve	VIC	In buffer area only
Bolwarra H45 B.R.	Natural Features Reserve	VIC	In buffer area only
Broadwater I90 B.R.	Natural Features Reserve	VIC	In buffer area only
Broadwater I91 B.R.	Natural Features Reserve	VIC	In buffer area only
Brucknell Creek F.F.R	Nature Conservation Reserve	VIC	In buffer area only
Budj Bim	National Park	VIC	In buffer area only
Cape Nelson	State Park	VIC	In buffer area only
Carpendeit	Reference Area	VIC	In buffer area only
Cooriemungle	Reference Area	VIC	In buffer area only
Cooriemungle Creek F.R	Nature Conservation Reserve	VIC	In buffer area only
Coradjil B.R.	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Coradjil N.C.R.	Natural Features Reserve	VIC	In buffer area only
Crinoline Creek	Reference Area	VIC	In buffer area only
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Deen Maar	Indigenous Protected Area	VIC	In buffer area only
Discovery Bay Coastal Park	Conservation Park	VIC	In buffer area only
Dunmore B.R.	Natural Features Reserve	VIC	In buffer area only
Ecklin South Swamp N.C.R.	Natural Features Reserve	VIC	In buffer area only
Fitzroy River SS.R.	Natural Features Reserve	VIC	In buffer area only
Framlingham Forest	Indigenous Protected Area	VIC	In buffer area only
Goose Lagoon W.R	Natural Features Reserve	VIC	In buffer area only
Gorae B.R.	Natural Features Reserve	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Heywood B.R.	Natural Features Reserve	VIC	In buffer area only
Hopkins Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Hopkins River, Framlingham SS.R.	Natural Features Reserve	VIC	In buffer area only
Jancourt N.C.R.	Natural Features Reserve	VIC	In buffer area only
Johanna Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Kurtonitj	Indigenous Protected Area	VIC	In buffer area only
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC	In buffer area only
Lake Aringa W.R	Nature Conservation Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Lake Condah	Indigenous Protected Area	VIC	In buffer area only
Lake Gillear W.R	Natural Features Reserve	VIC	In buffer area only
Latrobe B.R.	Natural Features Reserve	VIC	In buffer area only
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC	In buffer area only
Merri	Marine Sanctuary	VIC	In buffer area only
Myamyn B.R.	Natural Features Reserve	VIC	In buffer area only
Narrawong F.R.	Nature Conservation Reserve	VIC	In buffer area only
Nine Mile F.F.R.	Nature Conservation Reserve	VIC	In buffer area only
Nullawarre F.R.	Nature Conservation Reserve	VIC	In buffer area only
Port Campbell	National Park	VIC	In buffer area only
Portland H46 B.R.	Natural Features Reserve	VIC	In buffer area only
Portland H47 B.R.	Natural Features Reserve	VIC	In buffer area only
Pretty Hill F.R	Nature Conservation Reserve	VIC	In buffer area only
Princetown W.R	Natural Features Reserve	VIC	In buffer area only
St Helens F.R	Nature Conservation Reserve	VIC	In buffer area only
The Arches	Marine Sanctuary	VIC	In buffer area only
The Stones	Reference Area	VIC	In buffer area only
The Stones W.R.	Nature Conservation Reserve	VIC	In buffer area only
Timboon I1 B.R	Natural Features Reserve	VIC	In buffer area only
Tomahawk Creek	Reference Area	VIC	In buffer area only
Tower Hill W.R	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Trewalla H48 B.R.	Natural Features Reserve	VIC	In buffer area only
Trewalla H49 B.R.	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only
Tyrendarra	Indigenous Protected Area	VIC	In buffer area only
Tyrendarra F.R	Nature Conservation Reserve	VIC	In buffer area only
Unnamed P0059	Private Nature Reserve	VIC	In buffer area only
Unnamed P0126	Private Nature Reserve	VIC	In buffer area only
Woolsthorpe N.C.R.	Natural Features Reserve	VIC	In buffer area only
Yambuk F.F.R.	Nature Conservation Reserve	VIC	In buffer area only
Yambuk Wetlands N.C.R.	Natural Features Reserve	VIC	In buffer area only

Regional Forest Agreements

[Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In buffer area only

Nationally Important Wetlands

[Resource Information]

Wetland Name	State	Buffer Status
Aire River	VIC	In buffer area only
Cobden-Terang Volcanic Craters	VIC	In buffer area only
Lake Condah	VIC	In buffer area only
Lower Aire River Wetlands	VIC	In buffer area only
Lower Merri River Wetlands	VIC	In buffer area only
Princetown Wetlands	VIC	In buffer area only
Tower Hill	VIC	In buffer area only
Yambuk Wetlands	VIC	In buffer area only

EPBC Act Referrals				[Resource Information]
Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Cape Winds Offshore Windfarm Geophysical, Geotechnical and Marine Studies	2023/09629		Referral Decision	In buffer area only
Hexham Wind Farm	2022/09287		Assessment	In buffer area only
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Southern Winds Offshore Wind Project	2022/09435		Assessment	In buffer area only
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed	In buffer area only
Spinifex Offshore Surveys	2022/09359		Completed	In feature area
Willatook Wind Farm, Vic	2019/8439		Post-Approval	In buffer area only
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In feature area
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Kentbruck Green Power Hub, Vic	2019/8510	Controlled Action	Assessment Approach	In buffer area only
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval	In buffer area only
Penshurst Wind Energy Facility	2011/5991	Controlled Action	Completed	In buffer area only
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In buffer area only
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In buffer area only
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed	In buffer area only
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In feature area
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only
Development of wind energy facility	2005/2224	Not Controlled Action	Completed	In buffer area only
Drilling of Callister-1 exploration well in VIC/P51	2004/1633	Not Controlled Action	Completed	In buffer area only
Ellerslie Timber Bridge Partial Restoration	2009/4734	Not Controlled Action	Completed	In buffer area only
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In buffer area only
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed	In buffer area only
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Hawkesdale Wind Farm	2005/2140	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed	In buffer area only
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In buffer area only
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Portland Landfill Borehole Installation, Vic	2017/7886	Not Controlled Action	Completed	In buffer area only
Pulp mill and associated infrastructure 3km north of Heywood	2005/2125	Not Controlled Action	Completed	In buffer area only
Railway Bridge (H0151) Partial Demolition, Merri River	2010/5534	Not Controlled Action	Completed	In buffer area only
Redevelopment Project to Upgrade and Extend the Portland Trawler Wharf	2008/4317	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2006/2937	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2005/2142	Not Controlled Action	Completed	In buffer area only
Shaw River Power Station Project	2009/5088	Not Controlled Action	Completed	In buffer area only
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In buffer area only
Tarrone Power Station Project	2010/5299	Not Controlled Action	Completed	In buffer area only
The Sisters Wind Farm	2008/4268	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In buffer area only
Water pipelines, Mortlake Power Station	2006/2881	Not Controlled Action	Completed	In buffer area only
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Wind farm development	2005/1960	Not Controlled Action	Completed	In buffer area only
Wind Farm Development	2004/1929	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		(Particular Manner)		
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Gas Pipeline Crossing at Mount Emu Creek	2009/4913	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
8 Lot Industrial Subdivision	2008/4527	Referral Decision	Completed	In buffer area only
Portland Wave Energy Project	2008/3946	Referral Decision	Completed	In buffer area only
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In buffer area only
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In feature area
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur	In buffer area only
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur	In buffer area only
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

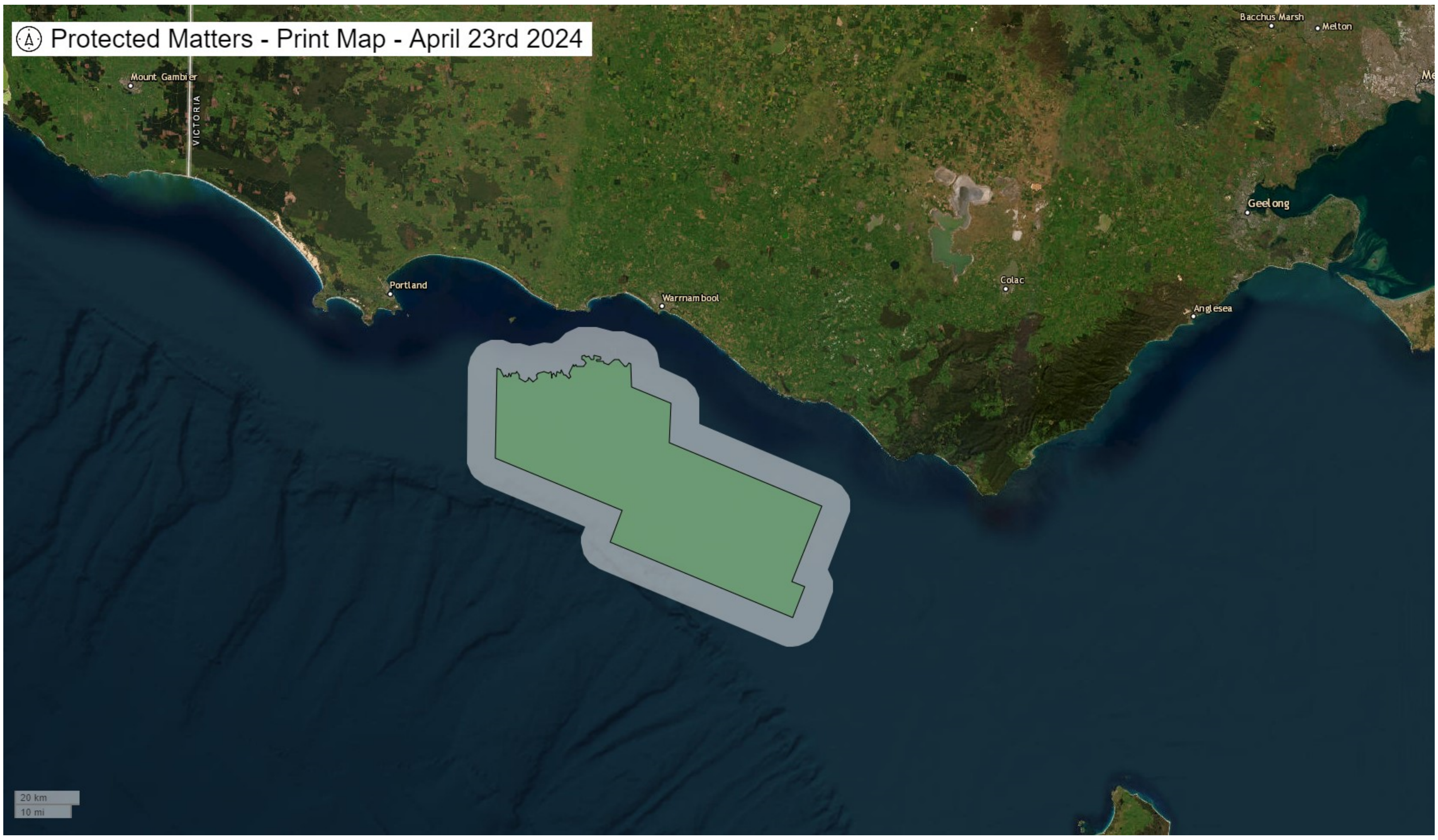

Figure 1: PMST Search Area - Underwater Sound for Fish (Active Source Area + 8km Buffer)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	44
Listed Migratory Species:	43

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	68
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	37
Key Ecological Features (Marine):	2
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida			
Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris			
Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini			
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus			
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Prototroctes maraena			
Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
MAMMAL			
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Listed Marine Species			[Resource Information]
Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur			
Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Phoebetria fusca			
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis			
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Stercorarius antarcticus as Catharacta skua			
Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata			
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Sternula albifrons as Sterna albifrons			
Little Tern [82849]		Species or species habitat may occur within area	In buffer area only
Thalassarche bulleri			
Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov.			
Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri			
Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat likely to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Spinifex Offshore Surveys	2022/09359		Completed	In feature area
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In feature area
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In buffer area only
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In feature area
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In feature area
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

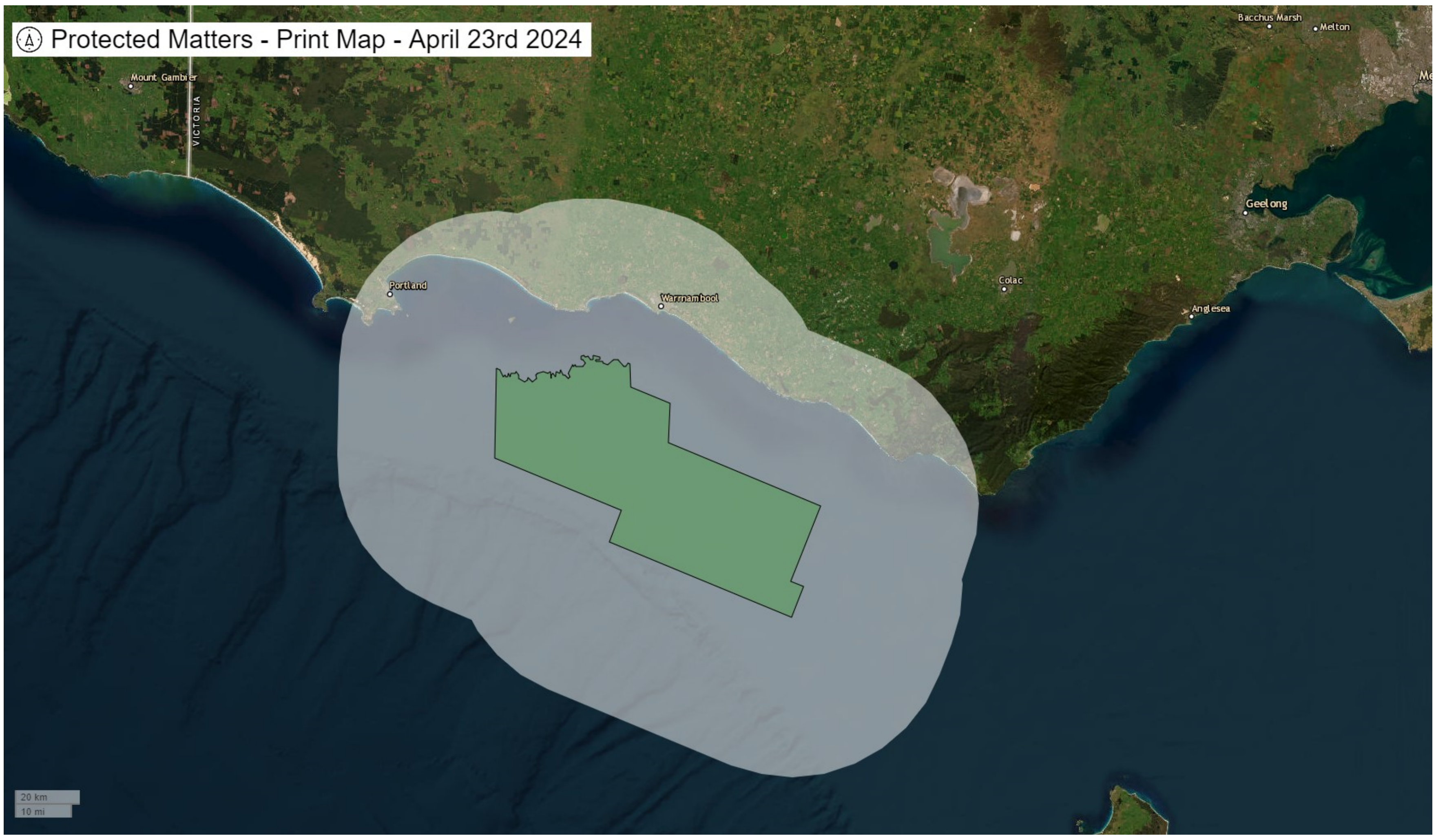

Figure 1: PMST Search Area - Underwater Sound for LF Cetaceans (Active Source Area + 44km Buffer)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	1
National Heritage Places:	3
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	9
Listed Threatened Species:	109
Listed Migratory Species:	66

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	19
Commonwealth Heritage Places:	None
Listed Marine Species:	110
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	1
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	58
Regional Forest Agreements:	1
Nationally Important Wetlands:	5
EPBC Act Referrals:	92
Key Ecological Features (Marine):	2
Biologically Important Areas:	22
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

World Heritage Properties [Resource Information]

Name	State	Legal Status	Buffer Status
Budj Bim Cultural Landscape	VIC	Declared property	In buffer area only

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In buffer area only
Indigenous			
Budj Bim National Heritage Landscape - Mt Eccles Lake Condah Area	VIC	Listed place	In buffer area only
Budj Bim National Heritage Landscape - Tyrendarra Area	VIC	Listed place	In buffer area only

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In buffer area only
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area	In buffer area only
Karst springs and associated alkaline fens of the Naracoorte Coastal Plain	Endangered	Community may occur within area	In buffer area only

Community Name	Threatened Category	Presence Text	Buffer Status
Bioregion			
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area	In buffer area only

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In buffer area only
Calyptorhynchus banksii graptogyne South-eastern Red-tailed Black-Cockatoo [25982]	Endangered	Species or species habitat known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area	In buffer area only
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
CRUSTACEAN			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat known to occur within area	In buffer area only
FISH			
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
FROG			
Litoria raniformis Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
INSECT			
Synemon plana Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area	In buffer area only
MAMMAL			
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area	In buffer area only
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isoodon obesulus obesulus			
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In buffer area only
Mastacomys fuscus mordicus			
Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area	In buffer area only
Miniopterus orianae bassanii			
Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area	In buffer area only
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Petauroides volans			
Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area	In buffer area only
Petaurus australis australis			
Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Potorous tridactylus trisulcatus			
Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area	In buffer area only
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Caladenia ornata Ornate Pink Fingers [76213]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat known to occur within area	In buffer area only
Dipodium campanulatum Bell Flower Hyacinth Orchid [55051]	Endangered	Species or species habitat may occur within area	In buffer area only
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Glycine latrobeana			
Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Haloragis exalata subsp. exalata			
Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Ixodia achillaeoides subsp. arenicola			
Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Lachnagrostis adamsonii			
Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area	In buffer area only
Lepidium aschersonii			
Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium			
Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum diversiflorum			
Gorae Leek-orchid [13210]	Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum litorale listed as Prasophyllum littorale			
Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat known to occur within area	In buffer area only
Prasophyllum spicatum			
Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Prasophyllum suaveolens			
Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area	In buffer area only
Pterostylis chlorogramma			
Green-striped Greenhood [56510]	Vulnerable	Species or species habitat known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Rutidosis leptorhynchoides Button Wrinklewort [67251]	Endangered	Species or species habitat likely to occur within area	In buffer area only
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In buffer area only
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Thelymitra orientalis Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Delma impar			
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Lissolepis coventryi			
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In buffer area only
SHARK			
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato			
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus			
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Ardenna tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caperea marginata			
Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus			
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus			
Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus			
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae			
Humpback Whale [38]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In buffer area only
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area	In buffer area only
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In buffer area only
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area	In buffer area only
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area	In buffer area only
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus			
Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pluvialis fulva			
Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Thalasseus bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Tringa brevipes			
Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola			
Wood Sandpiper [829]		Roosting known to occur within area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area	In buffer area only

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State	Buffer Status
Defence		
Defence - Training Depot, Darts RD 3305 Portland [21019]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21010]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21022]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21009]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21018]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21007]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21012]	VIC	In buffer area only

Commonwealth Land Name	State	Buffer Status
Defence - Training Depot, Darts RD 3305 Portland [21013]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21011]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21016]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21017]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21014]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21015]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21024]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21023]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21008]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21021]	VIC	In buffer area only
Defence - Training Depot, Darts RD 3305 Portland [21020]	VIC	In buffer area only
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC	In buffer area only

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Anseranas semipalmata			
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area	In buffer area only
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In buffer area only
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area	In feature area
Calidris alba Sanderling [875]		Roosting known to occur within area	In buffer area only
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area	In buffer area only
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Charadrius mongolus			
Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area	In buffer area only
Charadrius ruficapillus			
Red-capped Plover [881]		Roosting known to occur within area overfly marine area	In buffer area only
Chroicocephalus novaehollandiae as Larus novaehollandiae			
Silver Gull [82326]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis			
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora			
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans			
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi			
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor			
Little Penguin [1085]		Breeding known to occur within area	In buffer area only
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Gallinago megala			
Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area	In buffer area only
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In buffer area only
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Morus capensis Cape Gannet [59569]		Breeding known to occur within area	In buffer area only
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In buffer area only
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area	In buffer area only
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area	In buffer area only
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area	In buffer area only
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area	In buffer area only
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area overfly marine area	In buffer area only
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding known to occur within area	In buffer area only
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalasseus bergii as Sterna bergii			
Greater Crested Tern [83000]		Breeding known to occur within area	In buffer area only
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In buffer area only
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa brevipes as Heteroscelus brevipes			
Grey-tailed Tattler [851]		Roosting known to occur within area	In buffer area only
Tringa glareola			
Wood Sandpiper [829]		Roosting known to occur within area overfly marine area	In buffer area only
Tringa nebularia			
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area	In buffer area only
Tringa stagnatilis			
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area	In buffer area only
Fish			
Heraldia nocturna			
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis			
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps			
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Hippocampus minotaur			
Bullneck Seahorse [66705]		Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area	In buffer area only
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area	In feature area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat known to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Australian Marine Parks [Resource Information]

Park Name	Zone & IUCN Categories	Buffer Status
Apollo	Multiple Use Zone (IUCN VI)	In buffer area only

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Aire River W.R.	Natural Features Reserve	VIC	In buffer area only
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Bolwarra H43 B.R.	Natural Features Reserve	VIC	In buffer area only
Bolwarra H44 B.R.	Natural Features Reserve	VIC	In buffer area only
Bolwarra H45 B.R.	Natural Features Reserve	VIC	In buffer area only
Broadwater I90 B.R.	Natural Features Reserve	VIC	In buffer area only
Broadwater I91 B.R.	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Brucknell Creek F.F.R	Nature Conservation Reserve	VIC	In buffer area only
Budj Bim	National Park	VIC	In buffer area only
Cape Nelson	State Park	VIC	In buffer area only
Cooriemungle	Reference Area	VIC	In buffer area only
Cooriemungle Creek F.R	Nature Conservation Reserve	VIC	In buffer area only
Coradjil B.R.	Natural Features Reserve	VIC	In buffer area only
Coradjil N.C.R.	Natural Features Reserve	VIC	In buffer area only
Crinoline Creek	Reference Area	VIC	In buffer area only
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Deen Maar	Indigenous Protected Area	VIC	In buffer area only
Discovery Bay Coastal Park	Conservation Park	VIC	In buffer area only
Ecklin South Swamp N.C.R.	Natural Features Reserve	VIC	In buffer area only
Fitzroy River SS.R.	Natural Features Reserve	VIC	In buffer area only
Framlingham Forest	Indigenous Protected Area	VIC	In buffer area only
Goose Lagoon W.R	Natural Features Reserve	VIC	In buffer area only
Gorae B.R.	Natural Features Reserve	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Hopkins Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Hopkins River, Framlingham SS.R.	Natural Features Reserve	VIC	In buffer area only
Johanna Falls S.R.	Natural Features Reserve	VIC	In buffer area only
Kurtonitj	Indigenous Protected Area	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC	In buffer area only
Lake Aringa W.R	Nature Conservation Reserve	VIC	In buffer area only
Lake Gillear W.R	Natural Features Reserve	VIC	In buffer area only
Latrobe B.R.	Natural Features Reserve	VIC	In buffer area only
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC	In buffer area only
Merri	Marine Sanctuary	VIC	In buffer area only
Narrawong F.R.	Nature Conservation Reserve	VIC	In buffer area only
Nine Mile F.F.R.	Nature Conservation Reserve	VIC	In buffer area only
Nullawarre F.R.	Nature Conservation Reserve	VIC	In buffer area only
Port Campbell	National Park	VIC	In buffer area only
Portland H46 B.R.	Natural Features Reserve	VIC	In buffer area only
Portland H47 B.R.	Natural Features Reserve	VIC	In buffer area only
Pretty Hill F.R	Nature Conservation Reserve	VIC	In buffer area only
Princetown W.R	Natural Features Reserve	VIC	In buffer area only
St Helens F.R	Nature Conservation Reserve	VIC	In buffer area only
The Arches	Marine Sanctuary	VIC	In buffer area only
The Stones	Reference Area	VIC	In buffer area only
The Stones W.R.	Nature Conservation Reserve	VIC	In buffer area only
Timboon I1 B.R	Natural Features Reserve	VIC	In buffer area only
Tomahawk Creek	Reference Area	VIC	In buffer area only
Tower Hill W.R	Natural Features Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Trewalla H48 B.R.	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only
Tyrendarra	Indigenous Protected Area	VIC	In buffer area only
Tyrendarra F.R	Nature Conservation Reserve	VIC	In buffer area only
Unnamed P0059	Private Nature Reserve	VIC	In buffer area only
Unnamed P0126	Private Nature Reserve	VIC	In buffer area only
Woolsthorpe N.C.R.	Natural Features Reserve	VIC	In buffer area only
Yambuk F.F.R.	Nature Conservation Reserve	VIC	In buffer area only
Yambuk Wetlands N.C.R.	Natural Features Reserve	VIC	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In buffer area only

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Cobden-Terang Volcanic Craters	VIC	In buffer area only
Lower Merri River Wetlands	VIC	In buffer area only
Princetown Wetlands	VIC	In buffer area only
Tower Hill	VIC	In buffer area only
Yambuk Wetlands	VIC	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Cape Winds Offshore Windfarm Geophysical, Geotechnical and Marine Studies	2023/09629		Referral Decision	In buffer area only
Hexham Wind Farm	2022/09287		Assessment	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Southern Winds Offshore Wind Project	2022/09435		Assessment	In buffer area only
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed	In buffer area only
Spinifex Offshore Surveys	2022/09359		Completed	In feature area
Willatook Wind Farm, Vic	2019/8439		Post-Approval	In buffer area only
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In feature area
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval	In buffer area only
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In buffer area only
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed	In buffer area only
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed	In buffer area only
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In feature area
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Development of wind energy facility	2005/2224	Not Controlled Action	Completed	In buffer area only
Drilling of Callister-1 exploration well in VIC/P51	2004/1633	Not Controlled Action	Completed	In buffer area only
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In buffer area only
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed	In buffer area only
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Hawkesdale Wind Farm	2005/2140	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In buffer area only
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed	In buffer area only
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed	In buffer area only
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Portland Landfill Borehole Installation, Vic	2017/7886	Not Controlled Action	Completed	In buffer area only
Pulp mill and associated infrastructure 3km north of Heywood	2005/2125	Not Controlled Action	Completed	In buffer area only
Railway Bridge (H0151) Partial Demolition, Merri River	2010/5534	Not Controlled Action	Completed	In buffer area only
Redevelopment Project to Upgrade and Extend the Portland Trawler Wharf	2008/4317	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2005/2142	Not Controlled Action	Completed	In buffer area only
Ryan Corner Wind Farm	2006/2937	Not Controlled Action	Completed	In buffer area only
Shaw River Power Station Project	2009/5088	Not Controlled Action	Completed	In buffer area only
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In buffer area only
Tarrone Power Station Project	2010/5299	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In buffer area only
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Wind farm development	2005/1960	Not Controlled Action	Completed	In buffer area only
Wind Farm Development	2004/1929	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Gas Pipeline Crossing at Mount Emu Creek	2009/4913	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
8 Lot Industrial Subdivision	2008/4527	Referral Decision	Completed	In buffer area only
Portland Wave Energy Project	2008/3946	Referral Decision	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In buffer area only
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In feature area
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas [Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur	In buffer area only
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur	In buffer area only

Scientific Name	Behaviour	Presence	Buffer Status
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

- -Office of Environment and Heritage, New South Wales
- -Department of Environment and Primary Industries, Victoria
- -Department of Primary Industries, Parks, Water and Environment, Tasmania
- -Department of Environment, Water and Natural Resources, South Australia
- -Department of Land and Resource Management, Northern Territory
- -Department of Environmental and Heritage Protection, Queensland
- -Department of Parks and Wildlife, Western Australia
- -Environment and Planning Directorate, ACT
- -Birdlife Australia
- -Australian Bird and Bat Banding Scheme
- -Australian National Wildlife Collection
- -Natural history museums of Australia
- -Museum Victoria
- -Australian Museum
- -South Australian Museum
- -Queensland Museum
- -Online Zoological Collections of Australian Museums
- -Queensland Herbarium
- -National Herbarium of NSW
- -Royal Botanic Gardens and National Herbarium of Victoria
- -Tasmanian Herbarium
- -State Herbarium of South Australia
- -Northern Territory Herbarium
- -Western Australian Herbarium
- -Australian National Herbarium, Canberra
- -University of New England
- -Ocean Biogeographic Information System
- -Australian Government, Department of Defence
- Forestry Corporation, NSW
- -Geoscience Australia
- -CSIRO
- -Australian Tropical Herbarium, Cairns
- -eBird Australia
- -Australian Government – Australian Antarctic Data Centre
- -Museum and Art Gallery of the Northern Territory
- -Australian Government National Environmental Science Program
- -Australian Institute of Marine Science
- -Reef Life Survey Australia
- -American Museum of Natural History
- -Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
- -Tasmanian Museum and Art Gallery, Hobart, Tasmania
- -Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 23-Apr-2024

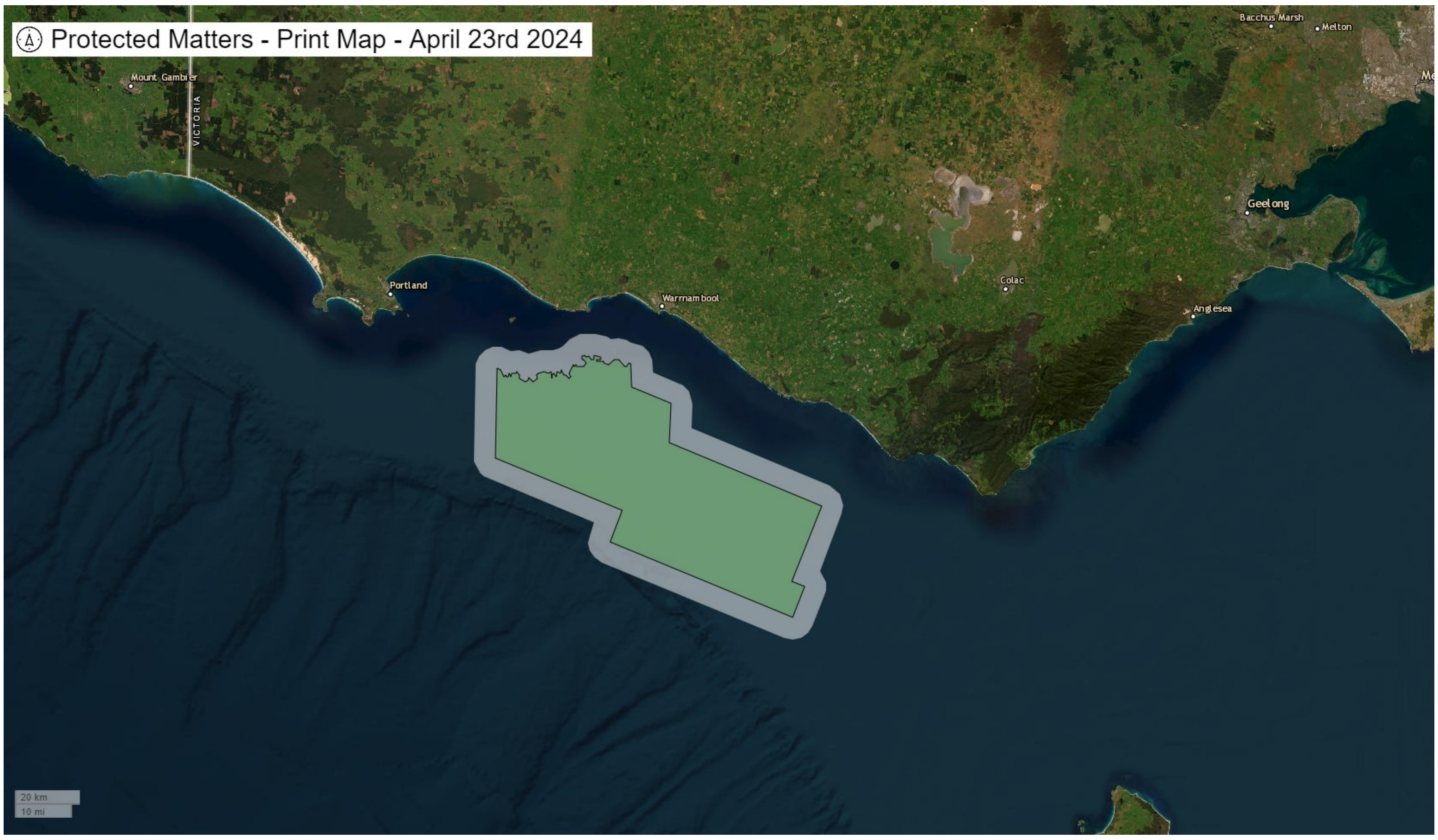

Figure 1: PMST Search Area - Underwater Sound for Turtles (Active Source Area + 6km Buffer)

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	42
Listed Migratory Species:	40

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	63
Whales and Other Cetaceans:	29
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	None
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	36
Key Ecological Features (Marine):	2
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
Commonwealth Marine Areas (EPBC Act)	In feature area
Commonwealth Marine Areas (EPBC Act)	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat may occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche salvini			
Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi			
White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
FISH			
Hoplostethus atlanticus			
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Prototroctes maraena			
Australian Grayling [26179]	Vulnerable	Species or species habitat may occur within area	In feature area
Seriolella brama			
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii			
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
MAMMAL			
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
REPTILE			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
SHARK			
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Centrophorus uyato			
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus			
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea			
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Physeter macrocephalus			
Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Numenius madagascariensis			
Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area	In buffer area only
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat may occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Stercorarius antarcticus as Catharacta skua Brown Skua [85039]		Species or species habitat may occur within area	In feature area
Sterna striata White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Fish			
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Vanacampus margaritifer			
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi			
Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus			
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri			
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus			
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat likely to occur within area	In feature area
Neophoca cinerea			
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata			
Minke Whale [33]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Spinifex Offshore Surveys	2022/09359		Completed	In feature area
Controlled action				
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval	In feature area
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed	In feature area
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In feature area
Gas Field Development	2006/2635	Not Controlled Action	Completed	In feature area
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
Bonney Coast Upwelling	South-east	In feature area
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 01-May-2024

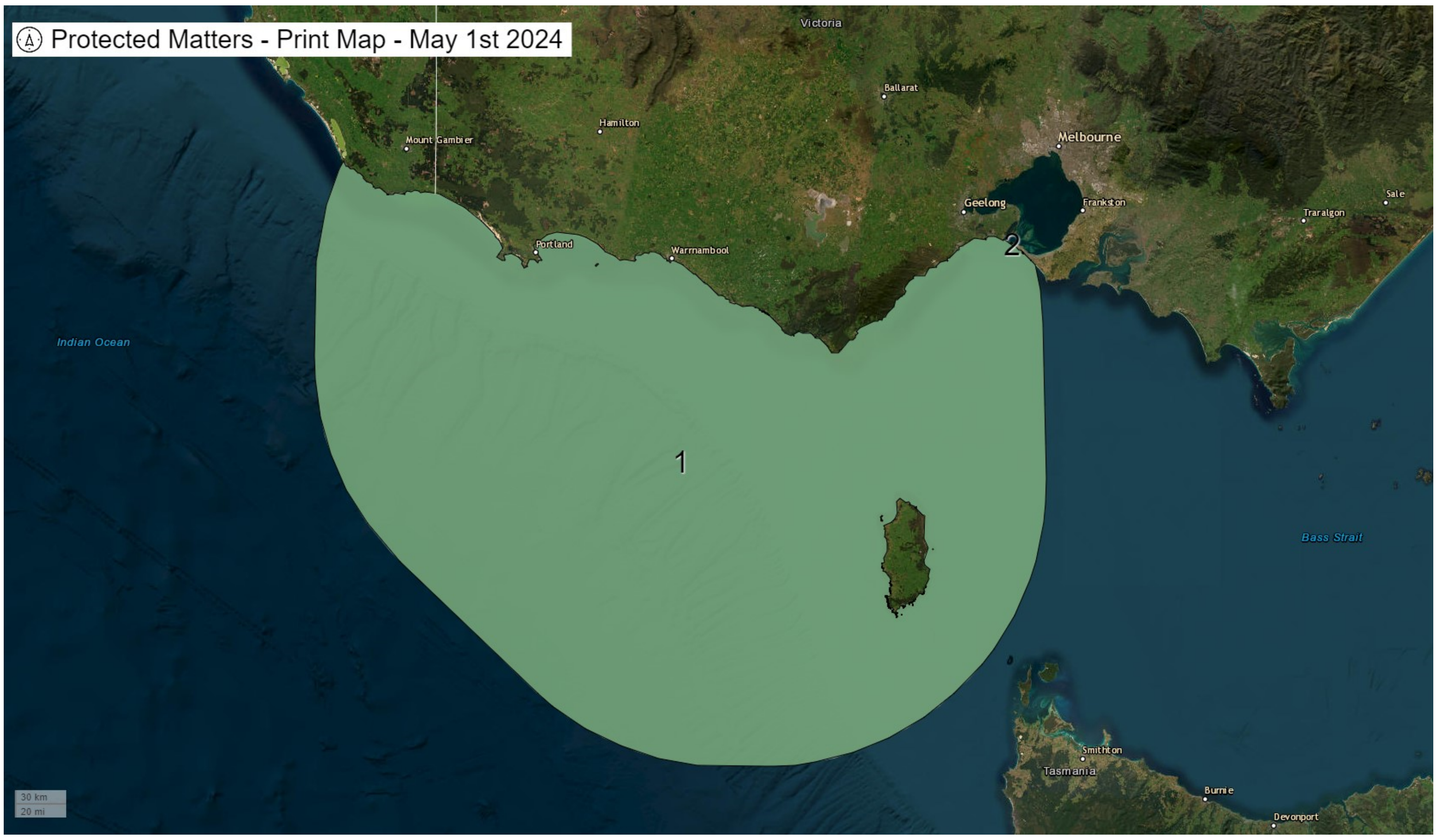

Figure 1: PMST Search Area - Environmental Planning Area

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International Importance (Ramsar	4
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	2
Listed Threatened Ecological Communities:	11
Listed Threatened Species:	135
Listed Migratory Species:	72

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	30
Commonwealth Heritage Places:	3
Listed Marine Species:	117
Whales and Other Cetaceans:	31
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	5
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	101
Regional Forest Agreements:	2
Nationally Important Wetlands:	18
EPBC Act Referrals:	156
Key Ecological Features (Marine):	2
Biologically Important Areas:	29
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place
Point Nepean Defence Sites and Quarantine Station Area	VIC	Listed place

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Glenelg estuary and discovery bay wetlands	Within Ramsar site
Lavinia	Within Ramsar site
Piccaninnie ponds karst wetlands	Within Ramsar site
Port phillip bay (western shoreline) and bellarine peninsula	Within Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
Commonwealth Marine Areas (EPBC Act)
Commonwealth Marine Areas (EPBC Act)

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community known to occur within area

Community Name	Threatened Category	Presence Text
Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion	Endangered	Community likely to occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community likely to occur within area
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area
Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains	Critically Endangered	Community likely to occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area
Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (Eucalyptus ovata / E. brookeriana)	Critically Endangered	Community likely to occur within area
Tasmanian white gum (Eucalyptus viminalis) wet forest	Critically Endangered	Community may occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community likely to occur within area

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Acanthiza pusilla magnirostris		
King Island Brown Thornbill, Brown Thornbill (King Island) [91709]	Endangered	Species or species habitat known to occur within area
Acanthornis magna greeniana		
King Island Scrubtit, Scrubtit (King Island) [82329]	Critically Endangered	Species or species habitat known to occur within area
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Aphelocephala leucopsis		
Southern Whiteface [529]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Aquila audax fleayi Tasmanian Wedge-tailed Eagle, Wedge-tailed Eagle (Tasmanian) [64435]	Endangered	Species or species habitat may occur within area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii graptogyne South-eastern Red-tailed Black-Cockatoo [25982]	Endangered	Species or species habitat known to occur within area
Ceyx azureus diemenensis Tasmanian Azure Kingfisher [25977]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Climacteris picumnus victoriae Brown Treecreeper (south-eastern) [67062]	Vulnerable	Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Endangered	Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Melanodryas cucullata cucullata South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat may occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Platycercus caledonicus brownii Green Rosella (King Island) [67041]	Vulnerable	Species or species habitat known to occur within area
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Strepera fuliginosa colei Black Currawong (King Island) [67113]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Xenus cinereus		
Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area
CRUSTACEAN		
Euastacus bispinosus		
Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat known to occur within area
FISH		
Galaxiella pusilla		
Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Endangered	Species or species habitat may occur within area
Hoplostethus atlanticus		
Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Nannoperca obscura		
Yarra Pygmy Perch [26177]	Endangered	Species or species habitat known to occur within area
Nannoperca variegata		
Variegated Pygmy Perch, Ewens Pygmy Perch, Golden Pygmy Perch [26178]	Vulnerable	Species or species habitat known to occur within area
Prototroctes maraena		
Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Rexea solandri (eastern Australian population)		
Eastern Gemfish [76339]	Conservation Dependent	Species or species habitat may occur within area
Seriolella brama		
Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii		
Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat known to occur within area
FROG		
Litoria raniformis		
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
INSECT		

Scientific Name	Threatened Category	Presence Text
Synemon plana Golden Sun Moth [25234]	Vulnerable	Species or species habitat may occur within area
MAMMAL		
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Endangered	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat known to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
PLANT		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat likely to occur within area
Astelia australiana Tall Astelia [10851]	Vulnerable	Species or species habitat may occur within area
Caladenia calcicola Limestone Spider-orchid [10065]	Vulnerable	Species or species habitat likely to occur within area
Caladenia colorata Coloured Spider-orchid, Small Western Spider-orchid, Painted Spider-orchid [54999]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Caladenia concolor Crimson Spider-orchid, Maroon Spider-orchid [5505]	Vulnerable	Species or species habitat may occur within area
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area
Caladenia ornata Ornate Pink Fingers [76213]	Vulnerable	Species or species habitat likely to occur within area
Caladenia tensa Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat may occur within area
Dodonaea procumbens Trailing Hop-bush [12149]	Vulnerable	Species or species habitat may occur within area
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area
Euphrasia collina subsp. muelleri Purple Eyebright, Mueller's Eyebright [16151]	Endangered	Species or species habitat known to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat known to occur within area
Grevillea infecunda Anglesea Grevillea [22026]	Vulnerable	Species or species habitat known to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Hiya distans listed as Hypolepis distans Scrambling Ground-fern [92548]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Ixodia achillaeoides subsp. arenicola		
Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat known to occur within area
Lachnagrostis adamsonii		
Adamson's Blown-grass, Adamson's Blowngrass [76211]	Endangered	Species or species habitat may occur within area
Leiocarpa gatesii		
Wrinkled Buttons [76212]	Vulnerable	Species or species habitat known to occur within area
Lepidium aschersonii		
Spiny Peppercress [10976]	Vulnerable	Species or species habitat known to occur within area
Lepidium hyssopifolium		
Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat known to occur within area
Leucochrysum albicans subsp. tricolor		
Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat may occur within area
Pimelea spinescens subsp. spinescens		
Plains Rice-flower, Spiny Rice-flower, Prickly Pimelea [21980]	Critically Endangered	Species or species habitat likely to occur within area
Pomaderris halmaturina subsp. halmaturina		
Kangaroo Island Pomaderris [21964]	Vulnerable	Species or species habitat known to occur within area
Prasophyllum diversiflorum		
Gorae Leek-orchid [13210]	Endangered	Species or species habitat likely to occur within area
Prasophyllum frenchii		
Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat known to occur within area
Prasophyllum litorale listed as Prasophyllum littorale		
Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Prasophyllum suaveolens Fragrant Leek-orchid [64956]	Endangered	Species or species habitat may occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat known to occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area
Rutidosis leptorhynchoides Button Wrinklewort [67251]	Endangered	Species or species habitat may occur within area
Senecio macrocarpus Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat likely to occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area
Taraxacum cygnorum Coast Dandelion, Native Dandelion [2508]	Vulnerable	Species or species habitat may occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Thelymitra orientalis		
Hoary Sun-orchid [88011]	Critically Endangered	Species or species habitat may occur within area
Xerochrysum palustre		
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Delma impar		
Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Lissolepis coventryi		
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area
SHARK		
Carcharodon carcharias		
White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Centrophorus uyato		
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus		
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat likely to occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Anous stolidus Common Noddy [825]		Species or species habitat likely to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis as Balaena glacialis australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus		
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]		Species or species habitat known to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus		
Sperm Whale [59]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis		
Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Phalaropus lobatus Red-necked Phalarope [838]		Roosting known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Pluvialis squatarola Grey Plover [865]	Vulnerable	Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Xenus cinereus Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Defence	
Defence - Training Depot, Darts RD 3305 Portland [21018]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21019]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21016]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21014]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21010]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21011]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21015]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21013]	VIC

Commonwealth Land Name	State
Defence - Training Depot, Darts RD 3305 Portland [21020]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21024]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21017]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21022]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21023]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21021]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21007]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21009]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21008]	VIC
Defence - Training Depot, Darts RD 3305 Portland [21012]	VIC
Defence - WARRNAMBOOL TRAINING DEPOT [21111]	VIC
Transport and Regional Services - Australian Maritime Safety Authority	
Commonwealth Land - Australian Maritime Safety Authority [41289]	SA
Commonwealth Land - Australian Maritime Safety Authority [41288]	SA
Unknown	
Commonwealth Land - [21583]	VIC
Commonwealth Land - [60115]	TAS
Commonwealth Land - [21492]	VIC
Commonwealth Land - [60112]	TAS
Commonwealth Land - [60114]	TAS
Commonwealth Land - [60111]	TAS
Commonwealth Land - [22391]	VIC
Commonwealth Land - [60113]	TAS
Commonwealth Land - [21570]	VIC

Commonwealth Heritage Places

[Resource Information]

Name	State	Status
Historic		
Cape Northumberland Lighthouse	SA	Listed place
Cape Wickham Lighthouse	TAS	Listed place

Name	State	Status
Sorrento Post Office	VIC	Listed place

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area
Anous stolidus		
Common Noddy [825]		Species or species habitat likely to occur within area
Anseranas semipalmata		
Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes		
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Species or species habitat known to occur within area
Ardenna grisea as Puffinus griseus		
Sooty Shearwater [82651]	Vulnerable	Species or species habitat may occur within area
Ardenna tenuirostris as Puffinus tenuirostris		
Short-tailed Shearwater [82652]		Breeding known to occur within area
Arenaria interpres		
Ruddy Turnstone [872]	Vulnerable	Roosting known to occur within area
Bubulcus ibis as Ardea ibis		
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata		
Sharp-tailed Sandpiper [874]	Vulnerable	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Vulnerable	Roosting known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat known to occur within area overfly marine area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Chroicocephalus novaehollandiae as Larus novaehollandiae		
Silver Gull [82326]		Breeding known to occur within area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor		
Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Gallinago megala		
Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area
Gallinago stenura		
Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea		
Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]	Endangered	Roosting known to occur within area overfly marine area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area
Morus capensis Cape Gannet [59569]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Morus serrator Australasian Gannet [1020]		Breeding known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Breeding known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Phalacrocorax fuscescens		
Black-faced Cormorant [59660]		Breeding known to occur within area
Phalaropus lobatus		
Red-necked Phalarope [838]		Roosting known to occur within area
Phoebetria fusca		
Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva		
Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola		
Grey Plover [865]	Vulnerable	Roosting known to occur within area overfly marine area
Pterodroma mollis		
Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Recurvirostra novaehollandiae		
Red-necked Avocet [871]		Roosting known to occur within area overfly marine area
Rhipidura rufifrons		
Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato)		
Australian Painted Snipe [77037]	Endangered	Species or species habitat known to occur within area overfly marine area
Stercorarius antarcticus as Catharacta skua		
Brown Skua [85039]		Species or species habitat may occur within area
Sterna striata		
White-fronted Tern [799]		Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Sternula albifrons as Sterna albifrons Little Tern [82849]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Thalasseus bergii as Sterna bergii		
Greater Crested Tern [83000]		Breeding known to occur within area
Thinornis cucullatus as Thinornis rubricollis		
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis		
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Tringa brevipes as Heteroscelus brevipes		
Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa glareola		
Wood Sandpiper [829]		Roosting known to occur within area overfly marine area
Tringa nebularia		
Common Greenshank, Greenshank [832]	Endangered	Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Xenus cinereus		
Terek Sandpiper [59300]	Vulnerable	Roosting known to occur within area overfly marine area
Fish		
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis		
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps		
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Hippocampus minotaur Bullneck Seahorse [66705]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys mollisoni Mollison's Pipefish [66260]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		

Current Scientific Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks

[Resource Information]

Park Name	Zone & IUCN Categories
Apollo	Multiple Use Zone (IUCN VI)
Franklin	Multiple Use Zone (IUCN VI)
Zeehan	Multiple Use Zone (IUCN VI)

Park Name	Zone & IUCN Categories
Nelson	Special Purpose Zone (IUCN VI)
Zeehan	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves		[Resource Information]
Protected Area Name	Reserve Type	State
Aire River	Heritage River	VIC
Aire River W.R.	Natural Features Reserve	VIC
Aireys Inlet B.R.	Natural Features Reserve	VIC
Anglesea B.R.	Natural Features Reserve	VIC
Badger Box Creek	Nature Reserve	TAS
Barham Paradise S.R.	Natural Features Reserve	VIC
Barwon Bluff	Marine Sanctuary	VIC
Bats Ridge W.R	Nature Conservation Reserve	VIC
Bay of Islands Coastal Park	Conservation Park	VIC
Black Pyramid Rock	Nature Reserve	TAS
Bolwarra H43 B.R.	Natural Features Reserve	VIC
Bolwarra H44 B.R.	Natural Features Reserve	VIC
Bolwarra H45 B.R.	Natural Features Reserve	VIC
Breamlea F.F.R.	Nature Conservation Reserve	VIC
Bucks Lake	Game Reserve	SA
Canunda	National Park	SA

Protected Area Name	Reserve Type	State
Cape Nelson	State Park	VIC
Cape Wickham	Conservation Area	TAS
Cape Wickham	State Reserve	TAS
Carpenter Rocks	Conservation Park	SA
Cataraqui Point	Conservation Area	TAS
Christmas Island	Nature Reserve	TAS
City of Melbourne Bay	Conservation Area	TAS
Colliers Forest Reserve	Conservation Covenant	TAS
Colliers Swamp	Conservation Area	TAS
Councillor Island	Nature Reserve	TAS
Counsel Hill	Conservation Area	TAS
Currie Lightkeepers Residence	Historic Site	TAS
Deen Maar	Indigenous Protected Area	VIC
Dingley Dell	Conservation Park	SA
Disappointment Bay	State Reserve	TAS
Discovery Bay	Marine National Park	VIC
Discovery Bay Coastal Park	Conservation Park	VIC
Douglas Point	Conservation Park	SA
Eagle Rock	Marine Sanctuary	VIC
Edna Bowman N.C.R.	Natural Features Reserve	VIC
Eldorado	Conservation Area	TAS
Gentle Annie	Conservation Area	TAS
Glenelg River	Heritage River	VIC
Goose Lagoon W.R	Natural Features Reserve	VIC
Great Otway	National Park	VIC

Protected Area Name	Reserve Type	State
Hedditch Hill S.R.	Natural Features Reserve	VIC
Johanna Falls S.R.	Natural Features Reserve	VIC
Lady Julia Percy Island W.R.	Nature Conservation Reserve	VIC
Lake Connewarre W.R	Natural Features Reserve	VIC
Lake Gillear W.R	Natural Features Reserve	VIC
Latrobe B.R.	Natural Features Reserve	VIC
Lavinia	State Reserve	TAS
Lawrence Rocks W.R.	Nature Conservation Reserve	VIC
Lily Pond B.R.	Natural Features Reserve	VIC
Lonsdale Lakes W.R	Nature Conservation Reserve	VIC
Lower Glenelg	National Park	VIC
Lower South East	Marine Park	SA
Marengo N.C.R.	Nature Conservation Reserve	VIC
Marengo Reefs	Marine Sanctuary	VIC
Merri	Marine Sanctuary	VIC
Mornington Peninsula	National Park	VIC
Mount Richmond	National Park	VIC
Muddy Lagoon	Nature Reserve	TAS
Narrawong F.R.	Nature Conservation Reserve	VIC
Nelson SS.R.	Natural Features Reserve	VIC
Nene Valley	Conservation Park	SA
New Year Island	Game Reserve	TAS

Protected Area Name	Reserve Type	State
Painkalac Creek	Reference Area	VIC
Piccaninnie Ponds	Conservation Park	SA
Point Addis	Marine National Park	VIC
Point Danger	Marine Sanctuary	VIC
Point Nepean	National Park	VIC
Porky Beach	Conservation Area	TAS
Port Campbell	National Park	VIC
Portland H46 B.R.	Natural Features Reserve	VIC
Portland H47 B.R.	Natural Features Reserve	VIC
Port Phillip Heads	Marine National Park	VIC
Princetown W.R	Natural Features Reserve	VIC
Red Hut Point	Conservation Area	TAS
Red Hut Road #1	Conservation Covenant	TAS
Red Hut Road #2	Conservation Covenant	TAS
Reid Rocks	Nature Reserve	TAS
Sea Elephant	Conservation Area	TAS
Sea Elephant River	Conservation Covenant	TAS
Seal Rocks	State Reserve	TAS
Seal Rocks	Conservation Area	TAS
South Rd Nugara	Conservation Covenant	TAS
Stokes Point	Conservation Area	TAS
Stony Creek (Otways)	Reference Area	VIC
The Arches	Marine Sanctuary	VIC
Tower Hill W.R	Natural Features Reserve	VIC
Twelve Apostles	Marine National Park	VIC

Protected Area Name	Reserve Type	State
Tyrendarra F.R	Nature Conservation Reserve	VIC
Unnamed (No.HA1038)	Heritage Agreement	SA
Unnamed (No.HA1404)	Heritage Agreement	SA
Unnamed (No.HA1457)	Heritage Agreement	SA
Unnamed (No.HA1560)	Heritage Agreement	SA
Unnamed (No.HA26)	Heritage Agreement	SA
Unnamed (No.HA42)	Heritage Agreement	SA
Unnamed P0176	Private Nature Reserve	VIC
Wild Dog B.R.	Natural Features Reserve	VIC
Wild Dog Creek SS.R.	Natural Features Reserve	VIC
Yambacoona	Conservation Covenant	TAS
Yambuk F.F.R.	Nature Conservation Reserve	VIC
Yambuk Wetlands N.C.R.	Natural Features Reserve	VIC

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included. Please see the associated resource information for specific caveats and use limitations associated with RFA boundary information.

RFA Name	State
Tasmania RFA	Tasmania
West Victoria RFA	Victoria

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Aire River	VIC
Bungaree Lagoon	TAS
Glenelg Estuary	VIC
Glenelg River	VIC
Lake Connewarre State Wildlife Reserve	VIC

Wetland Name	State
Lake Flannigan	TAS
Lavinia Nature Reserve	TAS
Long Swamp	VIC
Lower Aire River Wetlands	VIC
Lower Merri River Wetlands	VIC
Pearshape Lagoon 1	TAS
Pearshape Lagoon 2	TAS
Pearshape Lagoon 3	TAS
Pearshape Lagoon 4	TAS
Piccaninnie Ponds	SA
Princetown Wetlands	VIC
Tower Hill	VIC
Yambuk Wetlands	VIC

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Apollo Bay to Skenes Creek Coastal Trail	2022/09274		Assessment
Cape Winds Offshore Windfarm Geophysical, Geotechnical and Marine Studies	2023/09629		Referral Decision
Dolphin Tungsten Mine Grassy King Island	2023/09653		Referral Decision
Offshore Tidal Energy Facility and Submarine Cable	2008/4480		Completed
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Southern Winds Offshore Wind Project	2022/09435		Assessment
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Completed
Spinifex Offshore Surveys	2022/09359		Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval
City Of Greater Geelong Mosquito Control Program 2021-2030, Vic	2020/8782	Controlled Action	Further Information Request
Establishment of plantation for use of effluent water	2003/1063	Controlled Action	Completed
Green Point Wind Farm	2001/529	Controlled Action	Post-Approval
Kentbruck Green Power Hub, Vic	2019/8510	Controlled Action	Assessment Approach
Lonsdale Golf Club Redevelopment	2003/969	Controlled Action	Post-Approval
Lorne Golf Course redevelopment	2004/1513	Controlled Action	Post-Approval
Mosquito Control	2005/2132	Controlled Action	Post-Approval
Otway Development	2002/621	Controlled Action	Post-Approval
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval
Pelican Point residential subdivision	2006/2529	Controlled Action	Completed
Port Phillip Bay Channel Deepening	2002/576	Controlled Action	Post-Approval
Redevelopment of post office and construction of dwellings	2007/3639	Controlled Action	Completed
Residential and Golf Course Development Project	2003/1144	Controlled Action	Post-Approval
Residential Subdivision & Infrastructure Parish of Belfast	2005/1954	Controlled Action	Completed
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Airey Inlet water reclamation plant to Anglesea sewerage system	2006/2539	Not Controlled Action	Completed
Alteration of Grass Maintenance Regime within Powling St Wetlands	2012/6527	Not Controlled Action	Completed
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Anglesea Mine South Wall Vegetation removal, Anglesea, Vic	2017/8060	Not Controlled Action	Completed
Apollo Bay Water Storage Basin, VIC	2012/6484	Not Controlled Action	Completed
Barwon Heads Rd gas pipeline installation	2006/2769	Not Controlled Action	Completed
Barwon Heads Stormwater Outfall upgrade, Victoria	2016/7650	Not Controlled Action	Completed
Bluff Heights Estate Stages 2 to 4	2003/1047	Not Controlled Action	Completed
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed
Construction and operation of Barwon Water biosolids treatment facility	2008/4345	Not Controlled Action	Completed
Construction of Barwon Heads Bridge	2005/2375	Not Controlled Action	Completed
Construction of Infrastructure to Extract, Treat & Transfer Groundwater to Wurde	2008/4104	Not Controlled Action	Completed
Construction of Overtaking Lanes on Great Ocean Rd	2008/4044	Not Controlled Action	Completed
construction of pump station for pump diversion from the Barham River	2003/1242	Not Controlled Action	Completed
Construction of the Edgars Road Extension, from Childs Road, Lalor to Cooper Street, Epping	2003/1135	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Divestment of Norris Barracks	2003/963	Not Controlled Action	Completed
Drilling of Callister-1 exploration well in VIC/P51	2004/1633	Not Controlled Action	Completed
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Gas Fields Development	2011/5879	Not Controlled Action	Completed
Gas Pipeline Installation	2005/2495	Not Controlled Action	Completed
Gleneig Spiny Crayfish Habitat Rehabilitation	2011/6164	Not Controlled Action	Completed
Golflinks Road Residential Development & Water Storage Facility at Barwon Heads	2004/1793	Not Controlled Action	Completed
Grevillea infecunda tip cuttings and soil samples	2005/1979	Not Controlled Action	Completed
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Installation of a 35 metre telecommunications facility at Jirrahlinga Animal San	2003/1151	Not Controlled Action	Completed
Kelly Swamp Boardwalk Construction	2010/5371	Not Controlled Action	Completed
Kongorong Wind Farm	2002/568	Not Controlled Action	Completed
Lot 5 Pelican Point Road, Pelican Point SA - Proposed New Dwelling	2021/9011	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Maintenance and priority works to heritage buildings at Point Nepean Quarantine	2006/3151	Not Controlled Action	Completed
Maintenance Dredging South Channel 2012	2011/6198	Not Controlled Action	Completed
Maintenance of Access Track and Weed Removal	2009/4973	Not Controlled Action	Completed
Maintenance works at Barwon Heads Bridge	2003/1199	Not Controlled Action	Completed
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed
New Water Infrastructure Upgrade, Grassy Dam, King Island	2013/6882	Not Controlled Action	Completed
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed
Ocean Grove rising main 2 upgrade	2009/4978	Not Controlled Action	Completed
Ocean Grove Rising Main 2 Upgrade (OGRM2) - East Section & River Crossing	2010/5508	Not Controlled Action	Completed
Oceanlinx South Australia 1mW Greenwave Project	2012/6528	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
Piccaninnie Ponds flow path restoration project, SA	2013/6711	Not Controlled Action	Completed
Point Nepean Quarantine Station (former)/Restoration of Medical Superintendent's	2006/3149	Not Controlled Action	Completed
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed
Portland Landfill Borehole Installation, Vic	2017/7886	Not Controlled Action	Completed
Port Phillip Channel Deepening Project - Trial Dredge Program	2005/2164	Not Controlled Action	Completed
Proposed replacement of existing road culvert	2013/7077	Not Controlled Action	Completed
Queenscliff Harbour Redevelopment	2004/1352	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Redevelopment Project to Upgrade and Extend the Portland Trawler Wharf	2008/4317	Not Controlled Action	Completed
Rehabilitation of Lake Connewarre State Game Reserve	2002/708	Not Controlled Action	Completed
Remedial Works to the Swan Island Bridge	2003/1129	Not Controlled Action	Completed
Replacement of sewer pipelines	2002/623	Not Controlled Action	Completed
Residential/Resort/Golf Course development	2002/907	Not Controlled Action	Completed
Stage 1 residential subdivision, Anna Catherine Drive	2005/1992	Not Controlled Action	Completed
St Quentin Consulting Pty Ltd /Residential development/305 Great Ocean Road, Jan Juc/VIC/Development	2014/7184	Not Controlled Action	Completed
Torquay Sewerage Strategy - pipe replacement between Torquay and the Black Rock	2004/1704	Not Controlled Action	Completed
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Victorian Generator Project	2005/1984	Not Controlled Action	Completed
West Triton Drilling Program - Otway Basin	2007/3909	Not Controlled Action	Completed
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey in Permit Areas T/32P and T/33P	2002/845	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
2D Seismic Survey	2008/3962	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey, Petroleum Exploration Permit Area EPP27	2006/2776	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey in VIC/P50 and VIC/P46	2004/1810	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval
2D Siesmic Marine Survey	2008/4074	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey within Torquay Sub-basin off sthn Victoria	2012/6256	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
Benbows Paddock residential development, Cape Bridgewater	2007/3247	Not Controlled Action (Particular Manner)	Post-Approval
Bernoulli 3D Seismic Survey	2006/3053	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Construction of bridge across Barwon River	2006/2947	Not Controlled Action (Particular Manner)	Post-Approval
Construct private dwelling	2008/4234	Not Controlled Action (Particular Manner)	Post-Approval
Controlled Burn, Understorey Clearance and Removal of UXO	2003/1030	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval
Fuelbreak construction	2009/4915	Not Controlled Action (Particular Manner)	Post-Approval
Geelong Bypass Section 3	2005/2099	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
Maintenance Dredging Program 2012-21 in Port of Melbourne	2012/6332	Not Controlled Action (Particular Manner)	Post-Approval
OTE10 2D Marine Seismic Survey	2009/5223	Not Controlled Action (Particular Manner)	Post-Approval
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Residential Development and Associated Infrastructure at Port Fairy	2012/6687	Not Controlled Action (Particular Manner)	Post-Approval
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey in Petroleum Permit Area EPP27	2002/648	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey VIC-P46	2002/826	Not Controlled Action (Particular Manner)	Post-Approval
Shaw River Power Station Project - Water Supply Pipeline	2009/5091	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Shearwater 2D and 3D marine seismic survey	2005/2180	Not Controlled Action (Particular Manner)	Post-Approval
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval
Southern Margins T/35P and T/36P 3D Seismic Surveys	2007/3817	Not Controlled Action (Particular Manner)	Post-Approval
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
Surface Geochemical Exploration Program, TAS	2010/5780	Not Controlled Action (Particular Manner)	Post-Approval
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Torquay Sub-basin (VIC/P62) OTE12-3D Seismic Survey	2012/6655	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vegetation clearance and residential subdivision near Mt Gambier	2004/1370	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular Manner)	Post-Approval
Wolseley 3D seismic acquisition survey	2010/5703	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D & 3D Seismic Surveys - Permit Area - VIC/P50	2008/4517	Referral Decision	Completed
3D Marine Seismic Survey	2011/6156	Referral Decision	Completed
3D Seismic Survey	2008/4014	Referral Decision	Completed
8 Lot Industrial Subdivision	2008/4527	Referral Decision	Completed
Portland Wave Energy Project	2008/3946	Referral Decision	Completed
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed
Wind Farm	2001/139	Referral Decision	Completed
Wolseley 3D Seismic Acquisition Survey in Permit T/32P	2010/5291	Referral Decision	Completed

Key Ecological Features

[Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Bonney Coast Upwelling	South-east
West Tasmania Canyons	South-east

Biologically Important Areas

[Resource Information]

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Breeding	Known to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Eudyptula minor Little Penguin [1085]	Breeding	Known to occur
Eudyptula minor Little Penguin [1085]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Foraging	Known to occur

Scientific Name	Behaviour	Presence
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Breeding	Known to occur
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		

Scientific Name	Behaviour	Presence
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Known Foraging Area	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Regia MSS Commercial Fishery Review

9 August 2023

MILLODON CONSULTING

Klarite

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Disclaimer

Acknowledgements

Klarite would like to acknowledge the contributions of co-authors in this report, Millodon Consulting and s2 Services. Klarite also wishes to acknowledge that this report would not have been possible without the data provided by the Victorian Fisheries Authority and the Australian Fisheries Management Authority. We have made every attempt to faithfully represent the data we requested and were provided, respectful of the confidentiality requirements placed on the data.

Introduction

This review of commercial fisheries has been prepared for CGG Services (Australia) Pty Ltd (CGG) to identify Commonwealth and State (Victorian, Tasmanian, and South Australian) fisheries that have authority to fish within the Regia Marine Seismic Survey (Regia MSS) Activity Planning Area and/or Environmental Planning Area (Figure 1).

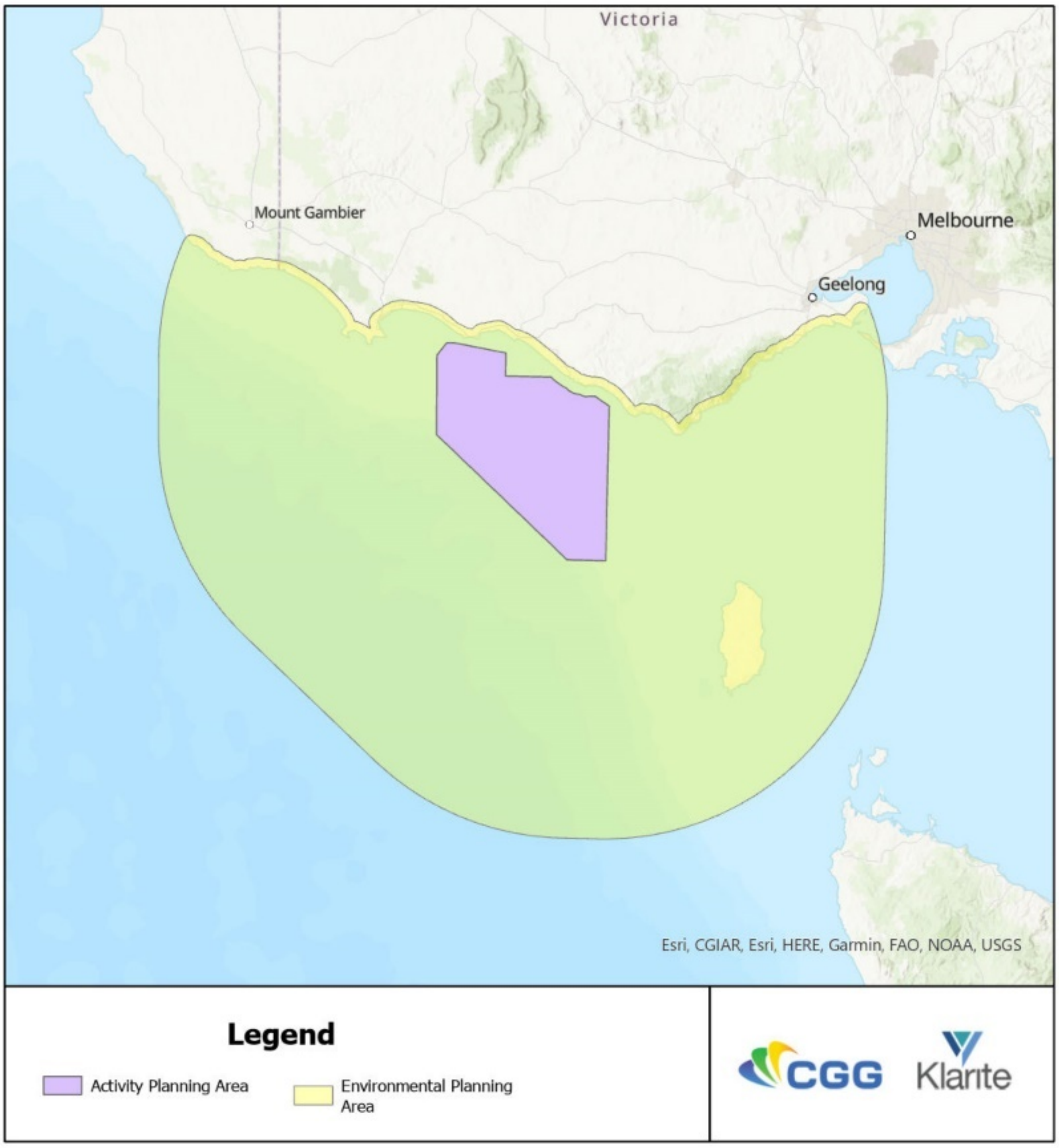

Figure 1: Regia Marine Seismic Survey Activity Planning Area and Environmental Planning Area

Commonwealth Fisheries

Commonwealth fisheries are managed by the Australian Fisheries Management Authority (AFMA) under the *Fisheries Management Act 1991* (Cth). AFMA jurisdiction covers the area of ocean from the coastline (under State-Commonwealth Offshore Constitutional Settlement Arrangements [OCS]) or from 3 nm from the coast out to the 200 nm limit (the Australian Fishing Zone (AFZ)). OCS arrangements are joint management arrangements of marine living resources that are found in waters subject to both Commonwealth and State control. Such arrangements provide for the management of the resources by the Commonwealth or respective State from the shoreline out to 200nm. Commonwealth commercial fisheries with authority to fish within the Activity Planning Area and Environmental Planning Area are:

- Bass Strait Central Zone Scallop Fishery (Bass Strait CZSF)
- Eastern Tuna and Billfish Fishery (ETBF)
- Skipjack Tuna Fishery (Eastern)
- Small Pelagic Fishery (SPF)
- Southern Bluefin Tuna Fishery (SBTF)
- Southern and Eastern Scalefish and Shark Fishery (SESSF)
- Southern Squid Jig Fishery
- Western Tuna and Billfish Fishery (ETBF)

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in the following sections. Maps of relative fishing intensity for 2010 – 2020 and the Activity Planning Area and Environmental Planning Area are also provided.

The maps show the maximum area fished and the fishing intensity for each fishery. Fishing intensity (in kilograms of catch per square kilometre) is classified in shades of red, orange, and green to show high, medium, and low intensity classes, respectively. The data attributes include the class, the range of values in the class and the unit of measure. The maximum area fished shows the area fished by all fishers aggregated by 1-degree (111 km × 111 km) grid cells. The data provided by AFMA has been filtered to exclude catch from analysis areas where fewer than 5 boats operated during a given year.

Data sources are from the Commonwealth Fishery Status Report 2022 (Patterson et al. 2022) and AFMA website (AFMA 2023).

Table 1 provides a summary of the Commonwealth fisheries with fishing intensity within the Activity Planning and Environmental Planning Areas.

Table 1: Summary of Commonwealth Fisheries with Fishing Intensity within the Activity Planning and Environmental Planning Areas

Fishery	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area	Note
Bass Strait Central Zone Scallop Fishery	No	Yes	The Activity Planning Area and Environmental Planning Area overlap the fishery maximum fished area but this is due to the size of the grids used for reporting as there have been no active scallop beds within the area of overlap. The Environmental Planning Area overlaps where there has been fishing intensity during 2010 – 2020.
Eastern Tuna and Billfish Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the fishery maximum fished area. The Activity Planning Area and Environmental Planning Area do not overlap where there has been fishing intensity during 2010 – 2020.
Skipjack Tuna Fishery (Eastern)	No	No	Not currently active. There has been no catch effort in the fishery since the 2008 - 2009 season.
Small Pelagic Fishery (Western sub-area)	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the fishery maximum fished area. The Activity Planning Area and Environmental Planning Area do not overlap where there has been fishing intensity during 2009 – 2020.
Southern Bluefin Tuna Fishery (SBTF)	No	No	The Activity Planning Area and Environmental Planning Area do not overlap the fishery maximum fished area or were there has been fishing intensity during 2010 – 2020. Between May and October Southern Bluefin Tuna may migrate through the Activity Planning and Environmental Planning Areas.

Fishery	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area	Note
Southern and Eastern Scalefish and Shark Fishery (SESSF) Shark Gillnet and Hook Sector	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the Shark Hook Sub-Sector fishery maximum fished area. The Environmental Planning Area overlaps the Shark Hook Sub-Sector where there has been fishing intensity during 2010 – 2020. The Activity Planning Area and Environmental Planning Area overlap the Shark Net Sub-Sector maximum fished area and where there has been fishing intensity during 2010 – 2020.
Southern and Eastern Scalefish and Shark Fishery (SESSF) Commonwealth Trawl Sector and Scalefish Hook Sector	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the Commonwealth Trawl Sub-sector maximum fished area and where there has been fishing intensity (otter trawl only not Danish seine) during 2010 – 2020. The Activity Planning Area and Environmental Planning Area overlap the Scalefish Hook Sector maximum fished area and where there has been fishing intensity during 2010 – 2020.
Southern Squid Jig Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the Southern Squid Jig Fishery and Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Squid maximum fished area and where there has been fishing intensity during 2010 – 2020.
Western Tuna and Billfish Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the Western Tuna and Billfish Fishery maximum fished area. The Activity Planning Area and Environmental Planning Area do not overlap where there has been fishing intensity during 2010 – 2020.

Bass Strait Central Zone Scallop Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Bass Strait Central Zone Scallop Fishery	Scallops	Fishery operates in the Bass Strait between the Victorian and Tasmanian and starts at 20 nm from their respective coastlines. Commercial scallops in the Bass Strait Central Zone Scallop Fishery are mainly found at depths of 35 - 100 m and are caught using a steel dredge that is towed by the vessel along muddy to coarse sand substrates. Fishing effort is concentrated around King and Flinders Islands which are outside of the Regia Activity Planning Area. Currently there are 10 active boats using towed dredges. Fishing season is 1 April to 31 December. Actual catch in 2021 was 2,344 tonnes. The major landing ports are Beauty Point, Devonport, and Stanley (Tasmania); Apollo Bay, Lakes Entrance, Melbourne, Port Welshpool, Queenscliff and San Remo (Victoria) Total fishery value in 2021 was A$4.7 million. In the 2021 fishing season there were 10 active vessels. The Activity Planning Area and Environmental Planning Area overlap the fishery maximum fished area, though fishing intensity from 2010 – 2020 has been to the east of the Activity Planning Area within the Environmental Planning Area (Figure 2). The area of overlap with the Activity Planning Area is due to the size of the grids used for reporting as there have been no active scallop beds within the area of overlap. Historical and current scallop beds are to the east and north of King Island outside of the Activity Planning Area (Koopman and Knuckey 2023). Fishing mortality: not subject to overfishing. Biomass: Not over fished.	No	Yes

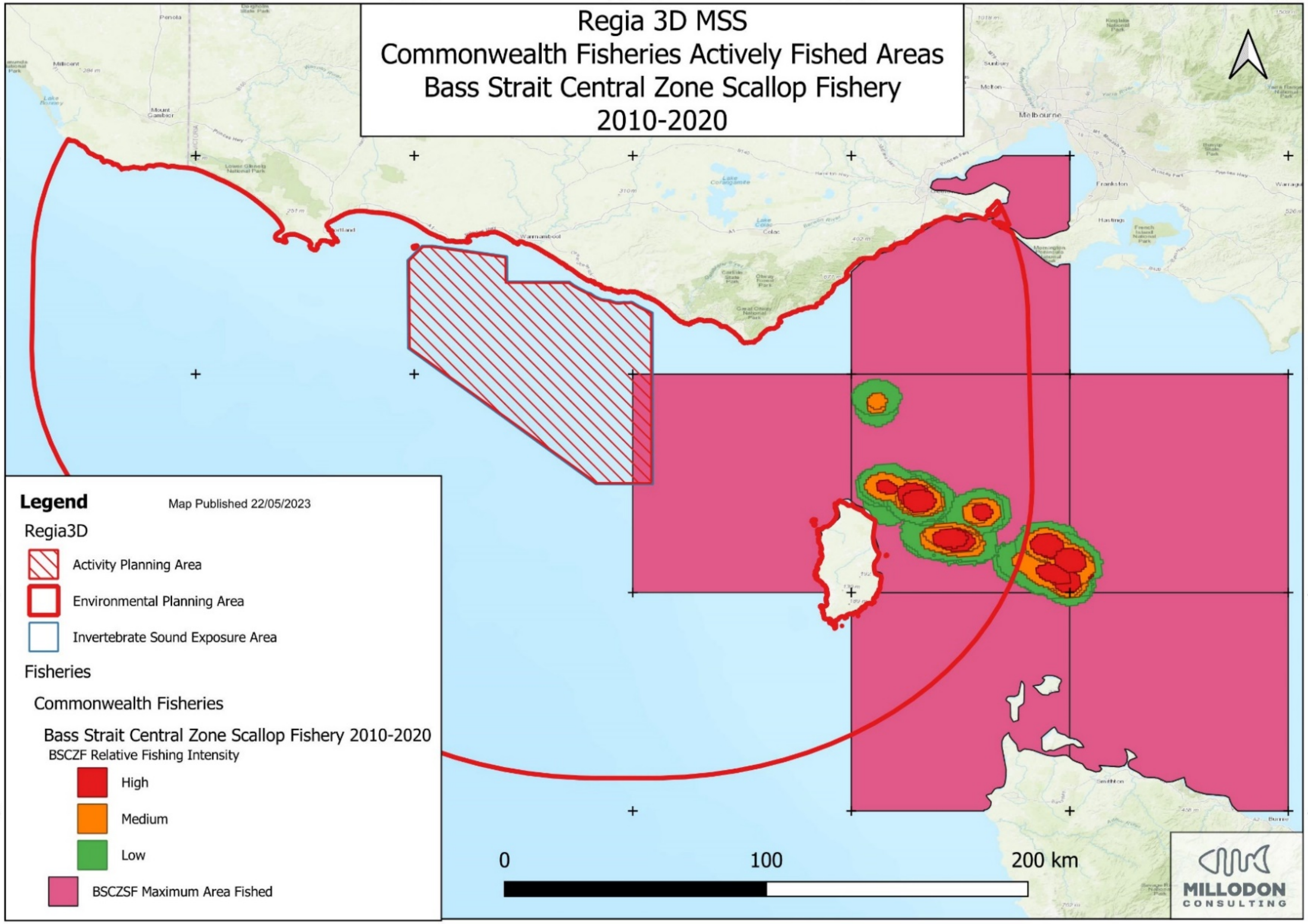

Figure 2: Bass Strait Central Zone Scallop Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Eastern Tuna and Billfish Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Eastern Tuna and Billfish Fishery	Albacore tuna Bigeye tuna Yellowfin tuna Swordfish Striped marlin	A longline and minor line fishery that operates in water depths > 200 m from Cape York to Victoria. Fishery effort is typically concentrated along the NSW coast and southern Queensland coast (Figure 3). No Victorian ports are used. In 2017 there was some fishing effort in Victoria at low levels. The number of active vessels has decreased within the fishery from around 152 in 1999 to 35 in 2021. Actual catch in the 2021 season was 5,148 tonnes. Total fishery value in 2021 was A$35.6 million. The Activity Planning Area and Environmental Planning Area overlap the fishery maximum fished area, though fishing intensity from 2010 – 2020 has been along the NSW coast and southern Queensland coast (Figure 3). Fishing mortality: not subject to overfishing. Biomass: Over fished – striped marlin. All other species not overfished.	Yes	Yes

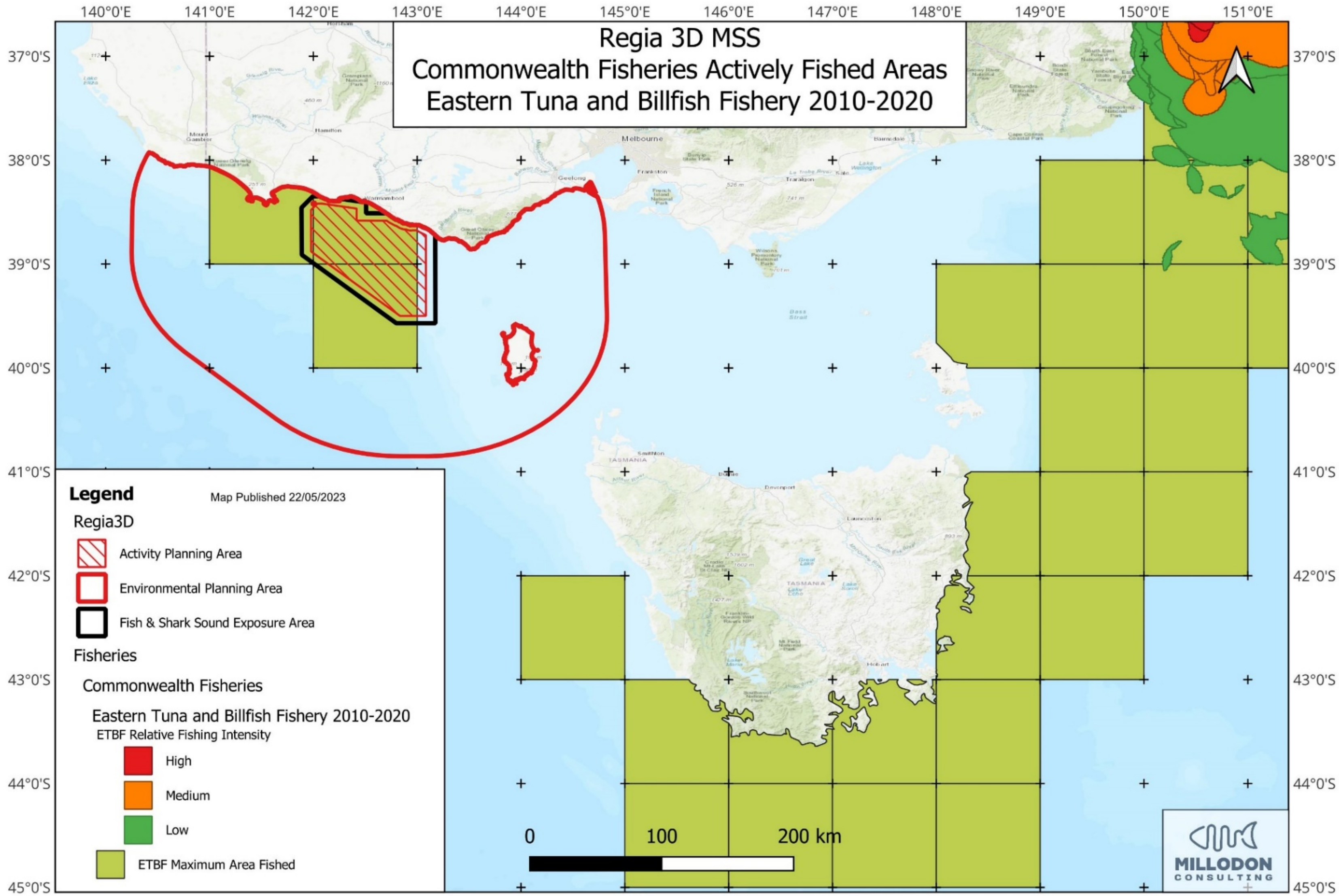

Figure 3: Eastern Tuna and Billfish Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Small Pelagic Fishery (Western sub-area)

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Small Pelagic Fishery (Western sub-area)	Australian sardine Blue mackerel Jack mackerel Redbait	The Small Pelagic Fishery extends from the southern Queensland to southern Western Australia. Fishers use midwater trawls and purse seine nets. Geelong is a major landing port. Total retained catch of the four target species was 18,878 tonnes in the 2021-22 season. Fishery effort generally concentrated in the near-shore Great Australian Bight to the west and south of Port Lincoln. The Environmental Planning Area and a small part of the Activity Planning Area overlap the fishery maximum fished area. There has been no ABARES classified fishing intensity from 2009 – 2020 in the Activity Planning Area or Environmental Planning Area (Figure 4). Fishing mortality: not subject to overfishing. Biomass: Not over fished.	Yes	Yes

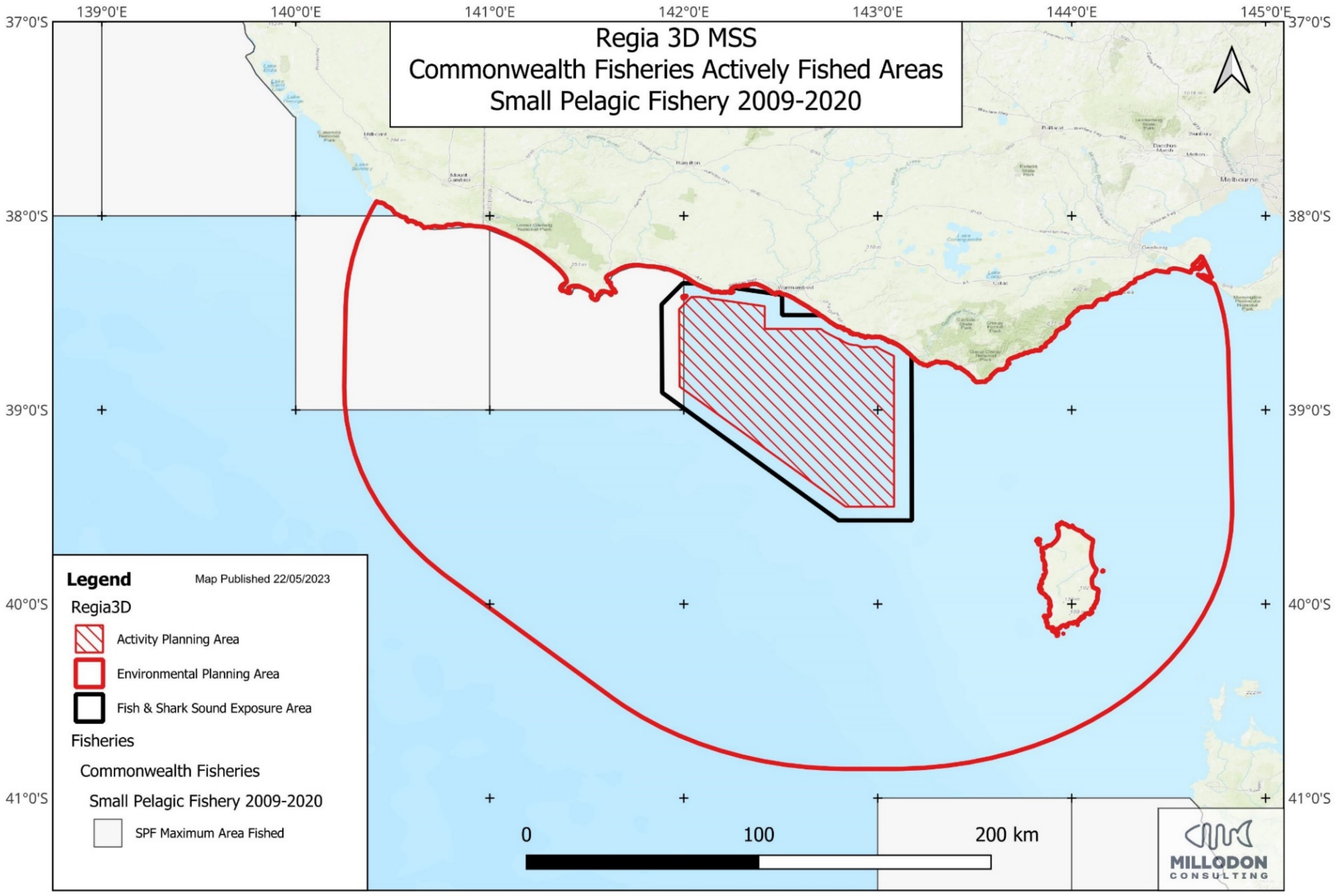

Figure 4: Small Pelagic Fishery (Western sub-area) Fishing Effort within the Activity Planning Area and Environmental Planning Area

Southern Bluefin Tuna Fishery (SBTF)

Fishery	**Target species**	**Description**	**Fishing activity within the Activity Planning Area**	**Fishing Activity within the Environmental Planning Area**
Southern Bluefin Tuna Fishery (SBTF)	Southern bluefin tuna	The SBTF covers the entire sea area around Australia, out to 200 nm from the coast. Southern bluefin tuna are also commonly caught off the NSW coastline. In this area, fishers catch these fish using the longline fishing method. A pelagic longline and purse seine fishery that was worth $41.39 million in 2020-21 (actual catch was 5,646 tonnes). The fishery operates year-round. Fishery effort is generally concentrated in the Great Australian Bight and off the southern NSW coast. The Activity Planning Area and Environmental Planning Area do not overlap the fishery maximum fished area or where there has been classified fishing intensity from 2010 – 2020 (Figure 5). Between May and October, when the waters off NSW and Victoria are cooler, Southern Bluefin Tuna may migrate through the Activity Planning and Environmental Planning Areas. Fishing mortality: not subject to overfishing. Biomass: Not over fished.	No	No

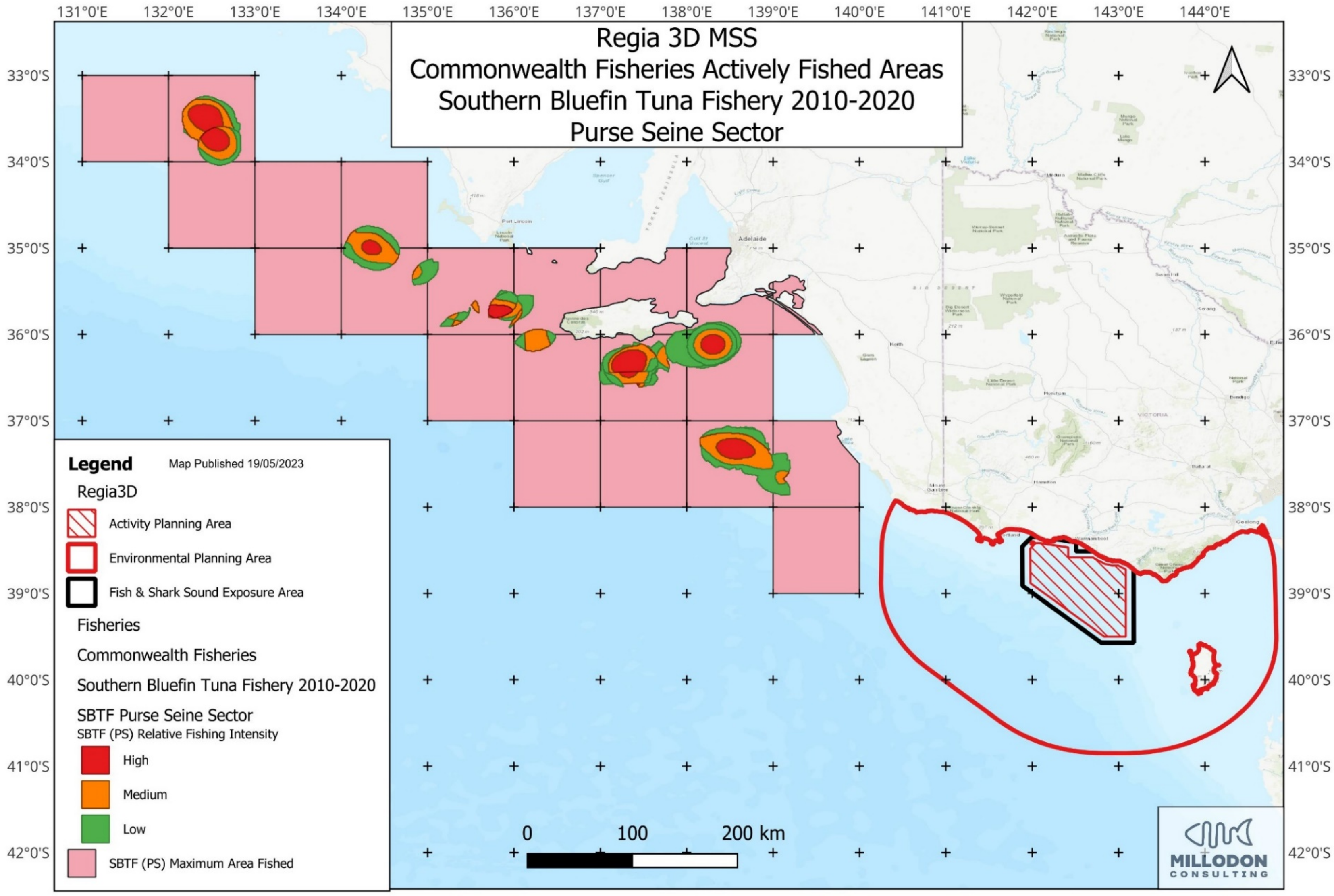

Figure 5: Southern Bluefin Tuna Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Gillnet and Hook Sector

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Southern and Eastern Scalefish and Shark Fishery (SESSF) Shark Gillnet and Hook Sector	Elephantfish Gummy shark Sawsharks School shark	The Southern and Eastern Scalefish and Shark Fishery (SESSF) stretches south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern Western Australia. The shark gillnet and shark hook sectors (SGSHS) are part of the Gillnet, Hook and Trap Sector (GHTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). The SGSHS uses demersal gillnet and demersal longline to target gummy shark. Sawsharks and elephantfish are caught as by-products of fishing for gummy sharks. Most fishing in the sector using nets occurs in Bass Strait targeting elephantfish, gummy shark, sawsharks and school shark. Fishing is generally concentrated east of King Island. Most fishing using hooks occurs off South Australia (Figure 7). The Activity Planning Area and Environmental Planning Area overlap the Shark Hook Sub-Sector maximum fished area but there has only been classified fishing intensity from 2010 – 2020 in the Environmental Planning Area (Figure 6). The Activity Planning Area and Environmental Planning Area overlap the Shark Net Sub-Sector maximum fished area and where there has been fishing intensity from 2010 – 2020 (Figure 7). Total retained catch of the target species was 2,150 tonnes in the 2021-22 season. No value is provided for 2021-22 season. In 2020-21, the fishery value was A$28.84 million. In the 2021-2022 fishing season there were 27 active gillnet vessels and 40 active hook vessels. Fishing mortality: school shark is uncertain. Biomass: school shark is over fished.	Yes	Yes

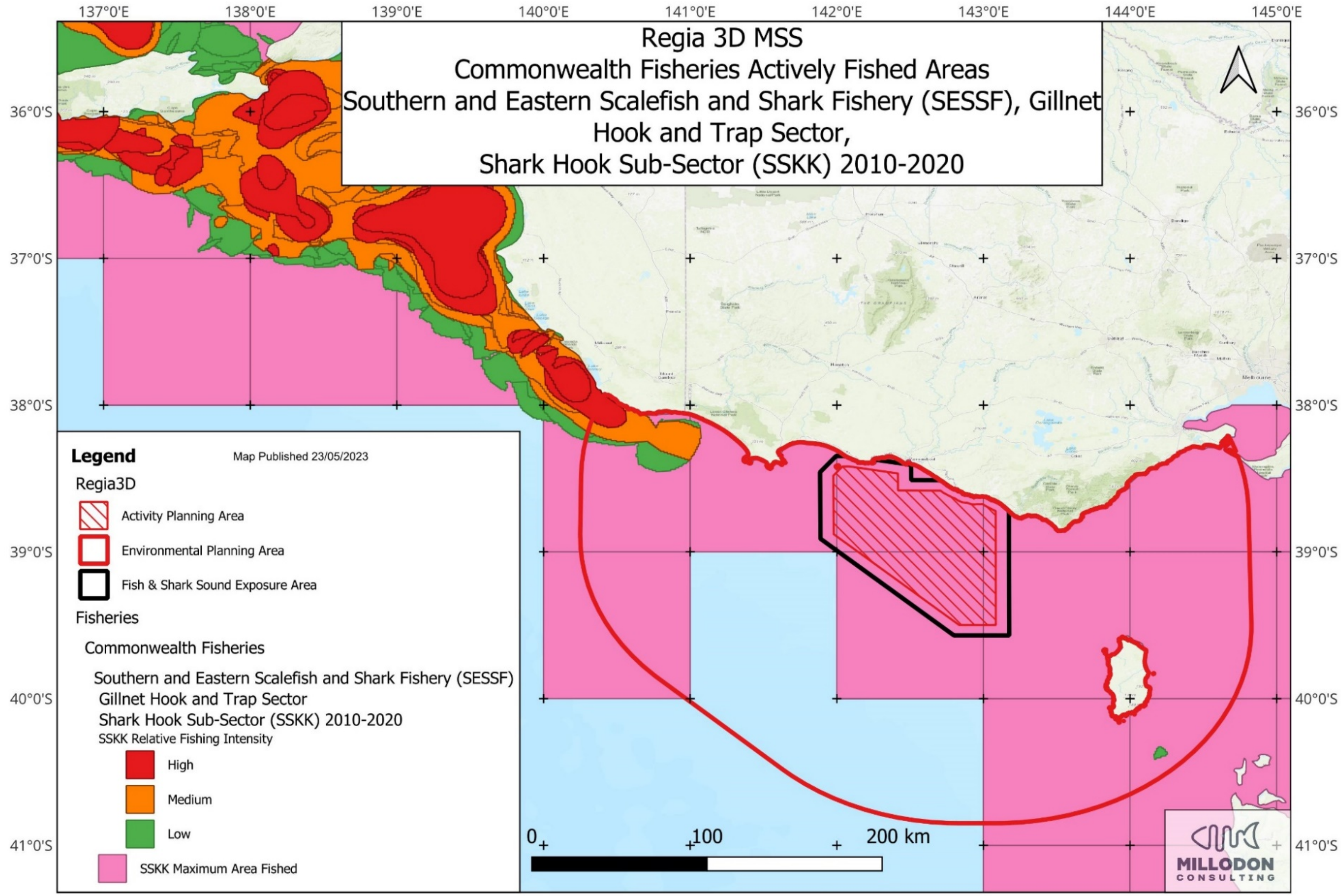

Figure 6: Southern and Eastern Scalefish and Shark Fishery Shark Hook Sub-Sector Fishing Effort within the Activity Planning Area and Environmental Planning Area

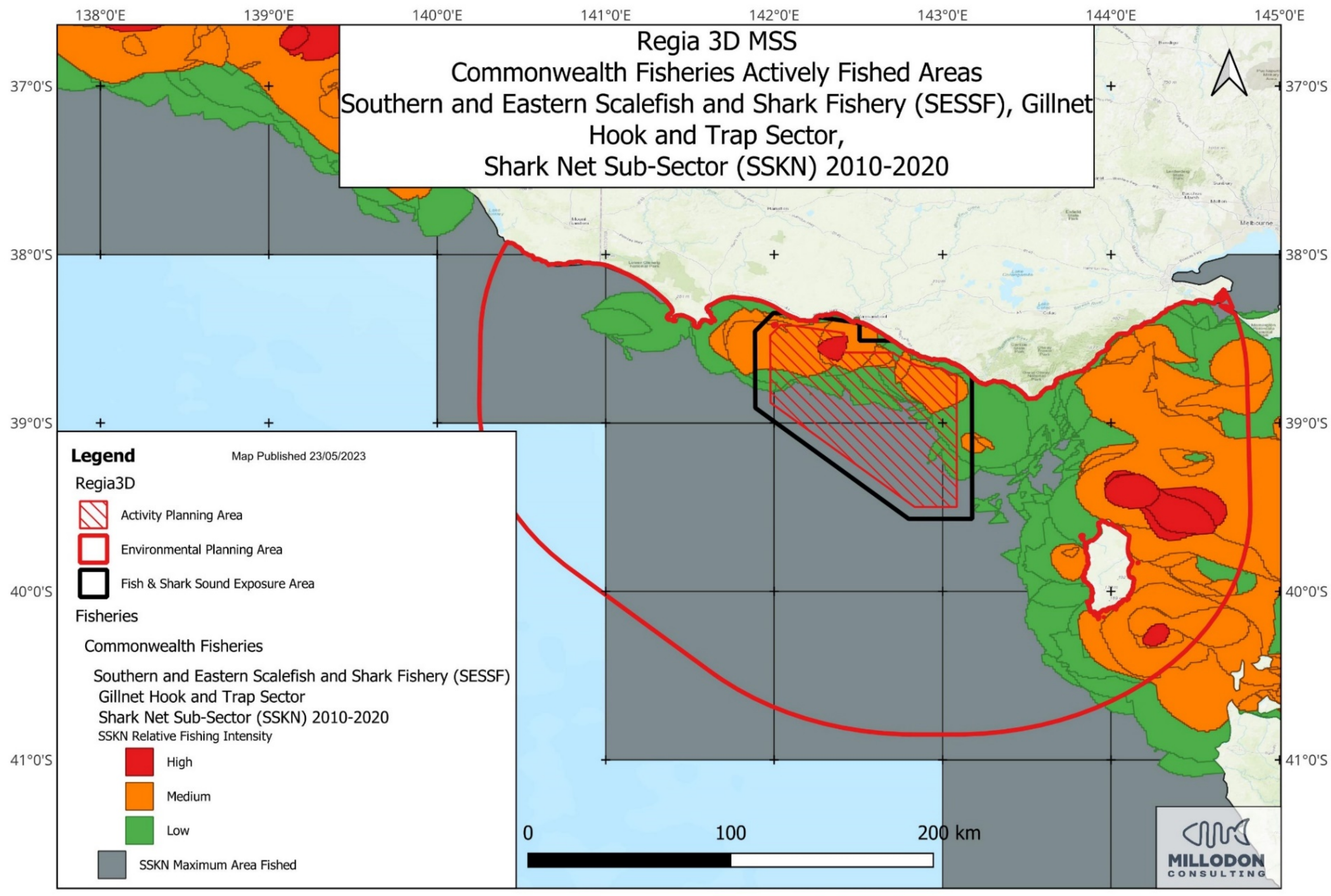

Figure 7: Southern and Eastern Scalefish and Shark Fishery Shark Net Sub-Sector Fishing Effort within the Activity Planning Area and Environmental Planning Area

Southern and Eastern Scalefish and Shark Fishery (SESSF) - Commonwealth Trawl Sector and Scalefish Hook Sector

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Southern and Eastern Scalefish and Shark Fishery (SESSF) Commonwealth Trawl Sector Scalefish Hook Sector	Blue-eye trevalla Blue grenadier Eastern school whiting Orange roughy Pink ling Ribaldo Tiger flathead	The Commonwealth Trawl Sector of the SESSF extends south from Barrenjoey Point in northern New South Wales to east of Kangaroo Island off South Australia. The Commonwealth Trawl Sector is a multispecies fisheries, targeting a variety of fish and shark species. The Commonwealth Trawl Sector and Scalefish Hook Sector are reported together as they share many target species. A multi-sector, multi-species fishery that uses a range of gear year-round targeting fish and shark species. Fishing is generally concentrated along the 200 m bathymetric contour. The Commonwealth Trawl Sector predominantly uses demersal otter trawl and Danish-seine fishing methods. The Scalefish Hook Sector uses a variety of longline and dropline hook fishing methods, some of which are automated. The Activity Planning Area and Environmental Planning Area overlap the Commonwealth Trawl Sub-sector maximum fished area and where there has been fishing intensity from 2010 – 2020 (Figure 8). Though the Activity Planning Area and Environmental Planning Area overlap the Danish Seine Sub-sector maximum fished area but not where there has been ABARES classified fishing intensity from 2010 – 2020 in either area (Figure 9). The Activity Planning Area and Environmental Planning Area overlap the Scalefish Hook Sector maximum fished area and where there has been low fishing intensity from 2010 – 2020 (Figure 10). In the 2021 – 2022 season there where 32 trawl, 19 Danish-seine and 21 scalefish hook vessels operating. Total retained catch of the target species was 19,501 tonnes in the 2021-22 season. No value is provided for 2021-22 season. In 2020-21, the fishery value was A$64 million. Fishing mortality: some species subject to overfishing. Biomass: some species over fished.	Yes	Yes

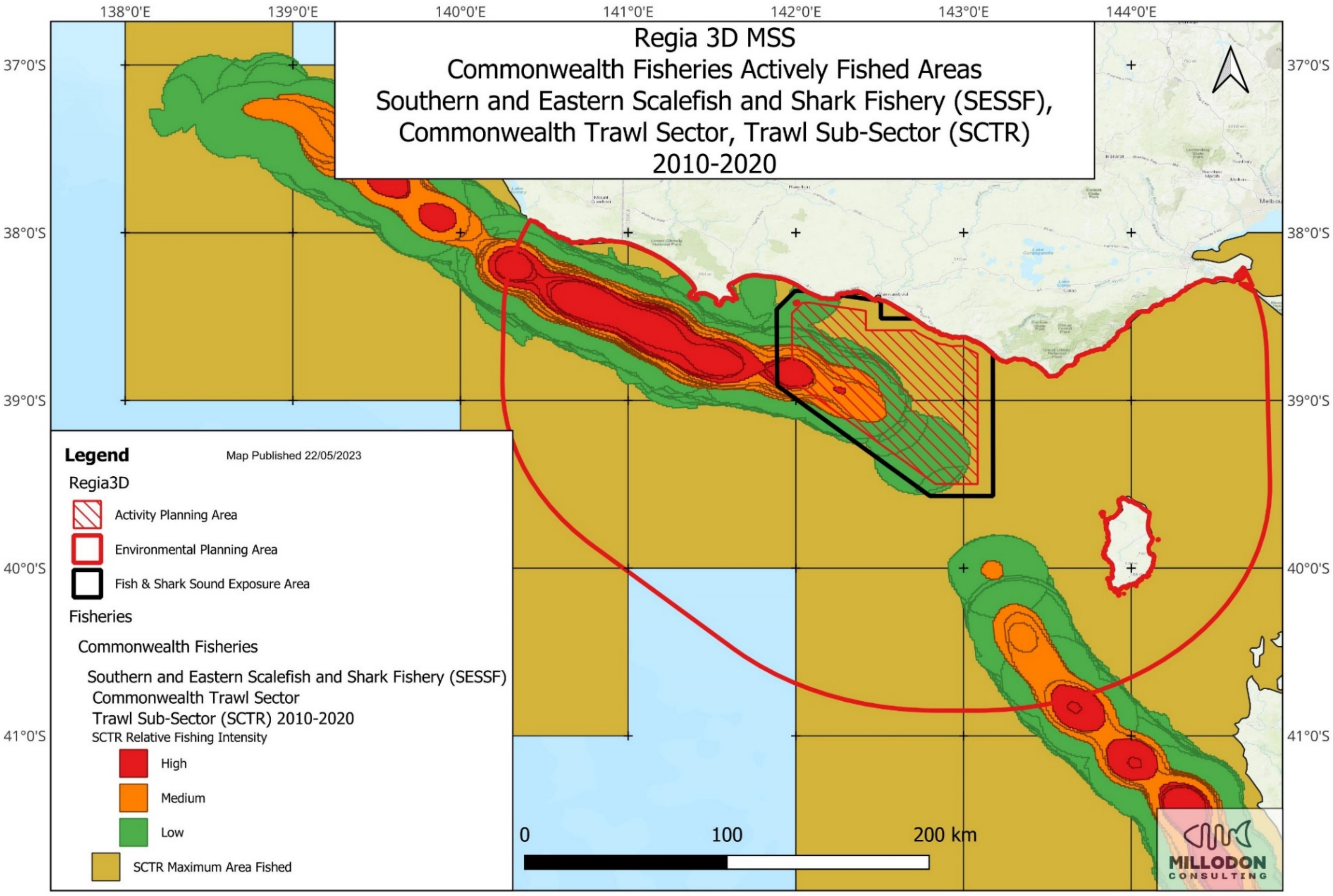

Figure 8: Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sub-Sector Fishing Effort within the Activity Planning Area and Environmental Planning Area

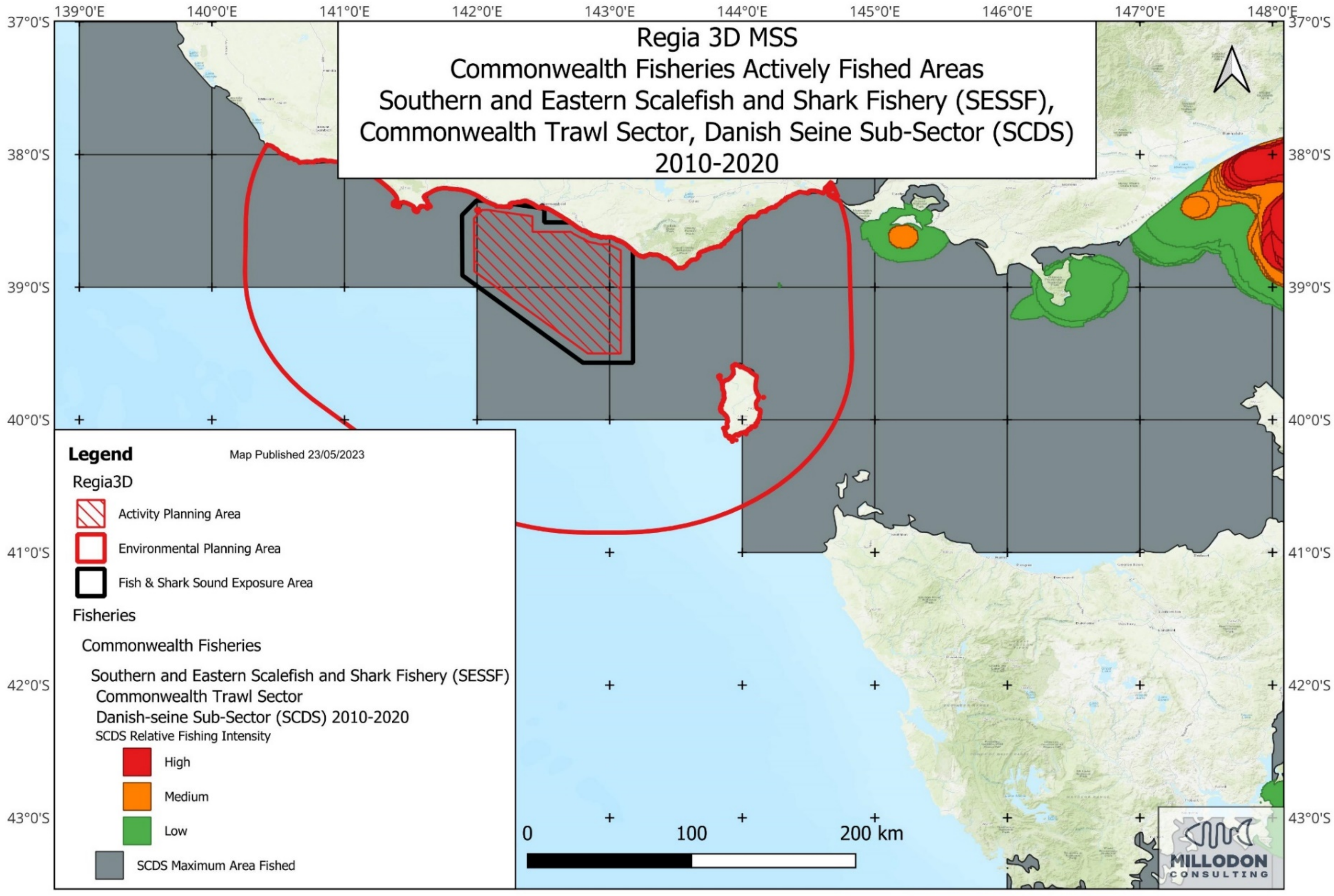

Figure 9: Southern and Eastern Scalefish and Shark Fishery Danish Seine Sub-Sector Fishing Effort within the Activity Planning Area and Environmental Planning Area

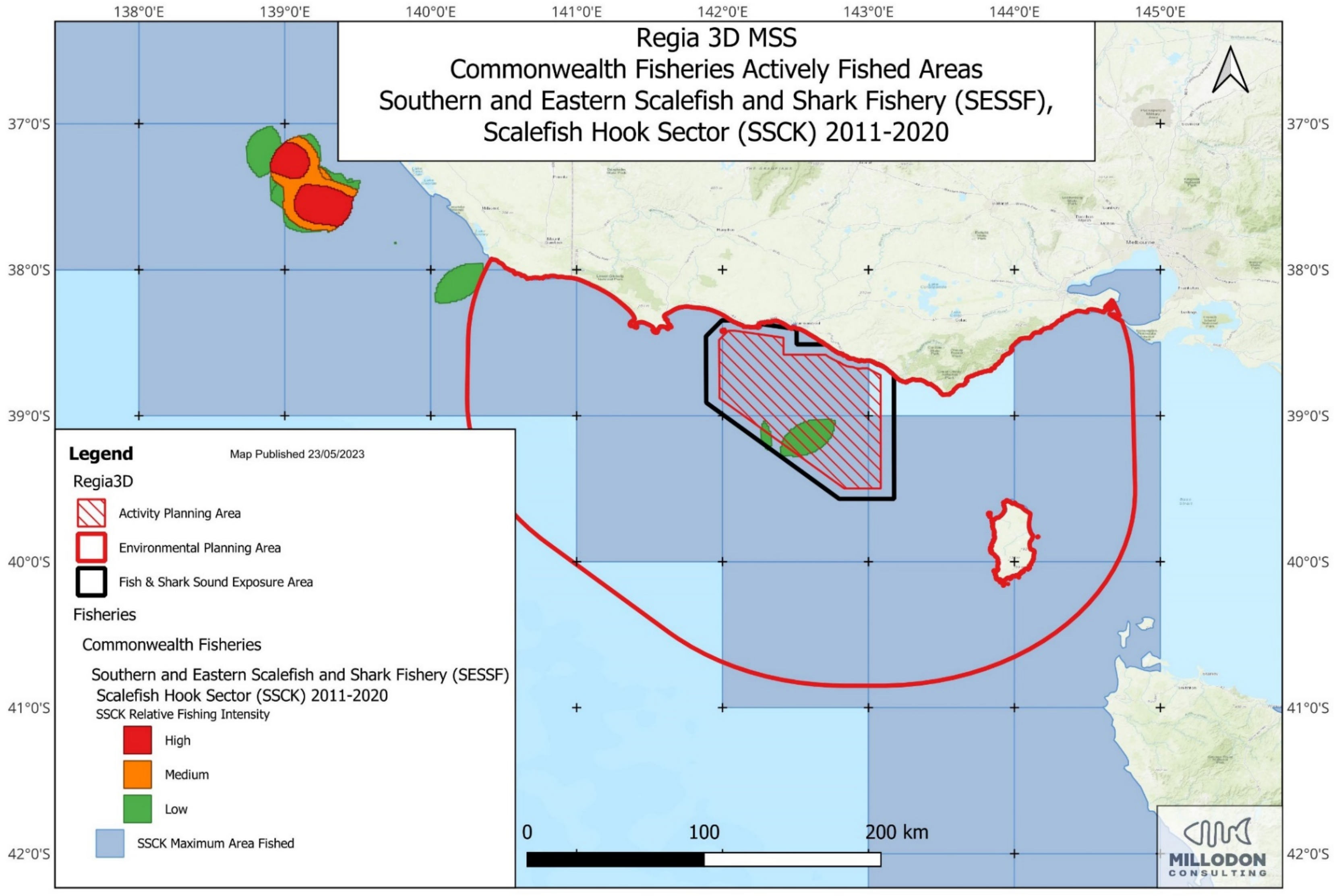

Figure 10: Southern and Eastern Scalefish and Shark Fishery Scalefish Hook Sector Fishing Effort within the Activity Planning Area and Environmental Planning Area

Southern Squid Jig Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Southern Squid Jig Fishery	Gould's squid (arrow squid)	A single species fishery that operates year-round. Portland and Queenscliff are the major Victorian landing ports. Jigging typically occurs midwater at depths between 50 and 100 m at night using large lights that illuminate the waters around a boat. The Commonwealth Trawl Fishery also catches Gould' squid. The Activity Planning Area and Environmental Planning Area overlap the Southern Squid Jig Fishery maximum fished area and where there has been fishing effort from 2010 – 2020 (shown as relative fishing intensity on Figure 11). The Activity Planning Area and Environmental Planning Area overlap the Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Squid maximum fished area and where there has been classified fishing intensity from 2010 – 2020 (Figure 12). In 2021, the actual catch of 939 tonnes was worth A$3.30 million. In 2021 there were eight active vessels in the fishery with the landing ports being Triabunna (Tasmania); Queenscliff and Apollo Bay (Victoria). Fishing mortality: not subject to overfishing. Biomass: Not over fished.	Yes	Yes

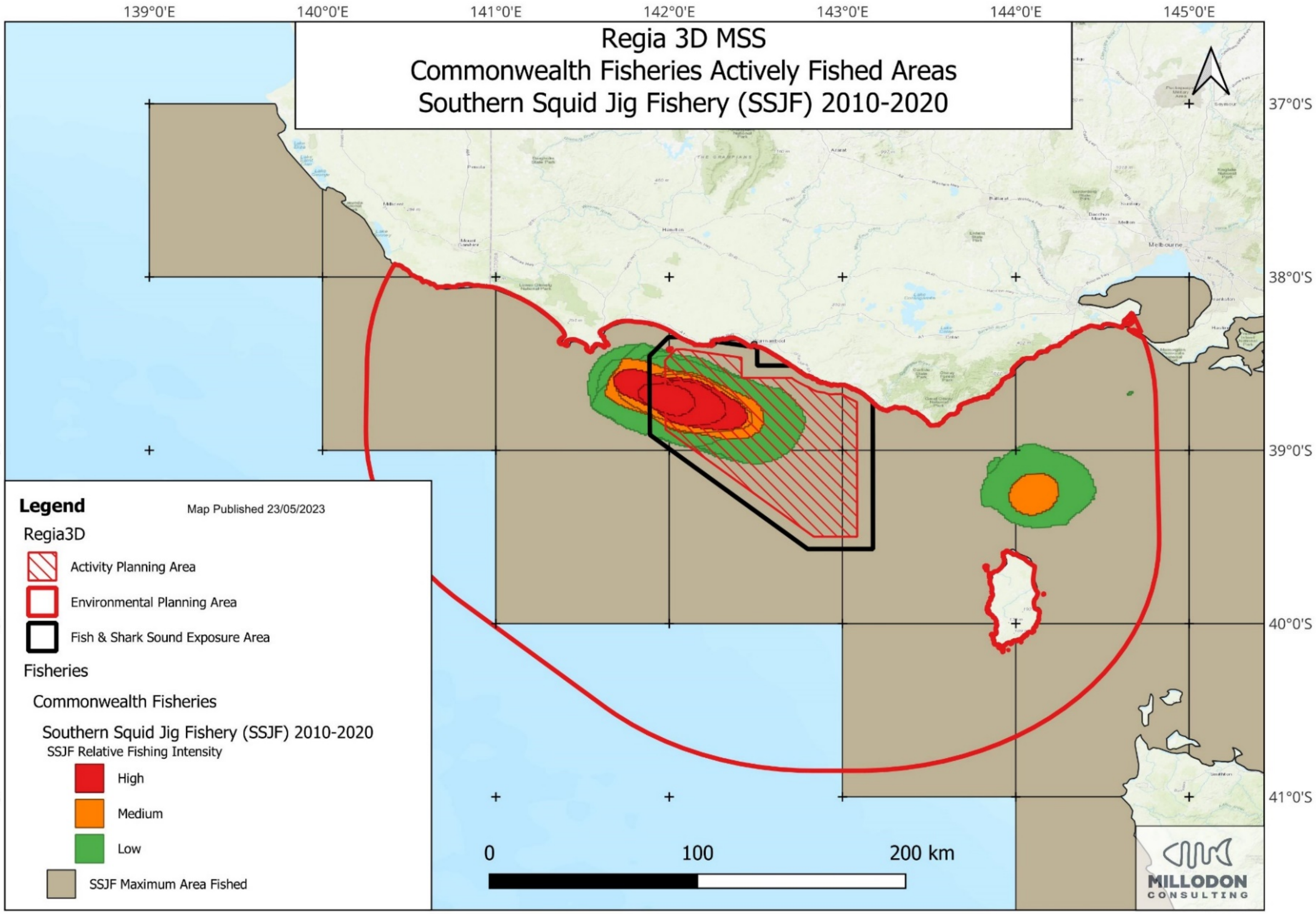

Figure 11: Southern Squid Jig Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

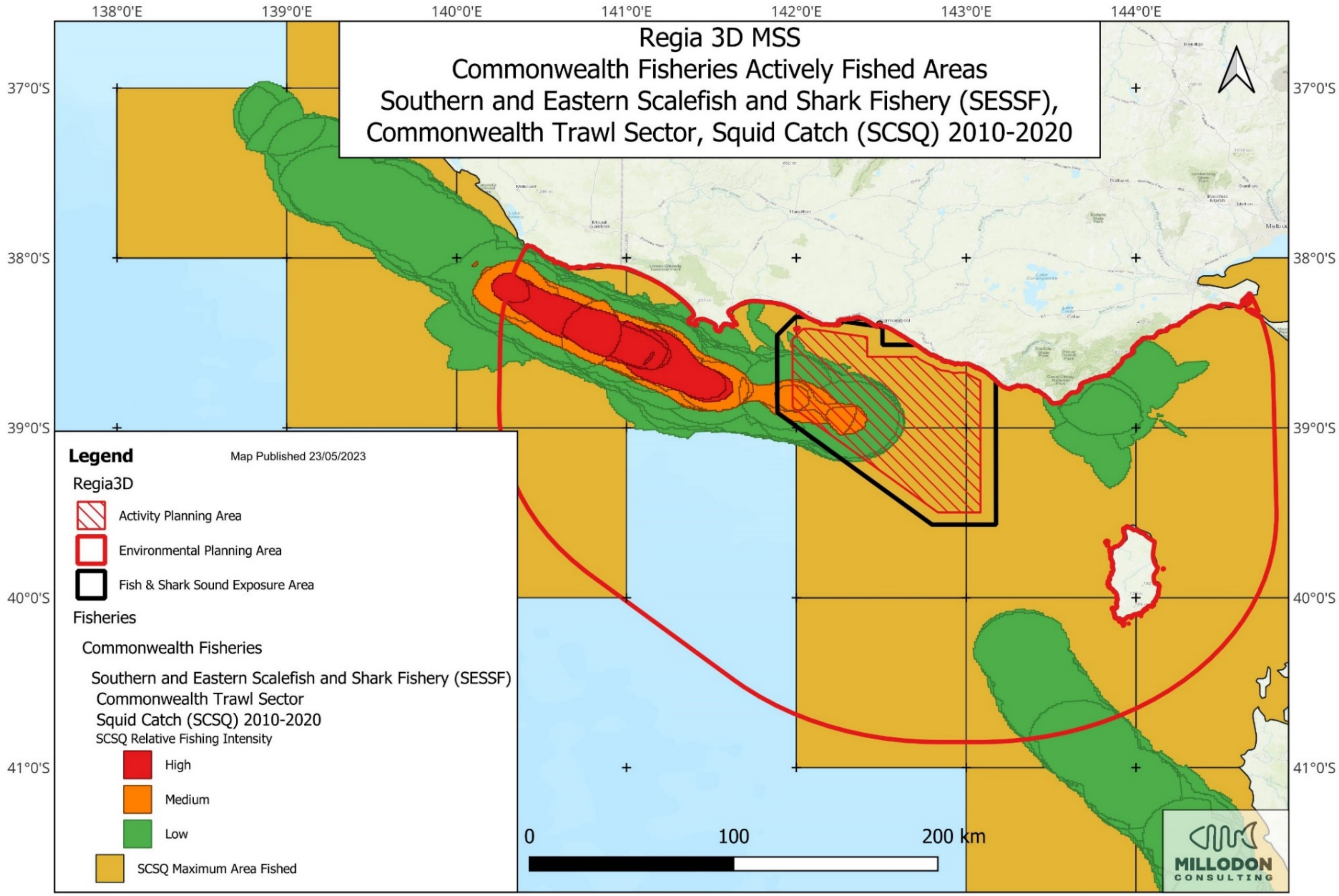

Figure 12: Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Squid Fishing Effort within the Activity Planning Area and Environmental Planning Area

Western Tuna and Billfish Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Western Tuna and Billfish Fishery	Albacore tuna Bigeye tuna Yellowfin tuna Broadbill swordfish Striped marlin	The Western Tuna and Billfish Fishery (WTBF) operates in Australia's Exclusive Economic Zone and high seas of the Indian Ocean. In recent years, fishing effort has concentrated off south-west Western Australia, with occasional activity off South Australia. The main fishing gear in the WTBF is pelagic longline, with low levels of minor-line fishing. The Activity Planning Area and Environmental Planning Area overlap the Western Tuna and Billfish Fishery maximum fished area but not where there has been classified fishing intensity from 2010 – 2020 (Figure 12). No Victorian ports are used. Actual catch in the 2021 season was 252 tonnes with the fishery value confidential due to only two active vessels. Fishing mortality: all except swordfish subject to overfishing. Biomass: Over fished – striped marlin. All other species not overfished.	Yes	Yes

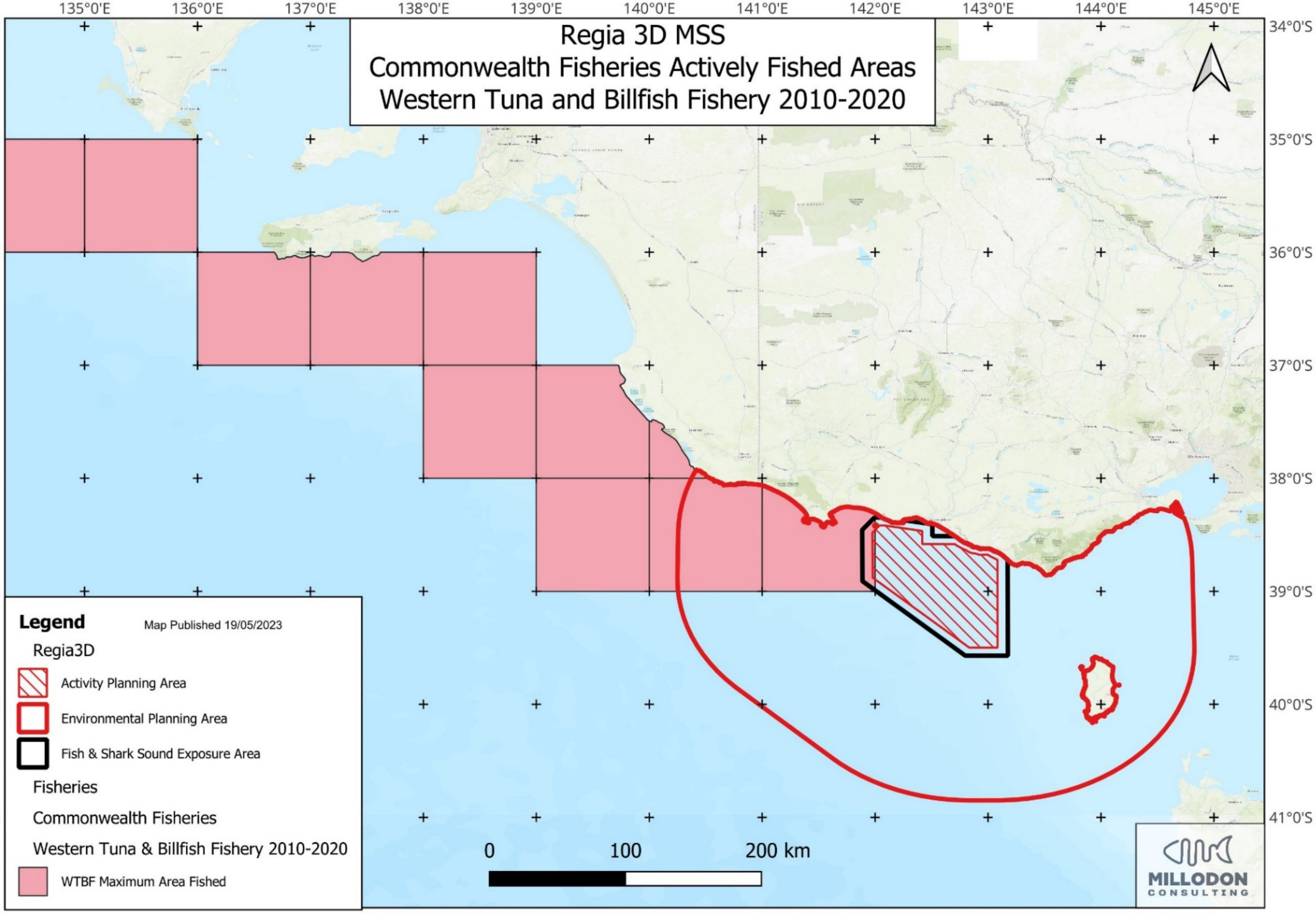

Figure 13: Western tuna and Billfish Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Victorian Fisheries

Victorian fisheries are managed by the Victorian Fisheries Authority (VFA) under the *Fisheries Act 1995* (Cth). VFA has regulatory responsibility for the management of fisheries in Victorian State Waters out to 3 nm and Commonwealth waters where the VFA manage fisheries on behalf of the Commonwealth under the Offshore Constitutional Settlement (OCS) arrangements. OCS arrangements are joint management arrangements of particular marine living resources that are found in waters subject to both Commonwealth and State control. Such arrangements allow for the management of the resources by State authorities, even in waters outside the State 3 nm territorial sea boundary. In Victoria, such arrangements are in place out to 20 nm for key species such as scallop and rock lobster.

Victorian commercial fisheries with jurisdictions to fish within the Activity Planning Area and Environmental Planning Area are:

- Abalone Fishery
- Bays and Inlet Fisheries
- Eel Fishery
- Giant Crab Fishery
- Multi-species Ocean Fisheries
- Octopus Fishery
- Pipi Fishery
- Rock Lobster Fishery
- Scallop (Ocean) Fishery
- Wrasse (Ocean) Fishery

No areas where aquaculture or seaweed harvesting occurs where identified within the Activity Planning Area and Environmental Planning Area.

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in the following sections. Maps are also provided showing where catch and effort has been reported in a VFA grid between 2011 – 2022 in relation to the Activity Planning Area and Environmental Planning Area.

Data sources are from the Victorian Fisheries Authority Commercial Fish Production Information Bulletin July 2021 to June 2022 (VFA 2022) and VFA website (VFA 2023).

Table 2 provides a summary of the Victorian fisheries with catch and effort within the Activity Planning and Environmental Planning Areas.

Table 2: Summary of Victorian Fisheries with Fishing Catch and Effort within the Activity Planning and Environmental Planning Areas

Fishery	**Fishing activity within the Activity Planning Area**	**Fishing Activity within the Environmental Planning Area**	**Note**
Abalone Fishery	No	Yes	The Activity Planning Area does not overlap the fishery while the Environmental Planning Area overlaps the Western and Central zones of the fishery.
Bays and Inlet Fisheries	No	No	The fishery is not within the Activity Planning Area or Environmental Planning Area.
Eel Fishery	No	No	As the Activity Planning Area or Environmental Planning Area does not overlap with coastal river basins there is no overlap with this fishery. The Activity Planning Area or Environmental Planning Area may overlap where glass eels migrate.
Giant Crab Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Giant Crab Fishery.
Multispecies Ocean Fisheries – Ocean General	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Ocean General Fishery.
Octopus Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Octopus Fishery.
Pipi Fishery	No	Yes	The Environmental Planning Area overlaps the actively fished areas of the Discovery Bay zones of the Pipi Fishery.
Rock Lobster Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Rock Lobster Fishery.
Scallop Fishery	No	No	The Scallop Fishery does not operate within the Activity Planning Area or Environmental Planning Area.
Wrasse (Ocean) Fishery	Yes	Yes	The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Wrasse (Ocean) Fishery.

Abalone Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Abalone Fishery	Blacklip abalone Greenlip abalone	The Abalone Fishery is one of Victoria's most valuable commercial fisheries. It operates along most of the Victorian shoreline, generally to 30 m depth where abalone are harvested by divers. Fishing is only allowed between sunrise and sunset. Abalone catch effort data was not provided by VFA due to confidentiality requirements but based on water depths, the Activity Planning Area does not overlap the fishery, while the Environmental Planning Area overlaps the Western and Central zones of the fishery. As of June 2022, there were 14 licences in the Western Zone and 33 in the Central Zone. Total allowable commercial catch limits of blacklip abalone for the Western Zone are considerably less than the Central Zone (2021-22 season: 66 tonnes compared with 251.2 tonnes, respectively). Greenlip abalone total allowable commercial catch limits are considerably lower than for blacklip abalone with 1.6 tonnes for the Western Zone and 3.46 tonnes for the Central Zone.	No	Yes

Bays and Inlet Fisheries

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Bays and Inlet Fisheries	Multi-species	Multi-species, multi gear fishery utilising octopus pot, bay fish trap, commercial hoop net, seine net, mesh net, fishing line (including a longline), mussel rake underwater breathing apparatus and a hand operated bait pump. The larger bay and inlet fisheries include Western Port, Port Phillip Bay, Corner Inlet/Nooramunga and the Gippsland Lakes. These areas are not within the Activity Planning Area or Environmental Planning Area.	No	No

Eel Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Eel Fishery	Short-finned eel Long-finned eel	Eel are harvested in Victorian coastal river basins south of the Great Dividing Range. Short-finned eels are found across the State, while long-finned eels are only found in eastern Victoria. Both species spend the majority of their life cycle in fresh water or estuaries but travel to the ocean to spawn once before dying. Spawning is thought to occur in the vicinity of the Coral Sea, although no precise spawning location for either species has been identified. Eggs are thought to be pelagic and hatch after about two days. Larvae are transported southwards along the east coast of Australia where they metamorphose into glass eels and swim into coastal bays and estuaries. Most short-finned glass eels migrate in the winter and spring, while long-finned glass eels migrate during summer and autumn. Commercial fishers are only permitted to use fyke nets to take eels and the number, dimensions, and mesh size of fyke nets is prescribed by regulation. As the Activity Planning Area or Environmental Planning Area does not overlap with coastal river basins there is no overlap with this fishery. However, the Activity Planning Area or Environmental Planning Area may overlap where glass eels migrate.	No	No

Giant Crab Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Giant Crab Fishery	Giant crab	Giant crabs are fished commercially in western Victoria. The fishery is a small quota managed fishery that is closely linked with the Rock Lobster Fishery. The majority of vessels are used primarily for rock lobster fishing with giant crab taken as by-product. However, a small number of fishers target giant crabs and processors who specialise in exporting giant crab have developed technologies to store and transport live crabs to international markets. The boundaries of the fishery mimic those of the Rock Lobster Fishery, however the fishery is based in the Western Zone. Giant crabs inhabit the continental slope at approximately 200 metres depth and are most abundant along the narrow band of the shelf edge. Closed seasons are: • Male: 15 September to 15 November to protect males during moult. • Female: 1 June to 15 November to protect females while breeding and in berry (with eggs attached). Total landed catch in 2015-16 was 10 tonnes. Data since then is not available due to insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data). The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Giant Crab Fishery (Figure 14). Data from VFA for the last 5 years (2018 - 2022 shows the number of days fished in a block for that period (Figure 14). Fishing intensity is concentrated along the edge of the shelf with a maximum of 78 days fished in Activity and Environment Planning Area.	Yes	Yes

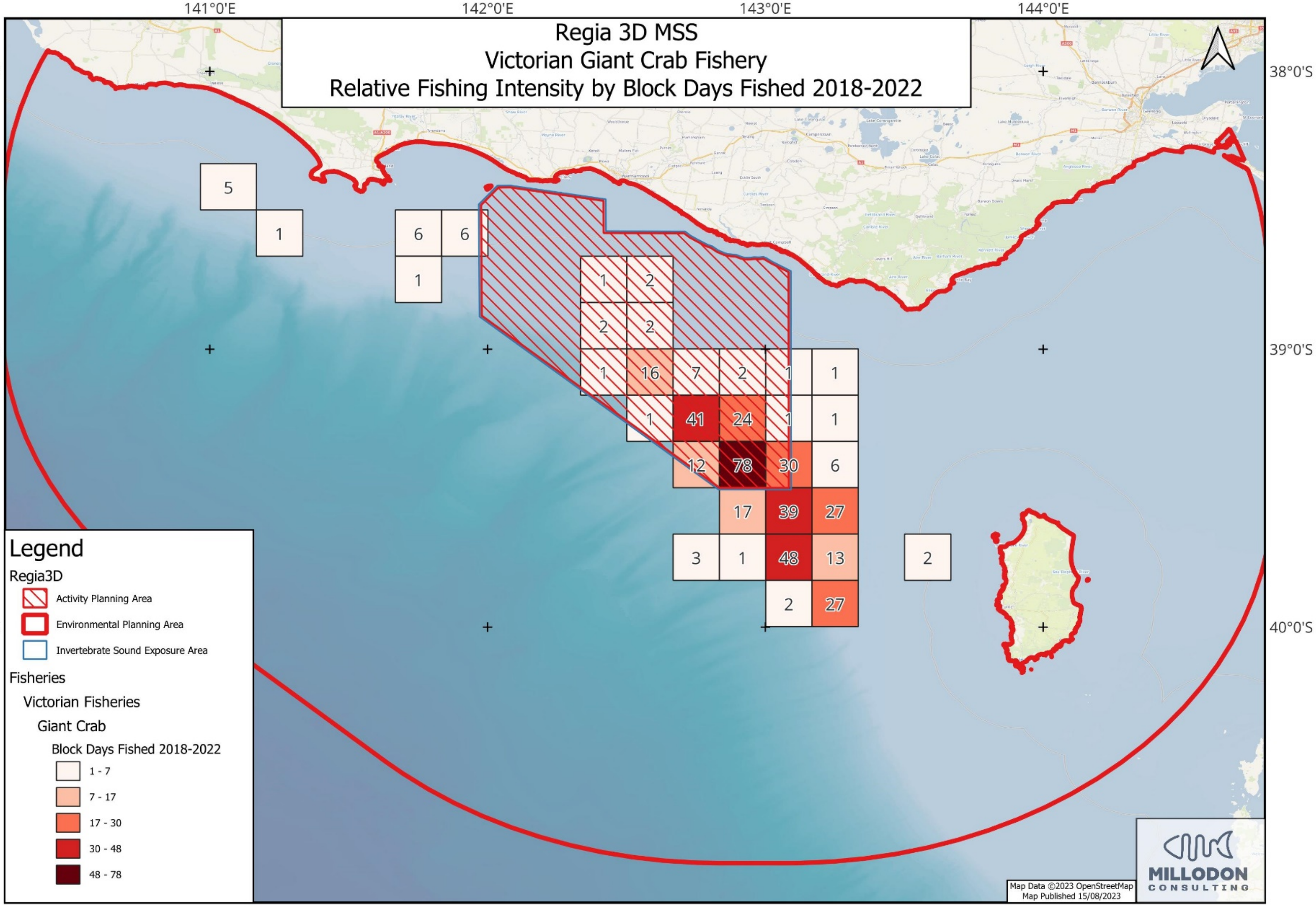

Figure 14: Giant Crab Fishery Relative Fishing Intensity within the Activity Planning Area and Environmental Planning Area

Multispecies Ocean Fisheries

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Multispecies Ocean Fisheries – Ocean General	Gummy shark School shark Australian salmon Snapper Small flathead bycatch	The wrasse, inshore trawl, southern rock lobster and giant crab fisheries are able to catch gummy shark and school sharks as part of their fishery. Snapper is caught using lines, nets and haul seine. Over 90% of the catch is from Port Phillip Bay, and around 5% from coastal waters. In 2020/21, 45 tonnes were landed but a value could not be provided as there is insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data). The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Ocean General Fishery (Figure 15). Data from VFA for the last 5 years (2018 - 2022 shows the number of days fished in a block for that period (Figure 15). Fishing intensity is concentration nearshore with a maximum of 79 days fished in Activity Planning Area and 363 days in the Environment Planning Area.	Yes	Yes

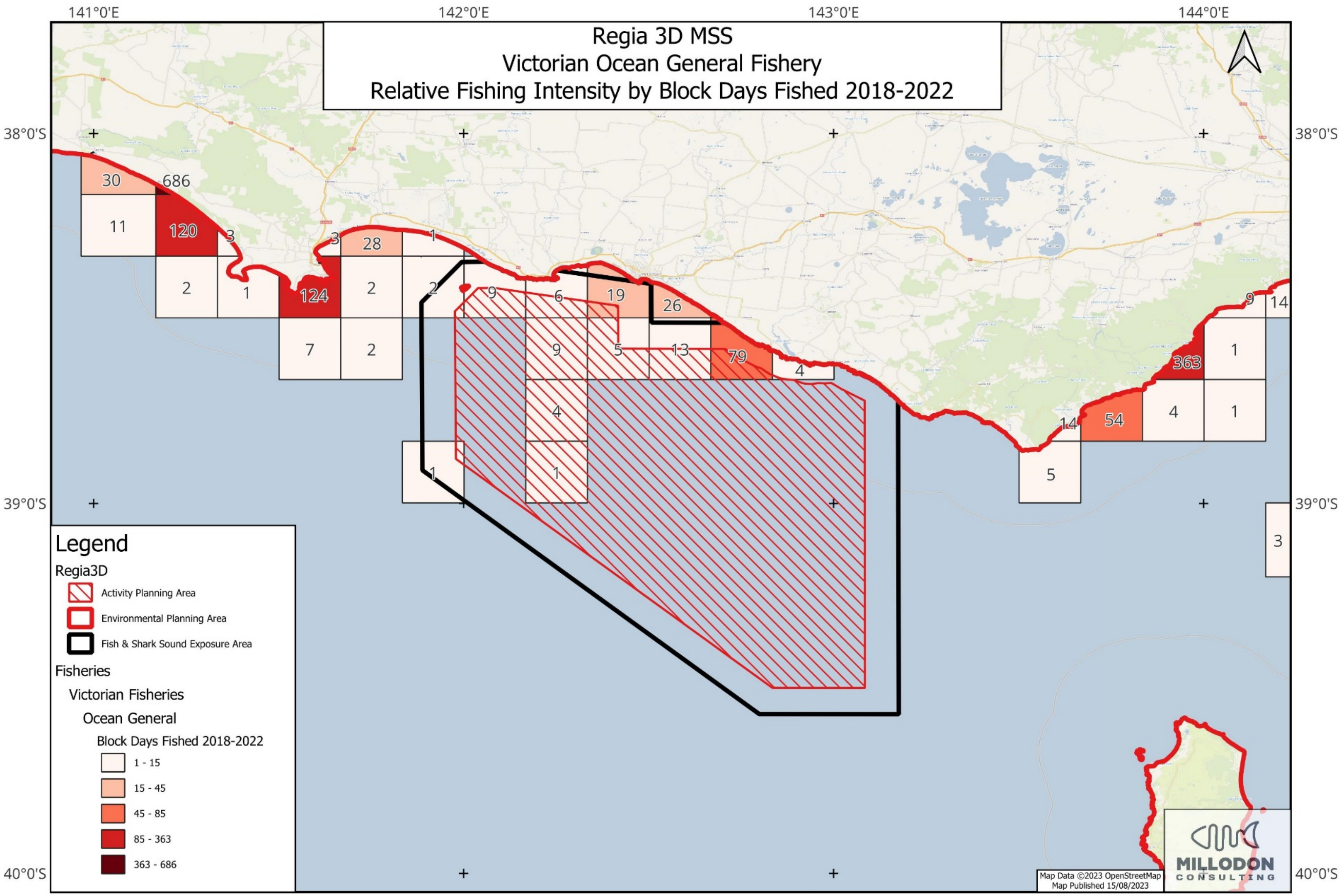

Figure 15: Ocean General Relative Fishing Intensity within the Activity Planning Area and Environmental Planning Area

Octopus Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Octopus Fishery	Pale octopus Maori octopus Gloomy octopus	Victoria's new Octopus (Eastern Zone) Fishery harvests mainly pale octopus in East Gippsland using purpose-built unbaited traps which minimise bycatch. The fishery may also catch Maori octopus and gloomy octopus. The fishery commenced on 1 August 2020. Three zones have been established for the management to commercial octopus fishing in Victoria: Eastern, Central and Western. Octopus Fishery Access Licences authorise commercial take of octopus from the Eastern Octopus Zone. Octopus fishing in the central and western octopus zones is less established and is being managed by the VFA through exploratory, temporary permits. The Activity Planning Area is within the Western Octopus Zone and the Environmental Planning Area is within the Western and Central Octopus Zones. The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Octopus Fishery (Figure 16). Data from VFA for the last 5 years (2018 - 2022 shows the number of days fished in a block for that period (Figure 16). Fishing intensity is concentration west of the Activity Planning Area with a maximum of 1 day fished in Activity Planning Area and 15 days in the Environment Planning Area.	Yes	Yes

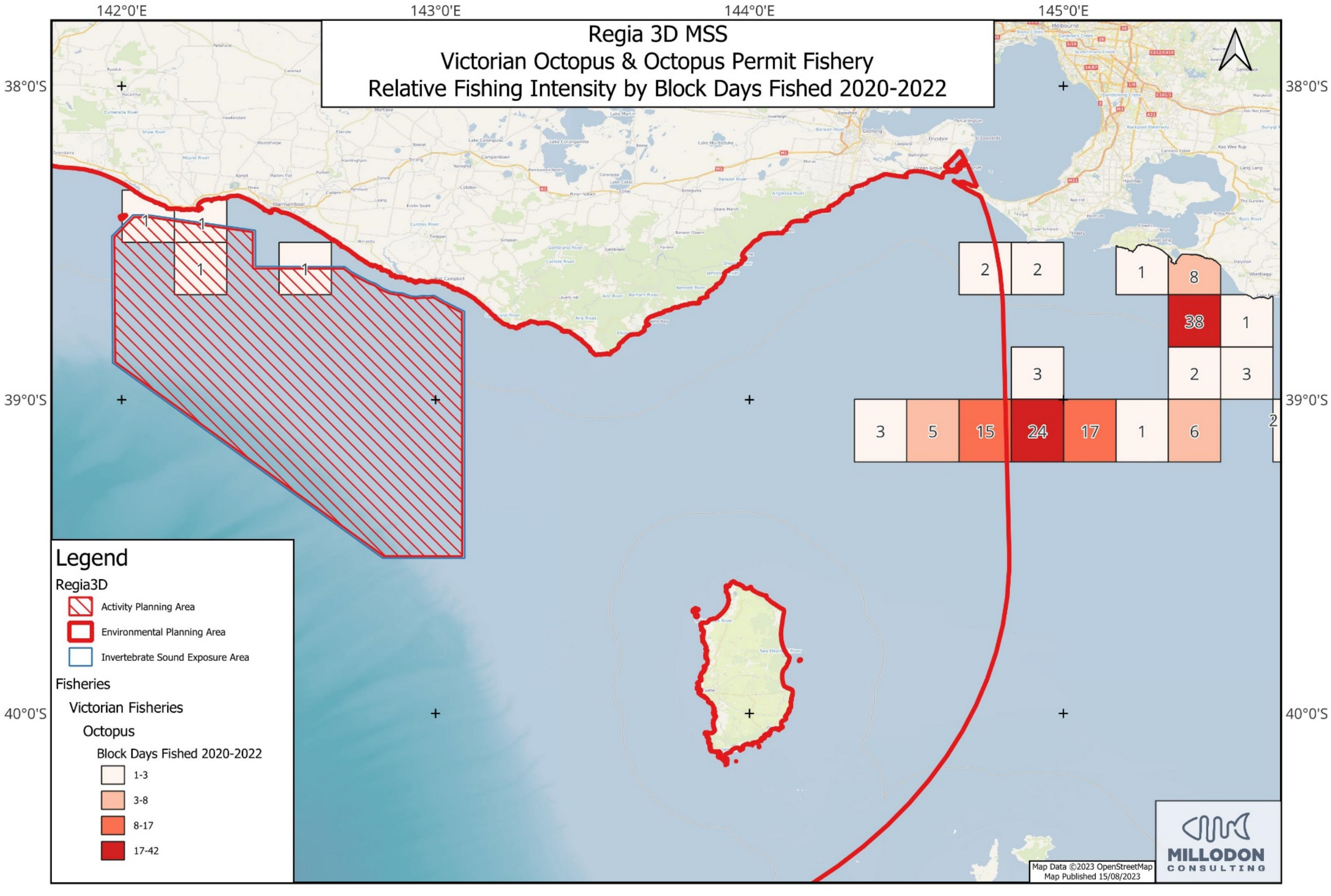

Figure 16: Octopus Fishery Relative Fishing Intensity within the Activity Planning Area and Environmental Planning Area

Pipi Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Pipi Fishery	Pipi	The new Victorian Pipi Fishery commenced on 1 April 2020. Pipi Fishery Access Licences have been issued for the Discovery Bay and Venus Bay commercial management zones. The Total Allowable Catch for the 2020/2021 season has been set at 10 tonne in Discovery Bay Western Zone, 40 tonne in Discovery Bay Eastern Zone and 2 tonne in the Venus Bay Commercial Zone. The Activity Planning Area does not overlap the area actively fished by the Pipi Fishery (Figure 17). The Environmental Planning Area overlaps the Discovery Bay zones (Figure 17).	No	Yes

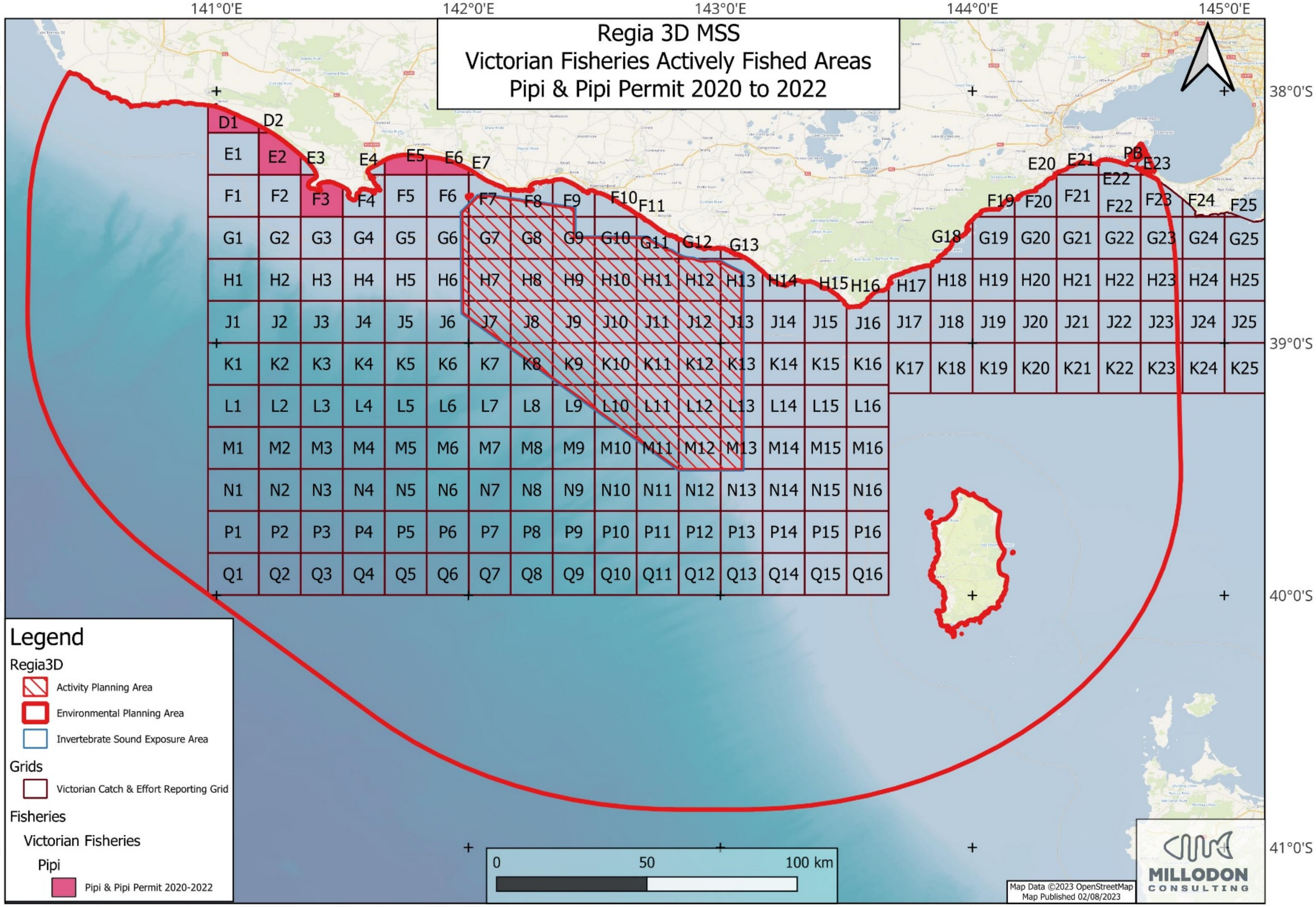

Figure 17: Pipi Fishery Permit Areas within the Activity Planning Area and Environmental Planning Area

Rock Lobster Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Rock Lobster Fishery	Southern rock lobster	The Rock Lobster Fishery is Victoria's most valuable fishery value of A$13.6 million in 2020/21 and is based on the southern rock lobster. The fishery is divided into two separately managed zones: the Eastern Zone and the Western Zone. Southern rock lobsters are found to depths of 150 m, with most of the catch coming from inshore waters less than 100 m deep. Fishing for rock lobsters is prohibited during closed seasons. • The closed season for female rock lobsters is from 1 June to 15 November and is designed to protect females in berry (with eggs attached) during the spawning period. • The closed season for male rock lobsters is from 15 September to 15 November and is designed to protect males during the moulting period when soft shells increase their vulnerability. The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Rock Lobster Fishery (Figure 18). Since 2009/10, annual quotas for the western zone that overlaps the Activity Planning Area have been set at between 230 and 260 tonnes and have been fully caught each year. In the western zone, most catch is landed through Portland, Port Fairy, Warrnambool, Port Campbell, and Apollo Bay. Data from VFA for the last 5 years (2018 - 2022 shows the number of days fished in a block for that period (Figure 18). Fishing intensity is concentration near with a maximum of 642 day fished in Activity Planning Area and 18.13 days in the Environment Planning Area.	Yes	Yes

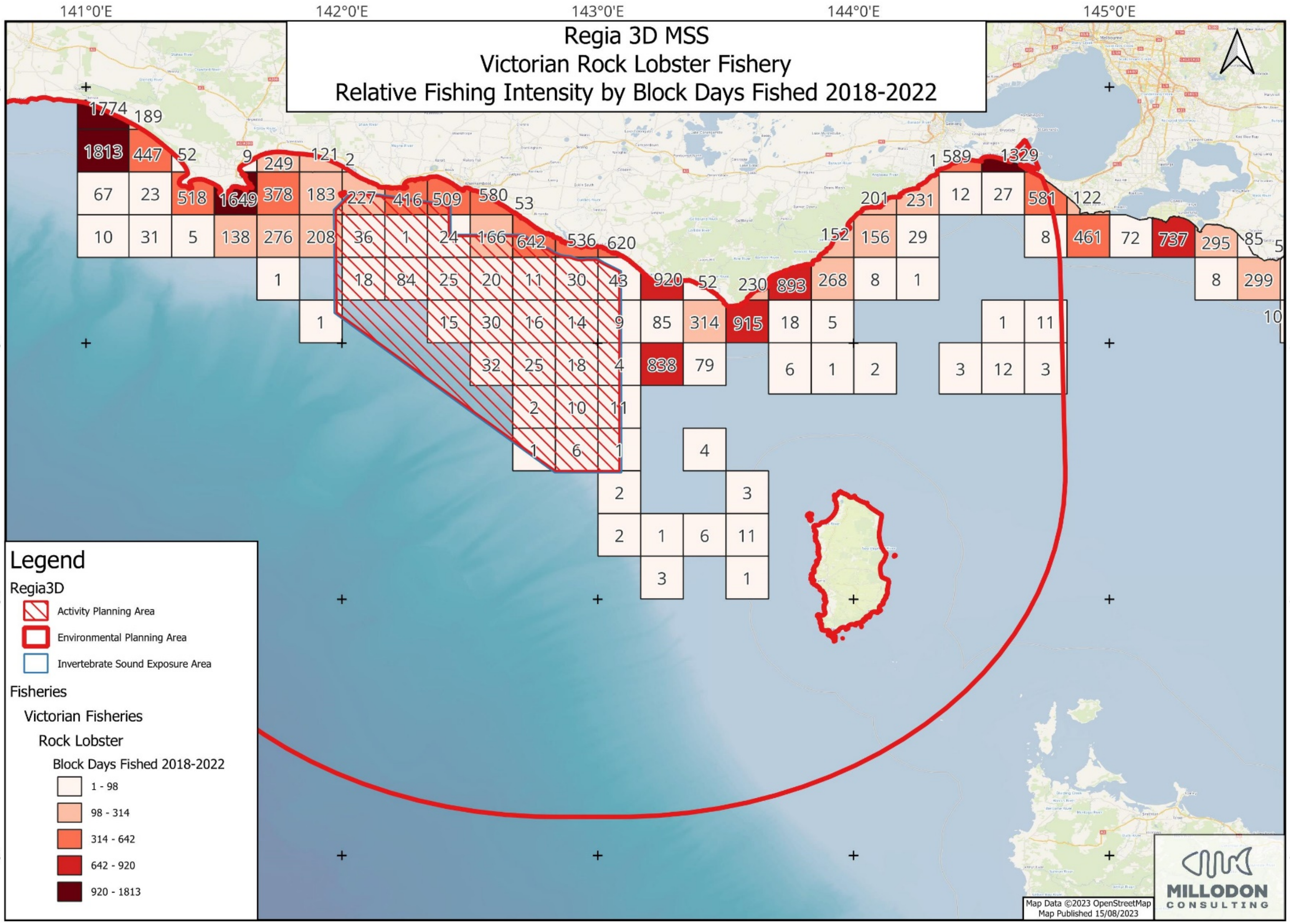

Figure 18: Rock Lobster Relative Fishing Intensity within the Activity Planning Area and Environmental Planning Area

Scallop Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Scallop Fishery	Scallops	The Scallop Fishery is within the waters of the Victorian zone extend out to 20 nm from the high tide water mark but exclude the bays and inlets along the coast where commercial fishing for scallops is prohibited. The Scallop Fishery does not operate within the Activity Planning Area or Environmental Planning Area (Figure 19).	No	No

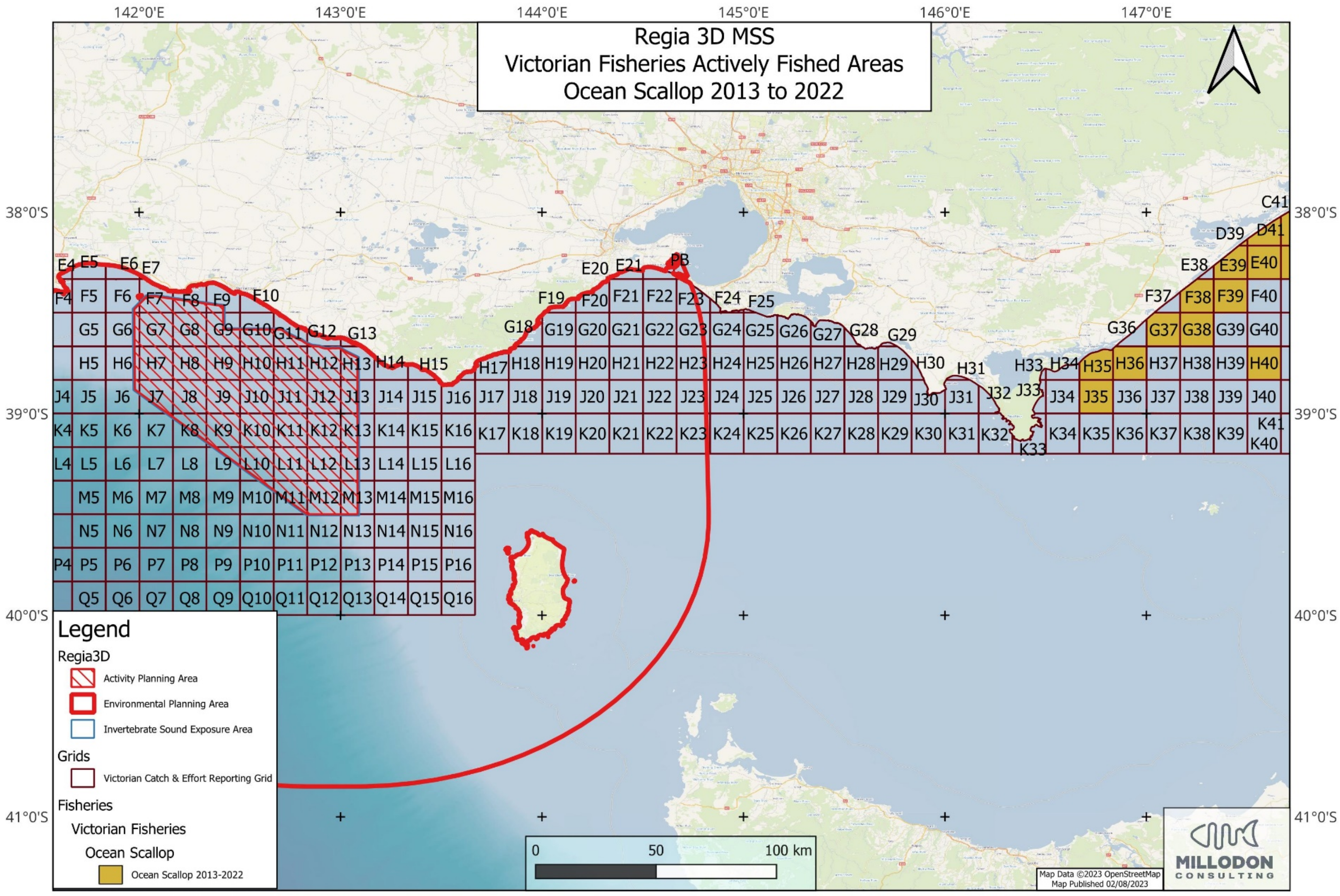

Figure 19: Scallop Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Wrasse (Ocean) Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Wrasse (Ocean) Fishery	Wrasse	The fishery extends along the entire length of the Victorian coastline and out to 20 nm offshore, except for marine reserves. Fishers mostly use hook and line. Limited entry fishery with 23 licences at June 2022. Total annual catch in 2021/22 was 21 tonnes. Most wrasse is harvested by hook and line, although commercial rock lobster fishers who also hold a commercial wrasse licences can keep those fish that they catch in their rock lobster pots. Wrasse inhabit depths up to 160 m, whereas fishers mostly operate in depths shallower than 30 m to reduce their losses due to barotrauma, where the swim bladder expands and damages the fish as it is hauled to the surface. The Activity Planning Area and Environmental Planning Area overlap the area actively fished by the Wrasse (Ocean) Fishery (Figure 20). Data from VFA for 2011 - 2022 shows the maximum number of vessels in grids within the Activity Planning Area was three, with a maximum fishing days of 106.	Yes	Yes

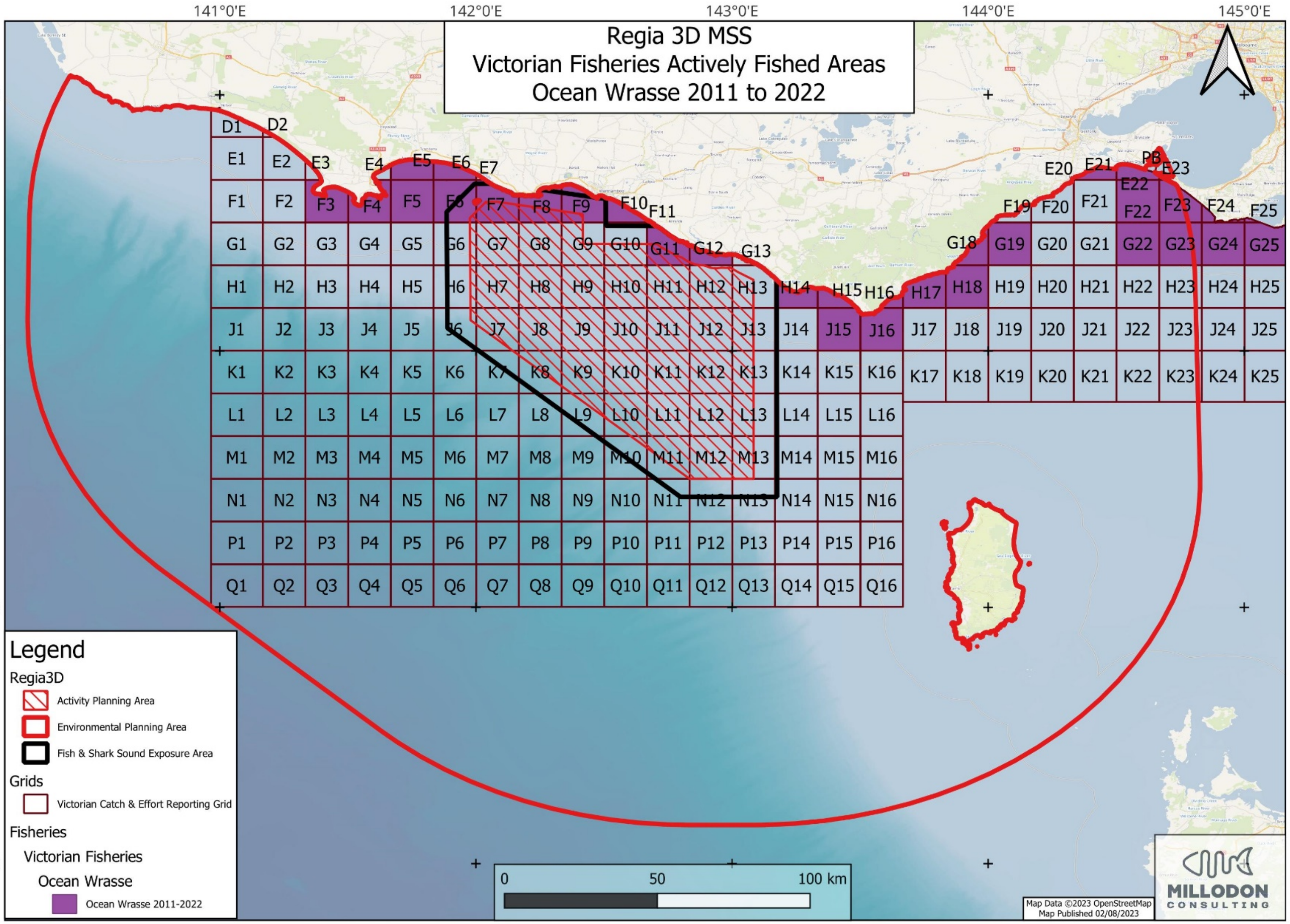

Figure 20: Wrasse (Ocean) Fishery Fishing Effort within the Activity Planning Area and Environmental Planning Area

Tasmanian Fisheries

The Department of Natural Resources and Environment Tasmania (DNRET) manages Tasmania's commercial fisheries under the *Living Marine Resources Management Act 1995*.

All fisheries except for the Giant Crab Fishery and the Rock Lobster Fishery operate within Tasmanian waters. The Giant Crab Fishery and the Rock Lobster Fishery also operate in Commonwealth waters under an Offshore Constitutional Settlement (OCS) between the Australian Government and the Government of Tasmania.

Via stakeholder consultation with DNRET it was confirmed that no Tasmanian fisheries overlap the Activity Planning Area and that the following fisheries may fish within the Environmental Planning Area around King Island.

- Abalone Fishery
- Giant Crab Fishery
- Octopus Fishery
- Rock Lobster Fishery

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in the following sections. Data sources are from the Fishing Tasmania (2023) and UTAS (2023) unless noted.

Abalone Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Abalone Fishery	Blacklip abalone Greenlip abalone	The Tasmanian wild abalone industry operates within Tasmanian coastal waters (Figure 21) and is a major contributor to the Tasmanian economy. It is the largest wild abalone fishery in the world, providing around 25% of the annual harvest. Abalone are hand-captured by divers in depths between 5-30 m. Blacklip abalone are collected on rocky substrate around the Tasmanian shoreline and are the main focus of the fishery. Greenlip abalone are distributed along the north coast and around the Bass Strait islands and usually account for around 5% of the total wild harvest. In 2020/21, the gross value of production of the fishery was around $50 million from a total catch of approximately 1,000 tonnes. The Activity Planning Area does not overlap the area actively fished by the Abalone Fishery, while the Environmental Planning Area overlaps the fishery area around King Island (Figure 21).	No	Yes

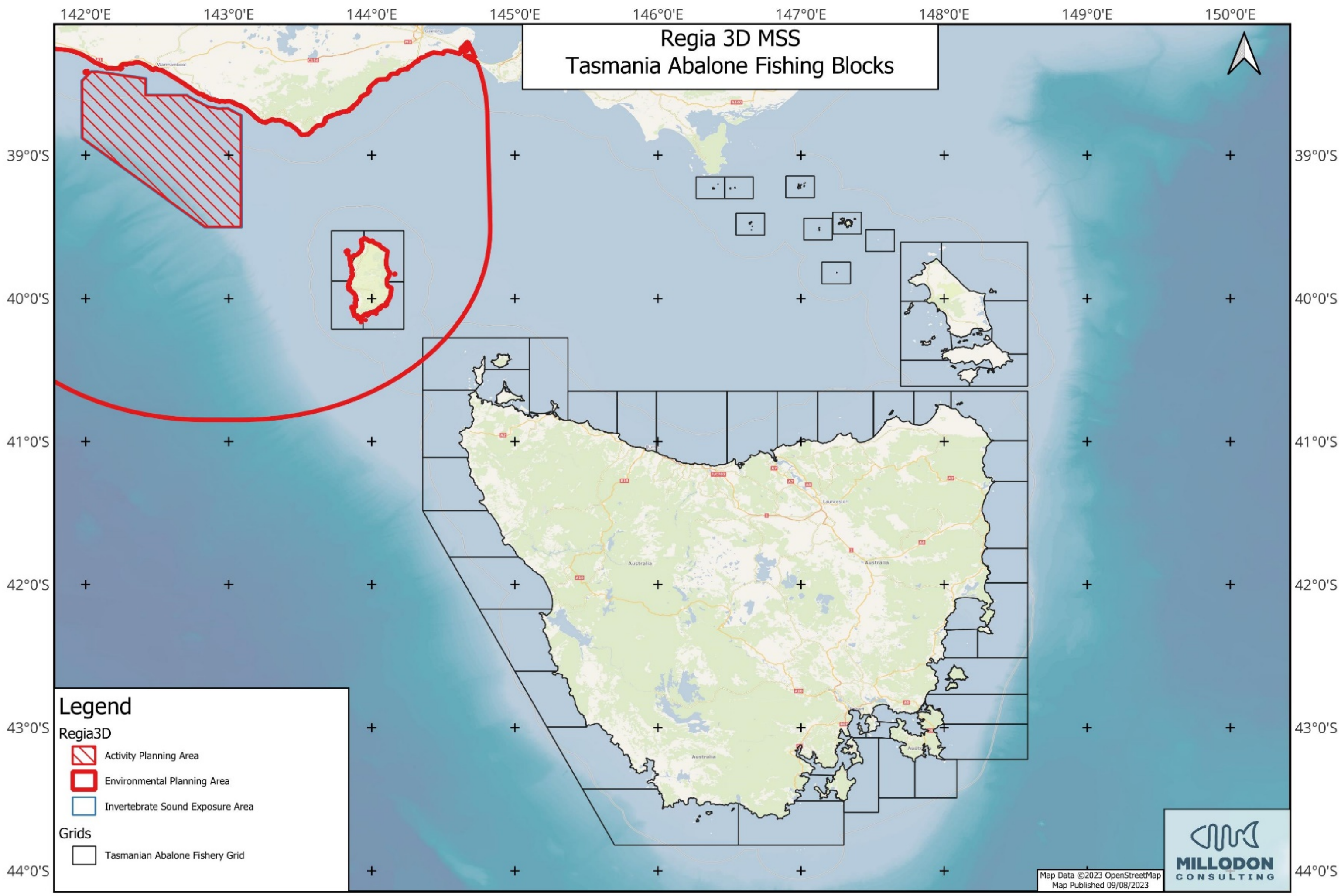

Figure 21: Tasmania Abalone Fishing Block Map

Giant Crab Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Giant Crab Fishery	Giant crab	The Giant Crab Fishery is a comparatively small fishery with the annual harvest set at 20.7 tonnes but with a high landed value of around $2 million. The fishery is managed by Tasmania under an Offshore Constitutional Settlement (OCS) between the Australian Government and the Government of Tasmania despite the majority of catch taken in Commonwealth waters. The Giant Crab Fishery has the following closures: • Females - from 15 November in a year to 31 May the following year inclusive. The Activity Planning Area does not overlap the Giant Crab Fishery, while the Environmental Planning Area overlaps the fishery area around King Island (Figure 22).	No	Yes

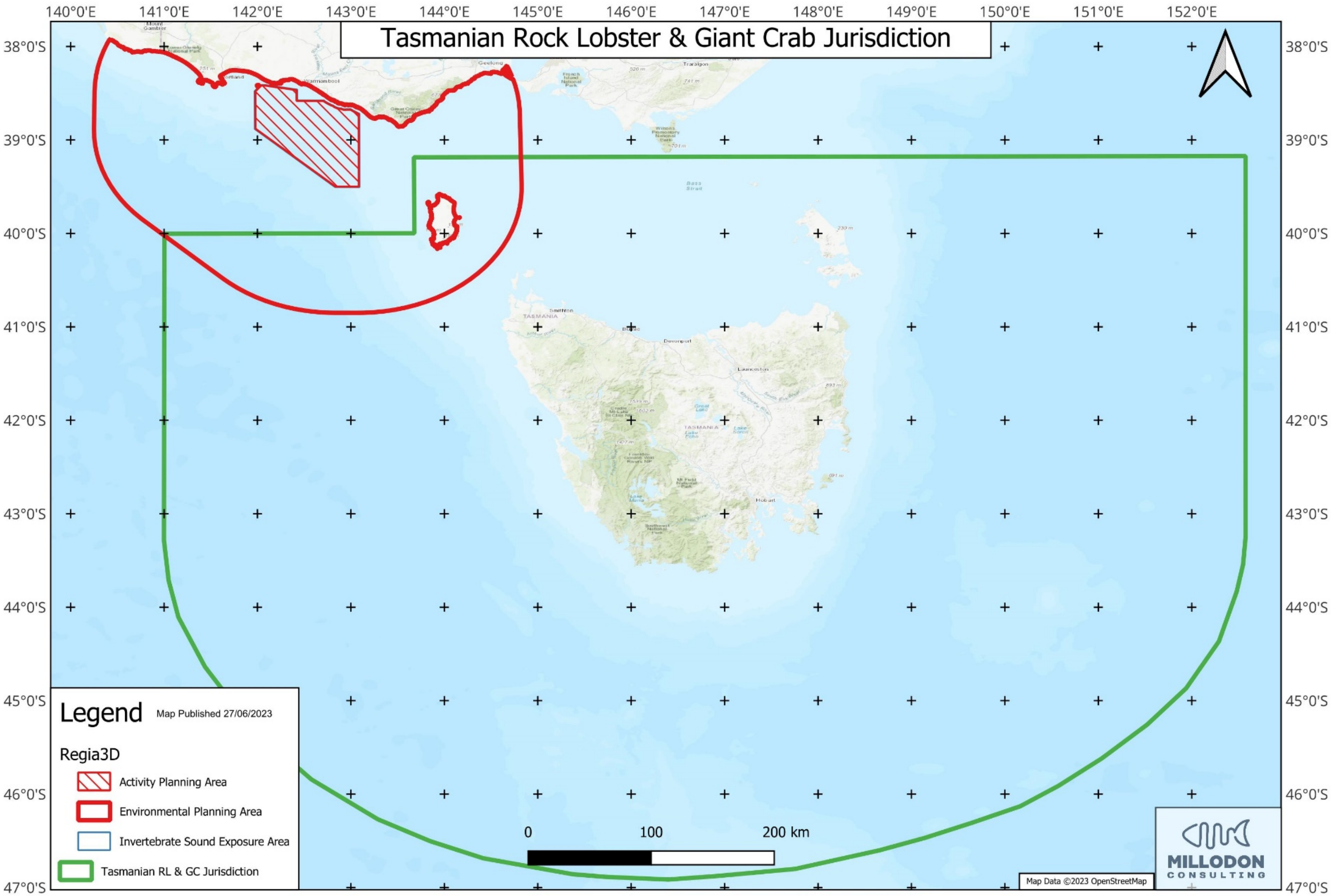

Figure 22: Tasmanian Giant Crab Fishery and Rock Lobster Fishery Jurisdiction

Octopus Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Octopus Fishery	Pale octopus Gloomy octopus Maori octopus	Information in this section is from Fraser et. al (2022). Octopus are caught commercially in Tasmanian waters across multiple fisheries using a range of gear types. Most catch comes from a targeted unbaited trap fishery for pale octopus in northern Tasmania, primarily Bass Strait, by fishers operating under the fishing licence (octopus). Holders of the fishing licence (octopus) also retain low quantities of Māori octopus as by-product and take occasional landings of gloomy octopus in years when the fishery extends towards eastern Bass Strait. The Scalefish and Rock Lobster fisheries take octopus as by-product. The total catch of pale octopus in 2020/21 was 154 t, representing the highest recorded catch. These catches are well above the average of 100 t observed over the last decade. Almost all the catch in 2020/21 (72%) occurred in only three fishing blocks – two east of King Island and one inshore adjacent to Stanley. Two licences have been issued for the operation of two vessels. The Activity Planning Area does not overlap the Octopus Fishery, while the Environmental Planning Area overlaps the fishery area on the west side of King Island (Figure 23).	No	Yes

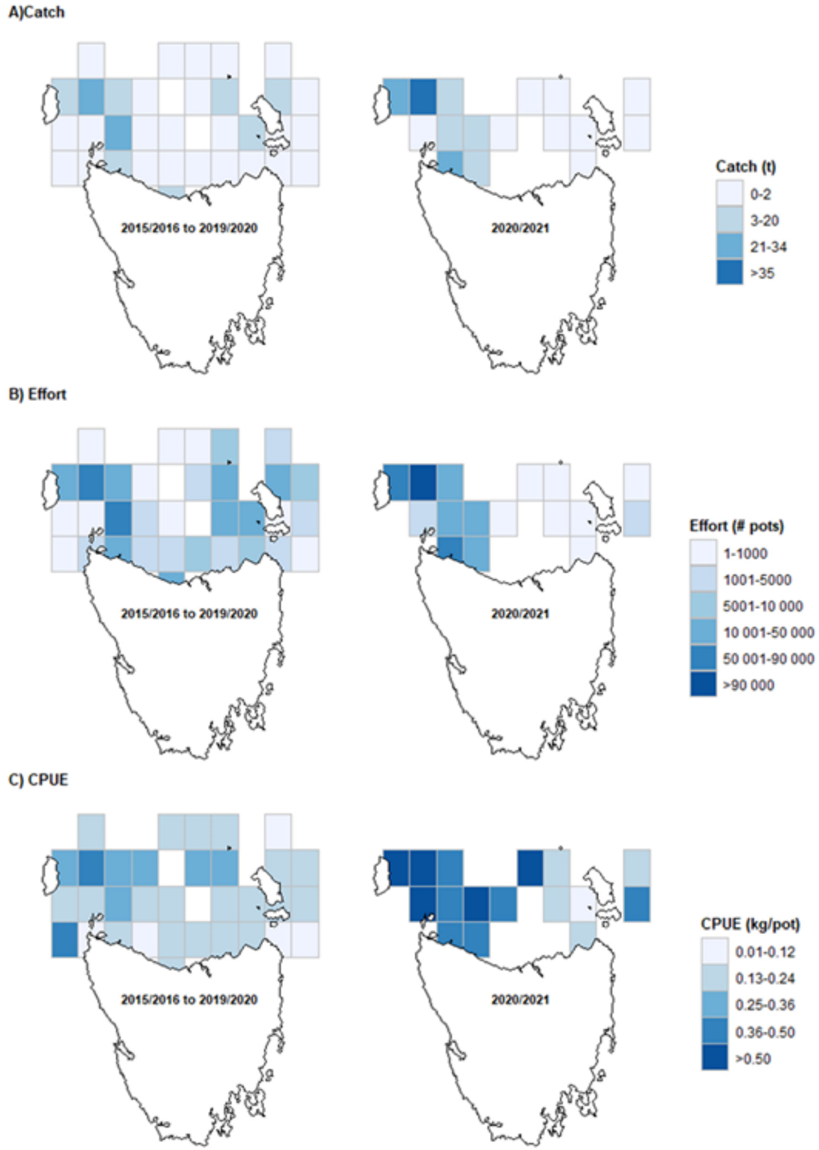

Figure 23: Pale Octopus Catch, effort (pot lifts) and nominal CPUE averaged over the last 5 years (left) and for 2020/21 (right) (Fraser et. al 2022)

Rock Lobster Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Rock Lobster Fishery	Southern rock lobster	The Rock Lobster Fishery primarily targets southern rock lobster, and small amounts of eastern rock lobster (less than 1% of the fishery). The commercial fishery currently catches just over 1,000 tonnes per annum with a landed value of about $90 million. Commercial fishers use baited pots to harvest lobster all around Tasmania, including in waters surrounding major islands. The fishery takes place in Tasmanian and Commonwealth waters (Figure 24). The Rock Lobster Fishery has the following season closures: • Males: 1 October to 15 November for all state waters (except for September closed region which is outside of Environmental Planning Area) to protect males during moulting period. • Females: 1 May to 15 November to protect females in berry (with eggs attached). The Activity Planning Area is not overlapped by the Tasmanian Rock Lobster Fishery, while the Environmental Planning Area overlaps the fishery area around King Island (Figure 24).	No	Yes

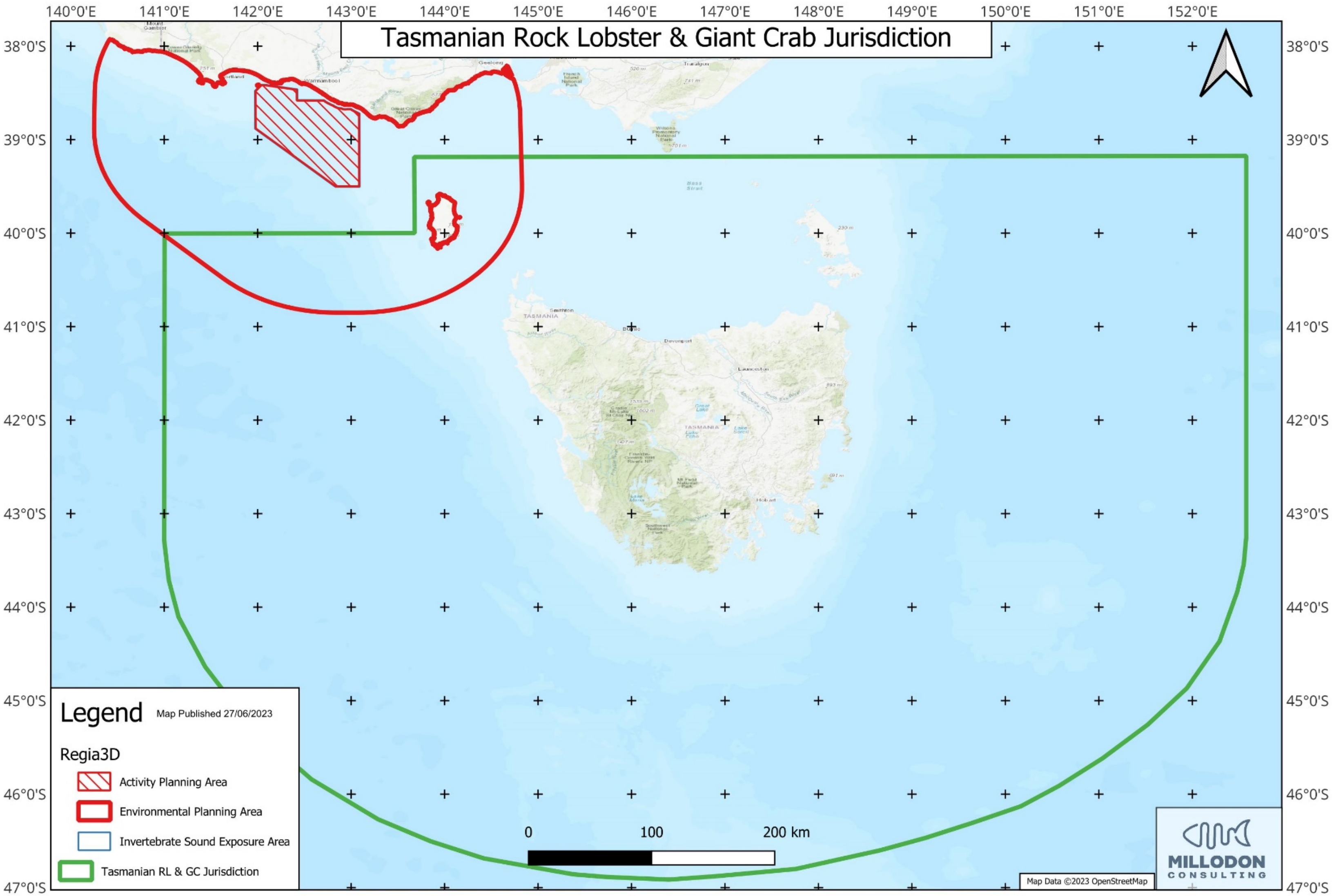

Figure 24: Tasmanian Giant Crab Fishery and Rock Lobster Fishery Jurisdiction

South Australian Fisheries

The *Fisheries Management Act 2007* and its regulations provide the legislative framework, objectives and guiding principles for the management of fisheries in South Australia. Management rules for commercial fisheries are provided in fisheries regulations under the Act.

The Department of Primary Industries and Regions (DPIR) is responsible for the ecologically sustainable development of South Australia's aquatic resources and the administration of the *Fisheries Management Act 2007*.

The Activity Planning Area does not overlap any South Australian Fisheries (Figure 25).

Data from DPIR identified that the Environmental Planning Area overlaps fishing blocks 56 and 58 in the Southern Zone of South Australia's Marine Fishing Areas (MFA) grid (Figure 25) where the following fisheries are active:

- Abalone Fishery
- Charter Boat Fishery
- Giant Crab Fishery
- Marine Scalefish Fishery
- Rock Lobster Fishery

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in the following sections. Data sources are from DPIR fishing data from 2012 to 2022 for fishing blocks 56 and 58, which the Environmental Planning Area overlaps, and DPIR (2023), unless noted.

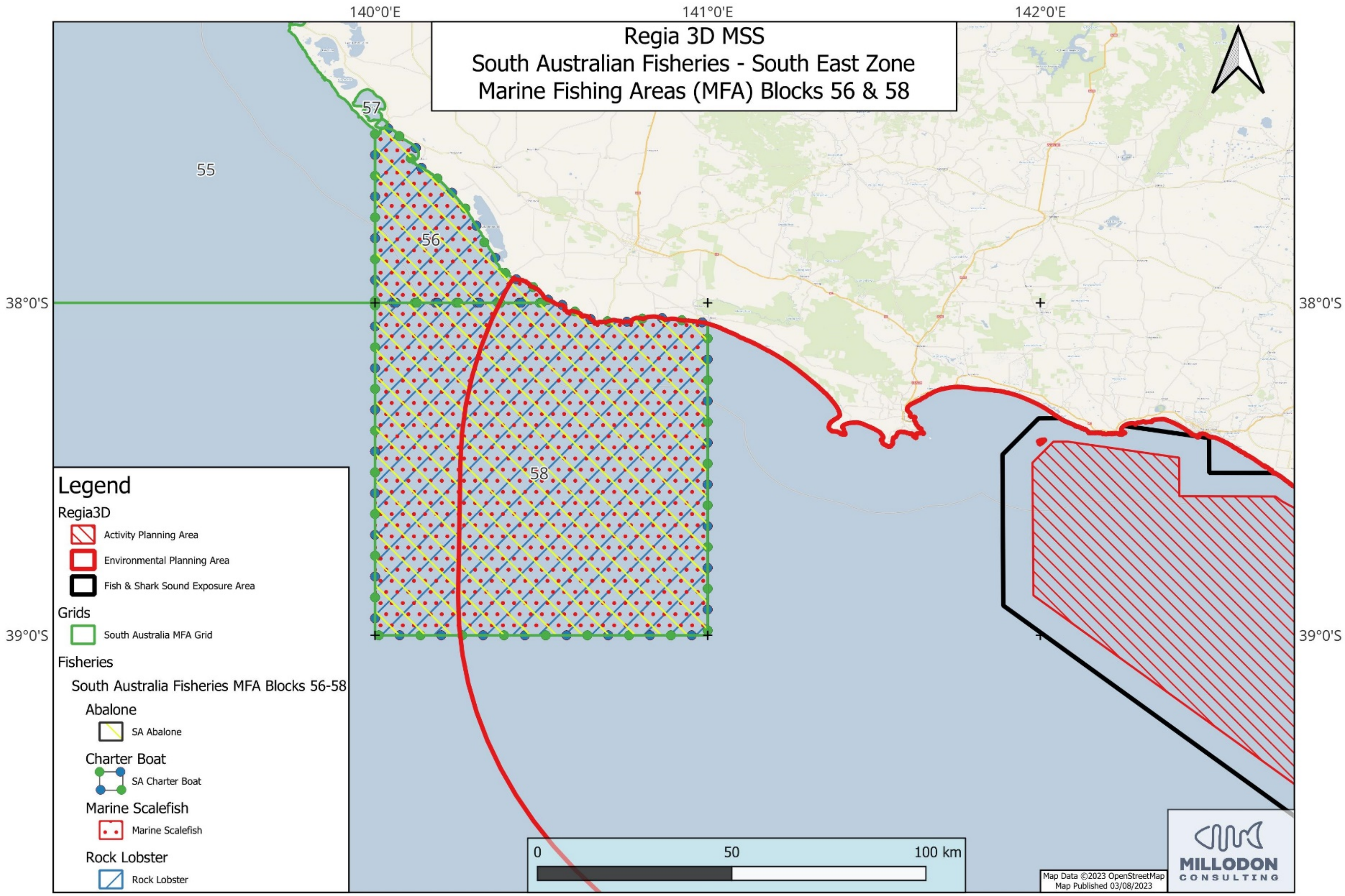

Figure 25: South Australian Fisheries within the Environmental Planning Area

Abalone Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Abalone Fishery	Blacklip abalone Greenlip abalone	The South Australian commercial abalone fishery takes greenlip and blacklip abalone that inhabit subtidal reefs out to approximately 30 m. Commercial abalone divers mostly operate from large, trailered boats. Divers use surface supplied air from the boat and may use motorised cages to mitigate physical interactions with white sharks. The Activity Planning Area does not overlap the fishery. The Environmental Planning Area overlaps the Southern Zone of the fishery where there have been six active licences from 2021 to 2022. Hours dived range from 921 to 1496 per year with annual catch between 101,133 to 153,491 kg.	No	Yes

Charter Boat Fishing

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Charter Boat Fishery	Various	The Charter Boat Fishery is a limited entry fishery with 82 licence holders of which 47 were active in 2020/2021. Fishing in inshore regions where water depths are < 50 m is the most frequent activity. Peak periods are between December and April (summer) and October. Seventy-eight species of fish, shark, mollusc, cephalopods, and crustacean are targeted with King George whiting, snapper and Bight redfish recording the highest catches. The above information is from Durante et al. (2022). The Activity Planning Area does not overlap the fishery. The Environmental Planning Area overlaps the fishery where there have been six active licences in 2019/20 but typically five or less than five licenses from 2012 to 2022.	No	Yes

Giant Crab Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Giant Crab Fishery	Giant crab	Information from in this section is from McLeay (2022). Giant Crab (*Pseudocarcinus gigas*), also known as king crab, is endemic to southern Australian waters and distributed from southern Western Australia to central New South Wales. While they occur at depths ranging from 20 to 600 m, the highest population densities are found at the edge of the continental shelf at depths of approximately 140 to 270 m. Fishers use a maximum of 100 steel-framed pots that must comply with pot dimension specifications. Commercial access to the giant crab resource is limited to licence holders in the Miscellaneous Fishery and Rock Lobster Fishery. Total allowable catch in the fishery is 22.1 t per year, consisting of 13.4 t in the Northern Zone and 8.7 t in the Southern Zone, with total catch ranging from 15.4 t in 2020/21 to 18.4 t in 2017/218. The giant crab fishing season is between 1 October 31 May, with the fishing season in the Southern Zone between 1 October and 30 April, and in the Northern Zone between 1 November and 31 May. The Activity Planning Area does not overlap the fishery. The Environmental Planning Area overlaps the southern zone of the fishery. DPIR could not provide data specific for the area overlapping the Environmental Planning Area as all data for the Giant Crab Fishery is confidential.	No	Yes

Marine Scalefish Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Marine Scalefish Fishery	King George Whiting Southern Garfish Southern Calamari	The Marine Scalefish Fishery is a multi-species and multi-gear fishery. Commercial fishing can be undertaken for more than 60 species of scalefish using a range of gear types. The Sardine Fishery is a part of the Marine Scalefish Fishery The Marine Scalefish Fishery operates in all coastal waters of South Australia between the Western Australian and Victorian border. For some species the Offshore Constitutional Settlement extends the fishery area out 200 nm to the Australian Exclusive Economic Zone miles. The fishing area includes gulfs, bays and estuaries, excluding the Coorong. The main species taken are: • King George Whiting • Southern Garfish • Southern Calamari. Those 4 species make up: • 60% of the total fishery production weight • 70% of the total fishery value. Not all species taken by this fishery are scalefish. Other species include squid, worms, and sharks. In 2020 there were >300 licences in the fishery. Total annual catches of primary species decline from 2,089 t in 2001 to 807 t in 2020. The Activity Planning Area does not overlap the fishery. The Environmental Planning Area overlaps the fishery where there have been 15 active licences in 2012/13 to less than 5 in 2021/22.	No	Yes

Rock Lobster Fishery

Fishery	Target species	Description	Fishing activity within the Activity Planning Area	Fishing Activity within the Environmental Planning Area
Rock Lobster Fishery	Rock lobster	The Rock Lobster Fishery is based on the capture of southern rock lobster (*Jasus edwardsii*). Other species are permitted to be landed and sold, including giant crab and octopus. Rock lobsters are commercially harvested with pots that are set overnight. Rock lobster licence holders may also harvest marine scalefish as endorsed on their licence. The Activity Planning Area does not overlap the fishery. The Environmental Planning Area is within the fishery Southern Zone which is closed from 31 May to 1 October. The total reported 2020 logbook catch was 1,275.5 t (99% of TACC). The annual catch within the Planning Area ranged from 331 t to 420 t from 2012 to 2022. During this period licence holders ranged from 43 to 71.	No	Yes

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Cover Sheet for Technical Reports

Documents

- **Appendix B7a** - Modelling Report on Sound Emissions: Regia Marine Seismic Survey by JASCO Applied Sciences
- **Appendix B7b** - Regia Marine Seismic Survey: Acoustic and Animat Modelling for Assessing Marine Fauna Sound Exposures (Document 03301, Version 2.0)

Purpose

This cover sheet accompanies two comprehensive reports detailing the acoustic modelling associated with the planned Regia Marine Seismic Survey (Regia MSS). These reports have been prepared to assess the potential impacts of sound emissions on marine life, with a focus on marine mammals, fish, sea turtles, benthic invertebrates, and humans.

Appendix B7a

Client: CGG Date: 29 May 2023 Status: Approved for Use

Authors: JASCO Applied Sciences

Summary: This report was the initial modelling requested by CGG to provide a detail prediction of the expected sound emissions from the Regia MSS. It includes modelling results, sound level contour maps, and comprehensive assessments of potential exposure for marine wildlife, including behavioural and physiological impacts.

Appendix B7b

Client: CGG Date: 5 June 2024 Status: Approved for Use

Authors: JASCO Applied Sciences

Summary: This report presents an expanded acoustic modelling study aimed at understanding and predicting the sound exposures to various marine fauna from additional areas of geophysical interest. The report was commissioned in response to consultation with local divers who wanted to understand the sound exposure regime at popular recreational and commercial dive sites. The updated modelling also accounted for changes in activity design up to the point it was commissioned. These include the increased minimum depth (to 50m) and the addition of the western edge of the survey to the permit boundary of petroleum title Vic/P79.

Intended Use

The information contained within these reports is critical for regulatory submission. It is intended to aid in the decision-making process regarding the permitting of the Regia MSS.

Access and Use Restrictions

The contents of these reports are relevant within the specific context described and should be considered alongside all accompanying information. Any use of this data in public or regulatory documents must clearly cite these reports, which should be made available to recipients in their entirety and unedited form.

Distribution

When finalised these reports are distributed to relevant stakeholders through the Regia MSS Consultation Hub found at www.regiamss.com.au.

Regia Marine Seismic Survey

Acoustic and Animat Modelling for Assessing Marine Fauna Sound Exposures

Initial Acquisition Area

JASCO Applied Sciences (Australia) Pty Ltd

29 May 2023

Submitted to:

Klarite
Contract: 0001

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P001749-001
Document 03076
Version 1.0

Suggested citation:

Koessler, M.W., A.M. Muellenmeister, S.C. Connell, and C.R. McPherson. 2023. Regia Marine Seismic Survey: Initial Acquisition Area. Initial Acquisition Area. Document 03076, Version 1.0. Technical report by JASCO Applied Sciences for Klarite.

The results presented herein are relevant within the specific context described in this report. They could be misinterpreted if not considered in the light of all the information contained in this report. Accordingly, if information from this report is used in documents released to the public or to regulatory bodies, such documents must clearly cite the original report, which shall be made readily available to the recipients in integral and unedited form.

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Executive Summary

JASCO Applied Sciences (JASCO) performed a numerical modelling study of underwater sound levels associated with the planned Regia Marine Seismic Survey (MSS) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals, fish, turtles, benthic invertebrates, sponges, coral, plankton and divers. The modelling considered a seismic source in triple configuration with a 2820 in^3 total volume, towed at a 7 m depth behind a single vessel, with a 12.5 m impulse interval (inter-pulse interval) and a 37.5 m crossline array separation.

JASCO's specialised airgun array source model was used to predict the acoustic signature of the seismic source and complementary underwater acoustic propagation models were used in conjunction with the modelled array signatures to estimate sound levels over a large area around the sources. Single-impulse sound fields were predicted at 11 sites over the proposed survey line plans, with water depths ranging from 40 to 174 m. Accumulated sound exposure fields were predicted for three representative scenarios for likely survey operations over 24 h. Three animal movement modelling scenarios, to address different line acquisition plans, for likely survey operations over 24 hours were modelled.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{pk\text{-}pk}$), and either single-impulse (i.e., per-pulse) or accumulated sound exposure levels (SEL, L_E) as appropriate for different noise effect criteria. A conservative sound speed profile that would be most supportive of sound propagation conditions for the period of the survey was defined and applied to all modelled sites.

SEL_{24h} is a cumulative metric that reflects the dosimetric effect of noise levels within 24 hours, based on the assumption that a receiver (e.g., an animal) is consistently exposed to such noise levels at a fixed position. More realistically, marine animals would not stay in the same location for 24 hours (especially in the absence of location-specific habitat) but rather a shorter period, depending on the animal's behaviour and the source's proximity and movements. Therefore, a reported radius for the SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be impaired, but rather that an animal could be exposed to the sound level associated with impairment (Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS)) if it remained at that location for 24 hours.

A more realistic representation of the potential exposures for foraging pygmy blue whales in the foraging Biologically Important Area (BIA) and both migrating and aggregating southern right whales within the known core range area and aggregation BIA was undertaken using animal movement modelling ('animat modelling'). Simulations with animats (i.e., simulated animals) restricted to the BIA provide an understanding of how animats will be exposed given the location and environment-specific context in which they are most likely to occur. Scenarios in which the pygmy blue and southern right whales are seeded in an unrestricted manner allow for the calculation of exposure range across the entire project area. These ranges may then be interpreted to determine BIA action zones for different project options and scenarios. The unrestricted seeding approach is informative in cases where there is very little or no overlap between the BIA and the planned active source area. While acoustic modelling inherently assumes static animals, the JASCO Animal Simulation Model Including Noise Exposure (JASMINE) combines modelled sound fields with realistic animal movements to predict how animals might be impacted through sound exposure. The exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving and movement parameters. JASMINE provides a framework for understanding and predicting sound exposure for species of interest and for calculating ranges to relevant regulatory thresholds. The distribution of distances to the source of simulated animals ('animats') predicted to be exposed to sound levels above relevant thresholds was used to calculate the horizontal distance that includes 95% of the animat distances that exceeded a given effect threshold ($ER_{95\%}$). Within the $ER_{95\%}$, there is generally some proportion of animats that do not exceed the threshold criteria. This occurs for several reasons, including the spatial and temporal characteristics of the sound field and the way in which the animats are exposed to the sound field over time, both vertically and horizontally. The probability that an animat within the $ER_{95\%}$ was exposed above threshold was also computed (P_{exp}) to provide additional context. Due to insufficient density data availability, the modelling results are not related to real-world density estimates for pygmy blue and southern right whales.

The acoustic analysis considered the distances away from the seismic source at which several effects criteria or relevant sound levels were reached. The results are summarised below considering all the representative single-impulse sites and all accumulated SEL scenarios for both acoustic modelling results and pygmy blue whale and southern right whale animat $ER_{95\%}$ results and probabilities.

Marine Mammals – Acoustic Results

- The maximum distance where the NOAA marine mammal behavioural response criterion of 160 dB re 1 µPa (SPL) for impulsive noise could be exceeded varied between 2.95 and 10.3 km for the 2820 in^3 seismic source, depending on modelled site.
- The results for marine mammal injury considered the criteria from Southall et al. (2019). These criteria contain two metrics (PK and SEL_{24h}), both required for the assessment of marine mammal PTS and TTS. The longest distance associated with either metric is required to be applied for assessment; Table 1 summarises the maximum distances, along with the relevant metric.
- The distance to PTS and TTS was always farthest in the broadside direction, distances are shown in Table 1.

Table 1. Summary of maximum (R_{max}) horizontal distances (in km) from all modelled sites and scenarios to behavioural response thresholds and temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals showing the relevant metric. Maximum extents are in the broadside direction of the 2820 in^3 seismic source.

Hearing group	Maximum modelled distance to effect threshold (R_{max})						
	Behavioural response[1]	Scenario A		Scenario B		Scenario C	
		TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)
Low-frequency cetaceans	10.3 (SPL)	34.0 (SEL_{24h})	4.89 (SEL_{24h})	14.8 (SEL_{24h})	1.65 (SEL_{24h})	43.5 (SEL_{24h})	1.90 (SEL_{24h})
High-frequency cetaceans		0.05 (SEL_{24h})	–	0.05 (SEL_{24h})	–	0.04 (SEL_{24h})	–
Very high-frequency cetaceans		0.74 (PK)	0.43 (PK)	0.74 (PK)	0.43 (PK)	0.65 (PK)	0.33 (PK)
Otariid Pinnipeds		0.05 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–

Noise exposure criteria: [1] NOAA (2019) and [2] Southall et al. (2019).
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Animal Movement Modelling

- The exposure ranges predicted using animat modelling are significantly more realistic, due to the incorporation of species-specific realistic movements, rather than conservative approach of calculating ranges using the maximum-over-depth sound fields and receivers which are stationary for 24 hours. This is because the exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving and movement parameters.

- Exposure ranges ($ER_{95\%}$) for single exposure metrics, such as the SPL behavioural response criteria, are typically comparable to the predicted acoustic ranges. Exposure ranges are generally slightly lower than the R_{max} acoustic ranges, which is the case for this study.
- All scenarios resulted in exposures above the behavioural response threshold NOAA (2019). Of these, the maximum $ER_{95\%}$ to the marine mammal behavioural response threshold NOAA (2019) was 8.43 km, with a probability of exposure of 85%. These results are summarised in Table 2.
- Exposure ranges from animal movement modelling for PTS and TTS criteria are typically shorter than those predicted using acoustic propagation modelling because of the shorter time ('dwell time') to accumulate sound energy of the moving animats. There were exposures above threshold for all considered scenarios and species. The maximum $ER_{95\%}$ to TTS and PTS thresholds (Southall et al. 2019) were 13.2 and 1.50 km, respectively, with probabilities of exposure of 58 and 50%.

Table 2. Summary of animat simulation results for PTS, TTS and SPL behavioural response criteria for pygmy blue whales and southern right whales Maximum Exposure ranges show $ER_{95\%}$ (km) first and probability of exposure of animats travelling within the $ER_{95\%}$ (P_{exp} (%)) in parentheses.

Species	Scenario	Behavioural response (SPL)[4]	TTS (SEL24h)[3]	PTS (SEL24h)[3]
		160[2]	168[1]	183[1]
Pygmy blue whale	A	8.09 (86%)	13.2 (58%)	1.40 (51%)
	B	6.82 (93%)	6.05 (60%)	0.53 (50%)
	C	6.77 (92%)	7.60 (60%)	0.34 (47%)
Southern right whale	A	8.43 (85%)	11.6 (60%)	1.50 (50%)
	B	6.81 (92%)	6.04 (52%)	0.54 (49%)
	C	7.58 (85%)	6.71 (37%)	0.25 (37%)

1 LF-weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)
2 SPL (L_p; dB re 1 µPa)
3 Southall et al. (2019) criteria for marine fauna.
4 NOAA (2019) recommended unweighted behavioural threshold for marine mammals.

Sea Turtles

- The PK sea turtle injury criteria of 232 dB re 1 µPa for PTS and 226 dB re 1 µPa for TTS from Finneran et al. (2017) was not exceeded at a distance longer than 20 m from the acoustic centre of the source.
- The maximum distance to the SEL_{24h} metrics of 204 dB re 1 µPa^{2}s for PTS and 189 dB re 1 µPa^{2}s for TTS (summarised in Table 3) for all scenarios was 0.07 km for PTS onset and 3.43 km for TTS onset for the 2820 in^3 seismic source (Finneran et al. 2017). As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that sea turtles travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.
- Table 3 summarises the distances to where the criterion for behavioural response of turtles to 166 dB re 1 µPa (SPL) and the 175 dB re 1 µPa (SPL) threshold for behavioural disturbance (McCauley et al. 2000) could be exceeded.

Table 3. Summary of horizontal distances (in km) to turtle behavioural response criteria, temporary threshold shift (TTS), and permanent threshold shift (PTS).

Hearing group	Maximum modelled distance to effect threshold (R_{max})							
	Behavioural response[1]	Behavioural disturbance[1]	Scenario A		Scenario B		Scenario C	
			TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]
Sea Turtles	5.97 (SPL)	2.55 (SPL)	3.43 (SEL_{24h})	0.07 (SEL_{24h})	1.14 (SEL_{24h})	0.07 (SEL_{24h})	0.82 (SEL_{24h})	0.06 (SEL_{24h})

Noise exposure criteria: [1] McCauley et al. (2000), and [2] Finneran et al. (2017)

Penguins

- The maximum distance to the OCW-weighted penguin TTS SEL_{24h} threshold of 188 dB re 1 μPa^{2}s was reached between 0.05 and 0.06 km for all scenarios was. PTS and PK thresholds were not resolved withing the modelled resolution of 20 m. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that a penguin underwater travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.
- The maximum distance where the OCW-weighted penguin behavioural response threshold of 120 dB re 1 μPa (SPL) for impulsive noise could be exceeded varied between 9.08 and 52.1 km for the 2820 in^3 seismic source, depending on modelled site.

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality and potential mortal injury as well as impairment in the following groups:
  - Fish without a swim bladder (also appropriate for sharks in the absence of other information),
  - Fish with a swim bladder that do not use it for hearing,
  - Fish that use their swim bladders for hearing,
  - Fish eggs and fish larvae.
- Table 4 summarises distances to effect criteria for fish, fish eggs, and fish larvae along with the relevant metric. Seafloor sound levels were assessed at a set of representative depths related to the planned acquisition lines ranging from 40 to 170 m.

Table 4. Summary of maximum fish, fish eggs, and larvae injury and temporary threshold shift (TTS) onset distances for single impulse and 24 hour sound exposure level (SEL_{24h}) modelled scenarios.

Relevant hearing group	Effect criteria	Water column	
		Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Recoverable injury	SEL_{24h}	0.07
	TTS	SEL_{24h}	7.86
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Recoverable injury	PK	0.22
	TTS	SEL_{24h}	7.86
Fish eggs, and larvae (relevant to plankton)	Injury	PK	0.22

Benthic invertebrates, Sponges, and Coral

To assist with assessing the potential effects on these receptors, the following results were determined:

- Crustaceans: The sound level of 202 dB re 1 µPa PK-PK from Payne et al. (2008), which is representative of no effects, was considered for seafloor sound levels; the sound level was reached at ranges between 295 and 711 m for the 2820 in^3 source.
- Bivalves: The distance where a particle acceleration of 37.57 ms^{-2} at the seafloor could occur was determined for comparing to results presented in Day et al. (2016a). This particle acceleration was reached at a range of 52 m for depth 40 m, 4 m for a depth of 50 m, and was not reached at any greater depth.
- Sponges and coral: The PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 µPa PK for sponges and corals (Heyward et al. 2018); the threshold was reached at a range of 2 m for depth 40 m and was not reached at any greater depth.

Divers and Swimmers

An SPL human health assessment of 145 dB re 1 µPa (SPL; LP) derived from (Parvin 2005) was considered for people swimming and diving. At the closest separation between considered modelled sites and receiver locations a sound level of 153.1 dB re 1 µPa (SPL; LP) was predicted at Little River and Taylors Beach. It is important to review the provided contour maps to contextualise levels at coast areas to understand where the human health assessment level may be reached.

1. Introduction

JASCO Applied Sciences (JASCO) performed a numerical estimation study of underwater sound levels associated with the planned Regia Marine Seismic Survey (MSS) to assist in understanding the potential acoustic effect on receptors including marine mammals, fish, sea turtles, benthic invertebrates, plankton, sponges, corals and divers.

This study considered a 2820 in^3 seismic source array. JASCO's specialised Airgun Array Source Model (AASM) was used to predict acoustic signatures and spectra (see Section 4.2). AASM accounts for individual airgun volumes, airgun bubble interactions, and array geometry to yield accurate source predictions.

Complementary underwater acoustic propagation models were used in conjunction with the array signature and spectra to estimate sound levels considering site-specific environmental influences. Single-impulse sound fields were predicted at eleven unique geographic locations linked to the considered survey line plans and three representative scenarios for accumulated SEL modelling were considered. Accumulated sound exposure fields were predicted for each representative scenario for likely survey operations over 24 hours (see Section 2).

The modelling methodology considered source directivity and range-dependent environmental properties. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{pk\text{-pk}}$), and either single-impulse (i.e., per-pulse) or accumulated sound exposure levels (SEL, L_E) as appropriate for different noise effect criteria.

The planned seismic acquisition area overlaps the pygmy blue whale foraging BIA as well as the aggregation BIA and known core range area for southern right whales. The acoustic modelling results were also used in conjunction with animal movement modelling ('animat modelling') simulations to predict the distance at which feeding pygmy blue whales (*Balaenoptera musculus brevicauda*), aggregating and migrating southern right whales (*Eubalaena australis*) are expected to be exposed above threshold criteria for PTS, TTS, and behavioural response. Estimates of sound exposure distribution were determined by moving large numbers of simulated animals (animats) through a modelled time-evolving sound field, computed using acoustic models. This approach provides the most realistic prediction of the maximum expected SPL and SEL_{24h} for comparison against the relevant thresholds.

Section 3 explains the metrics used to represent underwater acoustic fields and the effect criteria considered. Section 4 details the methodology for predicting the source levels and modelling the sound propagation, including the specifications of the seismic source and all environmental parameters the propagation models require. Section 4 also describes the methodology used in the animal movement and exposure modelling simulations. Section 5 presents the results, which are then discussed and summarised in Section 6.

2. Modelling Scenarios

Three nominal acquisition scenarios were considered for both acoustic propagation modelling and animal movement modelling. Acoustic modelling consisted of both source and propagation modelling and was conducted at eleven individual single-impulse sites for SEL and SPL while water column PK was assessed at six sites. The locations of the modelled sites are provided in Table 6 and the acquisition lines for the scenarios are shown in Figure 1. This study considered a 2820 in^3 seismic source towed in a triple array configuration at a speed of 4.5 knots with an impulse interval (inter-pulse interval) of 12.5 m and a crossline array separation of 37.5 m. The acoustic propagation modelling utilised the sound speed profile for December, as this month will likely result in favourable propagation conditions within potential acquisition time window for the proposed survey.

The single impulse sites and the accumulated SEL scenarios were determined based on proposed survey line plans with lines orientated at 113/293°. The single impulse sites and accumulated SEL scenarios were chosen to be representative of the range of water depths and the potential sound propagation characteristics of the considered line plans. Near-field sea-floor PK and PK-PK sound levels were assessed considering eleven water depths chosen to represent the depth range encompassed by the considered line plans. Particle motion modelling was also performed at these representative water depths.

The three scenarios account total number of impulses and acquisition time as shown in Table 5. The total assessment period for accumulated sound exposure level was 24 h and during line turns, the seismic source was not operating for modelling purposes. The time surveying and time on turns combine to a total 24 h period.

All animat simulations were run in two configurations: one with animats restricted to the BIA, and another with unrestricted animat seeding.

Table 5. Key parameters of the two accumulated sound exposure level (SEL) scenarios.

Scenario	Array	Impulse interval (m)	Tow direction (°)	Total impulses	Acquisition period (h)
A				8768	13.15
B	Triple 2820 in^3 seismic source	12.5	113/293	11306	16.96
C				11277	16.91

Table 6. Location details for the single impulse modelled sites. Sites were modelled at the tow azimuths used to model the 24 h scenario.

Site	Scenario(s)	Tow azimuths (°)	Latitude (°S)	Longitude (°E)	MGA[1] Zone 54		Water depth (m)
					X (m)	Y (m)	
1	A	113/293	38° 27' 38.76"	142° 6' 23.37"	596537	5742480	40
2†			38° 31' 45.72"	142° 13' 13.43"	606375	5734742	50
3†	A, B		38° 34' 46.31"	142° 18' 36.24"	614112	5729068	55
4			38° 36' 56.37"	142° 29' 18.79"	629594	5724822	58
5†			38° 29' 57.77"	142° 0' 26.98"	587853	5738294	45
6	B, C		38° 47' 44.74"	142° 29' 15.08"	629180	5704837	81
7			38° 39' 9.22"	142° 3' 4.80"	606865	5714555	71
8†			38° 42' 40.30"	142° 13' 44.82"	591481	5721254	62
9	C		38° 54' 13.43"	142° 24' 11.18"	621664	5692971	125
10†			38° 50' 31.49"	142° 12' 53.35"	605428	5700047	174
11			38° 46' 28.15"	142° 0' 39.98"	587832	5707763	167

[1] Map grid of Australia (MGA)
† FWRAM modelling conducted at these sites.

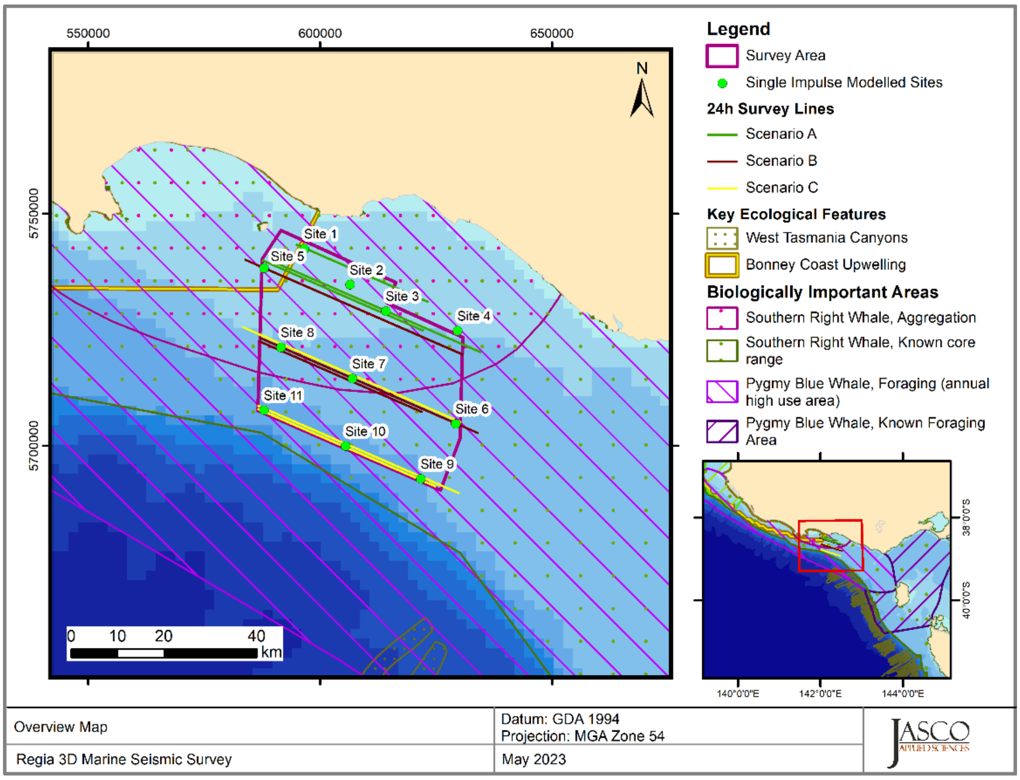

Figure 1. Overview of the modelled sites, acquisition lines, and features for the Regia Marine Seismic Survey.

Animal Movement modelling simulations were run for pygmy blue whales and southern right whales considering the three nominal acquisition scenarios. In general, animats are randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2) within the species preferred depth range. During the simulation, if an animat's movement takes itself outside of its preferred depth range, it will begin to make movements (while still following the parameters within its species behaviour file) back towards its preferred depth range. For all simulations, animats were seeded at a nominal horizontal sampling density of 4 animats/km^2. Each of the animat simulations were run for a representative 24 h duration.

Figure 2 shows an overview of the animat modelling simulation extents, along with the animat seeding areas for each scenario.

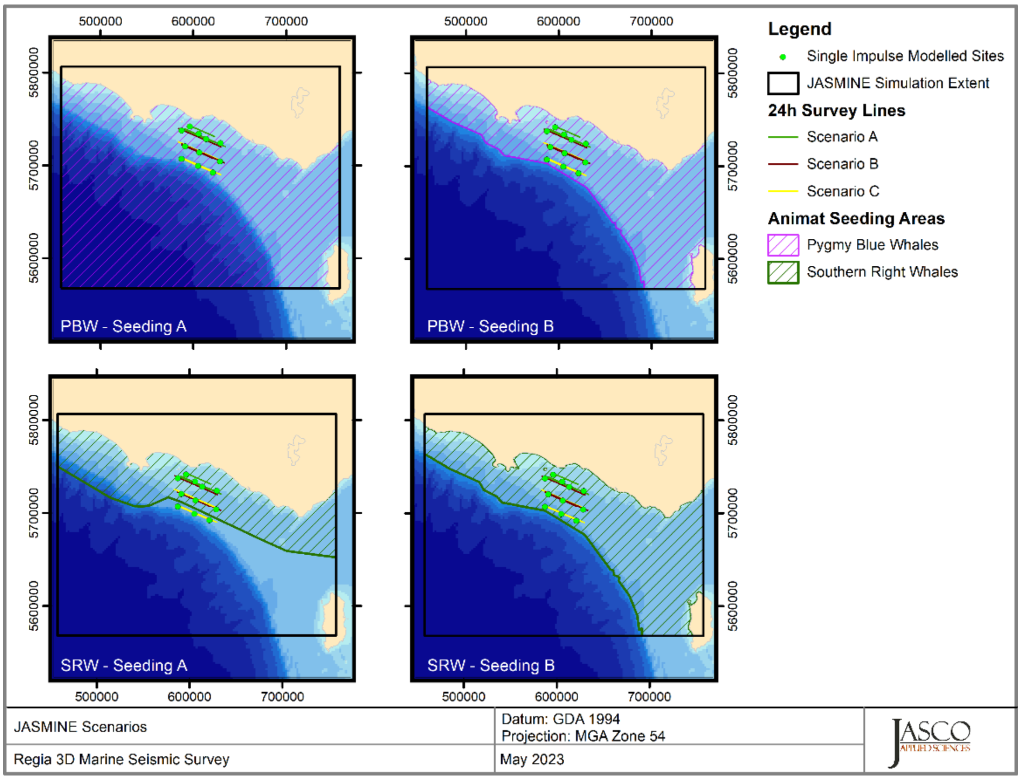

Figure 2. Overview Map of the considered scenarios for animal movement modelling.

2.1. Sensitive receivers

The Regia MSS lies within a foraging BIA for pygmy blue whales and an aggregation BIA for southern right whales. In addition, there are several swimming, diving and surfing beach that are within proximity of the survey. Lady Julia Percy Island, is also an important sensitive location, the closest modelled sites to the edge of the island are Site 1 and Site 5, at respective distances of about 9.3 and 8.4 km. The received acoustic levels at several receiver locations have been calculated and are presented below in Section 5.2.1.4. The receiver locations have been labelled 1–8 and are summarised in Table 7.

Table 7. Location details for the sensitive receiver sites.

Receiver ID	Sensitive receiver location	Receptors	Latitude (S)	Longitude (E)	MGA[1] Zone 54	
					X (m)	Y (m)
1	Lady Julia Percy Island	Seals, White Sharks	38° 25' 27.17"	142° 0' 35.78"	588158	5746633
2	Southern Right Whale Migration and Resting BIA	Southern Right Whales	38° 33' 42.51"	142° 43' 43.45"	650618	5730432
3	Discovery Bay	Human Swimmers	38° 22' 32.87"	141° 21' 27.02"	531227	5752428
4	Portland	Human Swimmers/Divers, Penguins	38° 18' 22.33"	141° 36' 44.44"	553538	5760033
5	Little River and Taylors Beach	Human Swimmers/Divers	38° 23' 41.36"	142° 10' 38.43"	602812	5749721
6	Port Fairy Bay	Human Swimmers/Divers, Penguins	38° 22' 7.15"	142° 15' 13.53"	609525	5752537
7	Twelve Apostles Marine Park	Human Swimmers/Divers	38° 41' 8.43"	143° 7' 13.02"	684418	5715970
8	Aire River Beach	Human Swimmers/Divers	38° 48' 31.92"	143° 27' 47.14"	713871	5701551

[1] Map Grid of Australia (MGA)

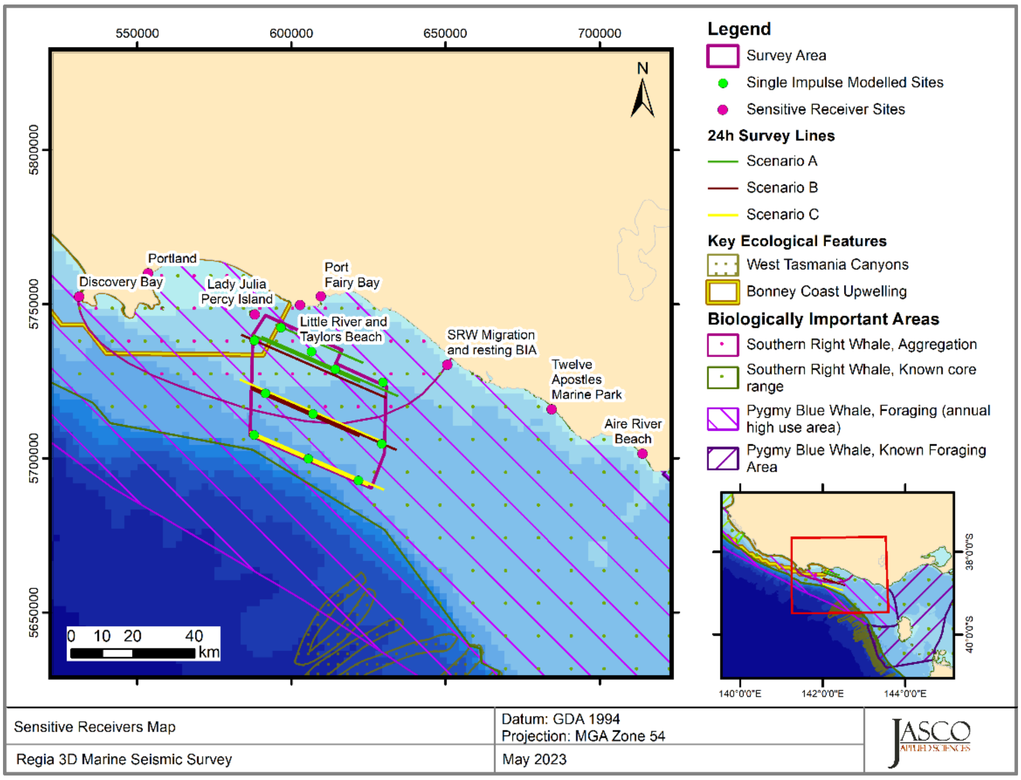

Figure 3. Sensitive receiver locations, modelled sites and acquisition lines for SEL_{24h}.

3. Noise Effect Criteria

The perceived loudness of sound, especially impulsive sound such as that from seismic airguns, is not generally proportional to the instantaneous acoustic pressure. Rather, perceived loudness depends on the pulse rise-time and duration, and the frequency content. Several sound level metrics, such as PK, SPL, and SEL, are commonly used to evaluate sound and its effects on marine life (Appendix A). The period of accumulation associated with SEL is defined, with this report referencing either a “per pulse” assessment or over 24 h. The acoustic metrics in this report reflect the updated ISO standard for acoustic terminology, ISO/DIS 18405:2017 (2017).

Whether acoustic exposure levels might injure or disturb marine mammals is an active research topic. Since 2007, several expert groups have developed SEL-based assessment approaches for evaluating auditory injury, with key works including Southall et al. (2007), Finneran and Jenkins (2012), Popper et al. (2014), United States National Marine Fisheries Service (NMFS 2018) and Southall et al. (2019). The number of studies that have investigated the level of behavioural disturbance to marine fauna by anthropogenic sound has also increased substantially.

The following noise criteria and sound levels for this study were chosen because they include standard thresholds, thresholds suggested by the best available science, and sound levels presented in literature for species with no suggested thresholds (Sections 3.1–3.5 and Appendix A):

1. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from (Southall et al. 2019) for the onset of Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) in marine mammals.
2. Marine mammal behavioural threshold based on the current US National Oceanic and Atmospheric Administration (NOAA 2019) criterion for marine mammals of 160 dB re 1 µPa (SPL; L_p) for impulsive sound sources.
3. Sound exposure guidelines for fish, fish eggs and larvae (including plankton) (Popper et al. 2014).
4. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in turtles.
5. Sea turtle behavioural response threshold of 166 dB re 1 µPa (SPL; L_p), (McCauley et al. 2000) as cited in the Recovery Plan for Marine Turtles in Australia (Department of the Environment and Energy et al. 2017), along with a sound level associated with behavioural disturbance 175 dB re 1 µPa (SPL; L_p) (McCauley et al. 2000)
6. Diving birds (penguins):
   - Thresholds for otariid pinnipeds are used as a proxy (Section 3.4): Peak pressure levels (PK; L_{pk}) and frequency–weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Southall et al. (2019) for the onset of PTS and TTS in otariids.
   - Behavioural response to impulsive sound of 120 dB re 1 µPa (SPL; L_p) for diving birds based on information from Sørensen et al. (2020).
7. Peak-peak pressure levels (PK-PK; $L_{pk\text{-}pk}$) and particle acceleration (ms^{-2}) at the seafloor to help assess effects of noise on crustaceans through comparing to results in Day et al. (2016a), Day et al. (2019), Day et al. (2016b), Day et al. (2017) and Payne et al. (2008).
8. A sound level of 226 dB re 1 µPa (PK; L_{pk}) reported for comparing to Heyward et al. (2018) for sponges and corals.
9. An SPL human health assessment threshold of 145 dB re 1 µPa (SPL; L_p) for sound exposure to people swimming and diving derived from Parvin (2005), and considering Ainslie (2008).

Additionally, to assess the size of the low-power zone required under the Australian Environment Protection and Biodiversity Conservation (EPBC) Act Policy Statement 2.1, Department of the

Environment, Water, Heritage and the Arts (DEWHA 2008), the distance to an unweighted per-pulse SEL of 160 dB re 1 µPa²·s (L_E) is reported.

The following subsections (Sections 3.1–3.5, along with Appendix A.4 and A.5), expand on the thresholds, guidelines and sound levels for marine mammals, fish, fish eggs, fish larvae, sea turtles, and benthic invertebrates.

3.1. Marine Mammals

There are two categories of auditory threshold shifts or hearing loss: permanent threshold shift (PTS), a physical injury to an animal's hearing organs; and Temporary Threshold Shift (TTS), a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued.

To help assess the potential for the possible injury and hearing sensitivity changes in marine mammals, this report applies the criteria recommended by Southall et al. (2019), considering both PTS and TTS. These criteria, along with the applied behavioural criteria (NOAA 2019), are summarised in Table 8, with descriptions included in Appendix A.4.1 (auditory impairment) and Appendix A.4.2 (behavioural response), with frequency weighting explained in Appendix A.5. Of particular note, whilst the newly published Southall et al. (2021) provides recommendations and discusses the nuances of assessing behavioural response, the authors do not recommend new numerical thresholds for onset of behavioural responses for marine mammals.

Table 8. Unweighted sound pressure level (SPL), 24-hour sound exposure level (SEL_{24h}), and peak pressure (PK) thresholds for acoustic effects on marine mammals.

Hearing group	NOAA (2019)	Southall et al. (2019)			
	Behaviour	PTS onset thresholds[1] (received level)		TTS onset thresholds[1] (received level)	
	SPL (L_p; dB re 1 µPa)	Weighted SEL (L_E; dB re 1 µPa² s)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL (L_E; dB re 1 µPa² s)	PK (L_{pk}; dB re 1 µPa)
Low-frequency cetaceans (baleen whales)	160	183	219	168	213
High-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)		185	230	170	224
Very-high-frequency cetaceans (*Kogia*, cephalorhynchid, and *L. australis*)		155	202	140	196
Pinnipeds[2] (Australian sea lion, Australian fur seal, New Zealand fur seal)		203	232	188	226

[1] Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS and TTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
[2] Listed as pinnipeds but equivalent to other marine carnivores in water in the Southall et al. (2019) criteria. Also equivalent to Otariid pindipeds listed in NMFS (2018).
L_p denotes sound pressure level period and has a reference value of 1 µPa.
$L_{pk, flat}$ peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24-hour period and has a reference value of 1 µPa²s.

3.2. Fish, Fish Eggs, and Fish Larvae

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to continue developing noise exposure criteria for fish and turtles, work begun by a panel convened by NOAA two years earlier. The resulting guidelines included specific thresholds for different levels of effects and for different groups of species (Popper et al. 2014). These guidelines defined quantitative thresholds for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- TTS.

Masking and behavioural effects can be assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds. However, as these depend upon activity-based subjective ranges, these effects are not addressed in this report and are included in Table 9 for completeness only. Because the presence or absence of a swim bladder has a role in hearing, fish's susceptibility to injury from noise exposure varies depending on the species and the presence and possible role of a swim bladder in hearing. Thus, different thresholds were proposed for fish without a swim bladder (also appropriate for sharks and applied to whale sharks in the absence of other information), fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing. Turtles, fish eggs, and fish larvae are considered separately. Table 9 lists relevant effects thresholds from Popper et al. (2014).

The SEL metric integrates noise intensity over some period of exposure. Because the period of integration for regulatory assessments is not well defined for sounds that do not have a clear start or end time, or for very long-lasting exposures, it is required to define a time. Popper et al. (2014) recommend applying a standard period, where this is either defined as a justified fixed period or the duration of the activity; however, Popper et al. (2014) also included caveats about how long the fish will be exposed because they can move (or remain in location) and so can the source. Popper et al. (2014) summarises that in all TTS studies considered, fish that showed TTS recovered to normal hearing levels within 18–24 hours. Due to this, a period of accumulation of 24 hours has been applied in this study for SEL, which is similar to that applied for marine mammals in NMFS (2016, 2018).

In the discussion of the criteria, Popper et al. (2014) discuss the complications in determining a relevant period of mobile seismic surveys, as the received levels at the fish change between impulses because the source is moving, and that in reality a revised guideline based on the closest PK or the per-pulse SEL might be more useful than one based on accumulated SEL. This is because exposures at the closest point of approach (CPA) are the primary exposures contributing to a receiver's accumulated level (Gedamke et al. 2011). Additionally, several important factors determine the likelihood and duration a receiver is expected to be in close proximity to a sound source (i.e., overlap in space and time between the source and receiver). For example, accumulation time for fast moving (relative to the receiver) mobile sources is driven primarily by the characteristics of the source (i.e., speed, duty cycle; NMFS 2016, 2018).

As discussed in Popper (2018), many fish species move around, some over large distances. The author suggests that it is reasonable to think that if the sound of a seismic source becomes too loud, the fish will move away from the source because they are able to determine the direction of a sound source. If the fish moves away, the amount of energy to which it is exposed is likely to be one or a few seismic pulses, and these would not likely be loud enough to result in any effect because the fish would move away at a much lower level signal than could cause harm. Data on TTS for fish are very limited, with the only study that examined recovery from seismic impulses being Popper et al. (2005). Popper (2018) states that if this study had been conducted on wild, free-swimming fish instead of caged ones, there would have been no effect whatsoever because they were likely to have moved away from the source as it approached them, as would happen with normally free-moving demersal and pelagic fish species associated with a 3-D seismic survey in northern Australian waters, extrapolating from the Bethany 3-D assessed in Popper (2018).

Therefore, the time over which energy should be accumulated in each individual fish in the survey area should be limited to the time over which fish receives the maximum exposure, and 24 h is likely too long a period for calculating the accumulation of energy in determining potential harm (e.g., damage or TTS) (Popper 2018). Even if fish do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses. Based on very limited data, recovery within 24 h (or less) is very likely. If TTS does occur, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, energy accumulating over longer periods than a few hours is probably inappropriate (Popper 2018).

Table 9. Criteria for seismic noise exposure for fish, adapted from Popper et al. (2014).

Type of animal	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	>219 dB SEL_{24h} or >213 dB PK	>216 dB SEL_{24h} or >213 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	210 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	207 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	186 dB SEL_{24h}	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae (relevant to plankton)	>210 dB SEL_{24h} or >207 dB PK	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Peak sound level (PK) dB re 1 μPa; SEL_{24h} dB re 1μPa^2·s. All criteria are presented as sound pressure, even for fish Without swim bladders, since no data for particle motion exist. Relative risk (high, moderate, or low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

3.3. Sea Turtles

There is a paucity of data regarding responses of turtles to acoustic exposure, and no studies of hearing loss due to exposure to loud sounds. Popper et al. (2014) suggested thresholds for onset of mortal injury (including PTS) and mortality for sea turtles and, in absence of taxon-specific information, adopted the levels for fish that do not hear well (suggesting that this likely would be conservative for sea turtles).

Finneran et al. (2017) presented revised thresholds for sea turtle injury and hearing impairment (TTS and PTS). Their rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol and Ketten 2006, Dow Piniak et al. 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper et al. 2014).

McCauley et al. (2000) observed the behavioural response of caged sea turtles—green (*Chelonia mydas*) and loggerhead (*Caretta caretta*)—to an approaching seismic airgun. For received levels above 166 dB re 1 μPa (SPL), the sea turtles increased their swimming activity, and above 175 dB re 1 μPa they began to behave erratically, which was interpreted as an agitated state. The

Recovery Plan for Marine Turtles in Australia (Department of the Environment and Energy et al. 2017) acknowledges the 166 dB re 1 µPa SPL reported (McCauley et al. 2000) as the level that may result in a behavioural response to marine turtles. The 175 dB re 1 µPa level from McCauley et al. (2000) is recommended as a criterion for behavioural disturbance. These thresholds are shown in Table 10.

Table 10. Acoustic effects of impulsive noise on sea turtles: Unweighted sound pressure level (SPL), 24 hour sound exposure level (SEL_{24h}), and peak pressure (PK) thresholds

Effect type	Criterion	SPL (L_p; dB re 1 µPa)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	PK (L_{pk}; dB re 1 µPa)
Behavioural response	McCauley et al. (2000)	166	NA	
Behavioural disturbance		175		
PTS onset thresholds[1] (received level)	Finneran et al. (2017)	NA	204	232
TTS onset thresholds[1] (received level)			189	226

[1] Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS and TTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
L_p denotes sound pressure level period and has a reference value of 1 µPa.
$L_{pk,flat}$ denotes peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24 h period and has a reference value of 1 µPa²s.

3.4. Diving Birds

There are no regulatory thresholds with regard to onset of hearing impairment for penguins, any other bird species, or phylogenetically or anatomically related species. The only scientifically robust thresholds in this context exist for marine mammals. To allow for assessing the noise–induced impact risk of impulsive airgun signals on penguins, the least sensitive marine mammal hearing group, other carnivores in water (OCW), from Southall et al. (2019), is recommended as a proxy. This hearing group has been selected due to similar hearing sensitivity in the frequency band of underwater hearing for diving birds and otariid pinnipeds, which are included in the group. This provides a conservative approach, as otariids are considered more sensitive to underwater sound at higher frequencies than penguins.

There are also no regulatory thresholds or criteria established to assess potential behavioural responses by penguins or flying seabirds to underwater noise. To allow for assessing the potential for such impacts, an onset criterion for behavioural responses of penguins and flying seabirds of 120 dB re 1 µPa (SPL) for impulsive sources was chosen based on information from Sørensen et al. (2020). They exposed gentoo penguins (*Pygoscelis papua*) in a controlled exposure experiment to underwater noise bursts (impulsive signals) and demonstrated that the animals show a graded reaction depending on received sound levels. For consistency with the approach to assess PTS and TTS, the behavioural response threshold is applied as OCW weighted.

3.5. Invertebrates

3.5.1. Benthic Invertebrates (Crustaceans and Bivalves)

Research is ongoing into the relationship between sound and its effects on crustaceans, including the relevant metrics for both effect and impact. Available literature suggests particle motion, rather than sound pressure, is a more important factor for crustacean and bivalve hearing. Water depth and seismic source size are related to the particle motion levels at the seafloor, with larger arrays and shallower water being related to higher particle motion levels, more likely relevant to effects on crustaceans and bivalves.

At the seafloor interface, crustaceans and bivalves are subject to particle motion stimuli from several acoustic or acoustically induced waves. These include the particle motion associated with an impinging sound pressure wave in the water column (the incident, reflected, and transmitted portions), substrate acoustic waves, and interface waves of the Scholte type. However, it is unclear which aspect(s) of these waves is/are most relevant to the animals, either when they normally sense the environment or their physiological responses to loud sounds so there is not enough information to establish similar criteria and thresholds as done for marine mammals and fish. Including recent research, such as Day et al. (2016b), current literature does not clearly define an appropriate metric or identify relevant levels (pressure or particle motion) for an assessment. This includes the consideration of what particle motion levels lead to a behavioural response, or mortality. Therefore, at this stage, we cannot propose authoritative thresholds to inform the impact assessment. However, levels can be determined for pressure metrics presented in literature to assist the assessment.

The pressure and acceleration examples provided in Day et al. (2016a) (Figures 11 and 12) indicate that the acceleration and pressure signals occurred simultaneously, which was interpreted as an indication that the waterborne sounds were responsible for the accelerations measured by the geophones. For clarity, it is important to distinguish that the acceleration from waterborne sound energy is *not* ground roll, which Day et al. (2016a) correctly define as the sound that propagates along the interface at a speed lower than the shear wave speed of the sediment. However, the report subsequently uses ground roll for all further discussions of particle acceleration. While Day et al. (2016a) discuss that they chose the simplest measure of ground roll, it should have been referring to as ‘the acceleration from waterborne sound energy’, or ‘waterborne acceleration’ for short.

For crustaceans, a PK-PK sound level of 202 dB re 1 µPa (Payne et al. 2008) is considered to be associated with no effect, and therefore applied in the assessment. Additionally for context related to different levels of potential impairment, the PK-PK sound levels determined for crustaceans in Day et al. (2016b), 209–212 dB re 1 µPa and 213 dB re 1 µPa from Day et al. (2019), are also included.

For bivalves, PK-PK sound levels of 212, and 213 are presented to allow comparison to the maximum sound levels measured in Day et al. (2016a) and Day et al. (2017) for scallops and pearl shell oyster.

Literature does not present a sound level associated with no impact, and as particle motion is the more relevant metric, particle acceleration from the seismic source has been presented for comparing the results in Table 7 of Day et al. (2016a). The maximum particle acceleration assessed for scallops was 37.57 ms^{-2}.

3.5.2. Plankton

To assess effects on plankton, there are only a few studies to base threshold criteria on. Popper et al. (2014) cites many of the references and studies on potential impacts of noise emissions on fish eggs and larvae prior to 2014. Results presented in Day et al. (2016b) for embryonic lobsters and Fields et al. (2019) for copepods align with those presented in Popper et al. (2014), which is that mortality and sub-lethal injury are limited to within tens of metres of seismic sources. Additionally, the Popper et al. (2014) criteria (Table 9), are extrapolated from simulated pile driving signals which have a more rapid rise time and greater potential for trauma than pulses from a seismic source.

Other research, such as McCauley et al. (2017), has indicated the potential for effects at longer range and at levels of 178 dB PK-PK, however, Fields et al. (2019) noted that it was difficult to reconcile the high mortality reported by McCauley et al. (2017) with the low mortalities reported in the greater previous body of earlier research and their experiment. They recommended further research into whether it is the sound pulse itself (i.e., the energy, peak pressures, or particle acceleration), the (turbulent) fluid flow occurring more slowly (i.e., not related to the sound pulse), or other effects such as the bubble cloud that which might cause higher mortality near the seismic source.

4. Methods

4.1. Parameter Overview

The specifications of the seismic sources and the environmental parameters used in the propagation models are described in additional detail in Appendix D. A single sound speed profile for December was considered in this modelling study (Appendix D.3.2). This was identified as the seasonal period that would provide the farthest propagation by comparing model predictions for a subset of months identified when the survey could be in operation.

The modelled sites in spanned water depths of 40–174 m. In shallower waters, less than 150 m, seabed geologic profile was characterised as a layered limestone, variable cemented with a thin lay of overlying sand for water depth less than 50 m. For sites in deeper water, greater than 150 m, the seabed geologic profile was characterised as a thick package of unconsolidated sediments. Three geological profiles were defined to represent the different geo-acoustic properties across the area encompassed by the considered line plans, and are representative of the different zones within the entire Survey Area (Appendix D.3.3).

4.2. Acoustic Source Model

The pressure signature of the individual airguns and the composite decidecade-band point-source equivalent directional levels (i.e., source levels) of the 2820 in^3 seismic source were modelled with JASCO's Airgun Array Source Model (AASM). Although AASM accounts for notional pressure signatures of each seismic source with respect to the effects of surface-reflected signals on bubble oscillations and inter-bubble interactions, the surface-reflected signal (known as surface ghost) is not included in the far-field source signatures. The acoustic propagation models account for those surface reflections, which are a property of the propagating medium rather than the source.

AASM considers:

- Array layout.
- Volume, tow depth, and firing pressure of each airgun.
- Interactions between different airguns in the array.

All seismic sources considered were modelled over AASMs full frequency range, up to 25 kHz. Appendix B.1 details this model.

4.3. Sound Propagation Models

Three sound propagation models were used to predict the acoustic field around the seismic source:

- Combined range-dependent parabolic equation and Gaussian beam acoustic ray-trace model (MONM-BELLHOP, 10 Hz to 25 kHz).
- Full Waveform Range-dependent Acoustic Model (FWRAM, 10 to 1024 Hz).
- Wavenumber integration model (VSTACK, 10 to 1024 Hz).

The models were used in combination to characterise the acoustic fields at short and long ranges in terms of SEL, SPL, PK, and PK-PK. Appendix C details each model. MONM-BELLHOP was used to calculate SEL of a 360° area around each source location. FWRAM was used to model synthetic seismic pulses and to generate a generalised range-dependent SEL to SPL conversion function for the considered modelled sites. The range-dependent conversion function was applied to predicted per-pulse SEL results from MONM-BELLHOP to estimate SPL values. FWRAM was also used to calculate water column PK and PK-PK levels.

VSTACK was used to calculate near field PK and PK-PK levels along 4 transects at the seafloor along the endfire and broadside directions considering a set of 11 unique water depths at 40, 50, 60, 70, 80, 90, 100, 120, 140, 160 and 170 m. This model was also used to model the peak particle acceleration magnitude considering the same 11 unique water depths. For modelled sites where the seabed is likely to be composed of outcropping limestone (Appendix D.3.3), an additional correction factor was applied to predictions to better estimate loss characteristics of the seabed (see Appendix C.3.2).

4.4. Geometry and Modelled Regions

To predict sound levels with MONM-BELLHOP was used to calculate propagation losses up to distances of 100 km from the source, with a horizontal separation of 20 m between receiver points along all modelled radials. The sound fields were modelled with a horizontal angular resolution of $\Delta\theta$ = 2.5° for a total of N = 144 radial planes. Receiver depths were chosen to span the entire water column over the modelled area, from 2 m to a maximum of 2700 m, with step sizes that increased with depth. To supplement the MONM results, high-frequency results for propagation loss were modelled using BELLHOP for frequencies from 1.25 to 25 kHz. The MONM and Bellhop results were combined to produce results for the full frequency range of interest.

FWRAM was run to 100 km along four radials (fore and aft endfire, and port and starboard broadside) for computational efficiency. This was done to compute SEL-to-SPL conversions (Appendix D.2) and also to quantify water column PK and PK-PK. The horizontal range step begins at 20 m and increases with range from the source.

The maximum modelled range for VSTACK was 1000 m, and a variable receiver range increment that increased away from the source was used, which increased from 10 to 25 m. The final tabulated distances were obtained through interpolating predicted received levels. Received levels were computed for receivers at 5 and 50 cm above the seafloor to assist in the assessment on invertebrates and fish respectively.

4.5. Accumulated SEL

New sound energy is introduced into an environment with each pulse from the seismic source. While some impact criteria are based on the per-pulse energy released, others, such as the marine mammal and fish SEL criteria (Section 3), account for the total acoustic energy marine fauna is subjected to over a specified duration, defined in this report as 24 h. An accurate assessment of the accumulated sound energy depends not only on the parameters of each seismic impulse but also on the number of impulses delivered in a duration and the relative positions of the impulses.

When there are many seismic impulses, it becomes computationally prohibitive to perform sound propagation modelling for every single event. The distance between the consecutive seismic impulses is small enough, such that the environmental parameters that influence sound propagation are virtually the same for many impulse points. The acoustic fields can, therefore, be modelled for a subset of seismic pulses and estimated at several adjacent ones. After sound fields from representative impulse locations are calculated, they are adjusted to account for the source position for nearby impulses.

Although estimating the cumulative sound field with the described approach is not as precise as modelling sound propagation at every impulse location, small-scale, site-specific sound propagation features tend to blur and become less relevant when sound fields from adjacent impulses are summed. Larger scale sound propagation features, primarily dependent on water depth, dominate the cumulative field. The accuracy of the present method acceptably reflects those large-scale features, thus providing a meaningful estimate of a wide area SEL field in a computationally feasible framework.

To produce the map of accumulated received sound level distributions and calculate distances to specified sound level thresholds, the maximum-over-depth were calculated at each sampling point within the modelled region. The radial grids of maximum-over-depth and seafloor sound levels for each impulse were then resampled (by linear triangulation) to produce a regular Cartesian grid. The sound field grids from all impulses were summed (see Equation A-5) to produce the cumulative sound field grid with cell sizes of 20 m. The contours and threshold ranges were calculated from these flat Cartesian projections of the modelled acoustic fields.

The unweighted (fish) and frequency-weighted SEL_{24h} results were rendered as contour maps, including contours that focus on the relevant criteria-based thresholds. Only contours at ranges larger than the nearfield of the seismic source were rendered.

4.6. Animal Movement and Exposure Modelling

4.6.1. Methodology

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was used to predict the exposure of animats to sound arising from the seismic activity. JASMINE integrates the predicted sound field with biologically meaningful movement rules for each marine mammal species (pygmy blue whales and southern right whales for the current analysis) that results in an exposure history for each animat in the model. An overview of the exposure modelling process using JASMINE is shown in Figure 4.

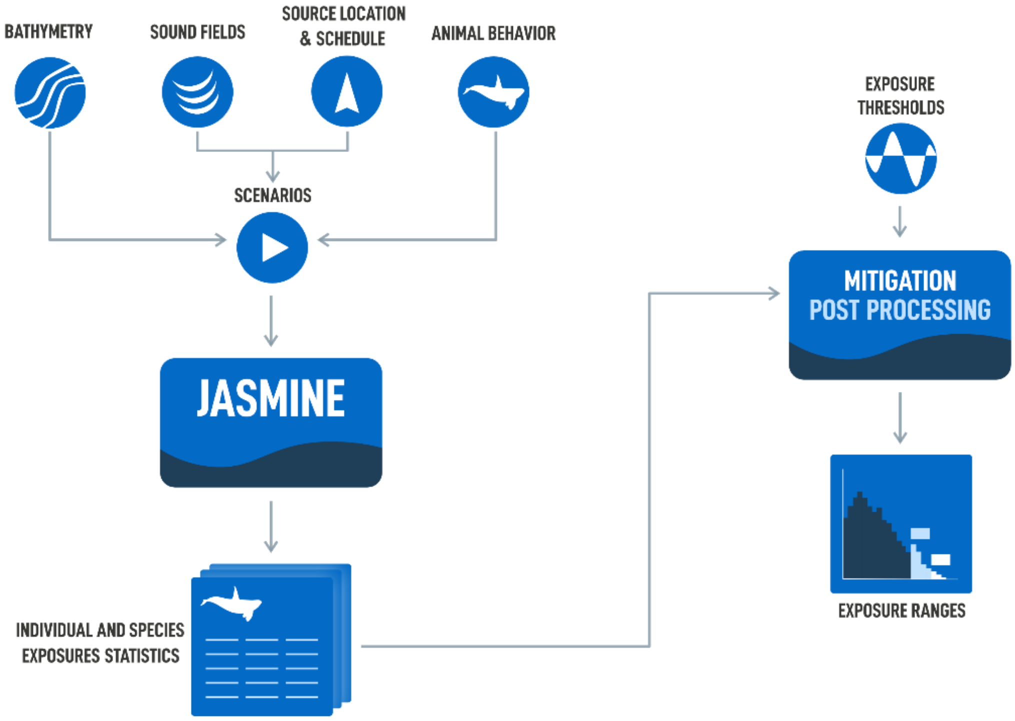

Figure 4. Exposure modelling process overview.

In JASMINE, the sound received by the animats is determined by the proposed seismic operations. As illustrated in Figure 5, animats are programmed to behave like the marine animals that may be present in an area. The parameters used for forecasting realistic behaviours (e.g., diving and foraging depth, swim speed, surface times) are determined and interpreted from marine mammal studies (e.g., tagging studies) where available, or reasonably extrapolated from related or comparable species. For cumulative metrics, an individual animats sound exposure levels are summed over a 24 h duration to determine its total received energy, and then compared to the relevant threshold criteria. For single-exposure metrics, the maximum exposure is evaluated against threshold criteria for each 24 h period. For additional information on JASMINE, see Appendix D.4.

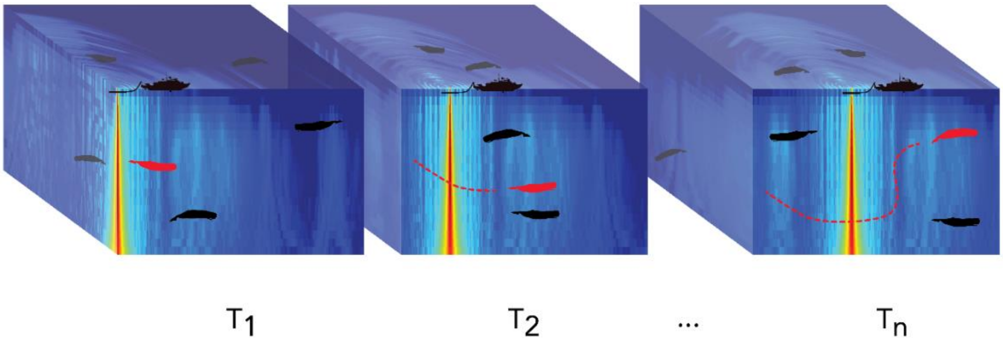

Figure 5. Depiction of animats in a moving sound field. Example animat (red) shown moving with each time step (T_n). The acoustic exposure of each animat is determined by where it is in the sound field, and its exposure history is accumulated as the simulation steps through time.

The exposure criteria for impulsive sounds (described in Section 3) were used to determine the number of animats that exceeded thresholds. To generate statistically reliable probability density functions, model simulations were run with animat sampling densities of 4 animats/km^2. The modelling results are not related to real-world density estimates for pygmy blue whales and southern right whales within BIAs or known core range area, as the number of animals potentially exposed is not calculated. To evaluate PTS, TTS and behavioural response, exposure results were obtained using detailed behavioural information for pygmy blue whales and southern right whales (described in Sections 4.6.3.1 and 4.6.3.2). Figure 2 illustrates the differences between the corresponding seeding areas.

The seismic source was modelled as a vessel towing an airgun array at a speed of 4.5 knots, with an impulse interval of 12.5 m. The simulated source tracks followed a racetrack configuration with acquisition not occurring on turns. At the time and location of each seismic pulse, the modelled source location with the closest distance was selected for exposure modelling. The track lines along with the acoustic modelling locations are shown in Figure 1.

Figure 6 shows an example animat track (generated for information purposes only and not related to the results presented in this report) with associated received levels from a stationary point source. The top panel displays the animat track relative to the point source, and the bottom panel displays the accumulation of SEL_{24h} for TTS and PTS criteria. At approximately 50 seconds, the animat is exposed so that the TTS threshold is exceeded, and at approximately 700 seconds the animat is exposed so that the PTS threshold is exceeded.

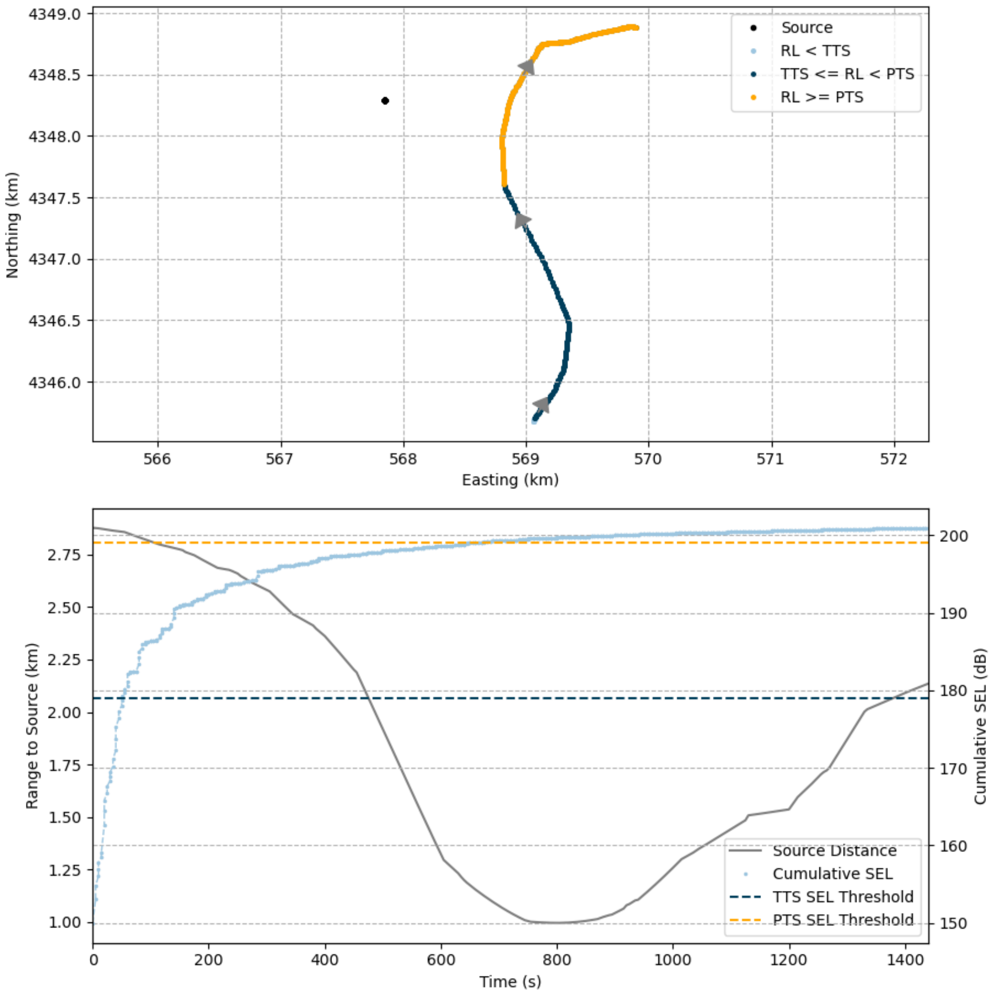

Figure 6. Animat track from an example simulation showing northward movement over a 1400 s duration. The upper panel shows a plan view of both a stationary point source and a foraging animat. Animat steps are coloured to indicate whether the accumulated sound energy at that point has exceeded either TTS or PTS threshold criteria. The lower panel shows horizontal distance in kilometres to the source (grey line; left y-axis) and cumulative 24-h SEL ($L_{E,24h}$, dB re 1 µPa²·s; right y-axis) as a function of time. Note that this example does not use data from the current study.

4.6.2. Exposure–based Radial Distance Estimation

The results from the animal movement and exposure modelling provided a way to estimate radial distances to effect thresholds. The distance to the closest point of approach (CPA) for each of the animats was recorded. The $ER_{95\%}$ (95% Exposure Range) is the horizontal distance that includes 95% of the animat CPAs that exceeded a given effect threshold (see Section 3). Within the $ER_{95\%}$, there is generally some proportion of animats that do not exceed threshold criteria. This occurs for several reasons, including the spatial and temporal characteristics of the sound field and the way in which animats sample the sound field over time, both vertically and horizontally. The sound field varies as a function of range, depth, and azimuth based on a variety of factors such as bathymetry, sound speed profile, and geoacoustic parameters. The way the animats sample the sound field depends upon species-typical swimming and diving characteristics (e.g., swim speed, dive depth, surface intervals, and reversals). Furthermore, even within a particular species definition, these characteristics vary with behavioral state (e.g., feeding, migrating). As this results in some animats not exceeding threshold criteria even within the $ER_{95\%}$, the probability that an animat within that distance was exposed above threshold within the $ER_{95\%}$ was also computed (P_{exp}) to provide additional context.

Acoustic ranges are reported for both $R_{95\%}$ and R_{max}, however, exposure ranges are reported for $ER_{95\%}$ only since, statistically, ER_{max} is not defined. JASMINE is a Monte Carlo simulation, and the results are probabilistic in nature. This is in contrast with acoustic modelling, where there is a specific maximum isopleth range for a given source/environment setup.

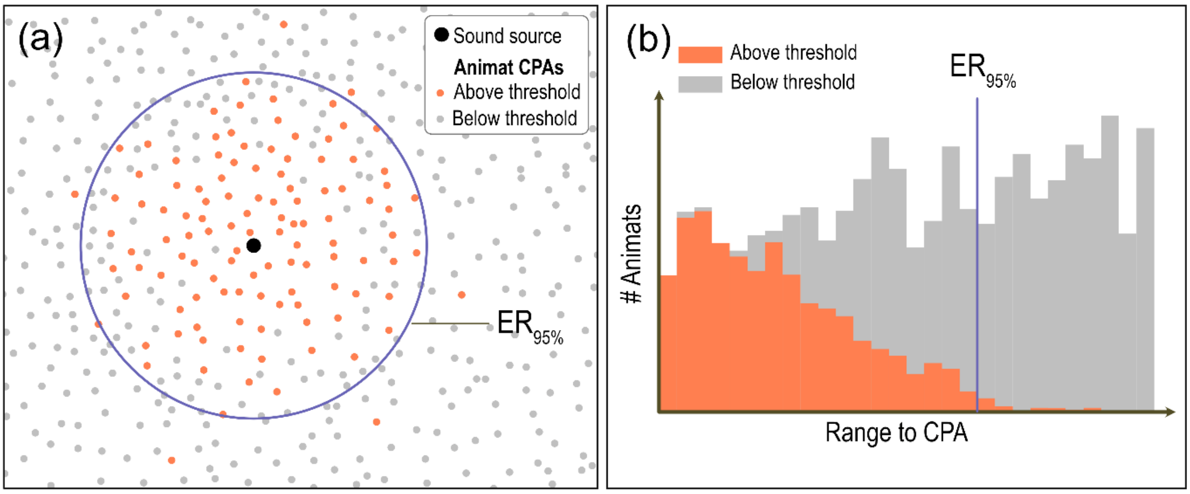

Figure 7. Example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animats near a sound source. Panel (b) shows the distribution of distances to animat CPAs. The 95% exposure range ($ER_{95\%}$) is indicated in both panels.

4.6.3. Species Specific Behaviour Profile Parameterisation

4.6.3.1. Pygmy Blue Whale Behaviour Profile

The project area overlaps with a known foraging BIA for pygmy blue whales (DoE (AU) 2015-2025). Therefore, only foraging behaviours were considered in the species profile.

Data on fine-scale foraging behaviour are not currently available for pygmy blue whales. Therefore, data from multi-sensor tags deployed on blue whales from the North Pacific were used to inform the feeding behaviours. Irvine et al. (2019) used intermediate-duration archival tags (SPLASH MK10) attached to eight blue whales off the coast of California and was able to determine two feeding modes based on depth: shallow and deep. These two feeding behaviours differed further between males and females, with females generally diving deeper than males during both shallow and deep feeding. In order to account for these differences, female and male pygmy blue whales were modelled separately, with values derived from Irvine et al. (2019). The remaining parameters for feeding behaviour were primarily sourced from Goldbogen et al. (2011), who deployed 25 multi-sensor suction cup tags (DTAGs) on blue whales off the coast of California. The exceptions were the values for travel speed, which was derived from satellite tags deployed on pygmy blue whales off southern Australia (Möller et al. 2020), and surface interval, which was derived from a satellite tag deployed on a pygmy blue whale off western Australia (Davenport et al. 2022).

4.6.3.2. Southern Right Whale Behaviour Profile

The project area is located in the known core range for southern right whales, and overlaps with a coastal aggregation BIA for this species. In aggregation areas, southern right whales concentrate from days to weeks before continuing to migrate along the coast (DCCEEW 2022). Animals of all demographics use these areas, including mothers with new calves. As such, two behavioural profiles were considered for southern right whales: migrating and aggregating.

The end of the year corresponds closest to the end of their calving/breeding season and the start of their migration (McCauley 2021). At this time, most pregnant females will likely have given birth, and sightings of mother/calf pairs have been documented in this area (Stamation et al. 2020). The behaviour of southern right whale mother/calf pairs can be dramatically different from other demographics, particularly in regards to the amount of time spent resting at the surface (Cusano et al. 2019, Nielsen et al. 2019). Therefore, separate behavioural profiles were modelled for mother/calf pairs and for all other demographics, resulting in four behavioural profiles for southern right whales: mother/calf migrating, mother/calf aggregating, non-mother/calf migrating, and non-mother/calf aggregating.

The behaviour of migrating southern right whales was modelled to reflect animats transiting through the known core range area on a 293º track to correspond with the tow direction. This reflects the animals migrating along the southern coast of Australia in a westerly or counter-clockwise direction (Burnell et al. 2001). Fine-scale behavioural data on southern right whales are limited, however migrating travel speed was derived from satellite-tagged southern right whales (Mackay et al. 2020). The remaining parameters used for the migrating species profiles were primarily sourced from multi-sensor tags (DTAGs and/or TDRs) deployed on North Atlantic right whales (Baumgartner and Mate 2003) (Dombroski et al. 2021).

Reproductive BIAs for southern right whales act as aggregation areas for mothers with new calves and for other demographics between additional known habitats. For the aggregating behavioural profiles, behaviours reflect those observed in North Atlantic right whales on calving grounds due to limited data on southern right whales: resting, travelling, and surface active. Additionally, the mother/calf profile includes nursing behaviour. The parameters used for the aggregating species profiles were again primarily sourced from North Atlantic right whales with the exception of behavioural probabilities, which were available from studies of southern right whales in South America (Thomas et al. 1984 and Lundquist et al. 2008).

5. Results

5.1. Acoustic Source Levels and Directivity

AASM (Section 4.2) was used to predict the horizontal and vertical overpressure signatures and corresponding power spectrum levels for the seismic sources, with results provided in Appendix B.3 along with the horizontal directivity plots for the selected source.

Table 11 shows the PK and per-pulse SEL source levels in the horizontal-plane broadside (perpendicular to the tow direction), endfire (along the tow direction), and vertical directions for the modelled array signature (2820 in^3 source). The vertical source level that accounts for the “surface ghost” (the out of phase reflected pulse from the water surface) is also presented to make it easier to compare the output of other seismic source models.

Figure B-2 in Appendix B.3 shows the broadside, endfire, and vertical overpressure signature and corresponding power spectrum levels for the source. The signature consists of a strong primary peak, related to the initial release of high-pressure air, followed by a series of pulses associated with bubble oscillations. Most energy was produced at frequencies below 500 Hz. Frequency-dependent peaks and nulls in the spectrum result from interference among airguns in the source and correspond with the volumes and relative locations of the airguns to each other.

Table 11. Far-field source level specifications for 2820 in^3 source, for 7 m tow depth. Source levels are for a point-like acoustic source with equivalent far-field acoustic output in the specified direction. Sound level metrics are per-pulse and unweighted.

Direction	Peak source pressure level ($L_{S,pk}$; dB re 1 µPa m)	Per-pulse source SEL ($L_{S,E}$; dB 1 µPa^{2}m^{2}s)	
		10–2000 Hz	2000–25000 Hz
Broadside	248.6	224.2	185.8
Endfire	244.7	222.7	186.3
Vertical	254.8	227.8	194.0
Vertical (surface affected source level)	254.8	230.5	196.9

5.2. Per-pulse Sound Fields

This section presents the per-pulse sound fields in terms of maximum-over-depth SPL, SEL, PK, and seafloor PK and PK-PK. The different metrics are presented for the following reasons:

- SPL sound fields were used to determine the distances to marine mammal and turtle behavioural thresholds (see Sections 3.1 and 3.3).
- Per-pulse SEL sound fields are used as inputs into the 24 h SEL scenario and to provide context for the range to 160 dB re 1 µPa^2·s, relevant for the EPBC Act Policy Statement 2.1 (DEWHA 2008).
- PK metrics within the water column are relevant to thresholds and guidelines for marine mammals, sea turtles, fish, fish eggs and larvae (as well as plankton; Sections 3.1–3.3).
- PK metrics at the seafloor are relevant to guidelines for fish, fish eggs and larvae (Section 3.3) and the sound level for no effect on corals and sponges.

- PK-PK metrics at the seafloor are relevant to sound levels used in the assessment of effect on benthic invertebrates (Section 3.5.1).

The maximum and 95% distances to per-pulse SEL and SPL metrics are presented in Tables 12–13. The SPL sound fields, and distances to relevant isopleths can be visualised on the contour maps presented in Figures 8–18. The SPL sound fields are also presented as vertical slices for selected azimuths along the endfire and broadside directions out to 50 km, with the airgun array in the centre (Figures 19–23).

Maximum distances to maximum-over-depth water column PK thresholds were calculated for five modelled single impulse sites, Sites 2, 3, 5, 8, and ,10, this was done at the sites where FWRAM was applied to calculate the SEL-SPL conversion (Appendix C.2 and D.2), and presented in Table 15. Seafloor sound levels were assessed considering eleven different representative water depths (40, 50, 60, 70, 80, 90, 100, 120, 140, 160 and 170 m). Tables 16 and 17 present the PK and PK-PK result Particle motion was also calculated considering these water depths, results are presented in Table 18.

5.2.1. Tabulated Results

5.2.1.1. Entire Water Column

Table 12. *Sites 1-11, 2820 in^3 source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) from the seismic source to modelled maximum-over-depth and maximum-over-tow direction unweighted per-pulse sound exposure level (SEL) isopleths from the modelled single impulse sites, with water depth indicated. The results presented are the maximum ranges from the set of modelled tow directions for each site, as described in Table 6.

Per-pulse SEL (L_E; dB re 1 µPa²·s)	Site 1 (40 m)		Site 2 (50 m)		Site 3 (55 m)		Site 4 (58 m)		Site 5 (45 m)		Site 6 (81 m)		Site 7 (71 m)		Site 8 (62 m)		Site 9 (125 m)		Site 10 (174 m)		Site 11 (167 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
190	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05
180	0.47	0.39	0.36	0.30	0.32	0.26	0.27	0.23	0.37	0.32	0.26	0.22	0.25	0.21	0.27	0.24	0.29	0.25	0.15	0.13	0.15	0.13
170	2.02	1.69	1.89	1.62	1.35	1.07	0.65	0.56	1.56	1.27	0.67	0.56	0.66	0.56	0.68	0.58	0.68	0.61	0.75	0.63	0.80	0.63
162[1]	4.62	3.82	4.74	3.85	2.95	2.35	1.35	1.17	3.46	2.93	1.47	1.13	1.40	1.18	1.43	1.24	1.44	1.29	2.90	2.20	2.84	2.35
160[2]	5.53	4.51	5.56	4.56	3.48	2.85	1.63	1.38	4.17	3.52	1.56	1.42	1.56	1.39	1.75	1.39	1.83	1.59	3.89	3.02	3.73	3.12
150	12.3	9.12	12.3	9.57	9.05	6.91	3.48	2.93	9.42	7.56	4.01	3.15	3.59	3.01	3.66	2.96	4.15	3.62	8.81	6.91	9.98	7.48
140	27.7	22.4	28.9	20.8	23.1	17.2	6.82	5.61	22.9	15.9	8.22	6.36	7.20	5.75	6.73	5.54	8.95	7.41	29.4	21.9	37.3	20.3
130	48.2	39.9	43.8	35.7	39.9	32.9	11.8	9.29	41.1	33.7	15.9	12.1	11.8	9.4	12.4	9.48	16.1	13.0	>100.0	/	>100.0	/

[1] Startle response level for squid (Fewtrell and McCauley 2012).
[2] Low power zone assessment criteria DEWHA (2008).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 13. *Sites 1-11, 2820 in³ source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) from the seismic source to modelled maximum-over-depth per-pulse sound pressure level (SPL) isopleths from the modelled single impulse sites, with water depth indicated. The results presented are the maximum ranges from the set of modelled tow directions for each site, as described in Table 6.

SPL (L_p; dB re 1 µPa)	Site 1 (40 m)		Site 2 (50 m)		Site 3 (55 m)		Site 4 (58 m)		Site 5 (45 m)		Site 6 (81 m)		Site 7 (71 m)		Site 8 (62 m)		Site 9 (125 m)		Site 10 (174 m)		Site 11 (167 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
200	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.03
190	0.37	0.29	0.30	0.25	0.26	0.22	0.24	0.20	0.32	0.29	0.23	0.20	0.22	0.18	0.23	0.19	0.27	0.23	0.13	0.11	0.13	0.12
180	1.59	1.32	1.48	1.25	1.07	0.90	0.61	0.50	1.30	1.12	0.60	0.51	0.58	0.48	0.58	0.49	0.64	0.56	0.72	0.59	0.69	0.58
175[1]	2.55	2.11	2.41	2.06	1.82	1.44	0.93	0.78	1.97	1.69	0.89	0.80	0.88	0.77	0.91	0.78	1.01	0.89	1.51	1.24	1.43	1.23
170	3.94	3.30	4.05	3.33	2.91	2.31	1.35	1.18	3.11	2.58	1.45	1.14	1.39	1.19	1.42	1.24	1.42	1.28	2.97	2.39	2.96	2.47
166[2]	5.82	4.70	5.97	4.76	4.27	3.43	1.88	1.54	4.44	3.62	1.87	1.55	1.83	1.53	1.91	1.58	2.09	1.86	4.91	3.80	4.60	3.90
160[3]	10.2	7.94	10.3	8.18	8.10	6.17	2.95	2.66	7.76	6.07	3.16	2.67	3.11	2.70	3.04	2.69	3.46	3.01	7.54	5.88	7.59	6.30
150	24.7	19.9	26.2	18.9	20.8	15.6	6.40	5.25	19.6	13.9	7.38	5.65	6.46	5.27	6.34	5.14	8.57	6.72	19.8	14.0	22.4	13.2
145[4]	37.5	29.9	39.3	28.4	31.8	23.9	8.34	6.75	32.5	22.6	10.8	8.05	8.28	6.78	8.38	6.66	12.3	9.35	52.4	37.8	53.0	32.8
140	47.1	39.2	42.9	34.8	38.9	31.9	11.1	8.7	39.8	32.7	14.9	11.4	11.3	8.75	11.7	8.53	14.9	12.2	>100.0	/	>100.0	/

[1] Threshold for turtle behavioural disturbance from impulsive noise.
[2] Threshold for turtle behavioural response to impulsive noise (NSF 2011).
[3] Marine mammal behavioural threshold for impulsive sound sources (NOAA 2019).
[4] Human health assessment threshold derived from (Parvin 2005).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 14. *Sites 1-11, Penguin behavioural threshold, SPL, 2820 in³ source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) from the seismic source to modelled maximum-over-depth per-pulse sound pressure level (SPL) isopleths from the modelled single impulse sites, with water depth indicated. The results presented are the maximum ranges from the set of modelled tow directions for each site, as described in Table 6.

Fauna group	SPL threshold (L_p; re 1 µPa)	Site 1 (40 m)		Site 2 (50 m)		Site 3 (55 m)		Site 4 (58 m)		Site 5 (45 m)		Site 6 (81 m)		Site 7 (71 m)		Site 8 (62 m)		Site 9 (125 m)		Site 10 (174 m)		Site 11 (167 m)	
		R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
Penguin behavioural response[a]	120	52.1	41.4	46.9	38.6	39.1	33.1	9.43	8.19	38.3	30.9	11.7	9.05	9.52	8.09	9.08	8.06	13.8	11.05	44.6	25.9	37.6	25.6

[a] Penguin behavioural response threshold (Weighted) for impulsive noise (Sørensen et al. (2020)).

Table 15. *2820 in³ source*: Maximum (R_{max}) horizontal distances (in km) from the seismic source to modelled maximum-over-depth peak pressure level (PK) thresholds based on Southall et al. (2019) for marine mammals, and Popper et al. (2014) for fish and Finneran et al. (2017) for sea turtles, for relevant modelled sites with water depth indicated. The results presented are the maximum ranges from the set of modelled tow directions for each site, as described in Table 6.

Hearing group	PK threshold (L_{pk}; dB re 1 µPa)	Distance R_{max} (km)				
		Site 2	Site 3	Site 5	Site 7	Site 10
Low-frequency cetaceans (PTS)	219	0.03	0.03	0.03	0.03	0.03
Low-frequency cetaceans (TTS)	213	0.06	0.09	0.12	0.06	0.06
High-frequency cetaceans (PTS)	230	–	–	–	–	–
High-frequency cetaceans (TTS)	224	–	–	–	–	–
Very-high-frequency cetaceans (PTS)	202	0.37	0.36	0.43	0.33	0.20
Very-high-frequency cetaceans (TTS)	196	0.74	0.63	0.74	0.65	0.37
Otariid Pinnipeds (PTS) Also applied to Penguins	232	–	–	–	–	–
Otariid Pinnipeds (TTS) Also applied to Penguins	226	–	–	–	–	–
Sea turtles (PTS)	232	–	–	–	–	–
Sea turtles (TTS)	226	–	–	–	–	–
Fish: No swim bladder (also applied to sharks)	213	0.06	0.09	0.12	0.06	0.06
Fish: Swim bladder not involved in hearing, Swim bladder involved in hearing Fish eggs, and larvae	207	0.22	0.21	0.23	0.21	0.12

A dash indicates the threshold is not reached within the limits of the modelling resolution (20 m).

5.2.1.2. Seafloor

Ranges presented for seafloor receptors are provided in Tables 16 and 17 for receiver depths of 50 and 5 cm above the seafloor. As an example, the seafloor PK results in Table 16 differ from the maximum-over-depth modelled results presented in Table 15. This is because the model used for the water column results, calculated using FWRAM do not represent the maximum sound levels at the seafloor close to the array. FWRAM is based on a wide-angle parabolic equation (PE) algorithm which is valid to only approximately 70° down angle from the horizontal, and while it provides accurate predictions in the horizontal direction, it cannot predict sound levels directly under the array. VSTACK was used to determine the levels at the seafloor directly under the array and is valid in the very nearfield directly under the source.

Table 16. *2820 in³ source*: Maximum (R_{max}) horizontal distances (in m) from the seismic source to modelled seafloor (receiver located 50 cm above seafloor) peak pressure level thresholds (PK) at eleven representative water depths.

Hearing group/animal type	PK threshold (L_{pk}; dB re 1 µPa)	Water Depth										
		40 m	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
		Distance R_{max} (m)										
Sound levels for sponges and corals[1]	226	2	*	*	*	*	*	*	*	*	*	*
Fish: No swim bladder (also applied to sharks)	213	102	110	74	73	73	70	67	56	46	9	*
Fish: Swim bladder not involved in hearing, Swim bladder involved in hearing Fish eggs, and larvae	207	179	190	139	147	152	150	149	148	148	127	122

[1] Heyward et al. (2018)
An asterisk indicates that the sound level was not reached.

Table 17. 2820 *in³ source*: Maximum (R_{max}) horizontal distances (in m) from the seismic source to modelled seafloor (receiver located 5 cm above seafloor) peak-peak pressure levels (PK-PK) at seven representative water depths. Results included in relation to benthic invertebrates.

PK-PK ($L_{pk\text{-}pk}$; dB re 1 µPa)	Water Depth										
	40 m	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
	Distance R_{max} (m)										
213[1,2,3]	157	172	132	140	143	146	146	146	140	120	113
212[2,3]	169	179	140	150	157	161	165	163	164	148	141
210[1,2]	250	211	163	168	177	187	195	206	212	212	210
209[1,2]	297	288	173	183	190	199	207	224	234	233	237
202[4]	711	631	295	311	324	340	352	368	386	603	608

[1] Day et al. (2019), lobster
[2] Day et al. (2016a), lobster and scallops
[3] Day et al. (2017), scallops.
[4] Payne et al. (2008), lobster

5.2.1.3. Particle Motion Metrics

The modelling considered receivers positioned at 5 cm off the seafloor. The maximum distance in metres to a peak particle acceleration magnitude of 37.57 ms^{-2} are presented in Table 18. The ranges for the particle acceleration threshold for invertebrates defined by Day et al. (2016a).

Table 18. Maximum (R_{max}) horizontal distances (in m) from the 2820 in^3 to particle motion threshold: Peak acceleration magnitude level (m/s^2) threshold for benthic invertebrates 5 cm above the seafloor, with water depth indicated. Results included in relation to benthic invertebrates (Section 3.5.1).

Hearing group/animal type	Peak Acceleration Magnitude (m/s^2)	Water Depth										
		40 m	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
		Distance R_{max} (m)										
Benthic invertebrates	37.57	52	4	*	*	*	*	*	*	*	*	*

An asterisk indicates that the sound level was not reached.

5.2.1.4. Sound Levels at Sensitive Receivers

The received per-pulse SPL sound levels at the sensitive receiver sites identified in Section 2.1 are provided in Table 19. For each receiver location, the maximum level from all modelled sites is shown below. The distance between the receiver and the modelled site that produced the maximum level are also shown.

Table 19. Maximum-over-depth received sound levels (SPL) at the sensitive receivers outlined in Section 2.1 along with the distance between the receiver and associated modelled site.

Receiver ID	Sensitive receiver	SPL (L_p; dB re 1 µPa)	Distance between receiver location and modelled site (km)	Associated Modelled Site
1	Lady Julia Percy Island	153.4	9.35	1
2	Southern Right Whales Migration and resting BIA	133.9	44.5	2
3	Discovery Bay	113.2	72.1	11
4	Portland	87.4	58.6	2
5	Little River and Taylors Beach	153.1	9.58	1
6	Port Fairy Bay	121.5	23.9	3
7	Twelve Apostles Marine Park	124.6	91.7	1
8	Aire River Beach	107.5	103.5	3

5.2.2. Sound Field Maps and Graphs

5.2.2.1. Sound Level Contour Maps

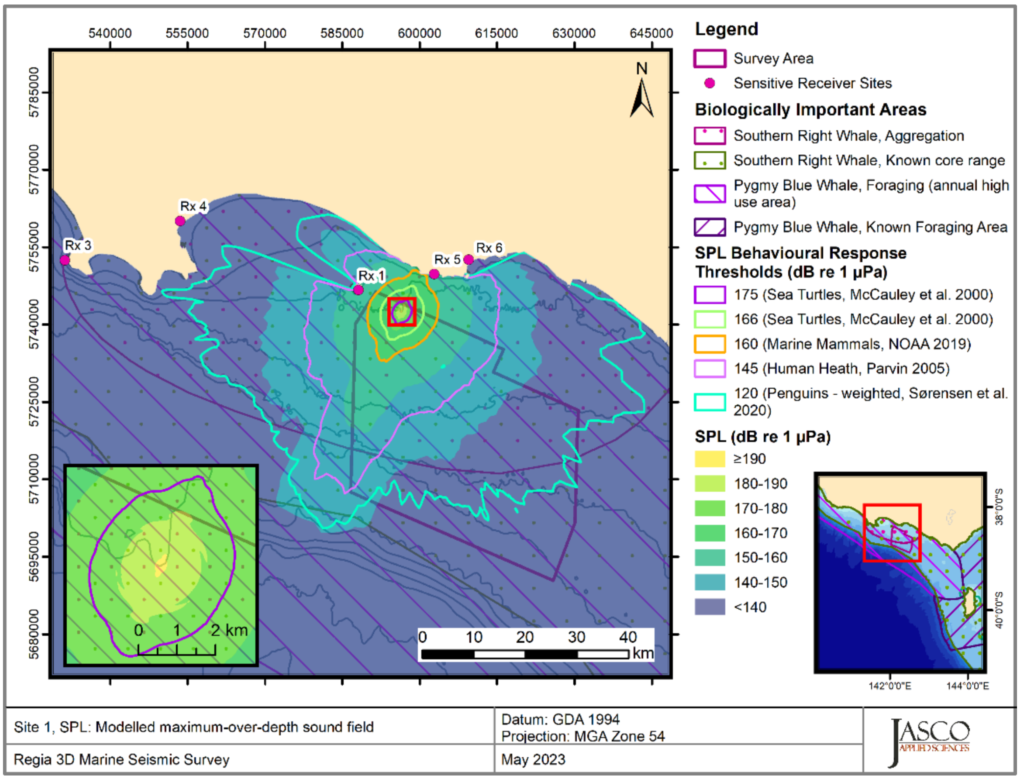

Figure 8. *Site 1, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

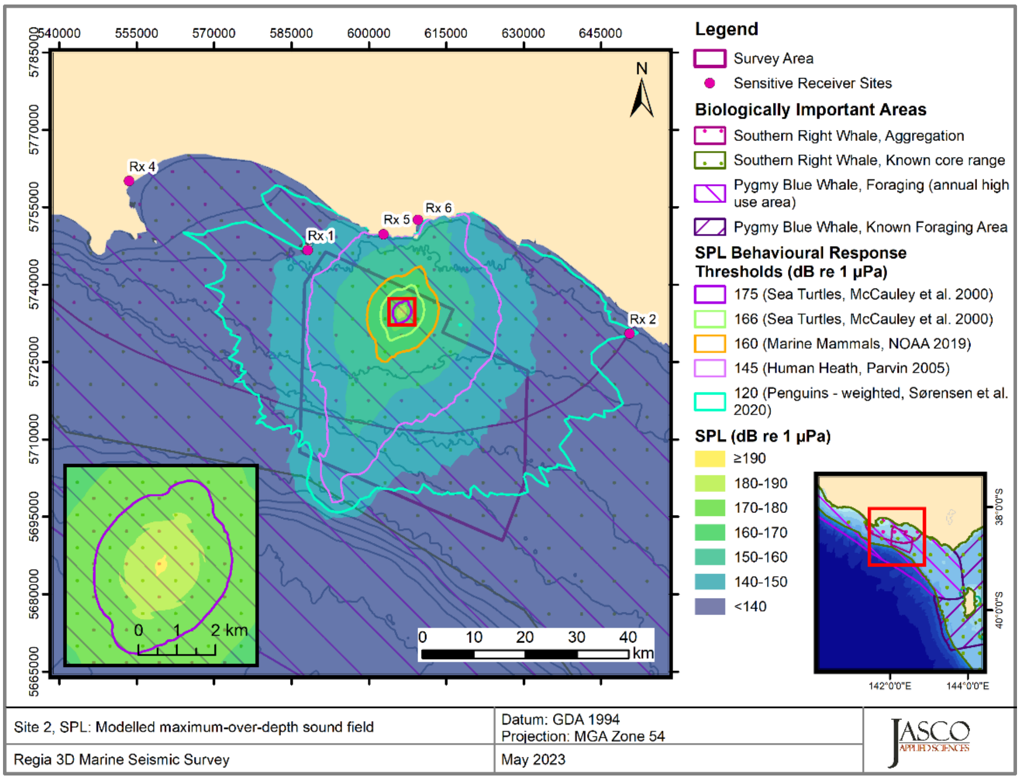

Figure 9. *Site 2, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

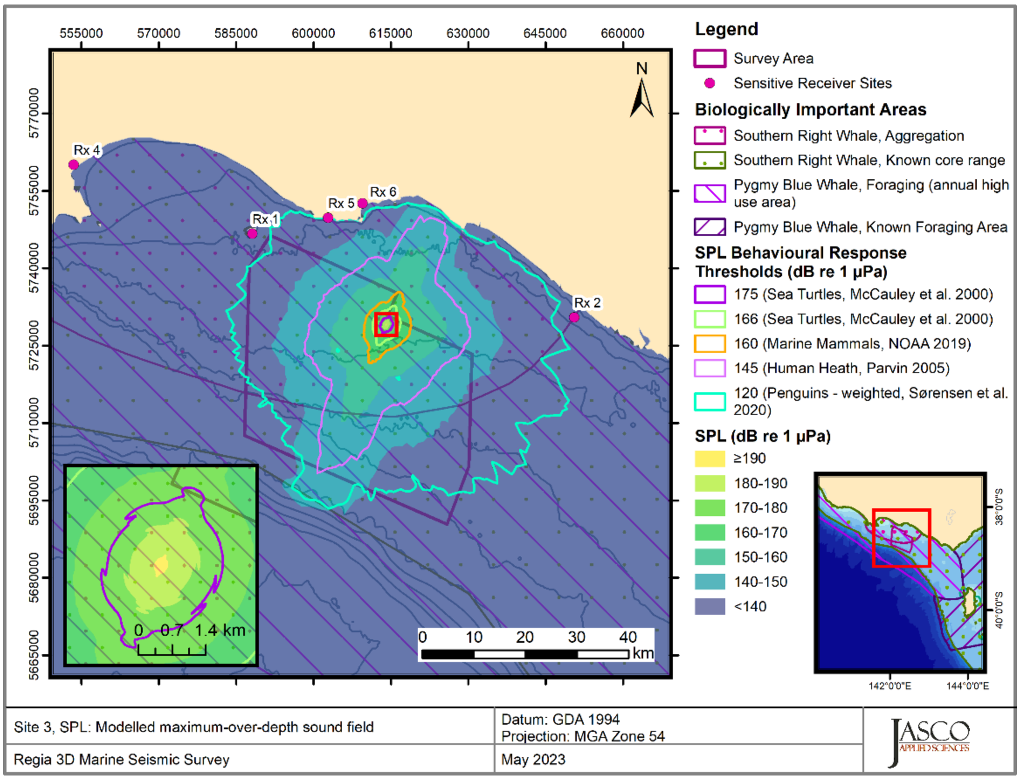

Figure 10. *Site 3, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

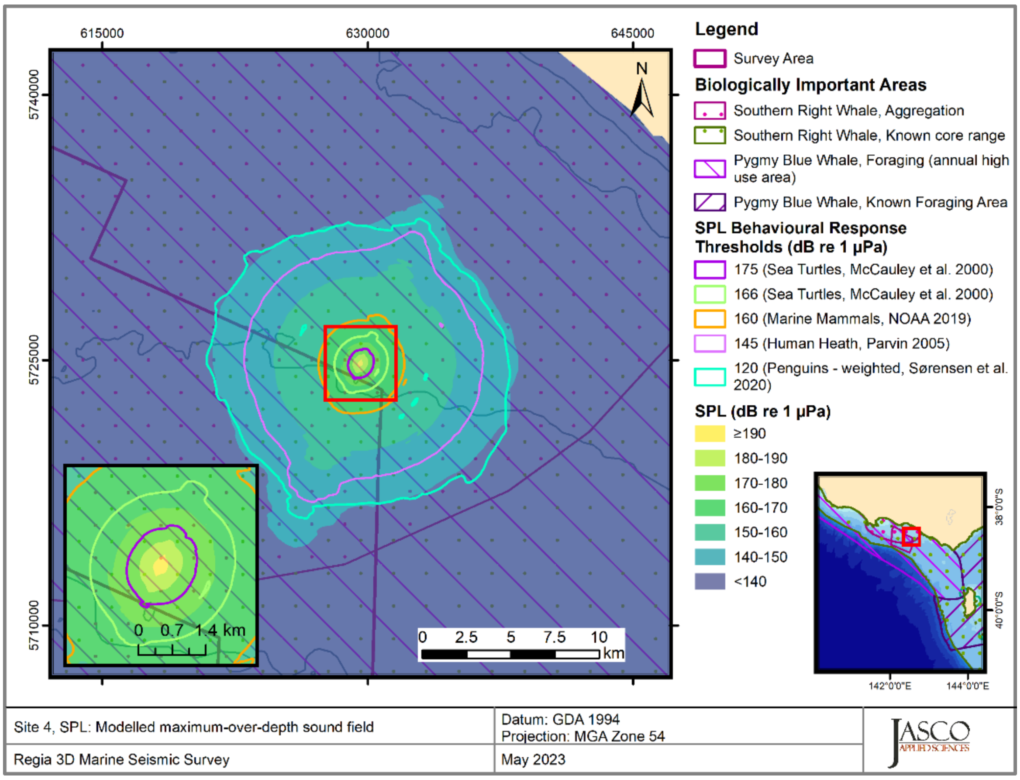

Figure 11. *Site 4, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

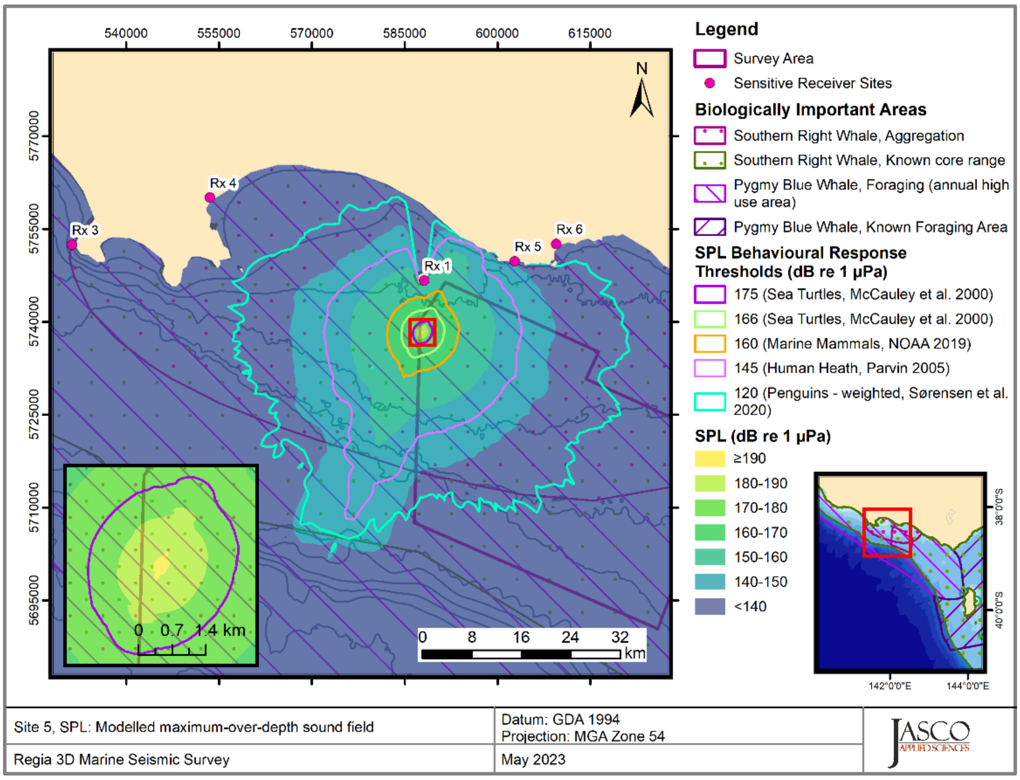

Figure 12. *Site 5, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

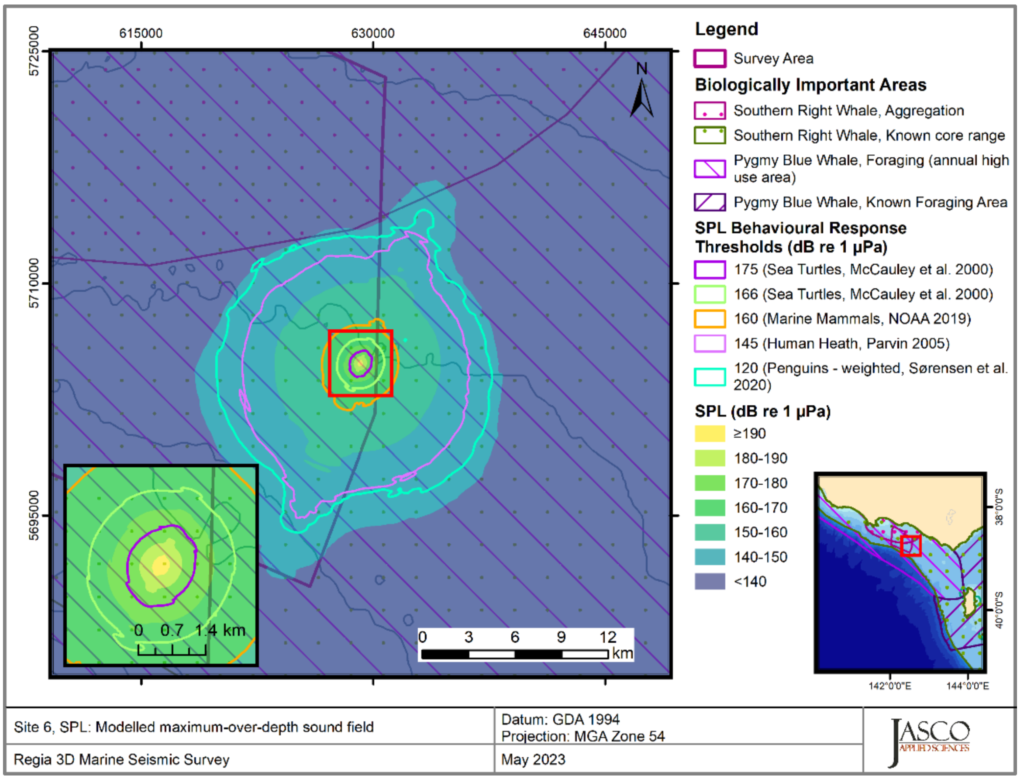

Figure 13. *Site 6, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

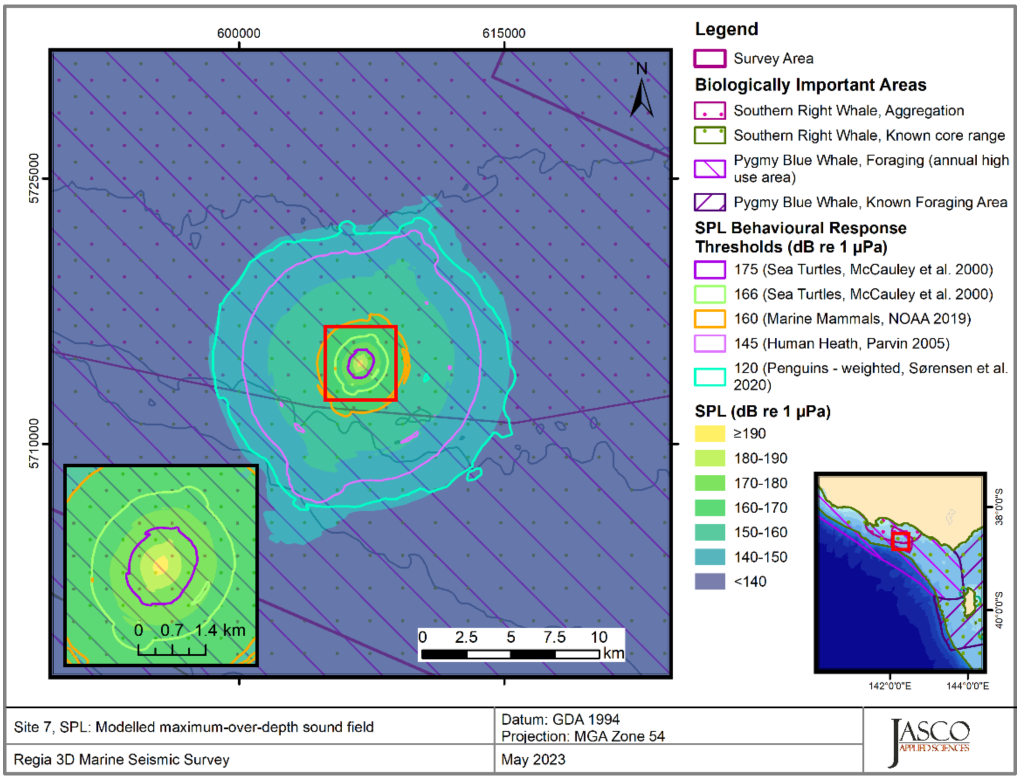

Figure 14. *Site 7, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

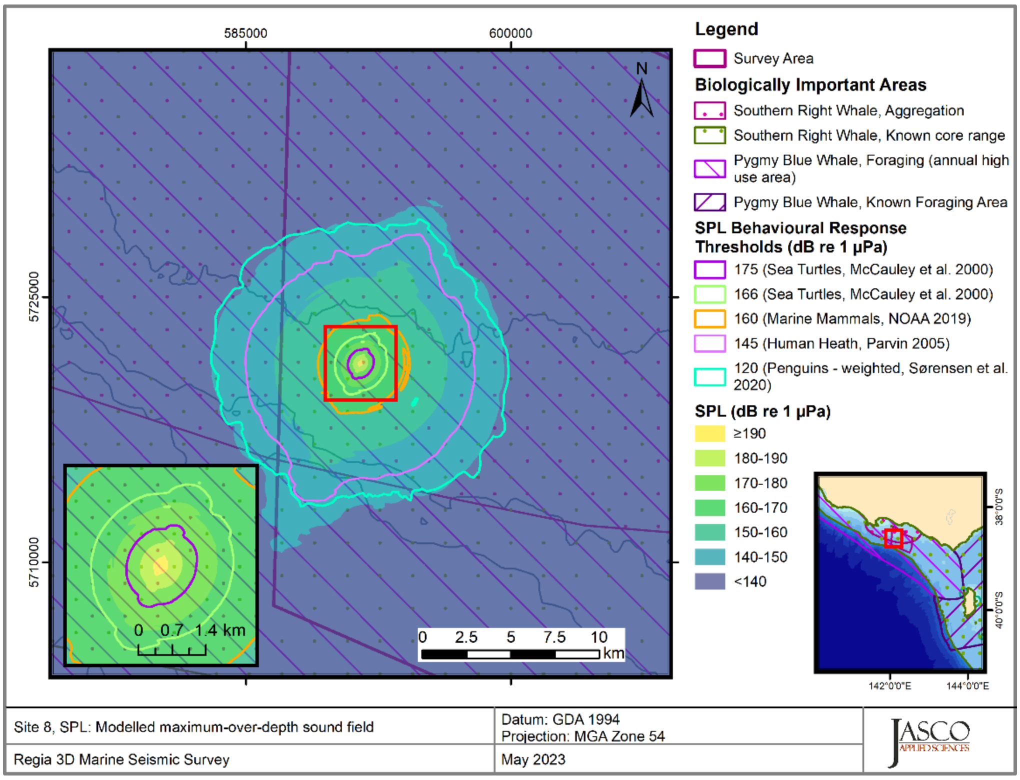

Figure 15. *Site 8, SPL, 2820 in^3 source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

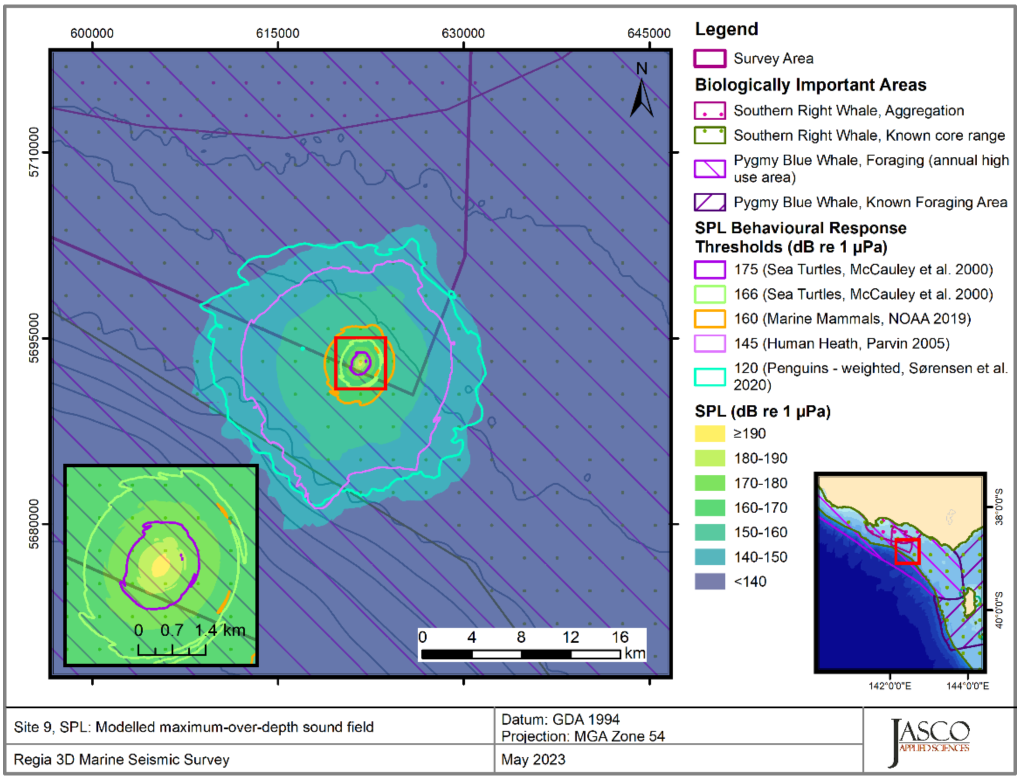

Figure 16. *Site 9, SPL, 2820 in^3 source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

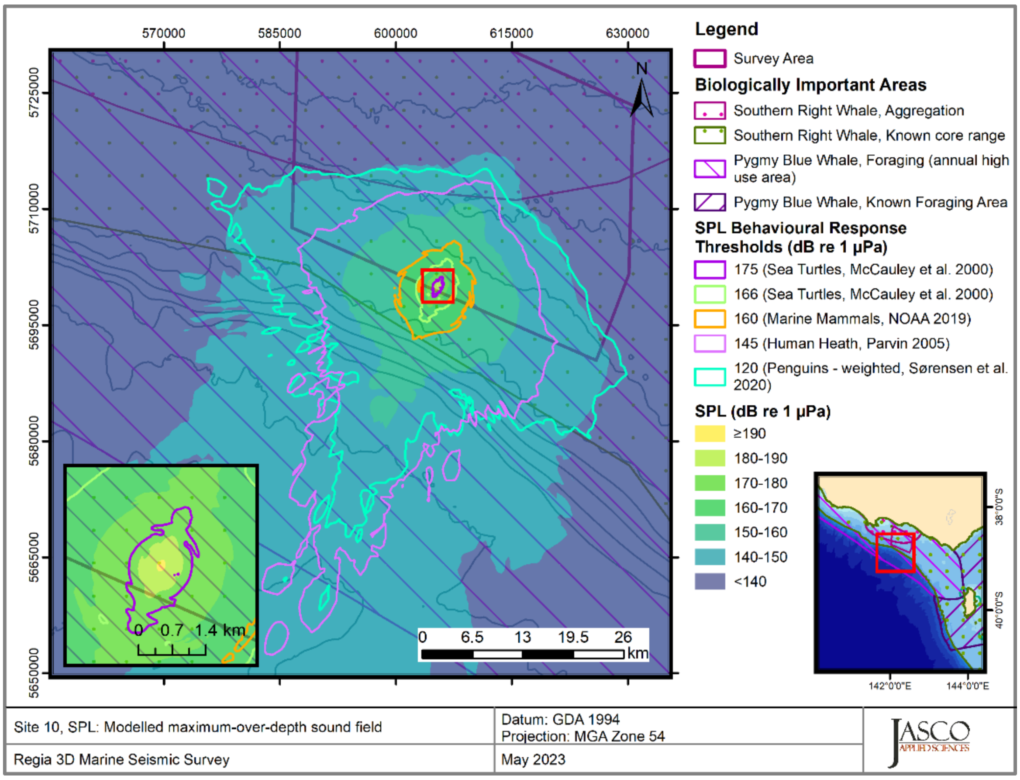

Figure 17. *Site 10, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

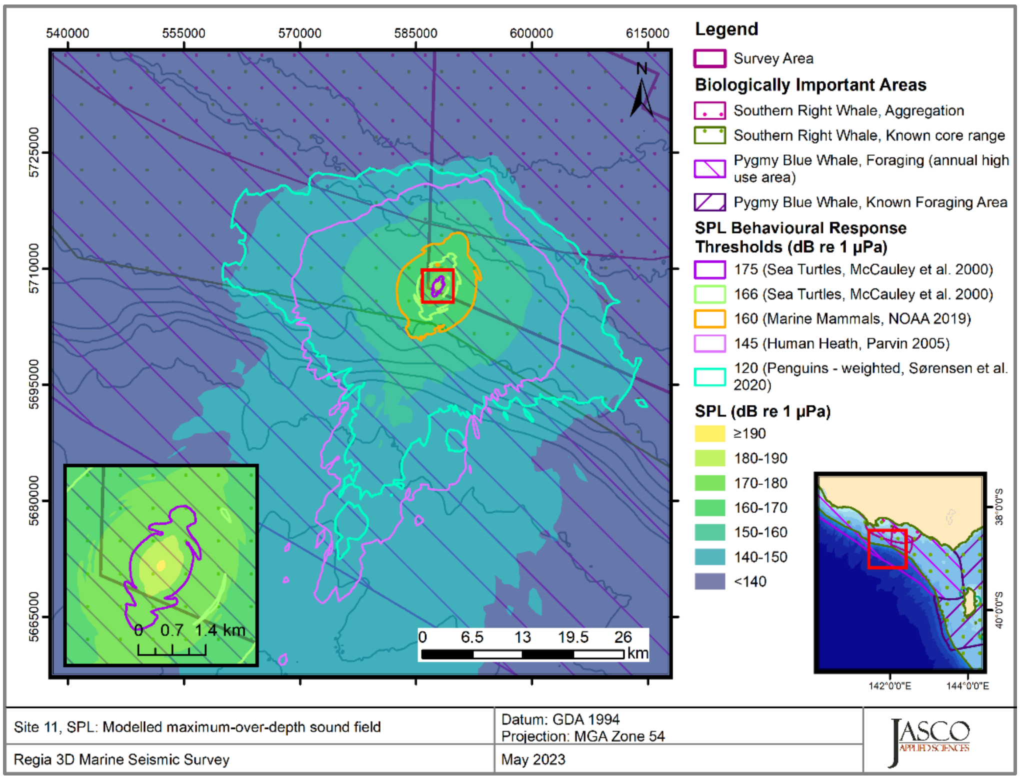

Figure 18. *Site 11, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

5.2.2.2. Vertical Slices of Modelled Sound Fields

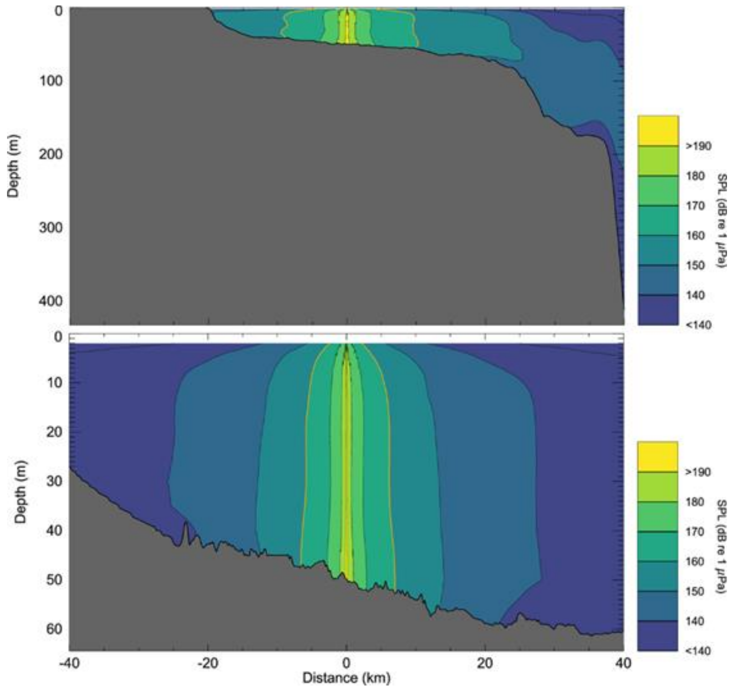

Figure 19. *Site 2, SPL, 2820 in*[3] *source, tow azimuth 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow azimuth for broadside, and the tow azimuth for the endfire slice.

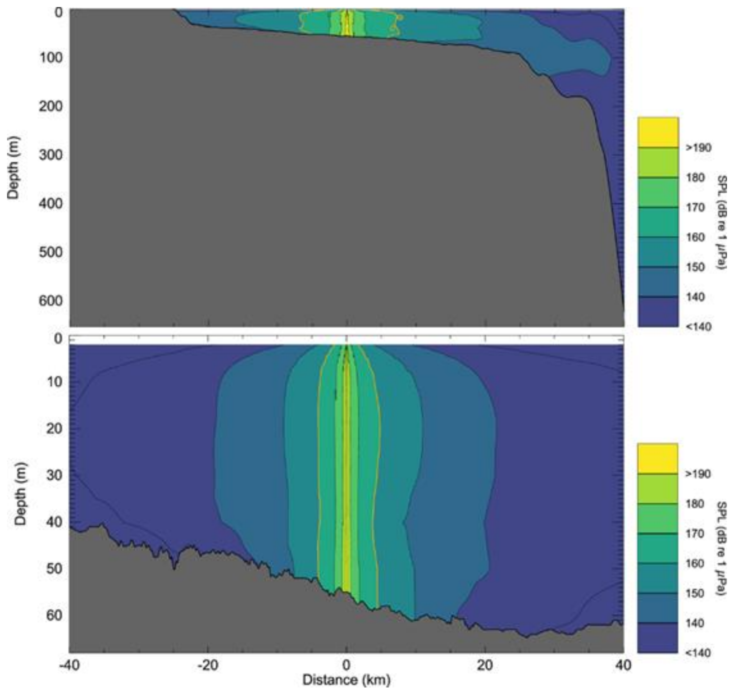

Figure 20. *Site 3, SPL, 2820 in*[3] *source, tow azimuth 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow azimuth for broadside, and the tow azimuth for the endfire slice.

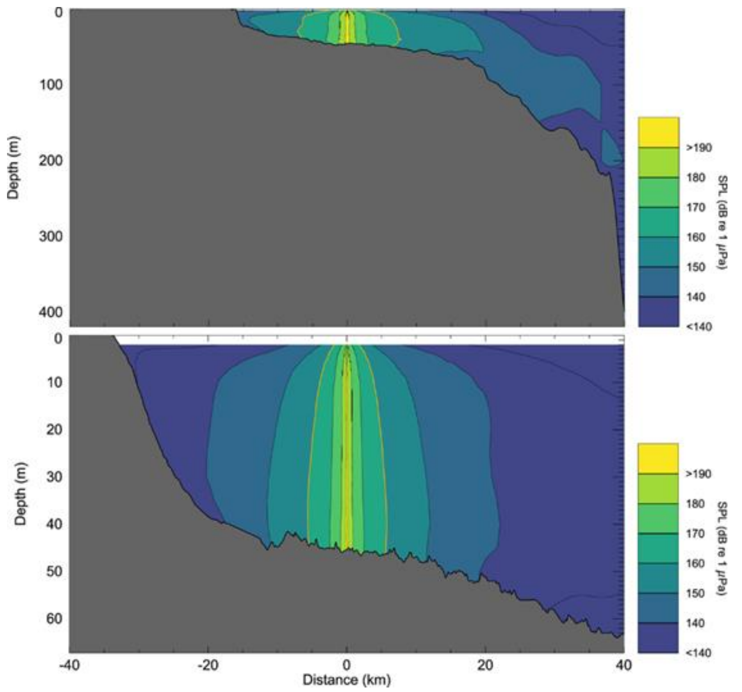

Figure 21. *Site 5, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow azimuth for broadside, and the tow azimuth for the endfire slice.

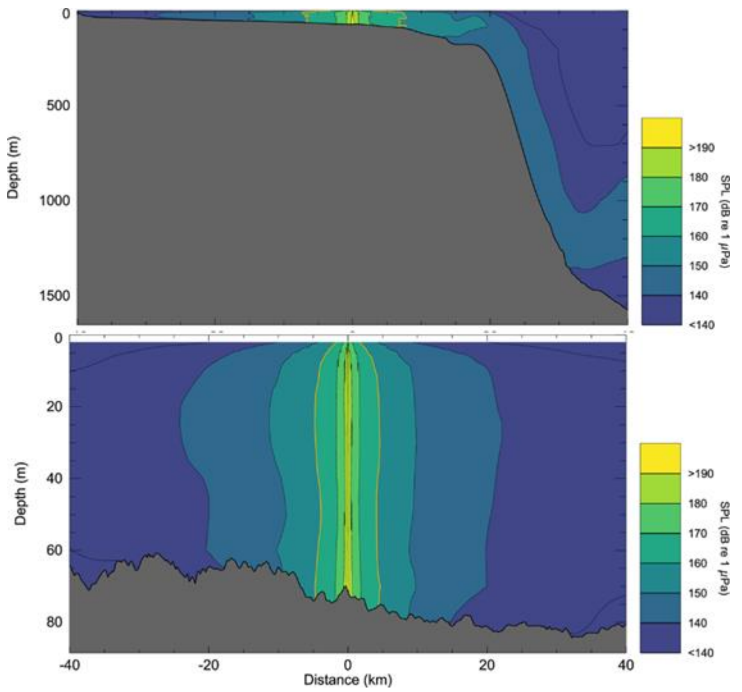

Figure 22. *Site 7, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow azimuth for broadside, and the tow azimuth for the endfire slice.

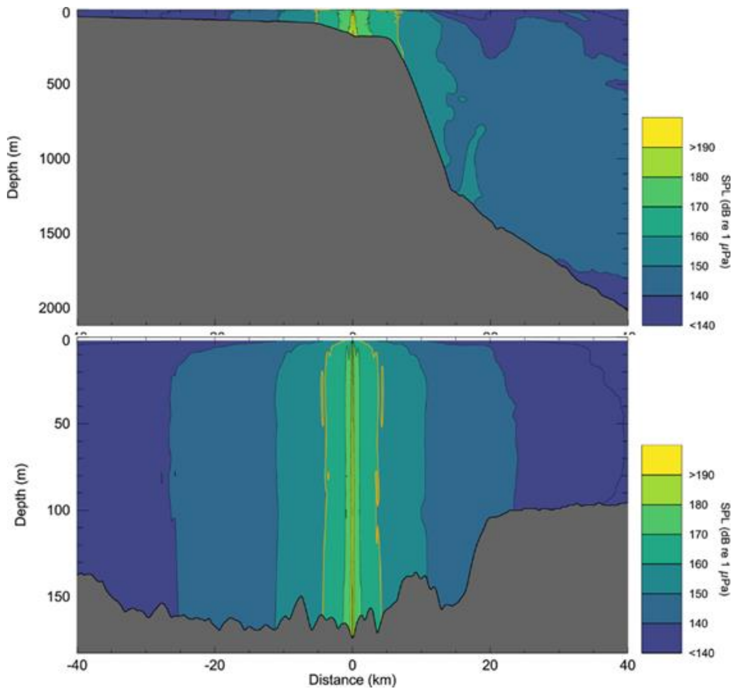

Figure 23. *Site 10, SPL, 2820 in³ source, tow azimuth 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow azimuth for broadside, and the tow azimuth for the endfire slice.

5.3. Multiple Source Fields

This section presents the sound fields in terms of SEL accumulated over 24 h for the modelled scenarios (Section 2). Frequency-weighted SEL_{24h} sound fields were used to estimate the maximum horizontal distances (R_{max}) to marine mammal and sea turtle PTS and TTS thresholds (listed in Table 20), and to estimate maximum distance and the area for injury and TTS guidelines for fish (Table 21).

The SEL_{24h} sound fields are presented as contour maps in Figures 24–26. These figures present the unweighted SEL_{24h} in 10 dB steps, as well as the isopleths corresponding to thresholds or guidelines that are large enough to be resolved on a map.

5.3.1. Tabulated Results

Table 20. Maximum-over-depth distances (in km) to frequency-weighted 24 h sound exposure level (SEL_{24h}) based permanent threshold shift (PTS) and temporary threshold shift (TTS) for marine mammals Southall et al. (2019) and sea turtles (Finneran et al. 2017) using the 2820 in^3 seismic source for all scenarios. Maximum extents are in the broadside direction.

Hearing group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Scenario A		Scenario B		Scenario C	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS							
LF cetaceans	183	4.89	401	1.65	232	1.90	186
HF cetaceans	185	–	–	–	–	–	–
VHF cetaceans	155	0.07	7.19	0.07	11.1	0.06	10.5
Otariid Pinnipeds	203	–	–	–	–	–	–
Penguins	203	–	–	–	–	–	–
Sea turtles	204	0.07	8.03	0.07	11.1	0.06	10.6
TTS							
LF cetaceans	168	34.0	2347	14.8	1997	43.5	2144
HF cetaceans	170	0.05	0.50	0.05	0.86	0.04	0.15
VHF cetaceans	140	0.55	76.4	0.29	63.2	0.34	50.9
Otariid Pinnipeds	188	0.05	2.69	0.06	1.66	0.06	2.12
Penguins	188	0.05	2.69	0.06	1.66	0.06	2.12
Sea turtles	189	3.43	313	1.14	171	0.82	125

A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Table 21. *Fish criteria*: Maximum horizontal distances (R_{max}, in km) from the survey lines and area (km²) to injury and temporary threshold shift (TTS) thresholds considering 24 h of survey activity.

Marine fauna group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Scenario A		Scenario B		Scenario C	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
Mortality and potential mortal injury							
Fish I	219	0.06	4.07	0.06	5.53	0.06	7.41
Fish II, fish eggs and fish larvae	210	0.07	9.22	0.07	11.1	0.06	11.4
Fish III	207	0.07	9.52	0.07	11.9	0.07	12.0
Fish recoverable injury							
Fish I	216	0.07	4.94	0.06	8.99	0.06	8.65
Fish II, III	203	0.11	15.1	0.07	14.8	0.07	15.0
Fish TTS							
Fish I, II, III	186	7.86	633	4.23	494	5.31	459

Fish I–No swim bladder; Fish II–Swim bladder not involved with hearing; Fish III–Swim bladder involved with hearing.

5.3.2. Sound Level Contour Maps

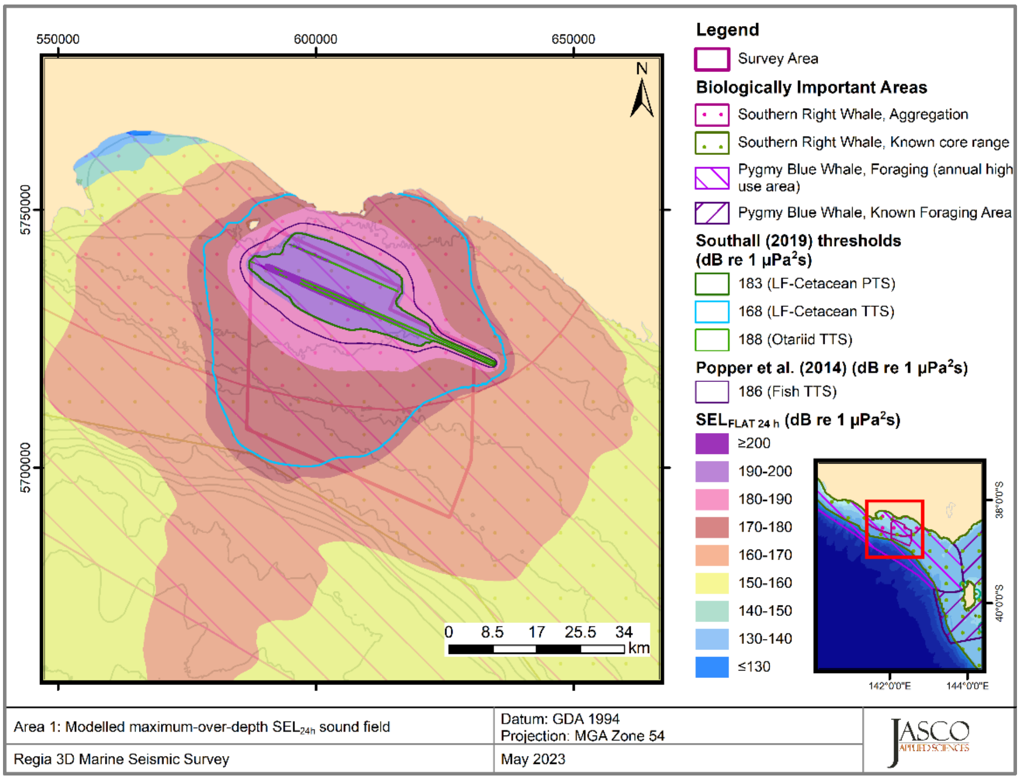

Figure 24. *Scenario A*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

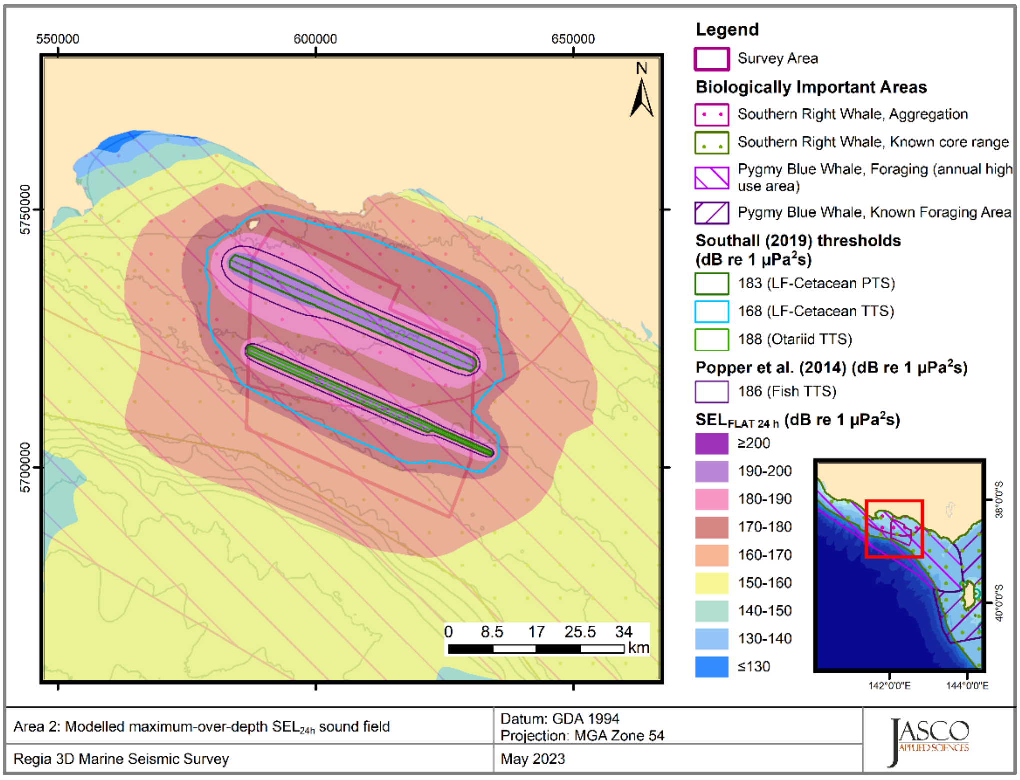

Figure 25. *Scenario B*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

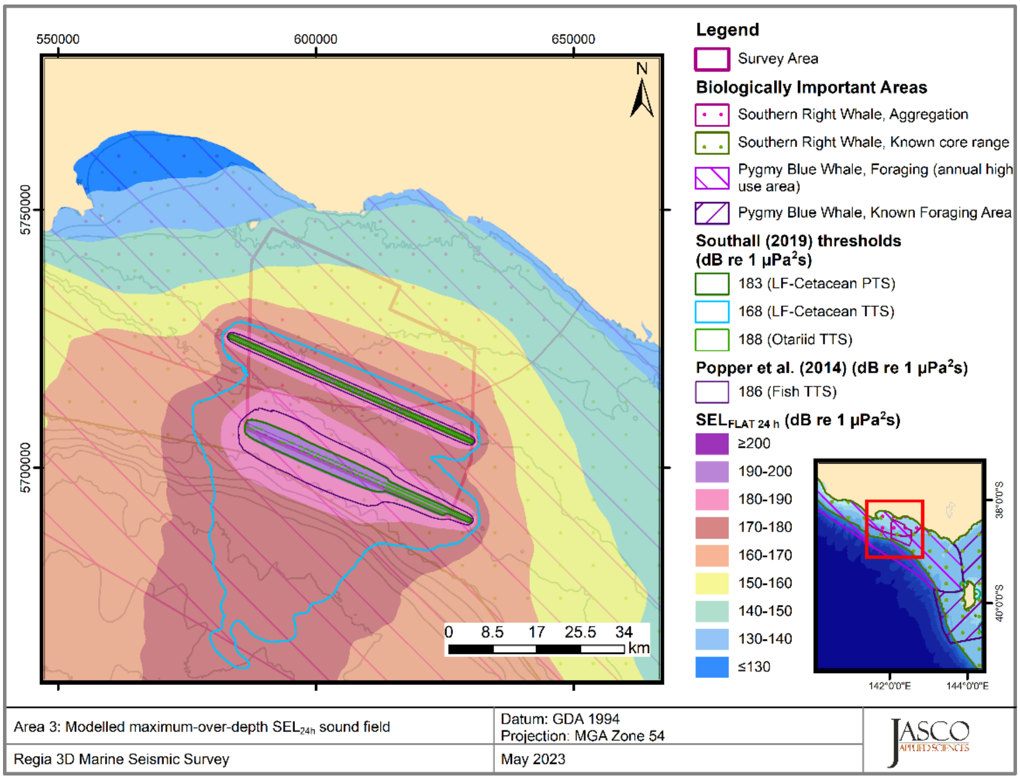

Figure 26. *Scenario C*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

5.4. Animal Movement Exposure Ranges

A summary of radial distances to exposure thresholds for pygmy blue whales and southern right whales, along with probability of exposure for each modelled scenario (Section 2) are included below. Tables 22 and 23 show results for scenarios with pygmy blue whale animats unrestricted (Seeding A) and restricted to the shelf (Seeding B), respectively, whilst Tables 24 and 25 show results for scenarios with southern right whale animats restricted to the extended aggregation BIA (Seeding A) and known core range area (Seeding B), respectively. Results include $ER_{95\%}$ exposure ranges calculated for the 160 dB behavioural response threshold and SEL_{24h} thresholds for both TTS and PTS, and the probability of an animat being exposed above the threshold within the $ER_{95\%}$.

Exposure ranges for TTS and PTS PK thresholds were not included in the exposure analysis since acoustic modelling predicted no PTS PK exceedance and ranges of less than 150 m for TTS PK (see Table 15). For the per-pulse PK metric, the exceedance distances are small and close enough to the source such that only minor differences are expected between acoustic and animat exposure predictions.

Sections 5.4.1 and 5.4.2 includes histograms of CPA ranges to SEL_{24h} PTS, TTS, and the behavioural response threshold for Scenario A, with results in Tables 22 to 25. Additional histograms for the remaining scenarios can be found in Appendix F.

Table 22. Summary of animat simulation results for pygmy blue whales with animats not restricted to the BIA (Seeding A). The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A				Scenario B				Scenario C			
	Female		Male		Female		Male		Female		Male	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
PTS (SEL_{24h})[1]	1.34	52	1.38	52	0.44	61	0.51	50	0.26	61	0.26	55
TTS (SEL_{24h})[2]	13.2	57	12.7	59	6.03	60	6.02	59	7.60	60	7.38	60
Behavioural response (SPL)[3]	7.92	87	7.96	87	6.82	93	6.77	93	6.77	92	6.77	91

[1] LF-weighted SEL_{24h} (183 dB re 1 µPa²·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 µPa²·s) (Southall et al.)
[3] SPL (160 dB re 1 µPa) (NOAA (2019))

Table 23. Summary of animat simulation results for pygmy blue whales with animats restricted to the shelf (Seeding B). The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A				Scenario B				Scenario C			
	Female		Male		Female		Male		Female		Male	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
PTS (SEL_{24h})[1]	1.40	51	1.25	58	0.44	57	0.53	50	0.34	47	0.28	53
TTS (SEL_{24h})[2]	13.2	58	12.5	60	6.05	60	5.91	60	5.93	67	5.75	68
Behavioural response (SPL)[3]	7.89	88	8.09	86	6.80	93	6.79	93	6.50	93	6.54	93

[1] LF-weighted SEL_{24h} (183 dB re 1 µPa²·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 µPa²·s) (Southall et al.)
[3] SPL (160 dB re 1 µPa) (NOAA (2019))

Table 24. Summary of animat simulation results for southern right whales with animats restricted to the adjusted aggregation BIA (Seeding A). The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A								Scenario B								Scenario C							
	Migrating				Aggregating				Migrating				Aggregating				Migrating				Aggregating			
	Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
PTS (SEL_{24h})[1]	1.50	50	0.79	52	1.38	51	1.12	56	0.45	53	0.52	36	0.42	52	0.38	48	0.20	63	0.21	80	0.15	66	0.14	66
TTS (SEL_{24h})[2]	11.6	60	8.63	75	10.2	60	9.77	61	6.04	52	5.73	45	5.52	57	4.88	60	6.70	41	6.64	39	6.71	37	6.62	37
Behavioural response (SPL)[3]	8.17	82	8.43	85	7.66	81	7.78	83	6.65	89	6.81	92	6.39	88	6.47	91	6.61	87	6.66	87	6.58	84	6.58	89

[1] LF-weighted SEL_{24h} (183 dB re 1 µPa^2·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 µPa^2·s) (Southall et al.)
[3] SPL (160 dB re 1 µPa) (NOAA (2019))

Table 25. Summary of animat simulation results for southern right whales with animats restricted to the known core range area (Seeding B). The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A								Scenario B								Scenario C							
	Migrating				Aggregating				Migrating				Aggregating				Migrating				Aggregating			
	Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf		Mother & Calf		No Calf	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
PTS (SEL_{24h})[1]	1.48	50	0.79	53	1.32	52	1.14	56	0.54	49	0.47	40	0.50	45	0.38	50	0.25	37	0.18	44	0.19	51	0.13	53
TTS (SEL_{24h})[2]	11.6	60	8.59	76	10.4	59	9.92	60	5.98	51	5.66	45	5.43	57	4.93	60	6.38	60	5.88	66	5.90	60	5.55	61
Behavioural response (SPL)[3]	8.22	81	8.38	86	7.67	81	7.83	84	6.66	89	6.80	92	6.46	87	6.50	91	6.85	88	7.58	85	6.45	87	6.49	91

[1] LF-weighted SEL_{24h} (183 dB re 1 μPa^2·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 μPa^2·s) (Southall et al.)
[3] SPL (160 dB re 1 μPa) (NOAA (2019))

5.4.1. Exposure Range Histograms: Pygmy Blue Whales

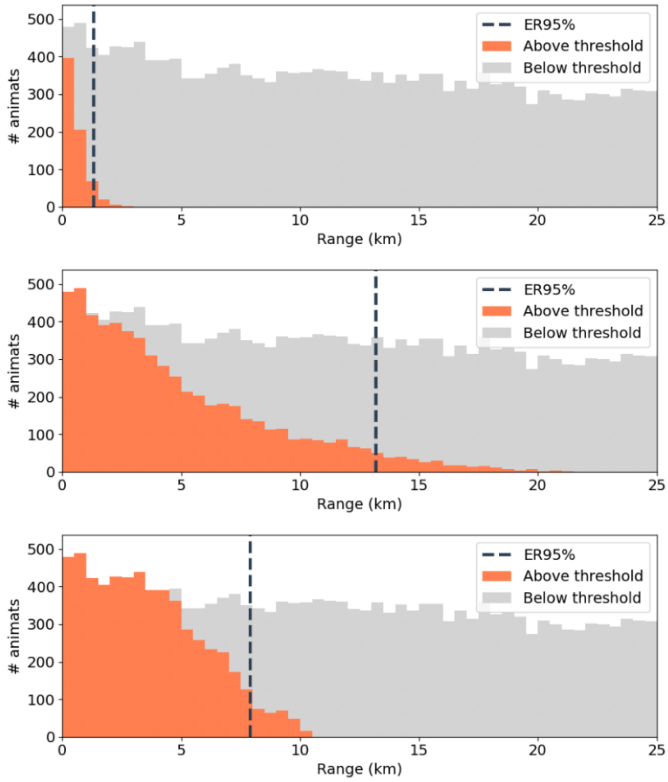

Figure 27. *Scenario A, female pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

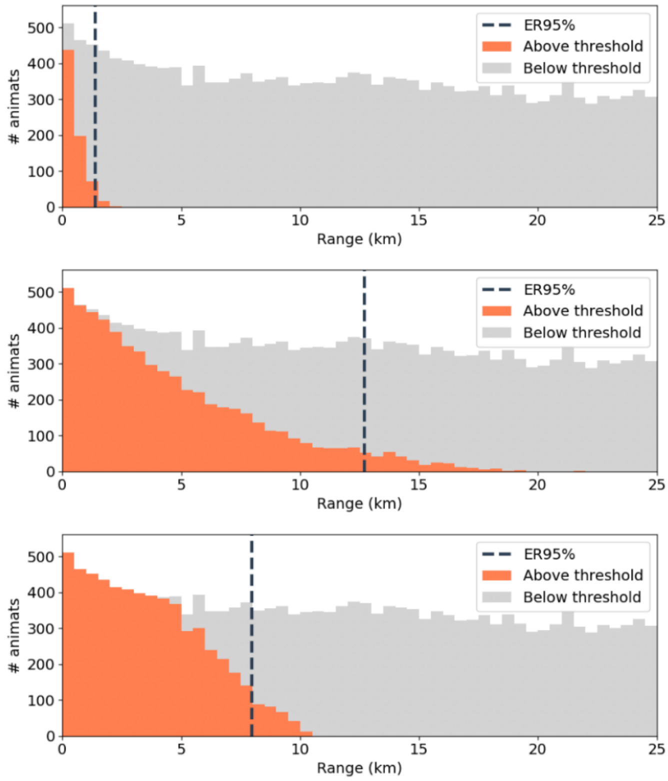

Figure 28. *Scenario A, male pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

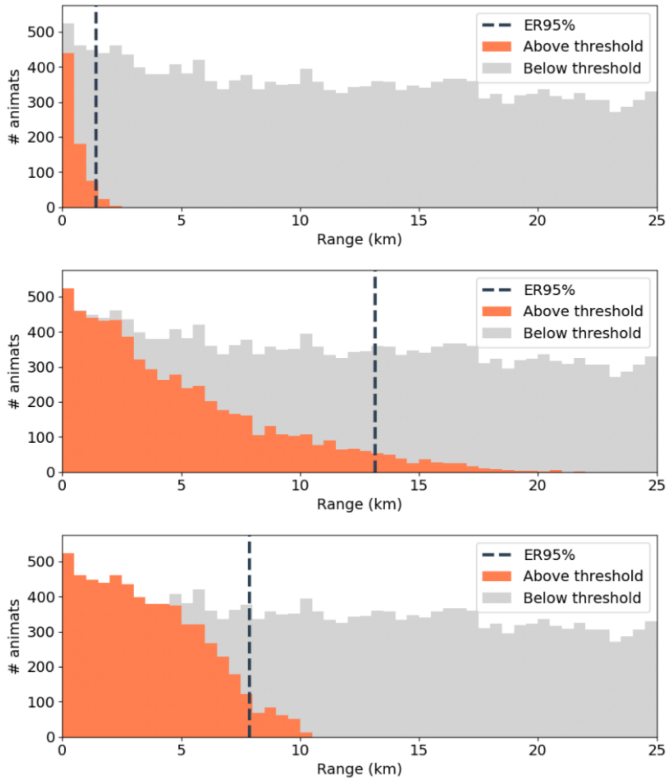

Figure 29. *Scenario A, female pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

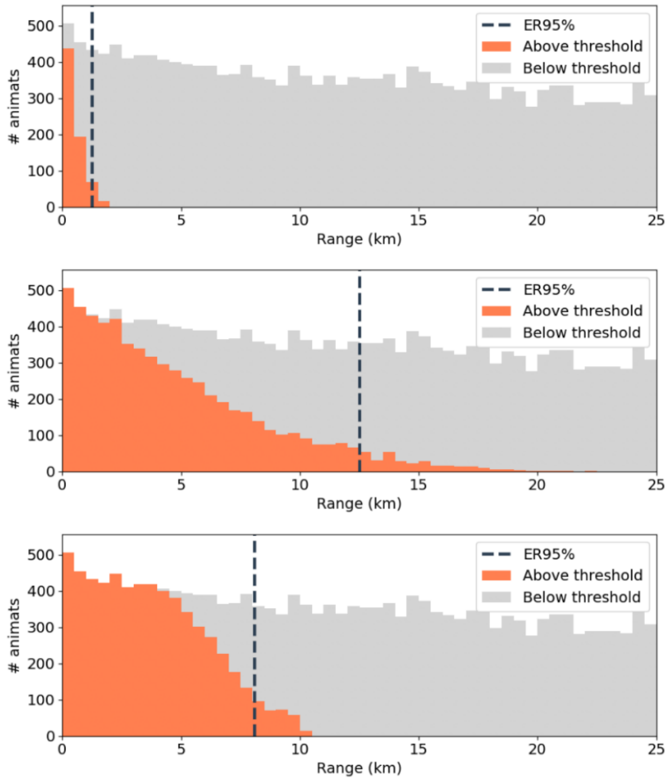

Figure 30. *Scenario A, male pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

5.4.2. Exposure Range Histograms: Southern Right Whales

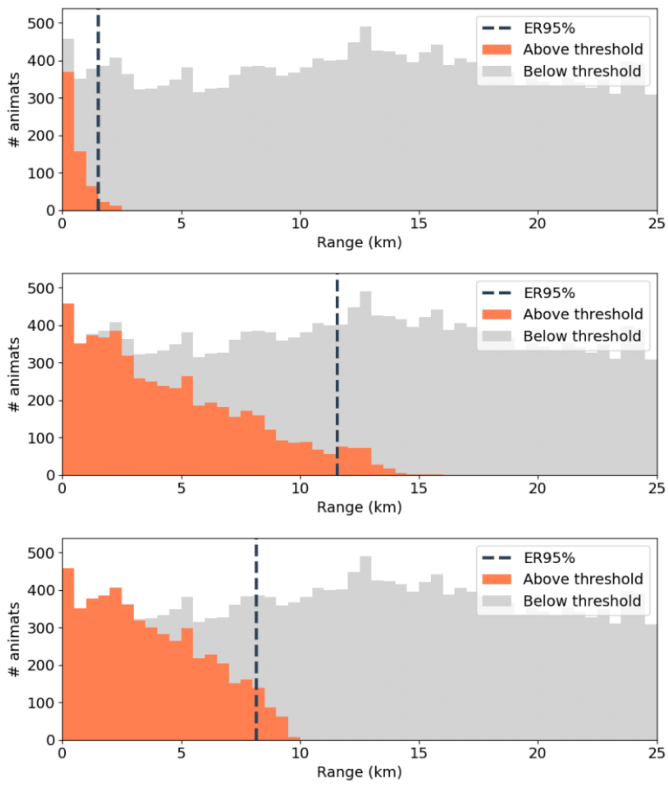

Figure 31. *Scenario A, migrating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

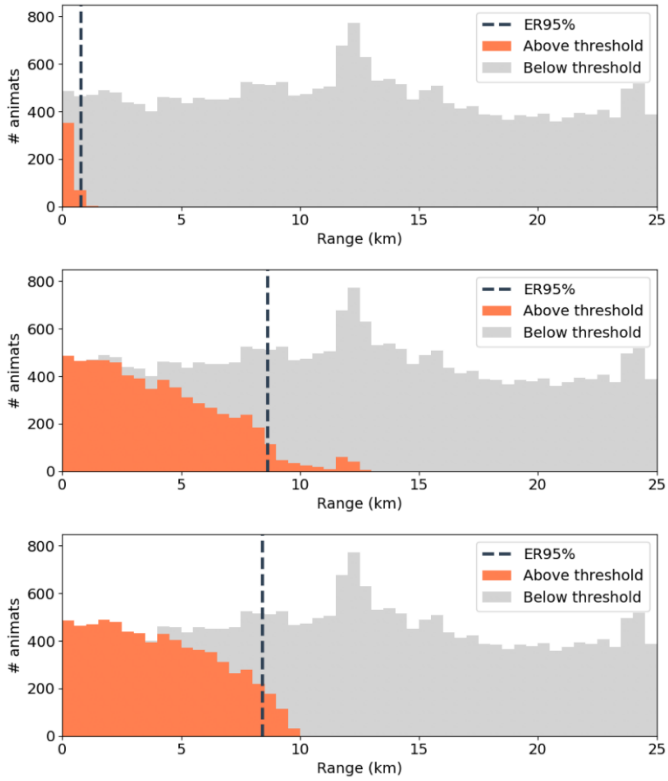

Figure 32. *Scenario A, migrating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

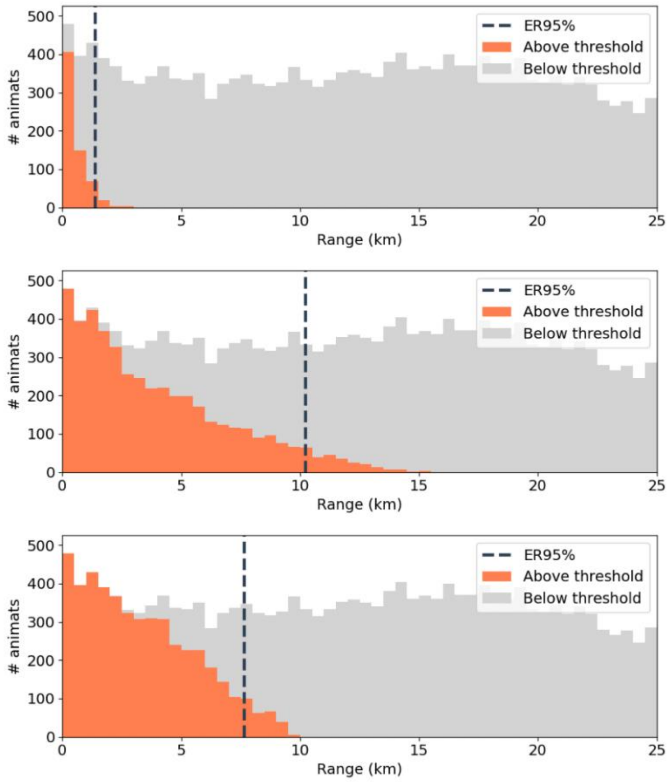

Figure 33. *Scenario A, aggregating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

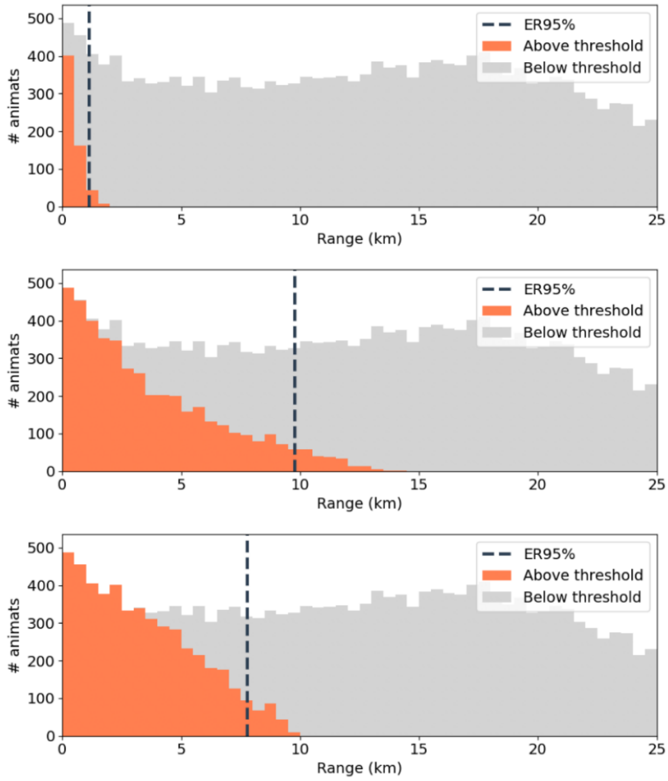

Figure 34. *Scenario A, aggregating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

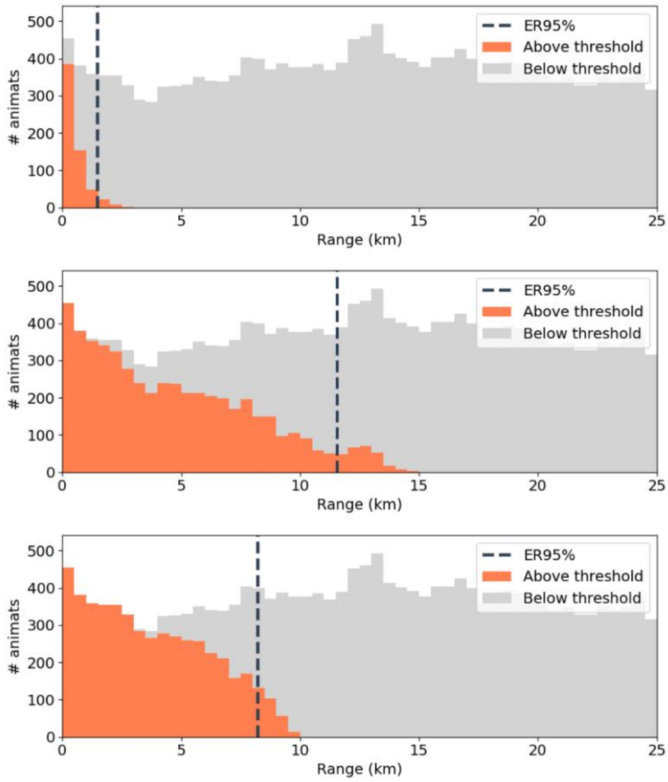

Figure 35. *Scenario A, migrating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

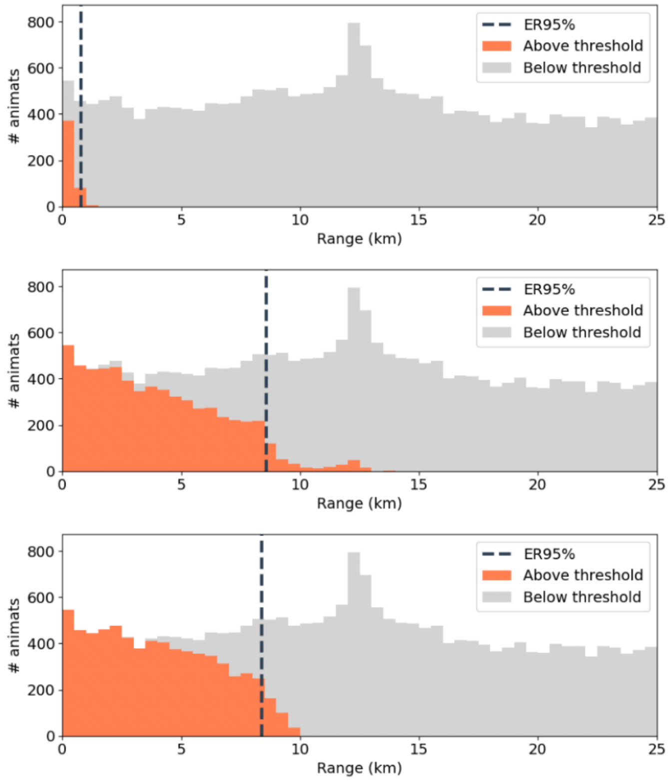

Figure 36. *Scenario A, migrating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

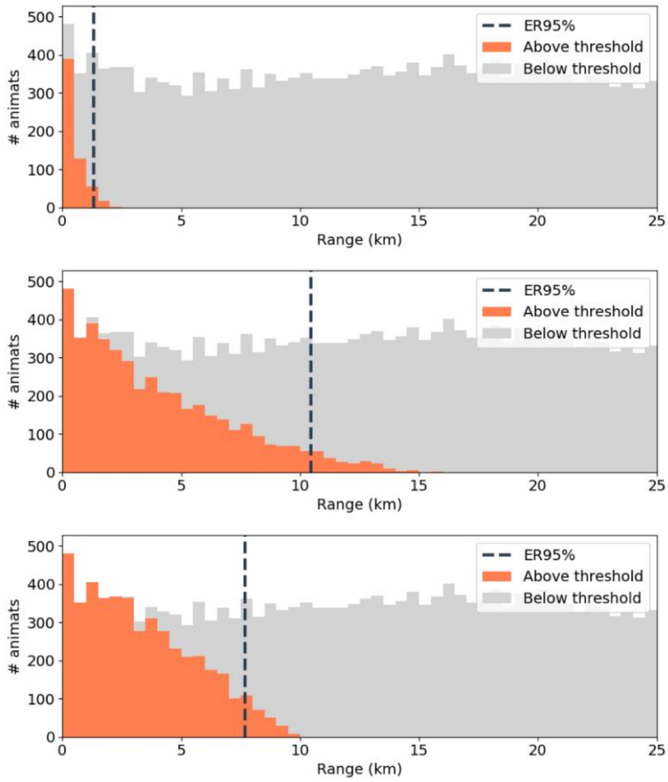

Figure 37. *Scenario A, aggregating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

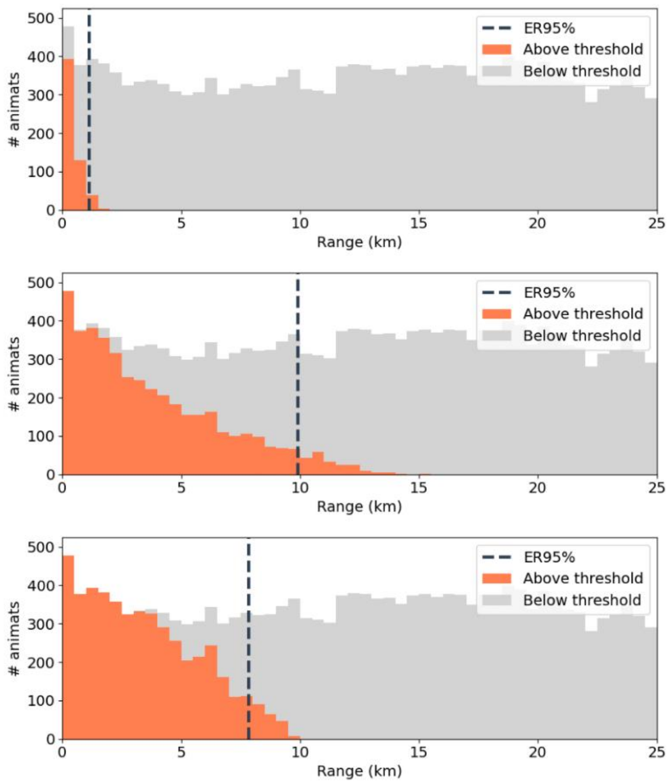

Figure 38. *Scenario A, aggregating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

6. Discussion and Summary

The modelling study predicted underwater sound levels associated with the planned Regia MSS. The underwater sound field from a 2820 in^3 seismic source was modelled (Appendix B.2). An analysis of seasonal sound speed profiles and associated sensitivity comparison indicated that December was likely to be the month most conductive to sound propagation. Only a subset of months when the survey could occur were consisted in the comparison. As such December was selected to ensure a conservative estimation of distances to received sound level thresholds over the potential survey periods (Appendix D.3.2). Modelling also accounted for site-specific bathymetric variations (Appendix D.3.1) and local geoacoustic properties (Appendix D.3.3).

Most acoustic energy from a seismic source is output at lower frequencies, in the tens to hundreds of hertz. The modelled array had a pronounced broadside directivity for decidecade bands between ~100 to 400 Hz (Appendix B.3), which caused a noticeable axial bulge in the modelled acoustic footprints. The overall broadband (10–25000 Hz) unweighted per-pulse SEL and peak pressure source levels of the seismic source operating at 7 m depth are detailed in Table 11.

6.1. Per-Pulse Sound Fields

The per-pulse modelled sites span water depths from about depths of 40–174 m across three different geological regions. The bathymetry within the vicinity of the survey varied between approximately 20–150 m; however, along a south-westward transect the environment generally transitions from shallower water of the Otway Shelf to the significantly deeper waters of the continental slope and abyssal plane (>1000 m). The frequency content of the seismic sources coupled with the bathymetry had a considerable effect on propagation at longer distances, with larger lobes of sound energy extending into the deeper waters. The maximum-over-depth sound footprint maps and vertical slice plots (Sections 5.2.2.1 and 5.2.2.2) assist in demonstrating the influence of the bathymetry and seabed composition on the sound field.

For the sites modelled in shallow water, less than 50 m depth, where the seabed was modelled as a sand layer underlain by variably cemented limestone (calcarenite). Literature suggests that this layer likely begins to thin as water depths increase in an offshore direction, and for water depths greater than 50 m it was considered absent with only the variably cemented calcarenite present at the seafloor interface. Modelled sites located in environments where the seabed was modelled as bare calcarenite generally displayed higher rates of loss at distance away from the source as compared to sites where a layer of sand overlies calcarenite.

The presence of unconsolidated coarse sand overlying semi-cemented calcarenite led to a more reflective seabed and likely led to large isopleths for low level thresholds, particularly in the offshore direction. This is most evident for the marine mammal behavioural threshold of 160 dB re 1 µPa (SPL) for impulsive sound sources. However, the distribution of sand layer is not well known and if the thickness of the sand layer is not as uniform as modelled then this variability could potentially lead to smaller radii.

The array directionality and frequency content coupled with the bathymetry had a considerable effect on propagation at longer distances, with larger lobes of sound energy extending into the deeper waters for all modelled sites. This is particularly evident for modelled Sites 9, 10 and 11 which are situated along the continental shelf break and continental slope. For source locations close to the continental shelf break modelling indicates that significant amounts energy reflected from the seabed slope can be trapped in the deep sound channel and propagate for large distances within the ocean interior. This phenomenon is evident in the slice plots showing the sound field in the broadside direction, where greater ranges to all isopleths are predicted to occur in the downward sloping offshore direction. The vertical slice plots in Section 5.2.2.2 assist in demonstrating the influence of the sloping bathymetry on the sound field.

6.2. Multiple Pulse Sound Fields

The accumulated SEL over 24 hours of seismic source operation was modelled considering three acoustic scenarios and three animal movement modelling scenarios, each with a realistic acquisition pattern based on provided survey designs. The modelling predicted the accumulation of sound energy, considering the change in location and the azimuth of the source at each pulse point, which was used to assess possible injury in marine mammals and the SEL_{24h} based fish criteria. The results were presented as maps of the accumulated exposure levels and tabulated values of ranges to threshold levels and exposure areas for the given effects criteria (Section 3).

The footprints and range maxima for all accumulated SEL thresholds are influenced by the seabed compositions along acquisition lines. The discussion above regarding ranges to isopleths also applies to the accumulated SEL calculations. The farthest ranges to thresholds for PTS and TTS were driven by the source orientation and bathymetry, particularly in the broadside and offshore directions.

6.3. Acoustic Results Summary

This section presents summary of the distances to the noise effect criteria applied in this study (Section 3) as relevant to the impact assessment. The effect criteria for impairment of marine mammals, fish and sea turtles use dual metrics (PK and SEL_{24h}), and the longest distance associated with either metric is required to be applied, and thus is presented in this summary.

The SEL_{24h} is a cumulative metric that reflects the dosimetric effect of noise levels within 24 h based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. Where the corresponding SEL_{24h} radii are larger than those for peak pressure criteria, they often represent an unlikely worst-case scenario. More realistically, marine mammals, fish, and sea turtles would not remain in the same location for 24 hours, but rather a shorter period, depending upon their behaviour, the proximity and movements of the source. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be impaired, but rather that an animal could be exposed to the sound level associated with impairment (either PTS or TTS) if it remained in that location for 24 h. A more realistic representation of the potential exposures was undertaken using animal movement modelling (‘animat modelling’), with the results summarised separately below.

A summary of predicted distances to criteria from acoustic modelling are presented below.

Marine Mammals

Table 26 summarises the distances to criteria for marine mammals, note that these distances are primarily associated with the broadside aspect of the array. Results for PK are presented in Table 15, while SEL_{24h} results are in Table 20.

Table 26. Summary of maximum (R_{max}) horizontal distances (in km) from modelled sites or scenarios to behavioural response thresholds and temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals. Maximum extents are in the broadside direction of the 2820 in^3 seismic source.

Hearing group	Maximum modelled distance to effect threshold (R_{max})						
	Behavioural response[1]	Scenario A		Scenario B		Scenario C	
		TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)
Low-frequency cetaceans	10.3 (SPL)	34.0 (SEL_{24h})	4.89 (SEL_{24h})	14.8 (SEL_{24h})	1.65 (SEL_{24h})	43.5 (SEL_{24h})	1.90 (SEL_{24h})
High-frequency cetaceans		0.05 (SEL_{24h})	–	0.05 (SEL_{24h})	–	0.04 (SEL_{24h})	–
Very high-frequency cetaceans		0.74 (PK)	0.43 (PK)	0.74 (PK)	0.43 (PK)	0.65 (PK)	0.33 (PK)
Otariid Pinnipeds		0.05 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–

Noise exposure criteria: [1] NOAA (2019) and [2] Southall et al. (2019).
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Sea Turtles

Table 27 summarises the distances to criteria for sea turtles, with the results for behavioural thresholds presented in Table 3 while SEL_{24h} results are in Table 20.

Table 27. Summary of horizontal distances (in km) to turtle behavioural response criteria, temporary threshold shift (TTS), and permanent threshold shift (PTS).

Hearing group	Maximum modelled distance to effect threshold (R_{max})							
	Behavioural response[1]	Behavioural disturbance[1]	Scenario A		Scenario B		Scenario C	
			TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]
Sea Turtles	5.97 (SPL)	2.55 (SPL)	3.43 (SEL_{24h})	0.07 (SEL_{24h})	1.14 (SEL_{24h})	0.07 (SEL_{24h})	0.82 (SEL_{24h})	0.06 (SEL_{24h})

Noise exposure criteria: [1] McCauley et al. (2000), and [2] Finneran et al. (2017)

Penguins

- The maximum distance to the OCW-weighted penguin TTS SEL_{24h} threshold of 188 dB re 1 µPa^{2}s was reached between 0.05 and 0.06 km for all scenarios was. PTS and PK thresholds were not resolved withing the modelled resolution of 20 m. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that a penguin underwater travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.

- The maximum distance where the OCW-weighted penguin behavioural response threshold of 120 dB re 1 µPa (SPL) for impulsive noise could be exceeded varied between 9.08 and 52.1 km for the 2820 in^3 seismic source, depending on modelled site.

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality and potential mortal injury as well as impairment in the following groups:
    - Fish without a swim bladder (also appropriate for sharks in the absence of other information),
    - Fish with a swim bladder that do not use it for hearing,
    - Fish that use their swim bladders for hearing,
    - Fish eggs and fish larvae.
- Table 28 summarises distances to effect criteria for fish, fish eggs, and fish larvae along with the relevant metric. Results for PK are presented in Tables 15 whilst SEL_{24h} results are in Tables 21.

Table 28. Summary of maximum fish, fish eggs, and larvae injury and temporary threshold shift (TTS) onset distances for single impulse and 24 hour sound exposure level (SEL_{24h}) modelled scenarios.

Relevant hearing group	Effect criteria	Water column	
		Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Recoverable injury	SEL_{24h}	0.07
	TTS	SEL_{24h}	7.86
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Recoverable injury	PK	0.22
	TTS	SEL_{24h}	7.86
Fish eggs, and larvae (relevant to plankton)	Injury	PK	0.22

Benthic invertebrates, Sponges, and Coral

To assist with assessing the potential effects on these receptors, the following results were determined:

- Crustaceans: The sound level of 202 dB re 1 µPa PK-PK from Payne et al. (2008), which is representative of no effects, was considered for seafloor sound levels; the sound level was reached at ranges between 295 and 711 m for the 2820 in^3 source.
- Bivalves: The distance where a particle acceleration of 37.57 ms^{-2} at the seafloor could occur was determined for comparing to results presented in Day et al. (2016a). This particle acceleration was reached at a range of 52 m for depth 40 m, 4 m for a depth of 50 m, and was not reached at any greater depth.
- Sponges and coral: The PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 µPa PK for

sponges and corals (Heyward et al. 2018); the threshold was reached at a range of 2 m for depth 40 m and was not reached at any greater depth.

Divers and Swimmers

An SPL human health assessment of 145 dB re 1 µPa (SPL; L_P) derived from (Parvin 2005) was considered for people swimming and diving. At the closest separation between considered modelled sites and receiver locations a sound level of 153.1 dB re 1 µPa (SPL; L_P) was predicted at Little River and Taylors Beach. It is important to review the provided contour maps to contextualise levels at coast areas to understand where the human health assessment level may be reached.

6.4. Animal Movement Modelling

The estimated sound fields produced by source and propagation models for the planned Regia MSS were incorporated into an animat sound exposure model for pygmy blue whales to estimate the radial distance within which 95% of the exposure exceedances occur ($ER_{95\%}$), along with the probability that an animat with the closest point of approach within that distance would be exposed above the relevant threshold (P_{exp}).

For the exposure analysis, all three acquisition scenarios were run with different animat seeding approaches. Survey lines from all nominal acquisition scenarios overlap with the foraging BIA for pygmy blue whales. Survey lines from Scenario A fully and from Scenarios B and C partially overlap with the aggregation BIA for southern right whales.

Sections 6.4.1 and 6.4.2 summarise the PTS, TTS, and behavioural exposure range results, with the tabulated results presented in Tables 22 to 25. Table 29 summarises the maximum exposure range results for pygmy blue whales and southern right whales across the different species profiles considered. Figure 39 summarises results for each modelled scenario and species profile, with pygmy blue and southern right whales considered.

Table 29. Summary of animat simulation results for PTS, TTS and SPL behavioural response criteria for pygmy blue whales and southern right whales Maximum Exposure ranges show $ER_{95\%}$ (km) first and probability of exposure of animats travelling within the $ER_{95\%}$ (P_{exp} (%)) in parentheses.

Species	Scenario	Behavioural response (SPL)[4]	TTS (SEL24h)[3]	PTS (SEL24h)[3]
		160[2]	168[1]	183[1]
Pygmy blue whale	A	8.09 (86%)	13.2 (58%)	1.40 (51%)
	B	6.82 (93%)	6.05 (60%)	0.53 (50%)
	C	6.77 (92%)	7.60 (60%)	0.34 (47%)
Southern right whale	A	8.43 (85%)	11.6 (60%)	1.50 (50%)
	B	6.81 (92%)	6.04 (52%)	0.54 (49%)
	C	7.58 (85%)	6.71 (37%)	0.25 (37%)

1 LF-weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)
2 SPL (L_p; dB re 1 µPa)
3 Southall et al. (2019) criteria for marine fauna.
4 NOAA (2019) recommended unweighted behavioural threshold for marine mammals.

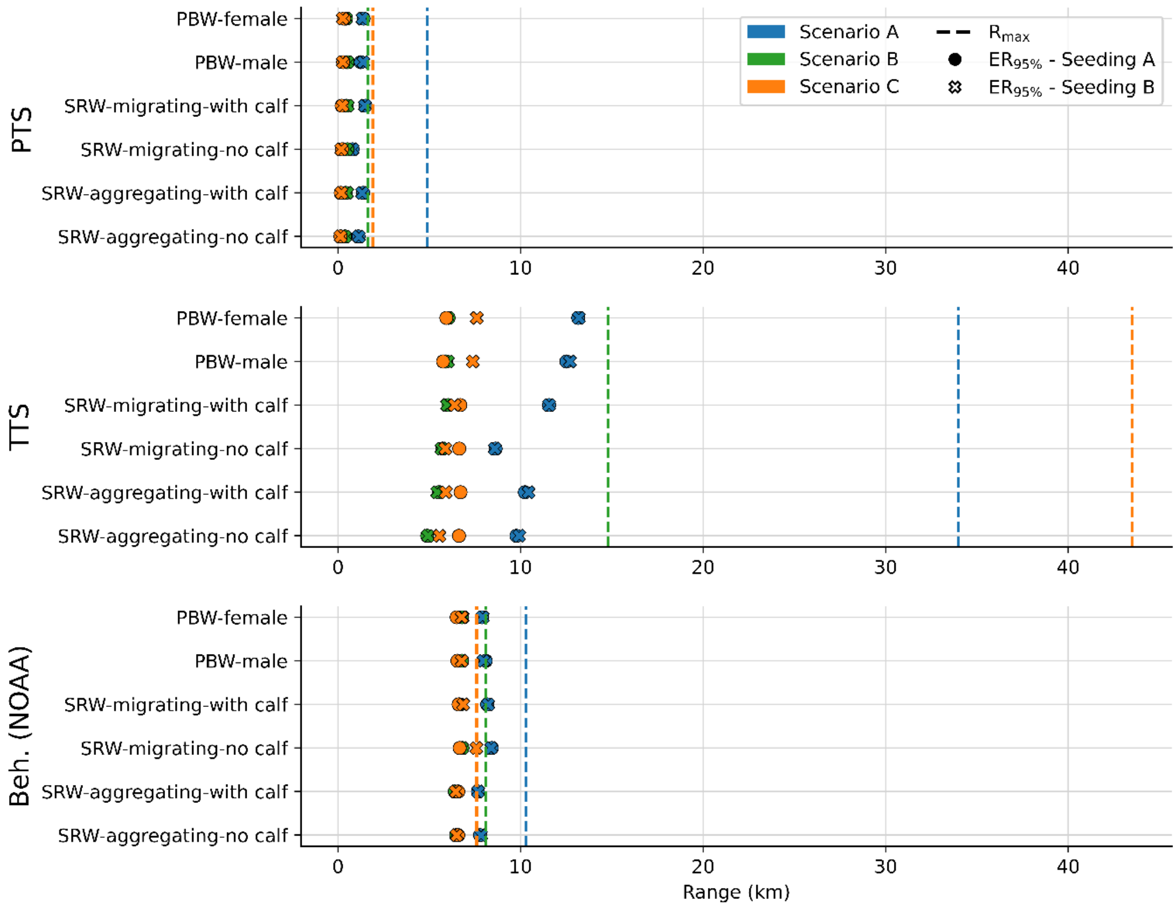

Figure 39. Acoustic (R_{max}) and exposure ranges ($ER_{95\%}$) for TTS/PTS and the behavioural thresholds (NOAA), shown for each species. Colour represents the acoustic modelled scenario. Seeding A and B refer to the different seeding areas for pygmy blue whales and southern right whales, presented in Figure 2.

6.4.1. PTS and TTS

Exposure ranges from animal movement modelling for PTS and TTS criteria are typically shorter than those predicted using acoustic propagation modelling because of the generally shorter time ('dwell time') to accumulate sound energy of the moving animats. In this study, PTS and TTS exposure ranges were substantially shorter than acoustic ranges to threshold, as shown in Figure 39.

All considered scenarios resulted in exposures above the PTS and TTS thresholds, and therefore exposure ranges.

The maximum $ER_{95\%}$ for pygmy blue whale scenarios was 13.2 and 1.4 km for TTS and PTS, respectively. The probability of exposure within $ER_{95\%}$ varied between 47 and 68%. For southern right whales, the maximum $ER_{95\%}$ for TTS and PTS were 11.6 and 1.5 km, respectively, with probability of exposure varying between 36 and 80%. The range of probabilities indicates that some, but not all, animats exposed within the 95th percentile range were exposed above threshold. This is because animats can move in and out of the modelling range as well as their vertical position in the water column, thus potentially limiting the length of time they are within the exposure radius. For example, an animat might approach within the predicted exposure range but if they are traveling more quickly on average than other animats, they may not accumulate as much exposure, or they may be spending more time at depths with quieter sound levels.

For this reason, female pygmy blue whale scenarios resulted in slightly larger exposure ranges than the corresponding male pygmy blue whale scenarios. Based on the vertical distribution of the sound field (see Section 5.2.2.2), female pygmy blue whale animats accumulate more exposures than the males since females generally dive deeper than males (Section 4.6.3.1) and therefore spend more time at depths with higher sound levels.

Exposure ranges are, on average, slightly longer for TTS and PTS for unrestricted vs restricted pygmy blue whale scenarios because unrestricted animats have more opportunities to be seeded in deeper water and further away from the sources, whereas restricted animats have more opportunities to be exposed to sound fields closer to the sources and for a longer time, which effectively lengthens their dwell time. This becomes apparent for the nominal acquisition lines of Scenario C, which are located close to the edge of the shelf. Any restricted foraging pygmy blue whale animats travelling close the survey lines and close to the border of Seeding Area B are forced to stay within the bounds, whereas unrestricted animats can move in and out of the modelling range.

Exposure ranges are, on average, slightly longer for TTS and PTS for mother and calf pair versus no calf southern right whale scenarios as well. This is primarily due to the inclusion of nursing behaviour, where animals spend time stationary at the surface (Thomas et al. 1984), and the long duration of resting periods with slow travel speeds for mother/calf pairs (Hain et al. 2013). As a result, they accumulate more sound energy and are exposed for a longer time.

The animat modelling was included in the scope of work to provide context to possible exposures to pygmy blue and southern right whales over an entire day. The distances to isopleths associated with the effect thresholds for PTS and TTS are more realistic than those from the static sound fields as they consider potential animal movements passing through the operational region.

6.4.2. Behavioural Effects

Exposure ranges ($ER_{95\%}$) for single exposure metrics, such as the SPL behavioural response criteria, are typically comparable to the predicted acoustic ranges. Maximum acoustic ranges (e.g., R_{max}) are conservatively calculated using the maximum-over-depth sound fields and assuming static receivers, while exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving parameters, so exposure ranges are generally slightly lower than the R_{max} acoustic ranges. In this case, exposure ranges were slightly shorter than acoustic ranges to threshold for most modelled scenarios.

Overall, ranges were longest for Scenario C. For all considered pygmy blue whale scenarios, the $ER_{95\%}$ to behavioural threshold ranged from 6.50–8.09 km for pygmy blue whales, with P_{exp} varying between 87 and 93%. For southern right whales, the $ER_{95\%}$ to behavioural threshold ranged from 6.39-8.43 km, with P_{exp} varying between 81 and 92%.

Glossary

Unless otherwise stated in an entry, these definitions are consistent with ISO 80000-3 (2017).

1/3-octave

One third of an octave. *Note*: A one-third octave is approximately equal to one decidecade (1/3 oct ≈ 1.003 ddec).

1/3-octave-band

Frequency band whose bandwidth is one one-third octave. *Note*: The bandwidth of a one-third octave-band increases with increasing centre frequency.

A-weighting

Frequency-selective weighting for human hearing in air that is derived from the inverse of the idealized 40-phon equal loudness hearing function across frequencies.

absorption

The reduction of acoustic pressure amplitude due to acoustic particle motion energy converting to heat in the propagation medium.

attenuation

The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium.

auditory frequency weighting

The process of applying an auditory frequency weighting function. In human audiometry, C-weighting is the most commonly used function, an example for marine mammals are the auditory frequency weighting functions published by Southall et al. (2007).

auditory frequency weighting function

Frequency weighting function describing a compensatory approach accounting for a species' (or functional hearing group's) frequency-specific hearing sensitivity. Example hearing groups are low-, mid-, and high-frequency cetaceans, phocid and otariid pinnipeds.

azimuth

A horizontal angle relative to a reference direction, which is often magnetic north or the direction of travel. In navigation it is also called bearing.

bandwidth

The range of frequencies over which a sound occurs. Broadband refers to a source that produces sound over a broad range of frequencies (e.g., seismic airguns, vessels) whereas narrowband sources produce sounds over a narrow frequency range (e.g., sonar) (ANSI S1.13-2005 (R2010)).

bar

Unit of pressure equal to 100 kPa, which is approximately equal to the atmospheric pressure on Earth at sea level. 1 bar is equal to 10^5 Pa or 10^{11} μPa.

boxcar averaging

A signal smoothing technique that returns the averages of consecutive segments of a specified width.

broadband level

The total level measured over a specified frequency range.

broadside direction

Perpendicular to the travel direction of a source. Compare with endfire direction.

cetacean

Any animal in the order Cetacea. These are aquatic species and include whales, dolphins, and porpoises.

compressional wave

A mechanical vibration wave in which the direction of particle motion is parallel to the direction of propagation. Also called primary wave or P-wave.

conductivity-temperature-depth (CTD)

Measurement data of the ocean's conductivity, temperature, and depth; used to compute sound speed and salinity.

decade

Logarithmic frequency interval whose upper bound is ten times larger than its lower bound (ISO 80000-3:2006).

decidecade

One tenth of a decade. *Note*: An alternative name for decidecade (symbol ddec) is "one-tenth decade". A decidecade is approximately equal to one third of an octave (1 ddec ≈ 0.3322 oct) and for this reason is sometimes referred to as a "one-third octave".

decidecade band

Frequency band whose bandwidth is one decidecade. *Note*: The bandwidth of a decidecade band increases with increasing centre frequency.

decibel (dB)

Unit of level used to express the ratio of one value of a power quantity to another on a logarithmic scale. Unit: dB.

duty cycle

The time when sound is periodically recorded by an acoustic recording system.

endfire direction

Parallel to the travel direction of a source. Also see **broadside direction**.

energy source level

A property of a sound source obtained by adding to the sound exposure level measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 $\mu Pa^2 m^2 s$.

energy spectral density source level

A property of a sound source obtained by adding to the energy spectral density level of the sound pressure measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 $\mu Pa^2 m^2 s/Hz$.

ensonified

Exposed to sound.

far field

The zone where, to an observer, sound originating from an array of sources (or a spatially distributed source) appears to radiate from a single point.

Fourier transform (or Fourier synthesis)

A mathematical technique which, although it has varied applications, is referenced in the context of this report as a method used in the process of deriving a spectrum estimate from time-series data (or the reverse process, termed the inverse Fourier transform). A computationally efficient numerical algorithm for computing the Fourier transform is known as fast Fourier transform (FFT).

flat weighting

Term indicating that no frequency weighting function is applied. Synonymous with unweighted.

frequency

The rate of oscillation of a periodic function measured in cycles-per-unit-time. The reciprocal of the period. Unit: hertz (Hz). Symbol: f. 1 Hz is equal to 1 cycle per second.

frequency weighting

The process of applying a frequency weighting function.

frequency-weighting function

The squared magnitude of the sound pressure transfer function. For sound of a given frequency, the frequency weighting function is the ratio of output power to input power of a specified filter, sometimes expressed in decibels. Examples include the following:

- *Auditory frequency weighting function*: compensatory frequency weighting function accounting for a species' (or functional hearing group's) frequency-specific hearing sensitivity.
- *System frequency weighting function*: frequency weighting function describing the sensitivity of an acoustic acquisition system, typically consisting of a hydrophone, one or more amplifiers, and an analogue to digital converter.

geoacoustic

Relating to the acoustic properties of the seabed.

harmonic

A sinusoidal sound component that has a frequency that is an integer multiple of the frequency of a sound to which it is related. For example, the second harmonic of a sound has a frequency that is double the fundamental frequency of the sound.

hearing group

Category of animal species when classified according to their hearing sensitivity and to the susceptibility to sound. Examples for marine mammals include very low-frequency (VLF) cetaceans, low-frequency (LF) cetaceans, mid-frequency (MF) cetaceans, high-frequency (HF) cetaceans, very high-frequency (VHF) cetaceans, otariid pinnipeds in water (OPW), phocid pinnipeds in water (PPW), sirenians (SI), other marine carnivores in air (OCA), and other marine carnivores in water (OCW) (NMFS 2018, Southall et al. 2019). See **auditory frequency weighting functions**, which are often applied to these groups. Examples for fish include species for which the swim bladder is involved in hearing, species for which the swim bladder is not involved in hearing, and species without a swim bladder (Popper et al. 2014).

hearing threshold

The sound pressure level for any frequency of the hearing group that is barely audible for a given individual for specified background noise during a specific percentage of experimental trials.

hertz (Hz)

A unit of frequency defined as one cycle per second.

high-frequency (HF) cetacean

See **hearing group**.

intermittent sound

A sound whose level abruptly drops below the background noise level several times during an observation period.

impulsive sound

Qualitative term meaning sounds that are typically transient, brief (less than 1 second), broadband, with rapid rise time and rapid decay. They can occur in repetition or as a single event. Examples of impulsive sound sources include explosives, seismic airguns, and impact pile drivers.

isopleth

A line drawn on a map through all points having the same value of some quantity.

knot

One nautical mile per hour. Symbol: kn.

level

A measure of a quantity expressed as the logarithm of the ratio of the quantity to a specified reference value of that quantity. Examples include sound pressure level, sound exposure level, and peak sound pressure level. For example, a value of sound exposure level with reference to 1 μPa^2 s can be written in the form x dB re 1 μPa^2 s.

low-frequency (LF) cetacean

See **hearing group**.

median

The 50th percentile of a statistical distribution.

mid-frequency (MF) cetacean

See **hearing group**.

M-weighting

See **auditory frequency weighting function** (as proposed by Southall et al. 2007).

mysticete

A suborder of cetaceans that use baleen plates to filter food from water. Members of this group include rorquals (Balaenopteridae), right whales (Balaenidae), and grey whales (*Eschrichtius robustus*).

non-impulsive sound

Sound that is not an impulsive sound. A non-impulsive sound is not necessarily a continuous sound.

octave

The interval between a sound and another sound with double or half the frequency. For example, one octave above 200 Hz is 400 Hz, and one octave below 200 Hz is 100 Hz.

otariid

A common term used to describe members of the Otariidae, eared seals, commonly called sea lions and fur seals. Otariids are adapted to a semi-aquatic life; they use their large fore flippers for propulsion. Their ears distinguish them from phocids. Otariids are one of the three main groups in the superfamily Pinnipedia; the other two groups are phocids and walrus.

otariid pinnipeds in water (OPW)

See **hearing group**.

other marine carnivores in air (OCA)

See **hearing group**.

other marine carnivores in water (OCW)

See **hearing group**.

parabolic equation method

A computationally efficient solution to the acoustic wave equation that is used to model propagation loss. The parabolic equation approximation omits effects of back-scattered sound, simplifying the computation of propagation loss. The effect of back-scattered sound is negligible for most ocean-acoustic propagation problems.

peak sound pressure level (zero-to-peak sound pressure level)

The level ($L_{p,pk}$ or L_{pk}) of the squared maximum magnitude of the sound pressure (p^2_{pk}). Unit: decibel (dB). Reference value (p_0^2) for sound in water: 1 µPa^2.

$$L_{p,\mathrm{pk}} := 10 \log_{10}\left(p^2_{\mathrm{pk}}/p_0^2\right) \mathrm{dB} \ = 20 \log_{10}\left(p_{\mathrm{pk}}/p_0\right) \mathrm{dB}$$

The frequency band and time window should be specified. Abbreviation: PK or L_{pk}.

peak-to-peak sound pressure

The difference between the maximum and minimum sound pressure over a specified frequency band and time window. Unit: pascal (Pa).

permanent threshold shift (PTS)

An irreversible loss of hearing sensitivity caused by excessive noise exposure. PTS is considered auditory injury.

phocid

A common term used to describe all members of the family Phocidae. These true/earless seals are more adapted to in-water life than are otariids, which have more terrestrial adaptations. Phocids use their hind flippers to propel themselves. Phocids are one of the three main groups in the superfamily Pinnipedia; the other two groups are otariids and walrus.

phocid pinnipeds in water (PPW)

See **hearing group**.

pinniped

A common term used to describe all three groups that form the superfamily Pinnipedia: phocids (true seals or earless seals), otariids (eared seals or fur seals and sea lions), and walrus.

point source

A source that radiates sound as if from a single point.

pressure, acoustic

The deviation from the ambient pressure caused by a sound wave. Also called sound pressure. Unit: pascal (Pa).

pressure, hydrostatic

The pressure at any given depth in a static liquid that is the result of the weight of the liquid acting on a unit area at that depth, plus any pressure acting on the surface of the liquid. Unit: pascal (Pa).

propagation loss (PL)

Difference between a source level (SL) and the level at a specified location, PL(x) = SL − L(x). Also see **transmission loss**.

received level

The level measured (or that would be measured) at a defined location. The type of level should be specified.

reference values

standard underwater references values used for calculating sound **levels**, e.g., the reference value for expressing sound pressure level in decibels is 1 μPa.

Quantity	Reference value
Sound pressure	1 μPa
Sound exposure	1 μPa^2 s
Sound particle displacement	1 pm
Sound particle velocity	1 nm/s
Sound particle acceleration	1 $\mu m/s^2$

rms

abbreviation for root-mean-square.

shear wave

A mechanical vibration wave in which the direction of particle motion is perpendicular to the direction of propagation. Also called a secondary wave or S-wave. Shear waves propagate only in solid media, such as sediments or rock. Shear waves in the seabed can be converted to compressional waves in water at the water-seabed interface.

sound

A time-varying disturbance in the pressure, stress, or material displacement of a medium propagated by local compression and expansion of the medium.

sound exposure

Time integral of squared sound pressure over a stated time interval. The time interval can be a specified time duration (e.g., 24 hours) or from start to end of a specified event (e.g., a pile strike, an airgun pulse, a construction operation). Unit: Pa^2 s.

sound exposure level

The level (L_E) of the sound exposure (E). Unit: decibel (dB). Reference value (E_0) for sound in water: 1 µPa^2 s.

$$L_E := 10\log_{10}(E/E_0)\,\mathrm{dB} \;= 20\log_{10}\left(E^{1/2}/E_0^{1/2}\right)\,\mathrm{dB}$$

The frequency band and integration time should be specified. Abbreviation: SEL.

sound exposure spectral density

Distribution as a function of frequency of the time-integrated squared sound pressure per unit bandwidth of a sound having a continuous spectrum. Unit: Pa^2 s/Hz.

sound field

Region containing sound waves.

sound intensity

Product of the sound pressure and the sound particle velocity. The magnitude of the sound intensity is the sound energy flowing through a unit area perpendicular to the direction of propagation per unit time.

sound particle acceleration

The rate of change of sound particle velocity. Unit: metre per second squared (m/s^2). Symbol: *a*.

sound particle motion

smallest volume of a medium that represents its mean physical properties.

sound particle displacement

Displacement of a material element caused by the action of sound, where a material element is the smallest element of the medium that represents the medium’s mean density.

sound particle velocity

The velocity of a particle in a material moving back and forth in the direction of the pressure wave. Unit: metre per second (m/s). Symbol: *v*.

sound pressure

The contribution to total pressure caused by the action of sound.

sound pressure level (rms sound pressure level)

The level ($L_{p,\text{rms}}$) of the time-mean-square sound pressure (p^2_{rms}). Unit: decibel (dB). Reference value (p_0^2) for sound in water: 1 μPa^2.

$$L_{p,\text{rms}} := 10 \log_{10}(p^2_{\text{rms}}/p_0^2)\ \text{dB} \ = 20 \log_{10}(p_{\text{rms}}/p_0)\ \text{dB}$$

The frequency band and averaging time should be specified. Abbreviation: SPL or Lrms.

sound speed profile

The speed of sound in the water column as a function of depth below the water surface.

soundscape

The characterization of the ambient sound in terms of its spatial, temporal, and frequency attributes, and the types of sources contributing to the sound field.

source level (SL)

A property of a sound source obtained by adding to the sound pressure level measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 μPa^{2}m^2.

spectrum

An acoustic signal represented in terms of its power, energy, mean-square sound pressure, or sound exposure distribution with frequency.

surface duct

The upper portion of a water column within which the sound speed profile gradient causes sound to refract upward and therefore reflect off the surface resulting in relatively long-range sound propagation with little loss.

temporary threshold shift (TTS)

Reversible loss of hearing sensitivity. TTS can be caused by noise exposure.

thermocline

The depth interval near the ocean surface that experiences temperature gradients due to warming or cooling by heat conduction from the atmosphere and by warming from solar heating.

transmission loss (TL)

The difference between a specified level at one location and that at a different location, TL(x1,x2) = L(x1) − L(x2). Also see **propagation loss**.

unweighted

Term indicating that no frequency weighting function is applied. Synonymous with flat weighting.

very high-frequency (VHF) cetacean

See **hearing group**.

very low-frequency (VLF) cetacean

See **hearing group**.

wavelength

Distance over which a wave completes one cycle of oscillation. Unit: metre (m). Symbol: λ.

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Appendix A. Acoustic Metrics

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 μPa. Because the perceived loudness of sound, especially pulsed sound such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate sound and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow the American National Standard Institute and International Organization for Standardization definitions and symbols for sound metrics (e.g., ISO 2017, ANSI R2013), but these standards are not always consistent.

The zero-to-peak sound pressure, or peak sound pressure (PK or $L_{p,pk}$; dB re 1 μPa), is the decibel level of the maximum instantaneous acoustic pressure in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{p,\mathrm{pk}} = 10\log_{10}\frac{\max|p^2(t)|}{p_0^2} = 20\log_{10}\frac{\max|p(t)|}{p_0} \tag{A-1}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of an acoustic event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure (PK-PK or $L_{p,pk\text{-}pk}$; dB re 1 μPa) is the difference between the maximum and minimum instantaneous sound pressure, possibly filtered in a stated frequency band, attained by an impulsive sound, $p(t)$:

$$L_{p,\mathrm{pk\text{-}pk}} = 10\log_{10}\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2} \tag{A-2}$$

The sound pressure level (SPL or L_p; dB re 1 μPa) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (T; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt\Big/p_0^2\right) \tag{A-3}$$

where $g(t)$ is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying SPL function. For short acoustic events, such as sonar pulses and marine mammal vocalizations, it is important to choose an appropriate time window that matches the duration of the signal. For in-air studies, when evaluating the perceived loudness of sounds with rapid amplitude variations in time, the time weighting function $g(t)$ is often set to a decaying exponential function that emphasizes more recent pressure signals. This function mimics the leaky integration nature of mammalian hearing. For example, human-based fast time-weighted SPL ($L_{p,fast}$) applies an exponential function with time constant 125 ms. A related simpler approach used in underwater acoustics sets $g(t)$ to a boxcar (unity amplitude) function of width 125 ms; the results can be referred to as $L_{p,boxcar\ 125ms}$. Another approach, historically used to evaluate SPL of impulsive signals underwater, defines $g(t)$ as a boxcar function with edges set to the times corresponding to 5% and 95% of the cumulative square pressure function encompassing the duration of an impulsive acoustic event. This calculation is applied individually to each impulse signal, and the results are referred to as 90% SPL ($L_{p,90\%}$).

The sound exposure level (SEL or L_E; dB re 1 µPa²·s) is the time-integral of the squared acoustic pressure over a duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)\,dt \Big/ T_0 p_0^2\right) \quad \text{(A-4)}$$

where T_0 is a reference time interval of 1 s. SEL continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered for its relevance to impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to pulsed sounds, SEL can be calculated by summing the SEL of the N individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the N individual events:

$$L_{E,N} = 10\log_{10}\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}} \quad \text{(A-5)}$$

If applied, the frequency weighting of an acoustic event should be specified, as in the case of weighted SEL (e.g., $L_{E,LF,24h}$; see Appendix A.5) or auditory-weighted SPL ($L_{p,ht}$). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should also be specified.

A.2. Particle Acceleration and Velocity Metrics

Since sound is a mechanical wave, it can also be measured in terms of the vibratory motion of fluid particles. Particle motion can be measured in terms of three different (but related) quantities: displacement, velocity, or acceleration. Acoustic particle velocity is the time derivative of particle displacement, and likewise acceleration is the time derivative of velocity. For the present study, acoustic particle motion has been reported in terms of acceleration and velocity.

The particle velocity (v) is the physical speed of a particle in a material moving back and forth in the direction of the pressure wave. It can be derived from the pressure gradient and Euler's linearised momentum equation where ρ_0 is the density of the medium:

$$v = -\int \nabla p(t)dt/\rho_0 \quad \text{(A-6)}$$

The particle acceleration (a) is the rate of change of the velocity with respect to time, and it can be obtained from equation A-6 as:

$$a = \frac{dv}{dt} = -\frac{\nabla p(t)}{\rho_0} \quad \text{(A-7)}$$

Unlike sound pressure, particle motion is a vector quantity, meaning that it has both magnitude and direction: at any given point in space, acoustic particle motion has three different time-varying components (x, y, and z). Given the particle velocity in the x, y, and z, directions, v_x, v_y, and v_z, the particle velocity magnitude $|v|$ is computed per the Pythagorean equation:

$$|v| = \sqrt{v_x + v_y + v_z} \quad \text{(A-8)}$$

The magnitude of particle acceleration is calculated similarly from the particle acceleration in the *x*, *y*, and *z* directions.

A.3. Decidecade Band Analysis

The distribution of a sound's power with frequency is described by the sound's spectrum. The sound spectrum can be split into a series of adjacent frequency bands. Splitting a spectrum into 1 Hz wide bands, called passbands, yields the power spectral density of the sound. This splitting of the spectrum into passbands of a constant width of 1 Hz, however, does not represent how animals perceive sound.

Because animals perceive exponential increases in frequency rather than linear increases, analysing a sound spectrum with passbands that increase exponentially in size better approximates real-world scenarios. In underwater acoustics, a spectrum is commonly split into decidecade bands, which are one tenth of a decade wide. They are approximately one third of an octave (base 2) wide and are therefore often referred to as 1/3-octave-bands. Each octave represents a doubling in sound frequency. The centre frequency of the ith band, $f_{\mathrm{c}}(i)$, is defined as:

$$f_{\mathrm{c}}(i) = 10^{\frac{i}{10}}\,\mathrm{kHz} \tag{A-9}$$

and the low (f_{lo}) and high (f_{hi}) frequency limits of the ith decade band are defined as:

$$f_{\mathrm{lo},i} = 10^{\frac{-1}{20}} f_{\mathrm{c}}(i) \quad \text{and} \quad f_{\mathrm{hi},i} = 10^{\frac{1}{20}} f_{\mathrm{c}}(i) \tag{A-10}$$

The decidecade bands become wider with increasing frequency, and on a logarithmic scale the bands appear equally spaced (Figure A-1). The acoustic modelling spans from band 7 (f_c (7) = 5 Hz) to band 44 ($f_{\mathrm{c}}(44)$ = 25 kHz).

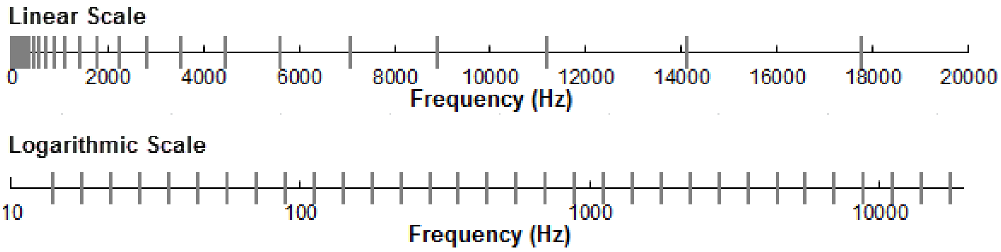

Figure A-1. Decidecade frequency bands (vertical lines) shown on a linear frequency scale and a logarithmic scale.

The sound pressure level in the ith band ($L_{p,i}$) is computed from the spectrum $S(f)$ between $f_{\mathrm{lo},i}$ and $f_{\mathrm{hi},i}$:

$$L_{p,i} = 10\log_{10} \int_{f_{\mathrm{lo},i}}^{f_{\mathrm{hi},i}} S(f)\,df \tag{A-11}$$

Summing the sound pressure level of all the bands yields the broadband sound pressure level:

$$\text{Broadband SPL} = 10\log_{10} \sum_i 10^{\frac{L_{p,i}}{10}} \tag{A-12}$$

Figure A-2 shows an example of how the decidecade band sound pressure levels compare to the sound pressure spectral density levels of an ambient noise signal. Because the decidecade bands are wider with increasing frequency, the decidecade band SPL is higher than the spectral levels at higher frequencies. Acoustic modelling of decidecade bands requires less computation time than 1 Hz bands and still resolves the frequency-dependence of the sound source and the propagation environment.

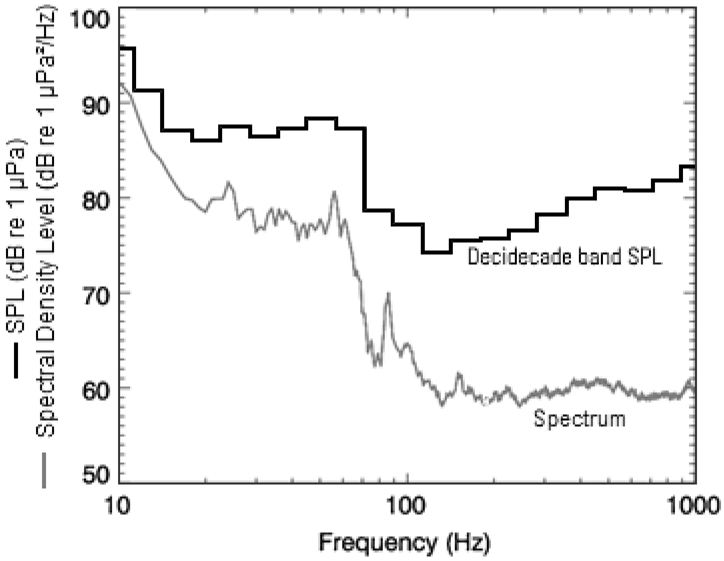

Figure A-2. Sound pressure spectral density levels and the corresponding decidecade band sound pressure levels of example ambient noise shown on a logarithmic frequency scale.

A.4. Marine Mammal Impact Criteria

It has been long recognised that marine mammals can be adversely affected by underwater anthropogenic noise. For example, Payne and Webb (1971) suggested that communication distances of fin whales are reduced by shipping sounds. Subsequently, similar concerns arose regarding effects of other underwater noise sources and the possibility that impulsive sources—primarily airguns used in seismic surveys—could cause auditory injury. This led to a series of workshops held in the late 1990s, conducted to address acoustic mitigation requirements for seismic surveys and other underwater noise sources (NMFS 1998, ONR 1998, Nedwell and Turnpenny 1998, HESS 1999, Ellison and Stein 1999). In the years since these early workshops, a variety of thresholds have been proposed for both injury and disturbance. The following sections summarize the recent development of thresholds; however, this field remains an active research topic.

A.4.1. Injury

In recognition of shortcomings of the SPL-only based injury criteria, in 2005 NMFS sponsored the Noise Criteria Group to review literature on marine mammal hearing to propose new noise exposure criteria. Some members of this expert group published a landmark paper (Southall et al. 2007) that suggested assessment methods similar to those applied for humans. The resulting recommendations introduced dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted 24h refers to the accumulation period for calculating SEL. The peak pressure level criterion is not frequency weighted whereas the SEL_{24h} is frequency weighted according to one of four marine mammal species hearing groups: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively) and Pinnipeds in Water (PINN). These weighting functions are referred to as M-weighting filters (analogous to the A-weighting filter for human; Appendix A.5). The SEL_{24h} thresholds were obtained by extrapolating measurements of onset levels of Temporary Threshold Shift (TTS) in belugas by the amount of TTS required to produce Permanent Threshold Shift (PTS) in chinchillas. The Southall et al. (2007) recommendations do not specify an exchange rate, which suggests that the thresholds are the same regardless of the duration of exposure (i.e., it implies a 3 dB exchange rate).

Wood et al. (2012) refined Southall et al.'s (2007) thresholds, suggesting lower injury values for LF and HF cetaceans while retaining the filter shapes. Their revised thresholds were based on TTS-onset levels in harbour porpoises from Lucke et al. (2009), which led to a revised impulsive sound PTS threshold for HF cetaceans of 179 dB re 1 μPa^2·s. Because there were no data available for baleen whales, Wood et al. (2012) based their recommendations for LF cetaceans on results obtained from MF cetacean studies. In particular they referenced Finneran and Schlundt (2010) research, which found mid-frequency cetaceans are more sensitive to non-impulsive sound exposure than Southall et al. (2007) assumed. Wood et al. (2012) thus recommended a more conservative TTS-onset level for LF cetaceans of 192 dB re 1 μPa^2·s.

As of present, an optimal approach is not apparent. There is consensus in the research community that an SEL-based method is preferable either separately or in addition to an SPL-based approach to assess the potential for injuries. In August 2016, after substantial public and expert input into three draft versions and based largely on the above-mentioned literature (NOAA 2013, 2015, 2016), NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes injury criteria with new thresholds and frequency weighting functions for the five hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018; with the criteria defined in NMFS (2018). The latest criteria are from Southall et al. (2019) which is applied in this report.

A.4.2. Behavioural Response

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. However, it is recognised that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison and Frankel 2012, Southall et al. 2016).

For impulsive noise, NMFS currently uses step function thresholds of 160 dB re 1 μPa SPL (unweighted) to assess and regulate noise-induced behavioural impacts for marine mammals (NOAA 2018, NOAA 2019). The threshold for impulsive sound is derived from the High-Energy Seismic Survey (HESS) panel (HESS 1999) report that, in turn, is based on the responses of migrating mysticete whales to airgun sounds (Malme et al. 1984). The HESS team recognised that behavioural responses to sound may occur at lower levels, but significant responses were only likely to occur above a SPL of 140 dB re 1 μPa. Southall et al. (2007) found varying responses for most marine mammals between a SPL of 140 and 180 dB re 1 μPa, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit step functions.

A.5. Marine Mammal Frequency Weighting

The potential for noise to affect animals depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

A.5.1. Marine Mammal Frequency Weighting Functions

In 2015, a US Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. The new frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] \tag{A-13}$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively), phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses acoustic impacts on marine mammals (NMFS 2018), and in the latest guidance by Southall (2019). The updates did not affect the content related to either the definitions of frequency-weighting functions or the threshold values. Table A-1 lists the frequency-weighting parameters for each hearing group. Figure A-3 shows the resulting frequency-weighting curves.

Table A-1. Parameters for the auditory weighting functions used in this project as recommended by Southall et al. (2019).

Hearing group	a	b	f_{lo} (Hz)	f_{hi} (kHz)	K (dB)
Low-frequency cetaceans (baleen whales)	1.0	2	200	19,000	0.13
High-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)	1.6	2	8,800	110,000	1.20
Very-high-frequency cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	1.8	2	12,000	140,000	1.36
Other marine carnivores in water (Australian sea lion, Australian fur seal, New Zealand fur seal, Penguins)	2.0	2	940	25,000	0.64

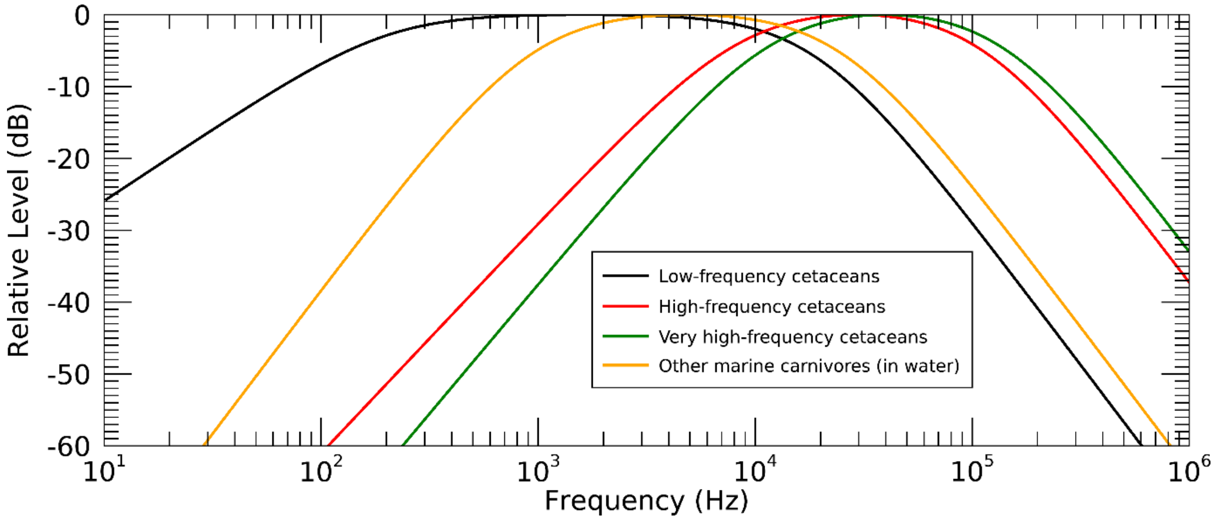

Figure A-3. Auditory weighting functions for functional marine mammal hearing groups used in this project as recommended by Southall et al. (2019).

Appendix B. Acoustic Source Model

B.1. Airgun Array Source Model

The source levels and directivity of the seismic source were predicted with JASCO's Airgun Array Source Model (AASM). AASM includes low- and high-frequency modules for predicting different components of the seismic source spectrum. The low-frequency module is based on the physics of oscillation and radiation of airgun bubbles, as originally described by Ziolkowski (1970), that solves the set of parallel differential equations that govern bubble oscillations. Physical effects accounted for in the simulation include pressure interactions between airguns, port throttling, bubble damping, and generator-injector (GI) gun behaviour discussed by Dragoset (1984), Laws et al. (1990), and Landrø (1992). A global optimisation algorithm tunes free parameters in the model to a large library of airgun source signatures.

While airgun signatures are highly repeatable at the low frequencies, which are used for seismic imaging, their sound emissions have a large random component at higher frequencies that cannot be predicted using a deterministic model. Therefore, AASM uses a stochastic simulation to predict the high-frequency (800−25,000 Hz) sound emissions of individual airguns, using a data-driven multiple-regression model. The multiple-regression model is based on a statistical analysis of a large collection of high quality seismic source signature data recently obtained from the Joint Industry Program (JIP) on Sound and Marine Life (Mattsson and Jenkerson 2008). The stochastic model uses a Monte-Carlo simulation to simulate the random component of the high-frequency spectrum of each airgun in an array. The mean high-frequency spectra from the stochastic model augment the low-frequency signatures from the physical model, allowing AASM to predict airgun source levels at frequencies up to 25,000 Hz.

AASM produces a set of "notional" signatures for each array element based on:

- Array layout
- Volume, tow depth, and firing pressure of each airgun
- Interactions between different airguns in the array

These notional signatures are the pressure waveforms of the individual airguns at a standard reference distance of 1 m; they account for the interactions with the other airguns in the array. The signatures are summed with the appropriate phase delays to obtain the far-field source signature of the entire array in all directions. This far-field array signature is filtered into decidecade-bands to compute the source levels of the array as a function of frequency band and azimuthal angle in the horizontal plane (at the source depth), after which it is considered a directional point source in the far field.

A seismic array consists of many sources and the point source assumption is invalid in the near field where the array elements add incoherently. The maximum extent of the near field of an array (R_{nf}) is:

$$R_{\mathrm{nf}} < \frac{l^2}{4\lambda} \tag{B-1}$$

where λ is the sound wavelength and l is the longest dimension of the array (Lurton 2002, §5.2.4). For example, a seismic source length of l = 21 m yields a near-field range of 147 m at 2 kHz and 7 m at 100 Hz. Beyond this R_{nf} range, the array is assumed to radiate like a directional point source and is treated as such for propagation modelling.

The interactions between individual elements of the array create directionality in the overall acoustic emission. Generally, this directionality is prominent mainly at frequencies in the mid-range between tens of hertz to several hundred hertz. At lower frequencies, with acoustic wavelengths much larger than the inter-airgun separation distances, the directionality is small. At higher frequencies, the pattern of lobes is too finely spaced to be resolved and the effective directivity is less.

B.2. Seismic Source

The layout of the 2820 in^3 seismic sources used for modelling in this study is provided in Figure B-1. Details of the airgun parameters are provided in Table B-1.

For the modelled array, the layout is presented in a nominal cartesian coordinate system. In this coordinate system the direction of vessel travel determines the relative position of the array elements as plotted and tabulated. The layout used for acoustic modelling was produced by transforming the coordinates of client supplied layouts such that the resultant layouts correspond to a vessel travel direction along the positive X-axis and the array is centred on the X-Y origin. When used with an acoustic model the positive X-axis in this nominal coordinate system aligns with the vessel tow direction or survey line azimuth.

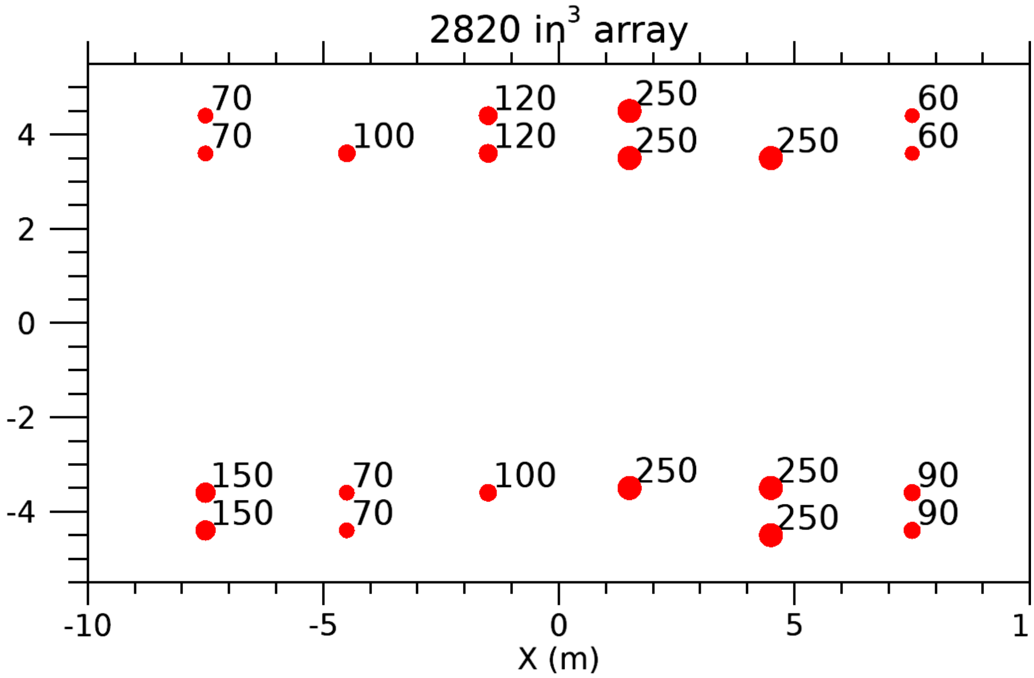

Figure B-1. Layout of the modelled 2820 in^3 seismic source where the plotted layout is such that the array is centred on the origin and vessel travel direction is in the positive x-direction. Tow depth was 7 m. The labels indicate the firing volume (in cubic inches) for each airgun. Also see Table B-1.

Table B-1. Layout of the modelled 2820 in^3 seismic source. Tow depth was 7 m. Firing pressure for all guns was 2000 psi. Greyed out values indicate spares. Also see Figure B-1.

String	Gun	*x* (m)	*y* (m)	*z* (m)	Vol (in^3)	String	Gun	*x* (m)	*y* (m)	*z* (m)	Vol (in^3)
1	1	7.5	-4.4	7	90	2	13	7.5	3.6	7	60
	2	7.5	-3.6	7	90		14	7.5	4.4	7	60
	3	4.5	-4.5	7	250		15	4.5	3.5	7	250
	4	4.5	-3.5	7	250		16	4.5	4.5	7	220
	5	1.5	-4.5	7	250		17	1.5	3.5	7	250
	6	1.5	-3.5	7	250		18	1.5	4.5	7	250
	7	-1.5	-4.4	7	100		19	-1.5	3.6	7	120
	8	-1.5	-3.6	7	100		20	-1.5	4.4	7	120
	9	-4.5	-4.4	7	70		21	-4.5	3.6	7	100
	10	-4.5	-3.6	7	70		22	-4.5	4.4	7	100
	11	-7.5	-4.4	7	150		23	-7.5	3.6	7	70
	12	-7.5	-3.6	7	150		24	-7.5	4.4	7	70

B.3. Array Source Levels and Directivity

Figure B-2 shows the broadside (perpendicular to the tow direction), endfire (parallel to the tow direction) and vertical overpressure signature and corresponding power spectrum levels for the 2820 in^3 seismic source (Appendix B.2). Horizontal decidecade-band source levels are shown as a function of band centre frequency and azimuth in Figure B-3.

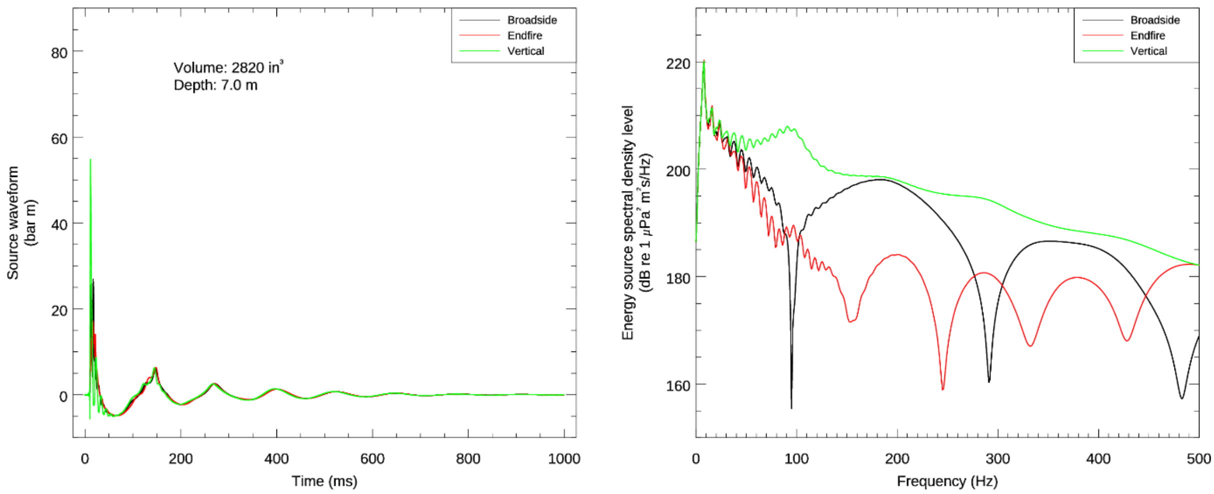

Figure B-2. Predicted source level details for the 2820 in^3 seismic source with a 7 m tow depth. (Left) the overpressure signature and (right) the power spectrum for in-plane horizontal (broadside), perpendicular (endfire), and vertical directions (no surface ghost).

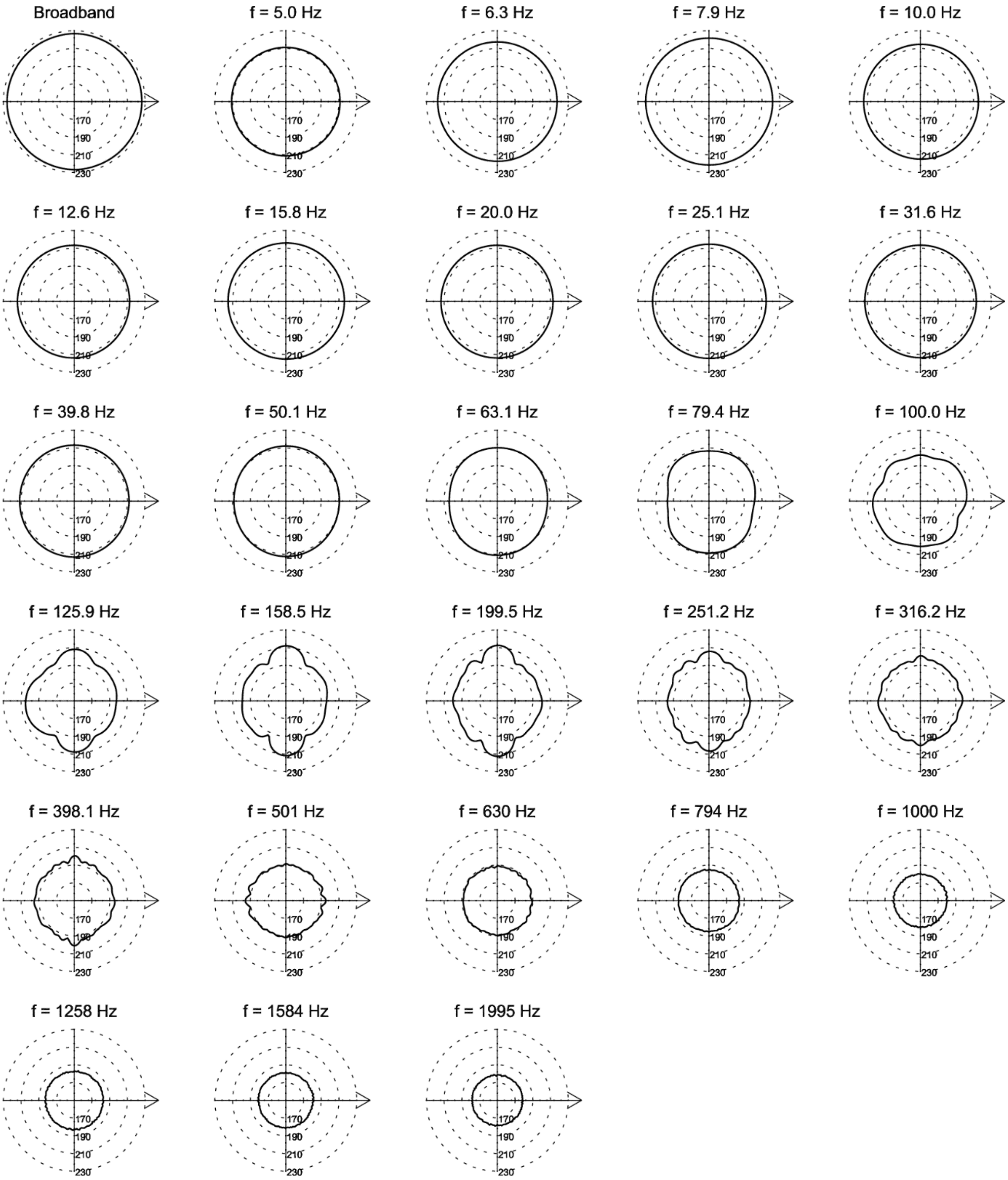

Figure B-3. Directionality of the predicted horizontal source levels for the 2820 in^3 seismic source, 5 Hz to 2 kHz. Source levels (in dB re 1 µPa^2·s m^2) are shown as a function of azimuth for the centre frequencies of the decidecade bands modelled; frequencies are shown above the plots. The perpendicular direction to the frame is to the right. Tow depth was 7 m (see Table B-1).

Appendix C. Sound Propagation Models

C.1. MONM-BELLHOP

Long-range sound fields were computed using JASCO's Marine Operations Noise Model (MONM). Compared to VSTACK, MONM less accurately predicts steep-angle propagation for environments with higher shear speed but is well suited for effective longer-range estimation. This model computes sound propagation at frequencies of 5 Hz to 1 kHz via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the US Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). MONM computes sound propagation at frequencies >1 kHz via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed, which results from partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

This version of MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is significant for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results.

MONM computes acoustic fields in three dimensions by modelling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure C-1).

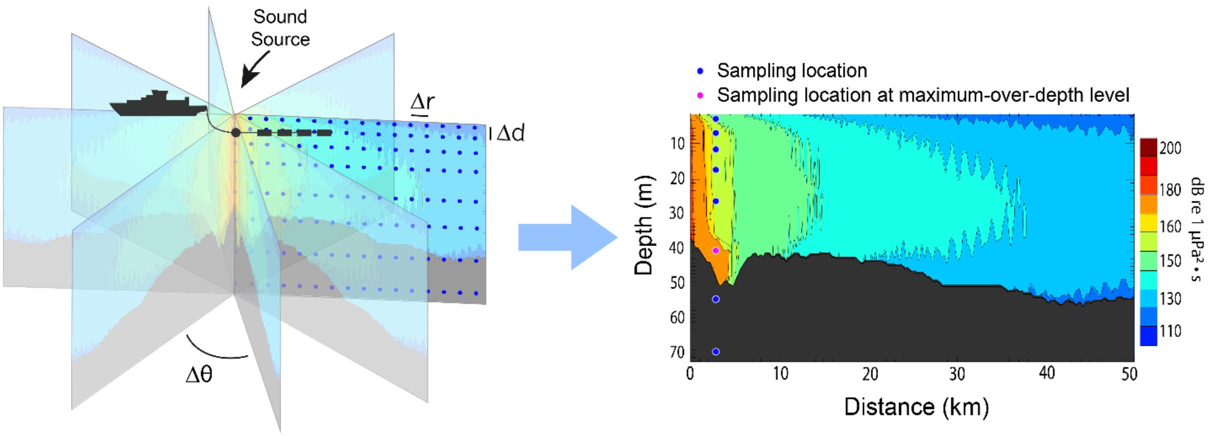

Figure C-1. The N×2-D and maximum-over-depth modelling approach used by MONM.

MONM treats frequency dependence by computing acoustic transmission loss at the centre frequencies of decidecade bands. Sufficiently many decidecade bands, starting at 5 Hz, are modelled to include most of the acoustic energy emitted by the source. At each centre frequency, the transmission loss is modelled within each of the N vertical planes as a function of depth and range from the source. The decidecade band received per-pulse SEL are computed by subtracting the band transmission loss values from the directional source level in that frequency band. Composite broadband received per-pulse SEL are then computed by summing the received decidecade band levels.

The received per-pulse SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. The maximum received per-pulse SEL at many sampling depths are taken over all samples within the water column, i.e., the maximum-over-depth received per-pulse SEL. These maximum-over-depth per-pulse SEL are presented as contours around the source.

C.2. Full Waveform Range-dependent Acoustic Model: FWRAM

For impulsive sounds from the seismic source, time-domain representations of the pressure waves generated in the water are required to calculate SPL and PK. Furthermore, the seismic source must be represented as a distributed source to accurately characterise vertical directivity effects in the near-field zone. For this study, synthetic pressure waveforms were computed using FWRAM, which is a time-domain acoustic model based on the same wide-angle parabolic equation (PE) algorithm as MONM. FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments, and it takes the same environmental inputs as MONM (bathymetry, water sound speed profile, and seafloor geoacoustic profile). Unlike MONM, FWRAM computes pressure waveforms via Fourier synthesis of the modelled acoustic transfer function in closely spaced frequency bands. FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012).

Besides providing direct calculations of the PK and SPL, the synthetic waveforms from FWRAM can also be used to convert the SEL values from MONM to SPL.

C.3. Wavenumber Integration Model

Sound pressure levels near the seismic source were modelled using JASCO's VSTACK wavenumber integration model. VSTACK computes synthetic pressure waveforms versus depth and range for arbitrarily layered, range-independent acoustic environments using the wavenumber integration approach to solve the exact (range-independent) acoustic wave equation. This model is valid over the full angular range of the wave equation and can fully account for the elasto-acoustic properties of the sub-bottom. Wavenumber integration methods are extensively used in the field of underwater acoustics and seismology where they are often referred to as reflectivity methods or discrete wavenumber methods. VSTACK computes sound propagation in arbitrarily stratified water and seabed layers by decomposing the outgoing field into a continuum of outward-propagating plane cylindrical waves. Seabed reflectivity in the model is dependent on the seabed layer properties: compressional and shear wave speeds, attenuation coefficients, and layer densities. The output of the model can be post-processed to yield estimates of the SEL, SPL, and PK.

VSTACK accurately predicts steep-angle propagation in the proximity of the source, but it is computationally slow at predicting sound pressures at large distances due to the need for smaller wavenumber steps with increasing distance. Additionally, VSTACK assumes range-invariant bathymetry with a horizontally stratified medium (i.e., a range-independent environment) which is azimuthally symmetric about the source. VSTACK is thus best suited to modelling the sound field near the source.

C.3.1. Particle Motion

VSTACK was also used to compute estimates of particle acceleration and velocity at four sites for the 2820 in^3 seismic source. Particle motion waveforms were modelled, and pulse metrics were computed from the time-domain traces. VSTACK uses the wavenumber integration approach to solve the exact acoustic wave equation for arbitrarily layered range-independent acoustic environments.

The VSTACK model setup for the particle velocity scenarios was identical to that for the peak pressure scenarios (Section 5.2.1.2) in terms of source treatment, frequency range and environmental model. The particle acceleration and velocity waveforms were computed to a maximum distance of 1000 m in the broadside and endfire directions from the centre of the airgun array for a receiver 5 cm above the seafloor.

As discussed above in Appendix A.2, particle velocity (v) is the physical speed of a particle in a material. It can be derived from the pressure gradient and Euler's linearised momentum equation where ρ_0 is the density of the medium. Since the wavenumber integration kernel is a product of analytic expressions in terms of range and depth, VSTACK computes particle velocity by computing the spatial gradient of the pressure field analytically in the frequency domain. Fourier synthesis is applied to compute time series synthetic pressure and/or velocity waveforms at depth and range receivers by convolving the source waveforms with the impulse response of the waveguide. Particle velocity metrics at each receiver location were calculated from the modelled particle motion along three perpendicular axes (horizontal and along the source-receiver path, horizontal and perpendicular to the source-receiver path, and vertical).

The particle velocity results were converted to acceleration by time differentiation. The peak particle acceleration and velocity were calculated from the maximum of the predicted acceleration and velocity magnitude, defined as “peak magnitude”.

C.3.2. Limestone Seabed Propagation Loss

For all modelled sites, an additional broadband correction was applied to the propagation loss results from MONM to better account for the additional propagation loss associated with a calcarenite/limestone seabed. The differences between the broadband per-pulse SEL from MONM and VSTACK were extracted at the same modelled ranges and depths for corresponded range independent environments. The 90th percentile of the resultant dB differences in range bins were selected to generate a correction function for representative sites to be modelled. The conversion functions were applied after to the summed decidecade band levels from MONM, but before gridding, and radii calculations for each modelled site in each modelled scenario considered.

Appendix D. Methods and Parameters

D.1. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure D-1).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure D-1(a). In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure D-1(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.

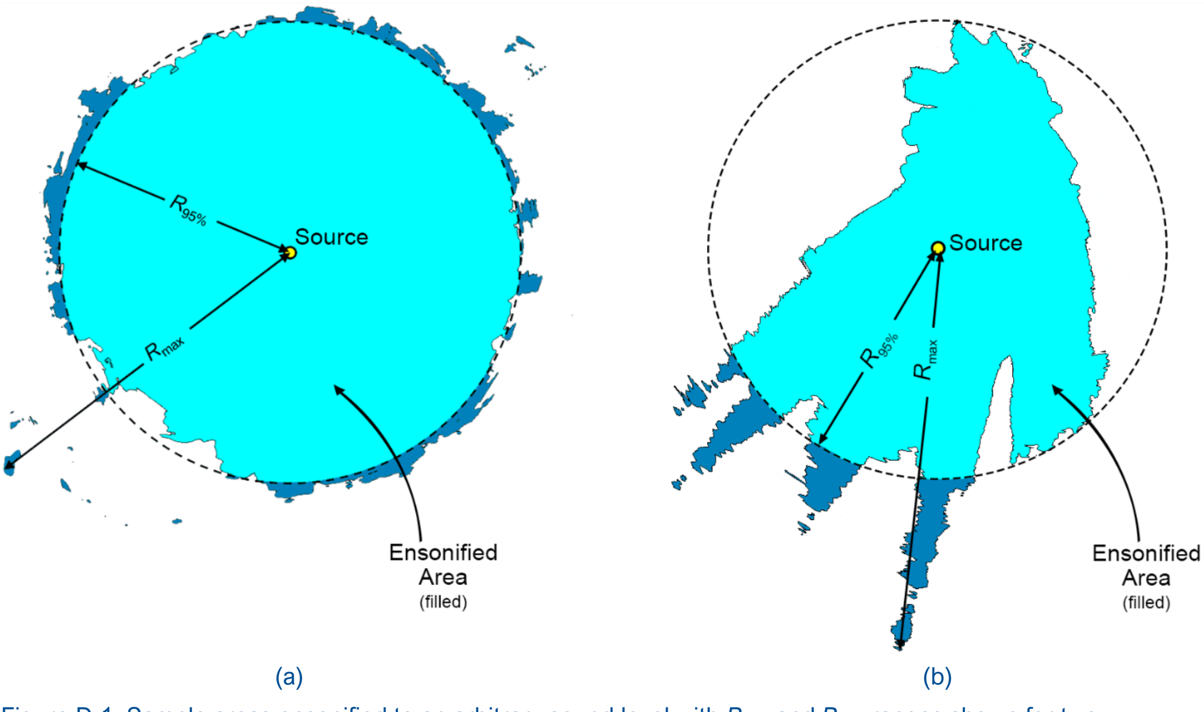

Figure D-1. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ ranges shown for two scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

D.2. Estimating SPL from Modelled SEL Results

The per-pulse SEL of sound pulses is an energy-like metric related to the dose of sound received over a pulse's entire duration. The pulse SPL on the other hand, is related to its intensity over a specified time interval. Seismic pulses typically lengthen in duration as they propagate away from their source, due to seafloor and surface reflections, and other waveguide dispersion effects. The changes in pulse length, and therefore the time window considered, affect the numeric relationship between SPL and SEL. This study has applied a fixed window duration to calculate SPL (T_{fix} = 125 ms; see Appendix A.1), as implemented in Martin et al. (2017b). Full-waveform modelling was used to estimate SPL, but this type of modelling is computationally intensive, and can be prohibitively time consuming when run at high spatial resolution over large areas.

For the current study, FWRAM (Appendix C.2) was used to model synthetic seismic pulses over the frequency range 5–1024 Hz. This was performed along all broadside and endfire radials at five sites. FWRAM uses Fourier synthesis to recreate the signal in the time domain so that both the SEL and SPL from the source can be calculated. The differences between the SEL and SPL were extracted for all ranges and depths that corresponded to those generated from the high spatial-resolution results from MONM. A 125 ms fixed time window positioned to maximize the SPL over the pulse duration was applied. The resulting SEL-to-SPL offsets were averaged in 0.02 km range bins along each modelled radial and depth, and the 90th percentile was selected at each range to generate a generalised range-dependent conversion function for each site. The range-dependent conversion function was applied to predicted per-pulse SEL results from MONM to model SPL values. Figures D-2 to D-6 show the conversion offsets for Sites 2, 3, 5, 8, and 10 with the 2820 in^3 array; the spatial variation is caused by changes in the received airgun pulse as it propagates from the source. The conversion to SPL from SEL was conducted considering the water depth and seabed geology at a given modelled site.

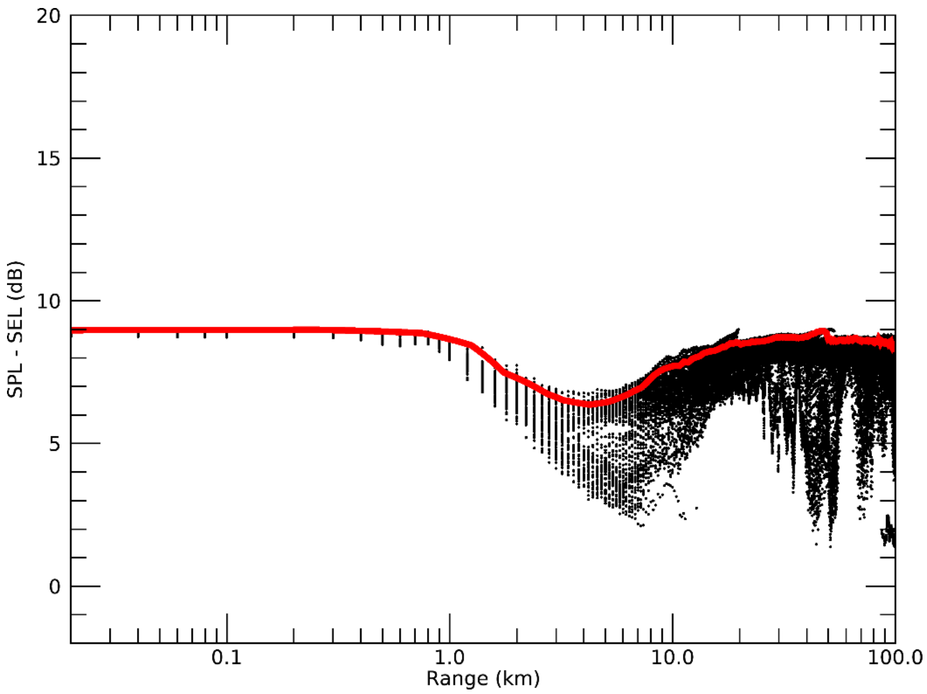

Figure D-2. *Site 2 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

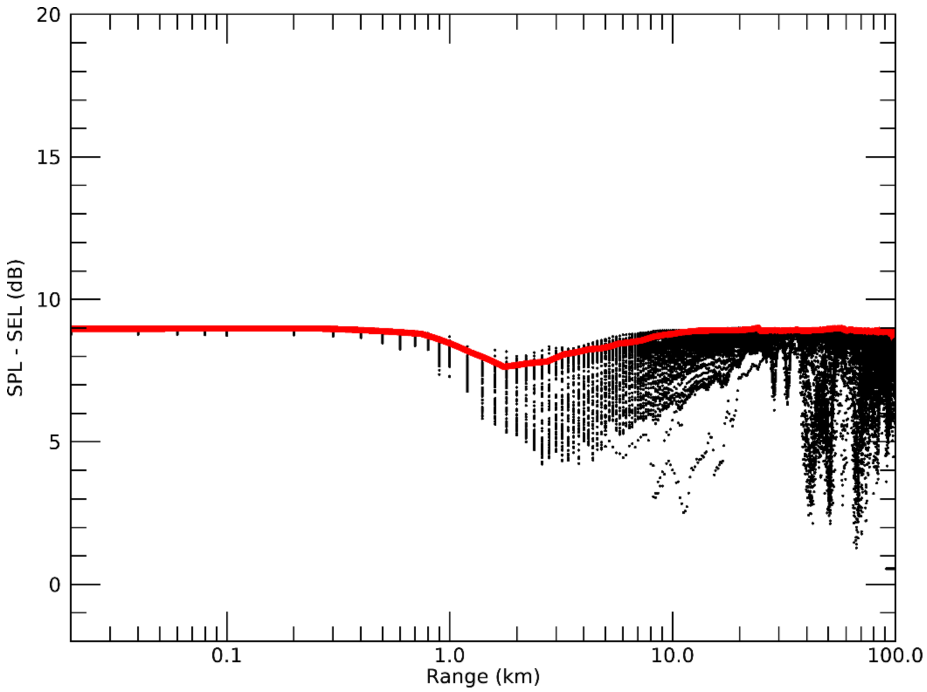

Figure D-3. *Site 3 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

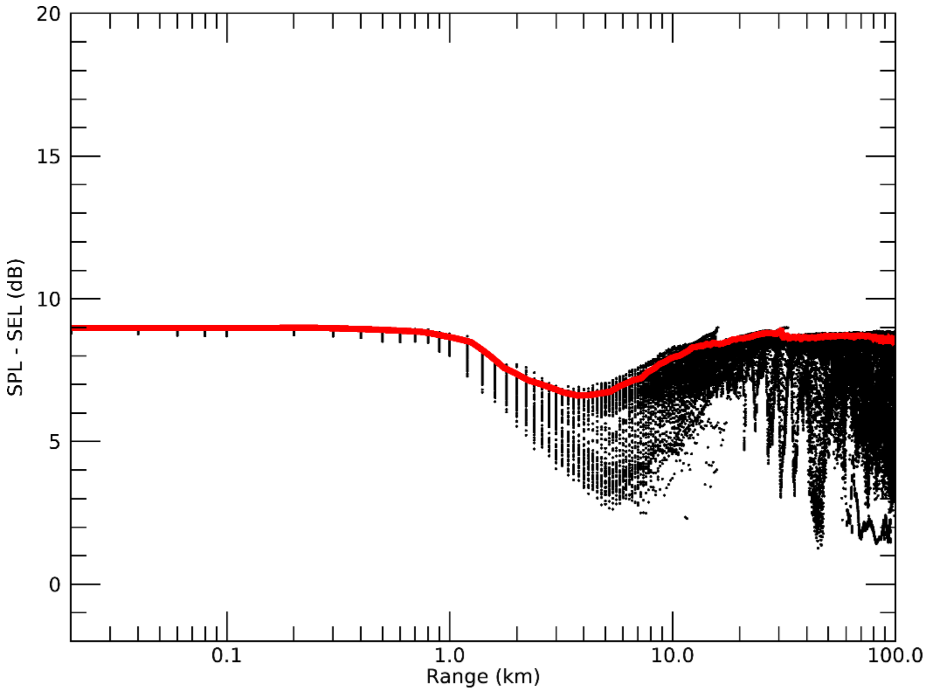

Figure D-4. *Site 5 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

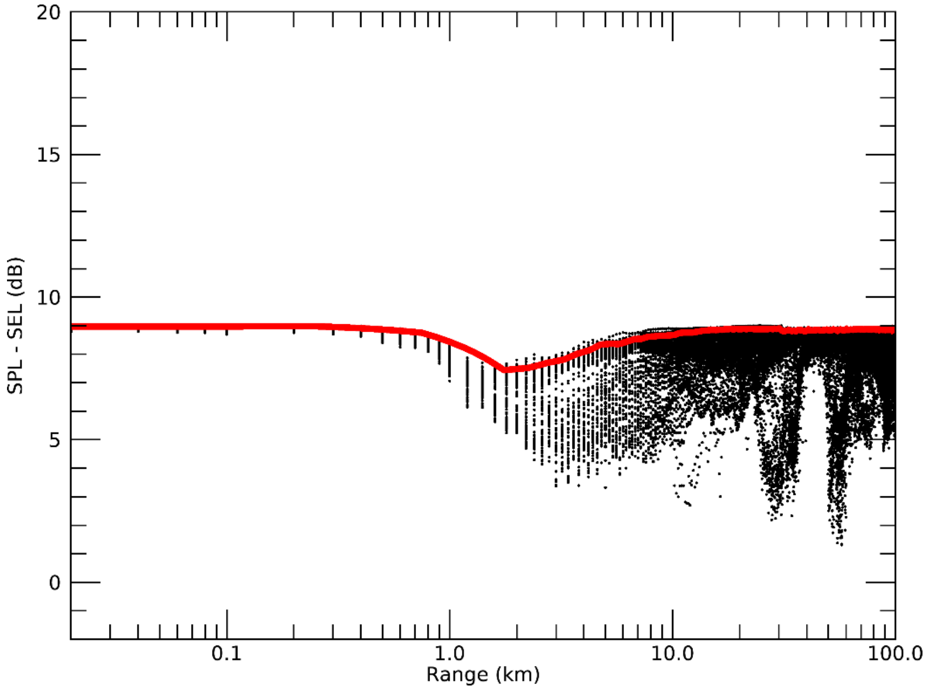

Figure D-5. *Site 8 tow direction 113*°: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

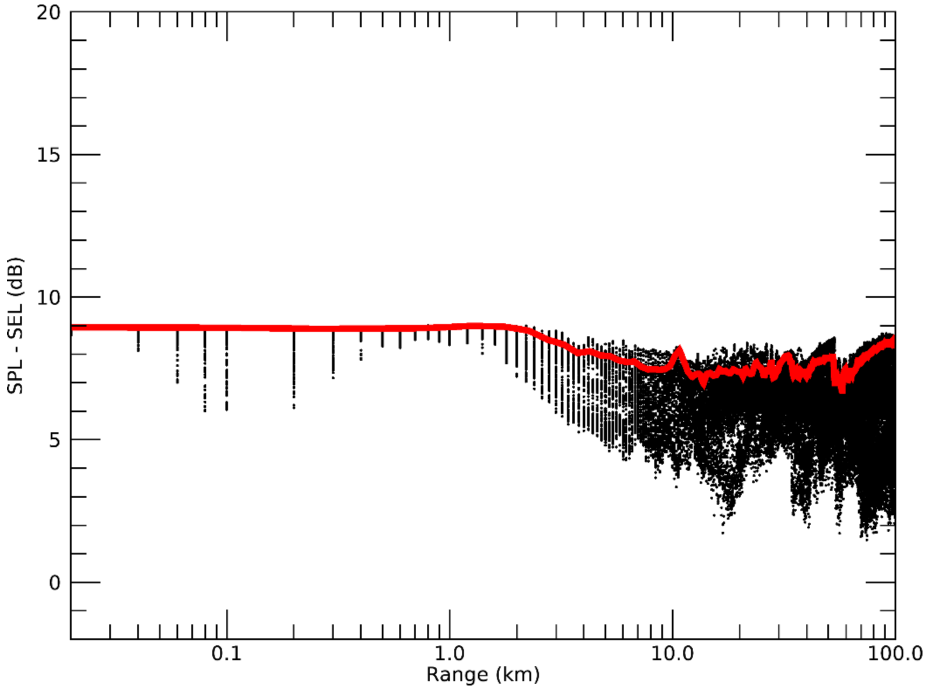

Figure D-6. *Site 10 tow direction 113*°: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

D.3. Environmental Parameters

D.3.1. Bathymetry

Water depths throughout the modelled area were extracted from Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009). Bathymetry data was extracted and re-gridded onto a Map Grid of Australia (MGA) coordinate projection (Zone 54) with a regular grid spacing of 200 × 200 m to generate the bathymetry in Figure D-7.

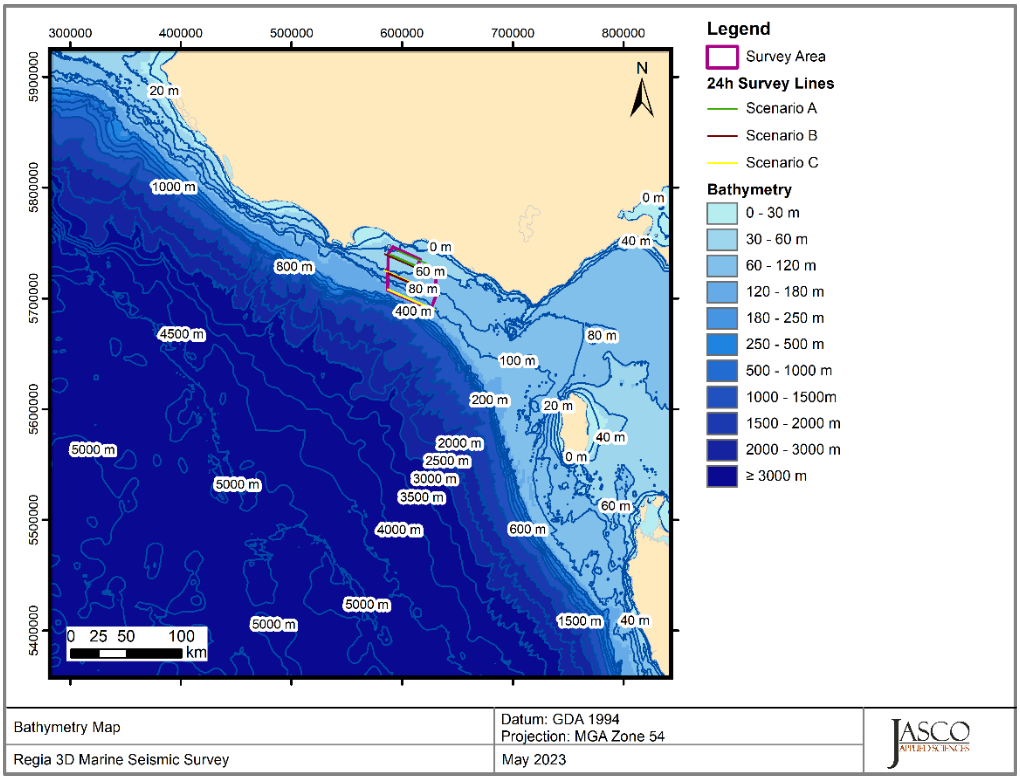

Figure D-7. Bathymetry map of the modelling area for the Regia Marine Seismic Survey.

D.3.2. Sound Speed Profile

The sound speed profiles for the modelled sites were derived from temperature and salinity profiles from the US Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the US Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles within a 100 km box radius encompassing all modelled sites. The December sound speed profile is expected to be most favourable to longer-range sound propagation during the proposed survey time frame due its upward refracting profile. As such, December was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. Figure D-8 shows the resulting profile used as input to the sound propagation modelling.

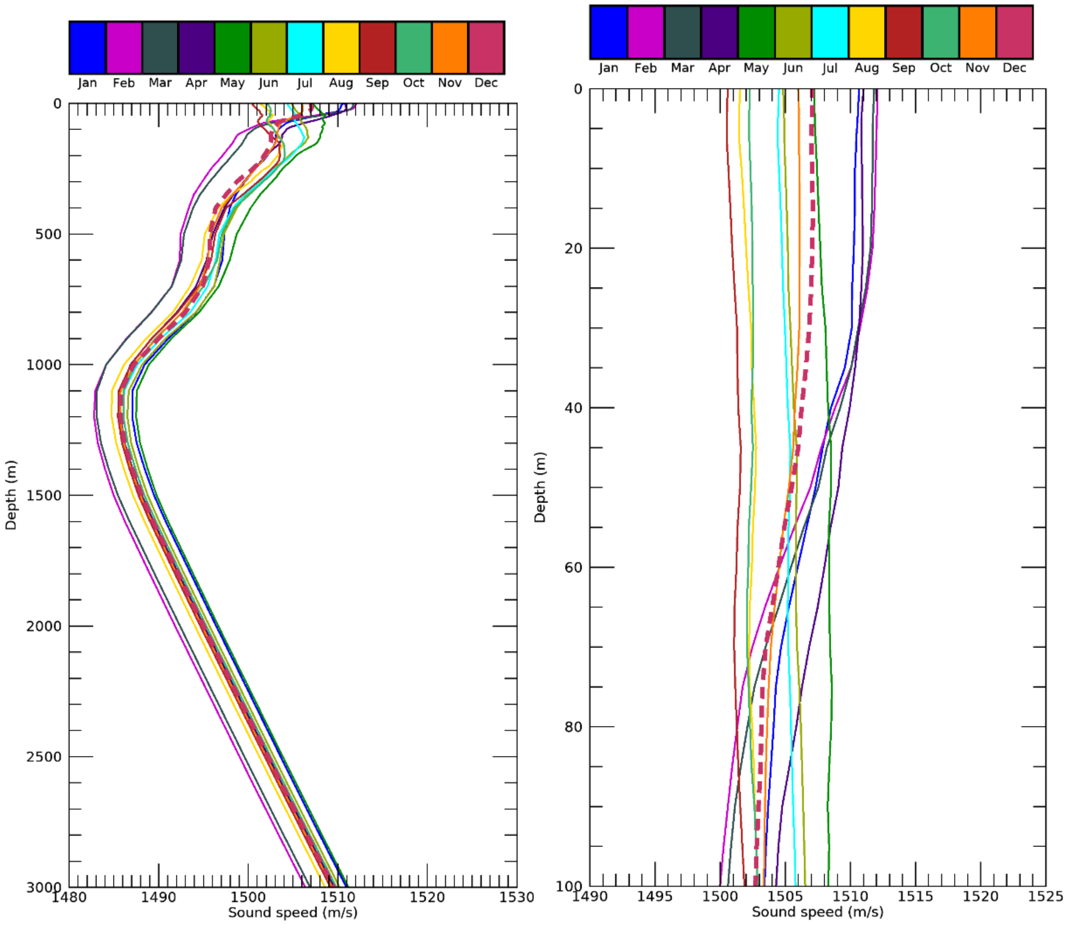

Figure D-8. The sound speed profile (December) used for all modelling, showing the entire water column (left) and the top 100 m within the profile (right). Profiles are calculated from temperature and salinity profiles from GDEM V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

D.3.3. Geoacoustics

The geoacoustic parameters used for modelling have been sourced from previous public reports completed by Jasco for modelling projects in the surrounding area. Similar to previous modelling studies in the region (Wood and McPherson 2018, Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021), several seabed types were considered for modelling. These seabed profiles are indicative of a benthic environment located on the continental shelf and upper slope and are consistent with larger scale geological data and interpretations of the Australian continental shelf environment (James and Bone 2010) within the Otway region.

For the sites modelled in shallow water (less than 50 m depth) the seabed was modelled as a sand layer underlain by variably cemented calcarenite. Literature and public reports suggest that this layer likely begins to thin as water depths increase in an offshore direction (Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021), and for water depths greater than 50 m it was considered absent with only the variably calcarenite present at the seafloor interface. These two seabed profiles are consistent with profiles described in association with measurement data (McCauley et al. 2016), and other modelling studies in the region (AIMS 2018).

Sites located above the calcarenite seabed generally displayed higher rates of loss (Duncan et al. 2009) at distance away from the source as compared to sites where a layer of sand overlies calcarenite and as such additional modelling was conducted to account for the propagation loss associated with a limestone seabed and additional modelled was conducted to account for the loss associated with exposed calcarenite (see Appendix C.3.2). For sites located in water along the shelf, geoacoustic parameters considered for modelling are provided in Tables D-1 and D-2

Table D-1. Geoacoustic profile used in the acoustic propagation models less than 50 m water depth. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-5	Fine Carbonate Sand	2.1	1634-1803	0.09-0.73		
5-25		2.2	2000-2120	0.30-0.34		
25-45		2.3	2120-2240	0.34-0.38		
45-65	Increasingly cemented calcarenite	2.4	2240-2360	0.38-0.42	315	3.65
65-85		2.5	2360-2480	0.42-0.46		
85-105		2.6	2480-2600	0.46-0.50		
>105	Well-cemented calcarenite	2.7	2600	0.50		

Table D-2. Geoacoustic profile used in the acoustic propagation models for between 50 m and 150 m water depth.Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-1	Well-cemented carbonate caprock	2.7	2600	0.5		
1-20		2.2	2000-2120	0.30-0.34		
20-40		2.3	2120-2240	0.34-0.38		
40-60	Increasingly cemented calcarenite	2.4	2240-2360	0.38-0.42	500	0.4
60-80		2.5	2360-2480	0.42-0.46		
80-10		2.6	2480-2600	0.46-0.50		
>100	Well-cemented calcarenite	2.7	2600	0.50		

For sites located along the shelf break/upper continental slope, the geoacoustic parameters used for modelling was derived from sedimentary grain size measurements from the Australian Government's Marine Sediments (MARS) database (Heap 2009). On average, the surficial grain size indicates silty carbonate sand is present. Information on the deeper geological structure was sparse, as such the seabed was assumed to consist of a thick package of unconsolidated sediments. However, this is consistent with the "shaved shelf" model of the discussed in James and Bone 2010, where sediments are transported and deposited from the shelf onto the slope. Representative grain sizes and porosity were used in the grain-shearing model proposed by Buckingham (2005) to estimate the geoacoustic parameters required by the sound propagation models. Table D-3 lists the geoacoustic parameters used for modelling for sites in water depths greater than 150 m.

Table D-3. Geoacoustic profile used in the acoustic propagation models for all modelled sites greater than 150 m water depth. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–10	Silty carbonate sand to semi-cemented carbonate	1.88	1605–1700	0.35–0.70	255	3.65
10–20		1.88–1.89	1700–1755	0.70–0.85		
20–50		1.89–1.90	1755–1850	0.85–1.15		
50–100		1.90–1.92	1850–1950	1.15–1.35		
100–200		1.92–1.96	1950–2100	1.35–1.60		
200–500		1.96–2.05	2100–2355	1.60–1.95		
>500		2.05	2355	1.95		

D.4. Animal Movement and Exposure Modelling

Animal movement and exposure modelling considers the movement of both sound sources and animals over time. Acoustic source and propagation modelling are used to generate 3-D sound fields that vary as a function of distance to source, depth, and azimuth. Sound sources are modelled at representative sites and the resulting sound fields are assigned to source locations using the minimum Euclidean distance. The sound received by an animal at any given time depends on its location relative to the source. Because the true locations of the animals within the sound fields are unknown, realistic animal movements are simulated using repeated random sampling of various behavioural parameters. The Monte Carlo method of simulating many animals within the operations area is used to estimate the sound exposure history of the population of simulated animals (animats).

Monte Carlo methods provide a heuristic approach for determining the probability distribution function (PDF) of complex situations, such as animals moving in a sound field. The probability of an events occurrence is determined by the frequency with which it occurs in the simulation. The greater the number of random samples, in this case the more simulated animats, the better the approximation of the PDF. Animats are randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2). Higher densities provide a finer PDF estimate resolution but require more computational resources. To ensure good representation of the PDF, the animat density is set as high as practical allowing for computation time. The animat density is much higher than the real-world density to ensure good representation of the PDF. The resulting PDF is scaled using the real-world density.

Several models for marine mammal movement have been developed (Ellison et al. 1987, Frankel et al. 2002, Houser 2006). These models use an underlying Markov chain to transition from one state to another based on probabilities determined from measured swimming behaviour. The parameters may represent simple states, such as the speed or heading of the animal, or complex states, such as likelihood of participating in foraging, play, rest, or travel. Attractions and aversions to variables like anthropogenic sounds and different depth ranges can be included in the models.

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was based on the open-source marine mammal movement and behaviour model (3MB, Houser 2006) and used to predict the exposure of animats to sound arising from the anthropogenic activities. Animats are programmed to behave like the species likely to be present in the survey area. The parameters used for forecasting realistic behaviours (e.g., diving, foraging, aversion, surface times, etc.) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. An individual animats modelled sound exposure levels are summed over the total simulation duration to determine its total received energy, and then compared to the assumed threshold criteria.

JASMINE uses the same animal movement algorithms as 3MB (Houser, 2006), but has been extended to be directly compatible with JASCO's Marine Operations Noise Model (MONM) and Full Waveform Range-dependent Acoustic Model (FRAWM) acoustic field predictions, for inclusion of source tracks, and importantly for animats to change behavioural states based on time and space dependent modelled variables such as received levels for aversion behaviour, although aversion was not considered in this study.

D.4.1. Animal Movement Parameters

JASMINE uses previously measured behaviour to forecast behaviour in new situations and locations. The parameters used for forecasting realistic behaviour are determined (and interpreted) from marine species studies (e.g., tagging studies). Each parameter in the model is described as a probability distribution. When limited or no information is available for a species parameter, a Gaussian or uniform distribution may be chosen for that parameter. For the Gaussian distribution, the user determines the mean and standard deviation of the distribution from which parameter values are drawn. For the uniform distribution, the user determines the maximum and minimum distribution from which parameter values are drawn. When detailed information about the movement and behaviour of a species are available, a user-created distribution vector, including cumulative transition probabilities, may be used (referred to here as a vector model; Houser 2006). Different sets of parameters can be defined for different behaviour states. The probability of an animat starting out in or transitioning into a given behaviour state can in turn be defined in terms of the animats current behavioural state, depth, and the time of day. In addition, each travel parameter and behavioural state has a termination function that governs how long the parameter value or overall behavioural state persists in simulation.

The parameters used in JASMINE describe animal movement in both the vertical and horizontal planes. The parameters relating to travel in these two planes are briefly described below.

Travel sub-models

- **Direction**– determines an animats choice of direction in the horizontal plane. Sub-models are available for determining the heading of animats, allowing for movement to range from strongly biased to undirected. A random walk model can be used for behaviours with no directional preference, such as feeding and playing. In a random walk, all bearings are equally likely at each parameter transition time step. A correlated random walk can be used to smooth the changes in bearing by using the current heading as the mean of the distribution from which to draw the next heading. An additional variant of the correlated random walk is available that includes a directional bias for use in situations where animals have a preferred absolute direction, such as migration. A user-defined vector of directional probabilities can also be input to control animat heading. For more detailed discussion of these parameters, see Houser (2006) and Houser and Cross (1999).
- **Travel rate**–defines an animats rate of travel in the horizontal plane. When combined with vertical speed and dive depth, the dive profile of the animat is produced.

Dive sub-models

- **Ascent rate**–defines an animats rate of travel in the vertical plane during the ascent portion of a dive.
- **Descent rate**–defines an animats rate of travel in the vertical plane during the descent portion of a dive.
- **Depth**–defines an animats maximum dive depth.
- **Reversals**–determines whether multiple vertical excursions occur once an animat reaches the maximum dive depth. This behaviour is used to emulate the foraging behaviour of some marine mammal species at depth. Reversal-specific ascent and descent rates may be specified.
- **Surface interval**–determines the duration an animat spends at, or near, the surface before diving again.

D.4.2. Exposure Integration Time

The interval over which acoustic exposure (L_E) should be integrated and maximal exposure (L_p) determined is not well defined. Both Southall et al. (2007) and the NMFS (2018) recommend a 24 h baseline accumulation period, but state that there may be situations where this is not appropriate (e.g., a high-level source and confined population). Resetting the integration after 24 h can lead to overestimating the number of individual animals exposed because individuals can be counted multiple times during an operation. The type of animal movement engine used in this study simulates realistic movement using swimming behaviour collected over relatively short periods (hours to days) and does not include large-scale movement such as migratory circulation patterns. For this study, a representative 24-hour period was simulated.

Ideally, a simulation area is large enough to encompass the entire range of a population so that any animal that could approach the source during an operation is included. However, there are limits to the simulation area, and computational overhead increases with area. For practical reasons, the simulation area is limited. In the simulation, every animat that reaches a border is replaced by another animat entering at the opposing border—e.g., an animat crossing the northern border of the simulation is replaced by one entering the southern border at the same longitude. When this action places the animat in an inappropriate water depth, the animat is randomly placed on the map at a depth suited to its species definition. The exposures of all animats (including those leaving the simulation and those entering) are kept for analysis. This approach maintains a consistent animat density and allows for longer integration periods with finite simulation areas.

D.4.3. Seeding Density and Scaling

Seeding density refers to the spatial sample rate, in units of animats/km^2, used in the simulation. It is not related to the real-world animal density, but rather is a model parameter that controls how samples are drawn from the model space. The minimum required seeding density for any given project depends on several factors such as bathymetry, source characteristics, and the behavioural profile of the animats, with the main constraint being computation time and resources. Seeding density is adjusted as needed based on model conditions specific to a project or project area.

In the present study, the exposure criteria for impulsive sounds were used to determine the number of animats exceeding exposure thresholds. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 4 animat/km^2 over the entire simulation area. The modelling results are not related to real-world animal densities and the number of real-world animals potentially exposed was not calculated.

Appendix E. Model Validation Information

Predictions from JASCO's Airgun Array Source Model (AASM) and propagation models (MONM, FWRAM and VSTACK) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Artic, Canadian and southern United States waters, Greenland, Russia and Australia (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities which have included internal validation of the modelling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016).

Appendix F. Supplemental Results

Histograms of CPA ranges to SEL_{24h} PTS, TTS, and the behavioural response threshold for Scenarios B and C are shown in Figures 1 to 24.

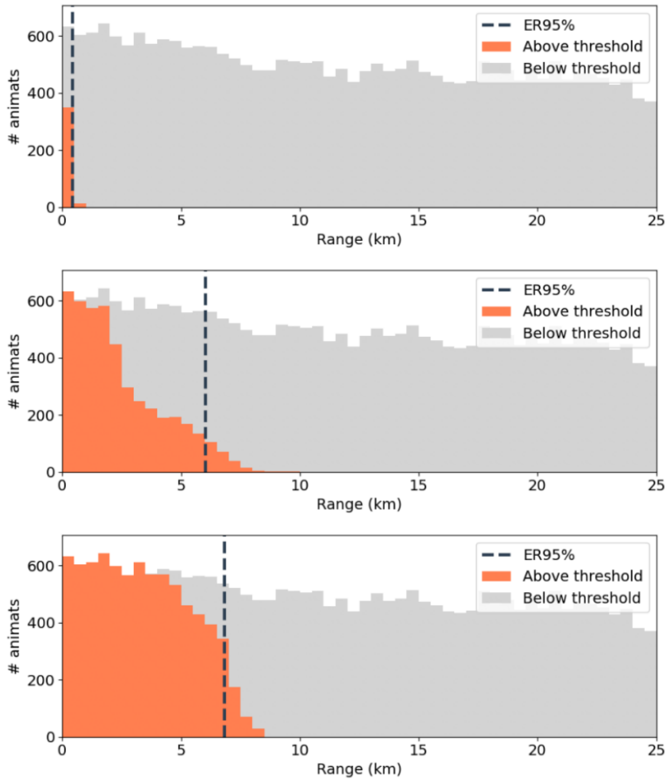

Figure F-1. *Scenario B, female pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

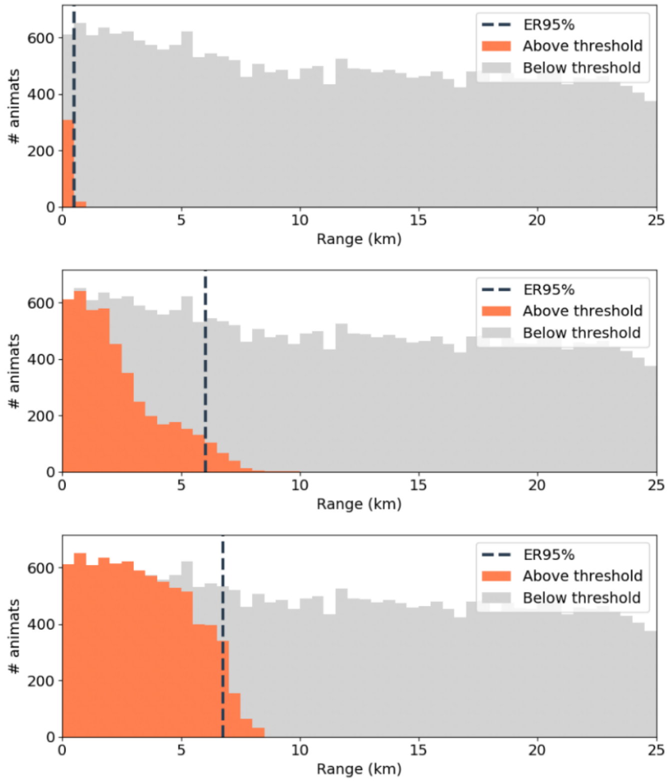

Figure F-2. *Scenario B, male pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

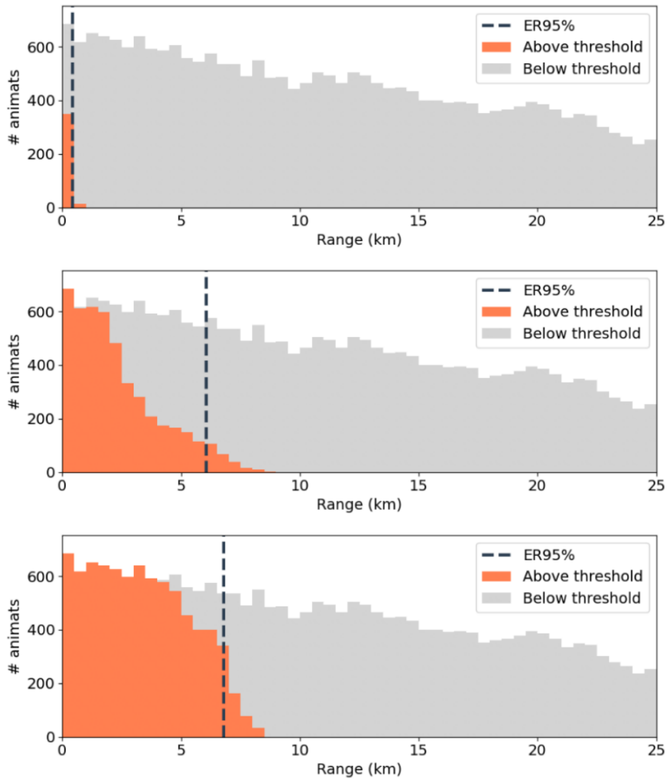

Figure F-3. *Scenario B, female pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

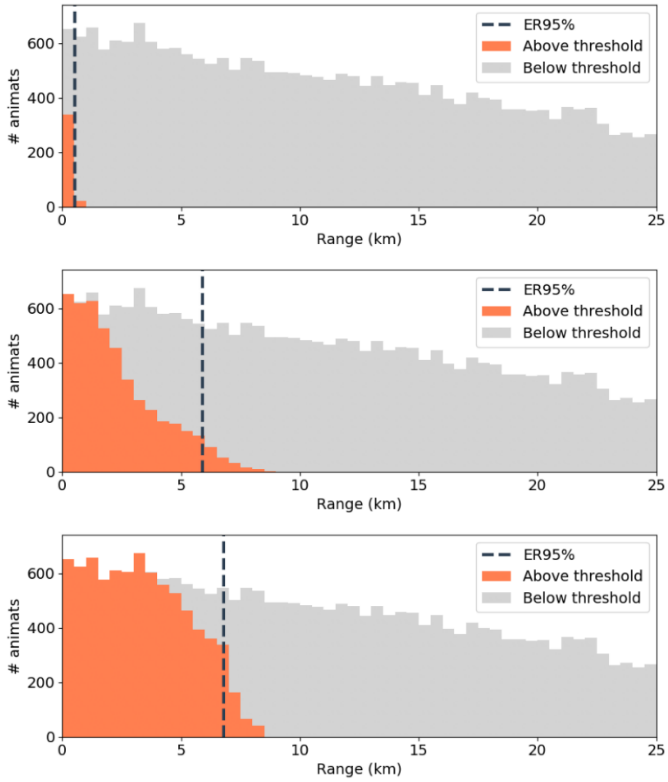

Figure F-4. *Scenario B, male pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

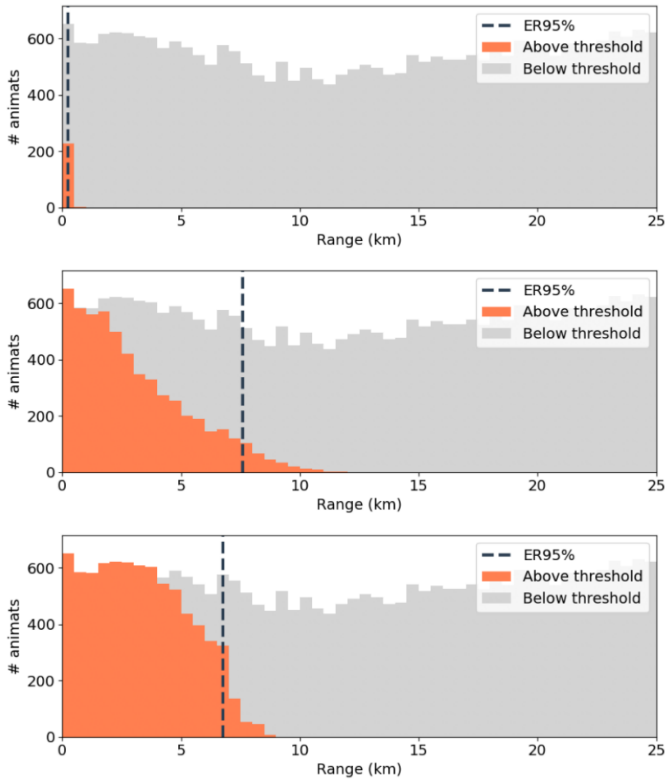

Figure F-5. *Scenario C, female pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

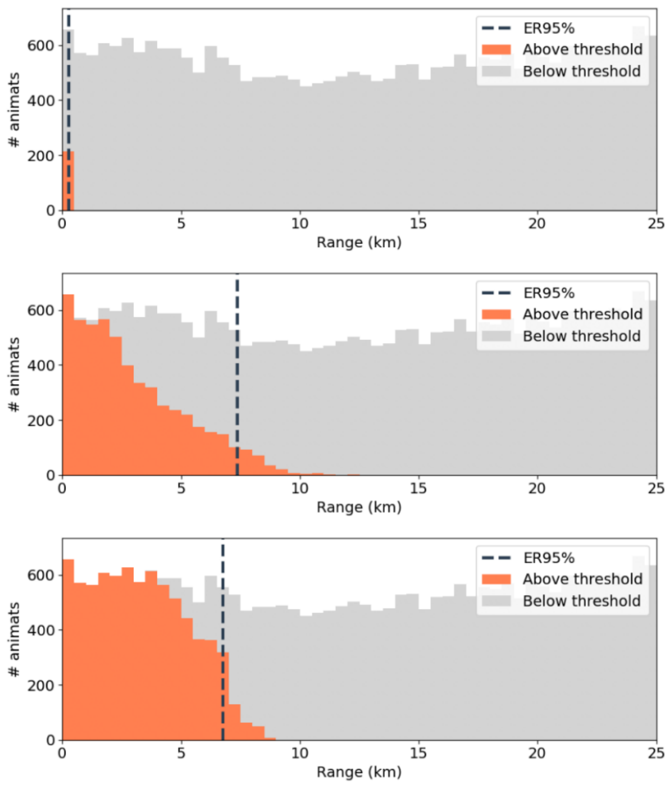

Figure F-6. *Scenario C, male pygmy blue whale animats, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

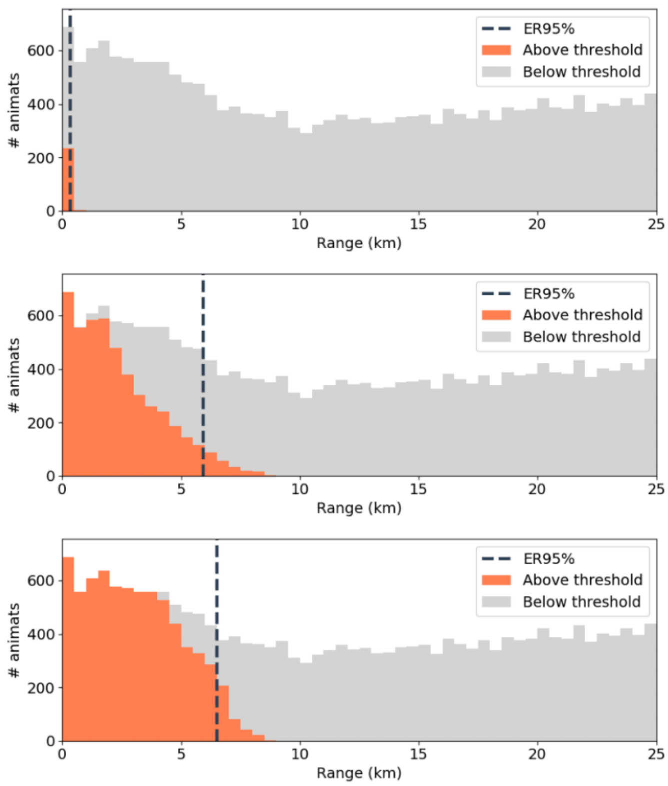

Figure F-7. *Scenario C, female pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

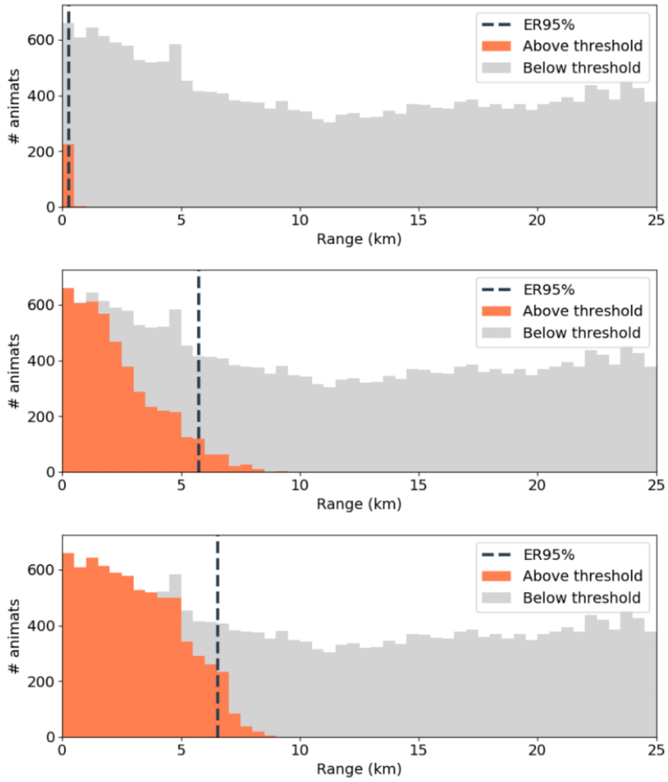

Figure F-8. *Scenario C, male pygmy blue whale animats, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

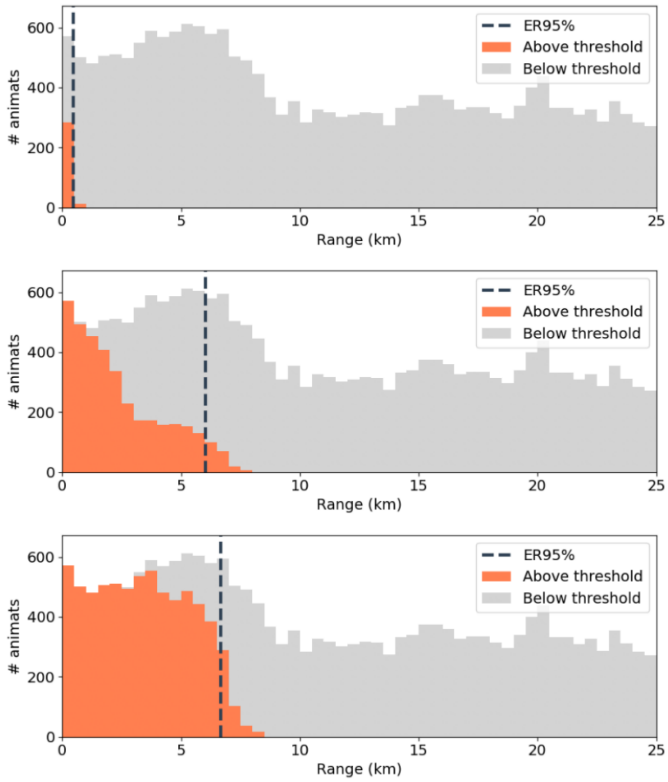

Figure F-9. *Scenario B, migrating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

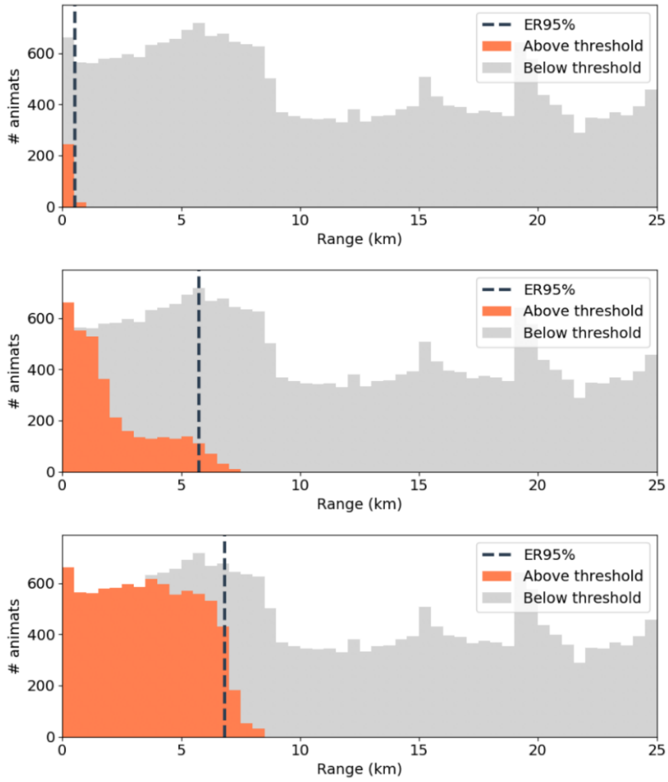

Figure F-10. *Scenario B, migrating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

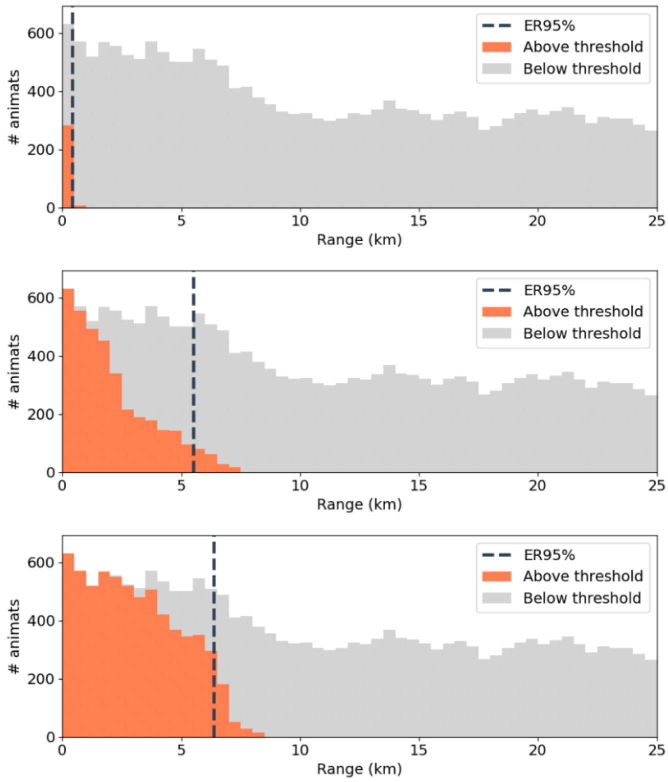

Figure F-11. *Scenario B, aggregating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

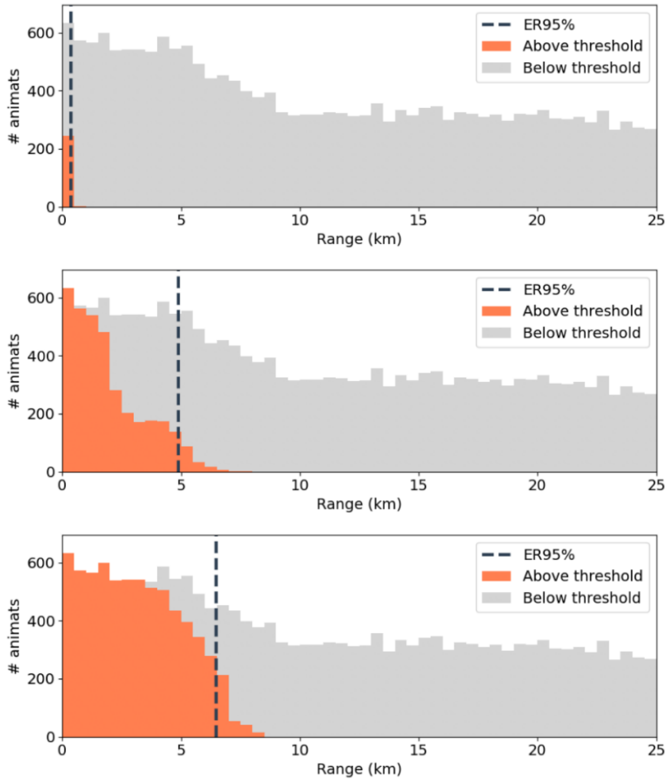

Figure F-12. *Scenario B, aggregating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

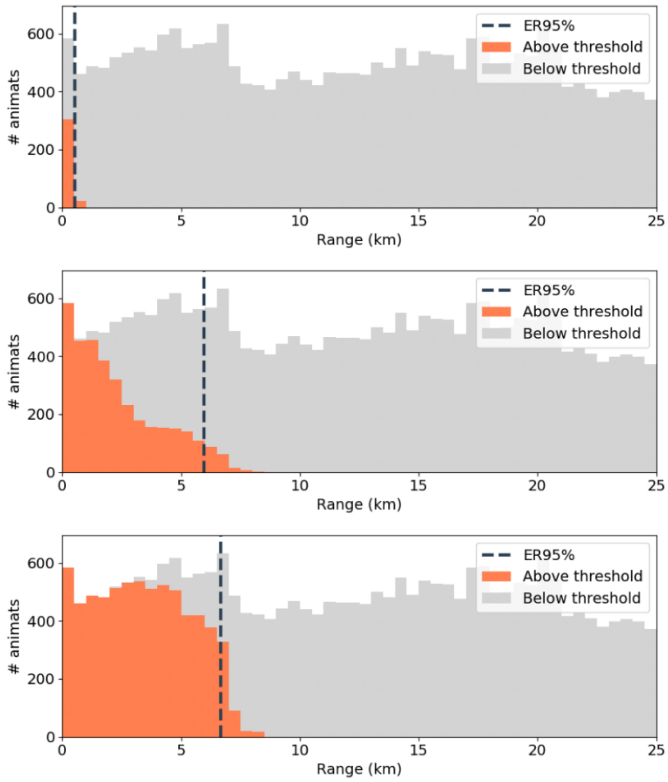

Figure F-13. *Scenario B, migrating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

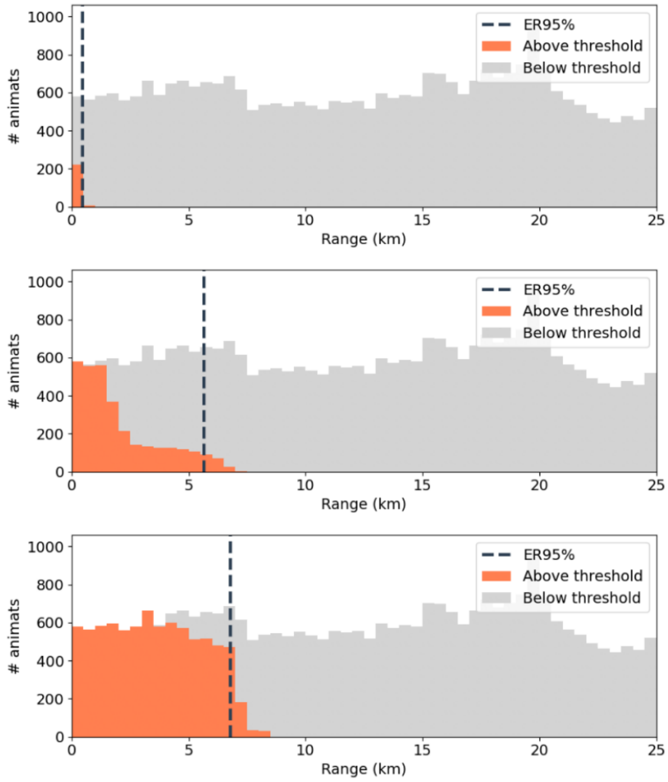

Figure F-14. *Scenario B, migrating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

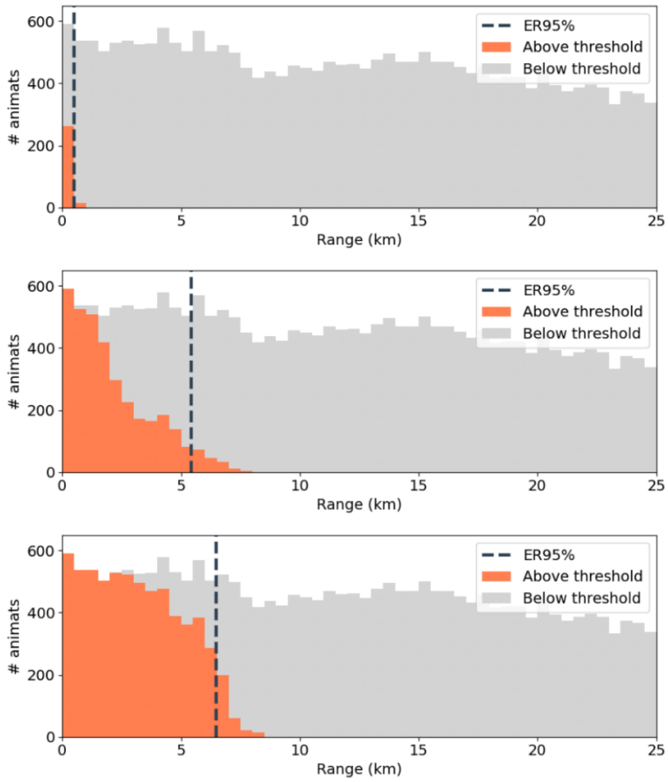

Figure F-15. *Scenario B, aggregating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

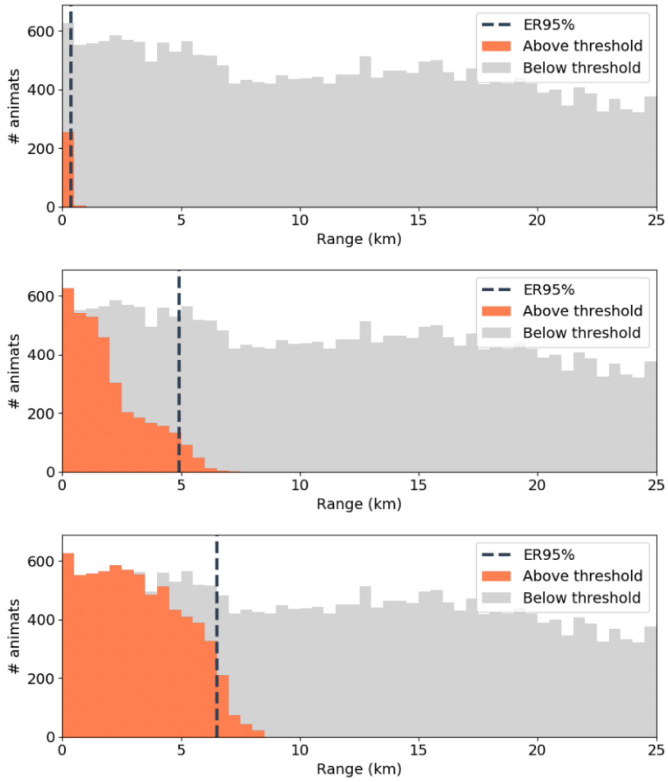

Figure F-16. *Scenario B, aggregating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

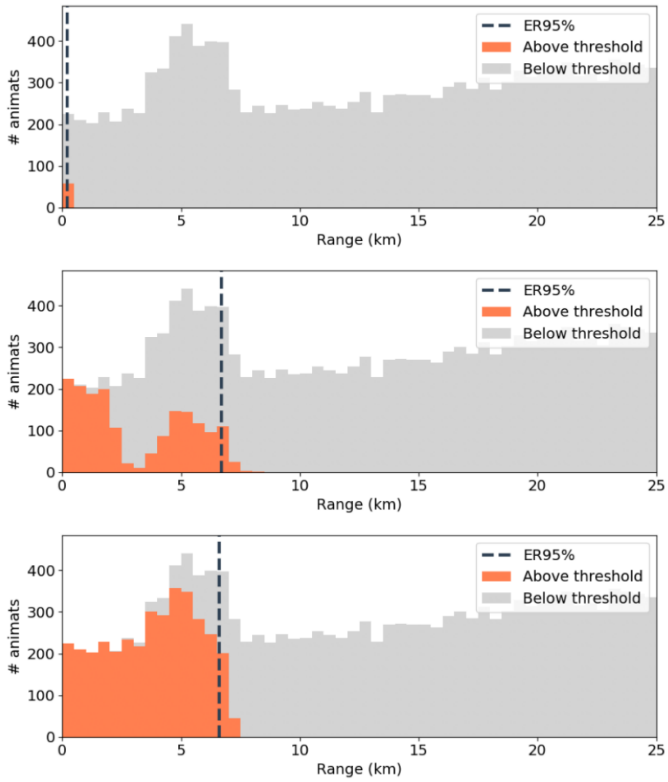

Figure F-17. *Scenario C, migrating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

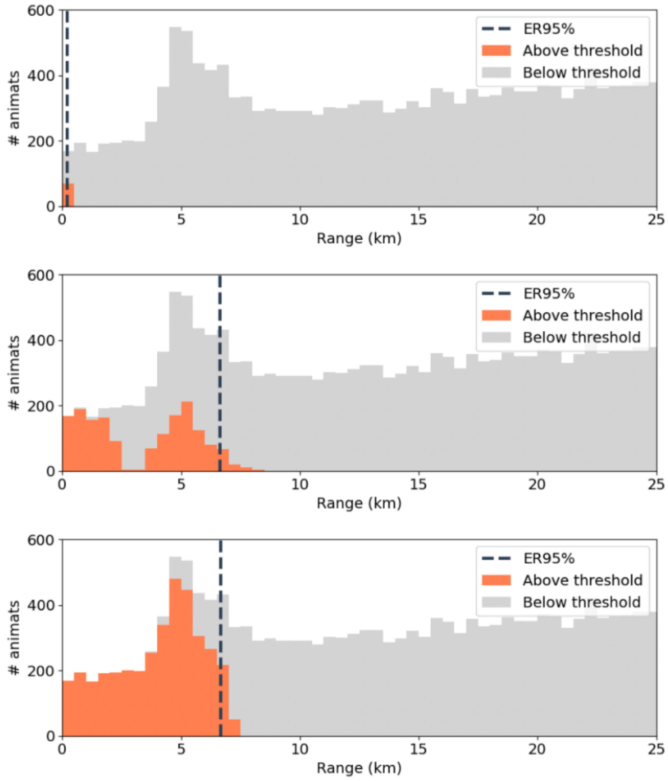

Figure F-18. *Scenario C, migrating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

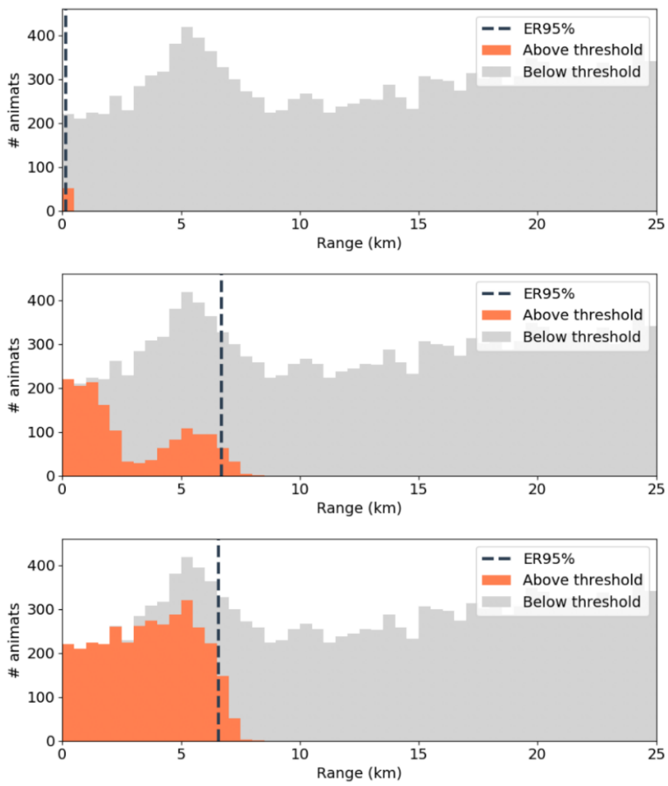

Figure F-19. *Scenario C, aggregating southern right whales, mother & calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

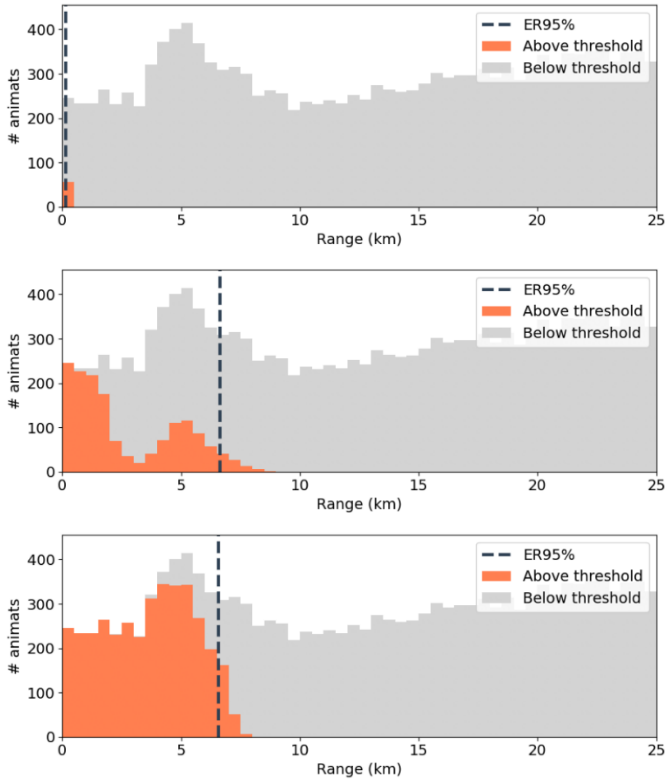

Figure F-20. *Scenario C, aggregating southern right whales, no calf, seeding A*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

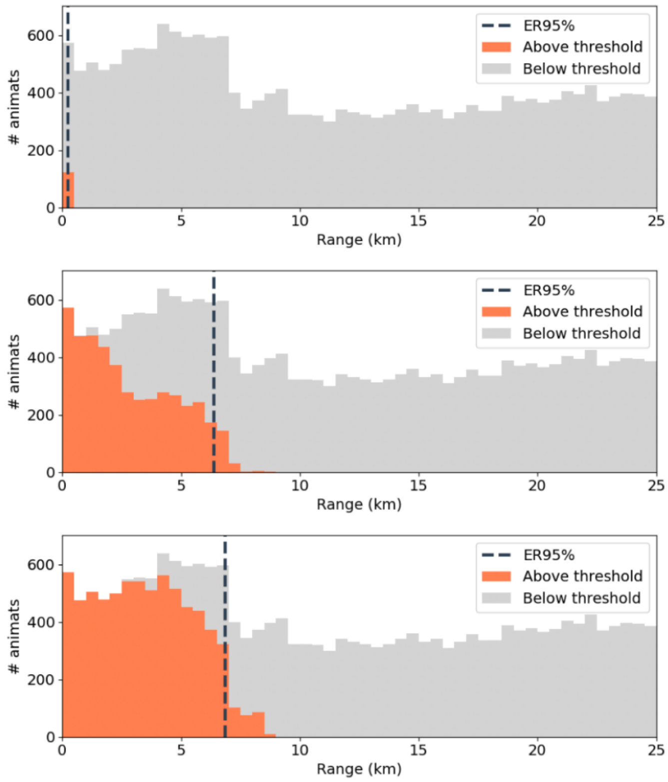

Figure F-21. *Scenario C, migrating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

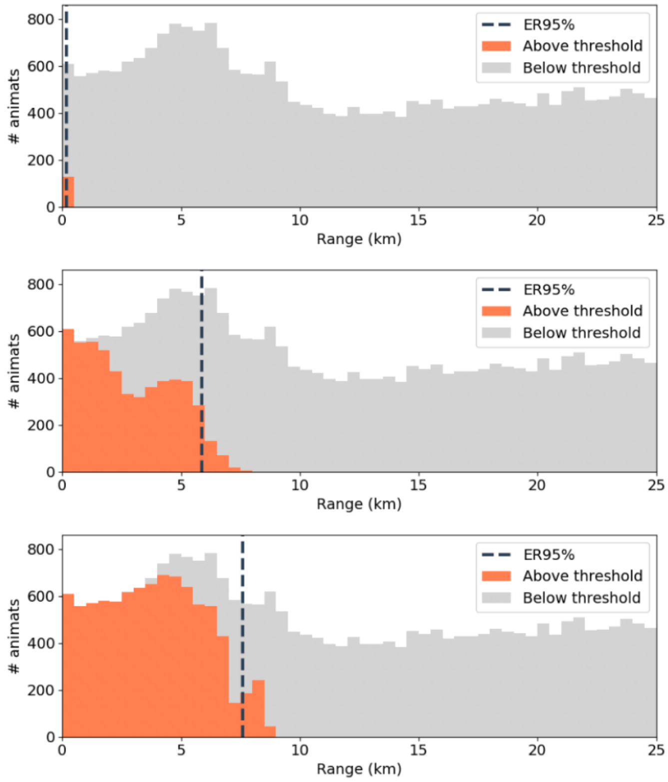

Figure F-22. *Scenario C, migrating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

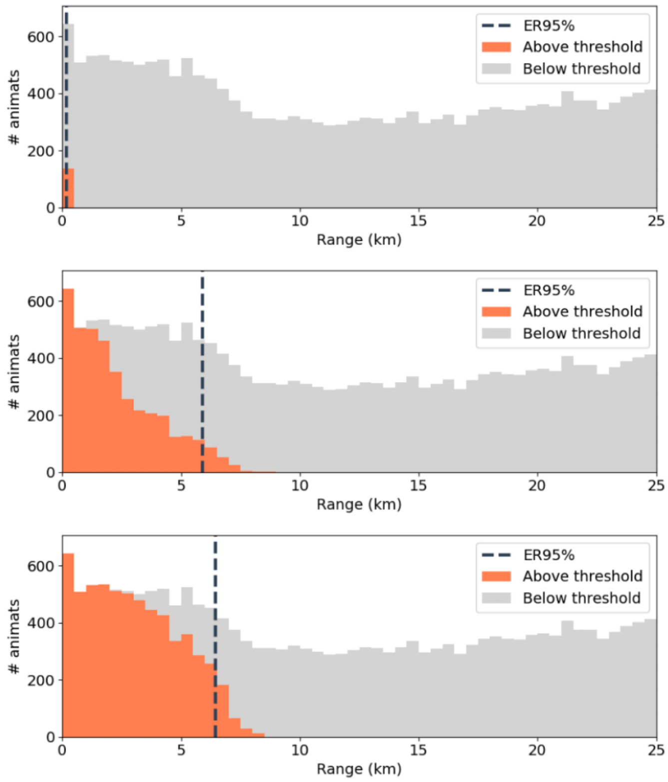

Figure F-23. *Scenario C, aggregating southern right whales, mother & calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

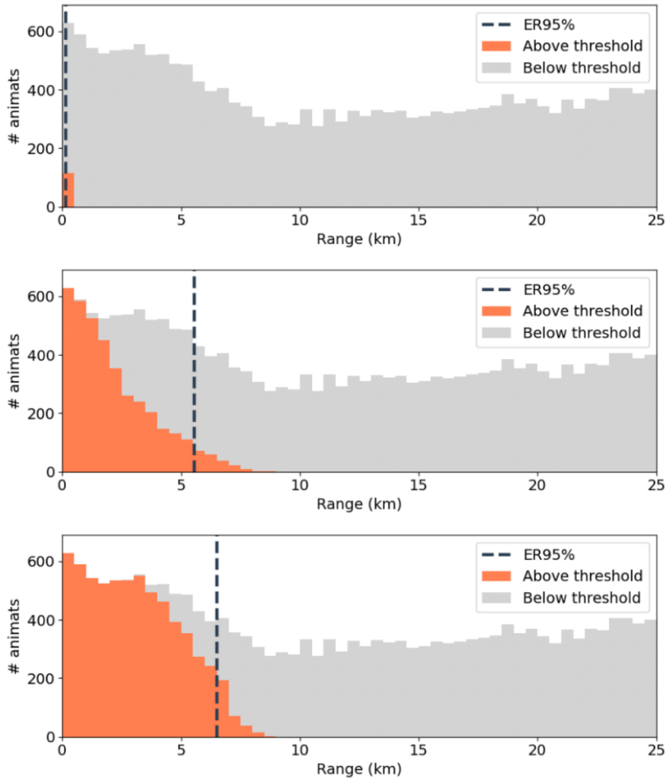

Figure F-24. *Scenario C, aggregating southern right whales, no calf, seeding B*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

Regia Marine Seismic Survey

Acoustic Modelling for Assessing Sound Exposures

JASCO Applied Sciences (Australia) Pty Ltd

5 June 2024

Submitted to:

Klarite
Contract: 0001

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P001749-001
Document 03301
Version 2.0

JASCO
APPLIED SCIENCES

Suggested citation:

Stephen T.J., V.E. Warren, S.C. Connell, M.W. Koessler and C.R. McPherson. 2024. Regia Marine Seismic Survey: Acoustic Modelling for Assessing Sound Exposures. Document 03301, Version 2.0. Technical report by JASCO Applied Sciences for Klarite.

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Executive Summary

JASCO Applied Sciences (JASCO) performed a numerical modelling study of underwater sound levels associated with the planned Regia Marine Seismic Survey (MSS) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals, fish, turtles, benthic invertebrates, plankton and recreational divers and swimmers. The modelling considered a seismic source in triple configuration with a 2820 in^3 total volume, towed at a 7 m depth behind a single vessel, with a 12.5 m impulse interval (inter-pulse interval) and a 37.5 m crossline array separation.

JASCO's specialised airgun array source model was used to predict the acoustic signature of the seismic source and complementary underwater acoustic propagation models were used in conjunction with the modelled array signatures to estimate sound levels over a large area around the sources. Single-impulse sound fields were predicted at 15 sites over the proposed survey line plans. Accumulated sound exposure fields for a 24-hour period were predicted for four representative survey operation scenarios. Four animal movement modelling scenarios, to address the four different survey operations, were also modelled.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{pk\text{-pk}}$), and either single-impulse (i.e., per-pulse) or accumulated sound exposure levels (SEL, L_E) as appropriate for different noise effect criteria. A conservative sound speed profile that would be most supportive of sound propagation conditions for the period of the survey was defined and applied to all modelled sites.

SEL_{24h} is a cumulative metric that reflects the dosimetric effect of noise levels over 24 hours, based on the assumption that a receiver (e.g., an animal) is consistently exposed to such noise levels at a fixed position. More realistically, marine animals would not stay in the same location for 24 hours (especially in the absence of location-specific habitat) but rather a shorter period, depending on the animal's behaviour and the source's proximity and movements. Therefore, a reported radius for the SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be impaired, but rather that an animal could be exposed to the sound level associated with impairment (Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS)) if it remained at that location for 24 hours.

A more realistic representation of the potential exposures for pygmy blue whales and southern right whales within the modelling area was undertaken using animal movement modelling ('animat modelling'). While acoustic modelling inherently assumes static animals, the JASCO Animal Simulation Model Including Noise Exposure (JASMINE) combines modelled sound fields with realistic animal movements to predict how animals might be impacted through sound exposure. Calculated exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving and movement parameters.

The distribution of distances of animats predicted to be exposed to sound levels above relevant thresholds was used to calculate 95th percentile exposure ranges ($ER_{95\%}$). Within the $ER_{95\%}$, there is generally some proportion of animats that do not exceed the threshold criterion. This occurs for several reasons, including the spatial and temporal characteristics of the sound field and the way in which the animats are exposed to the sound field over time, both vertically and horizontally. The probability that an animat within the $ER_{95\%}$ was exposed above the threshold criterion was also computed (P_{exp}) to provide additional context.

The acoustic analysis considered the distances away from the seismic source at which several effects criteria or relevant sound levels were reached. The results are summarised below considering all the representative single-impulse modelling sites and all accumulated SEL scenarios for both acoustic modelling results and pygmy blue whale and southern right whale animat $ER_{95\%}$ results and probabilities.

Marine Mammals – Acoustic Results

- The maximum distance where the NOAA marine mammal behavioural response criterion of 160 dB re 1 µPa^2 (SPL) for impulsive noise could be exceeded varied between 2.91 and 11.8 km from the 2820 in^3 seismic source, depending on modelled site.
- The results for marine mammal injury considered the criteria from Southall et al. (2019). These criteria contain two metrics (PK and SEL_{24h}), both required for the assessment of marine mammal PTS and TTS. The longest distance associated with either metric is required to be applied for assessment; Table 1 summarises the maximum distances, along with the relevant metric.

Table 1. Summary of maximum (R_{max}) horizontal distances (in km) from all modelled sites and scenarios to behavioural response thresholds, temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals showing the relevant metric.

Hearing group	Maximum modelled distance to effect threshold (R_{max})								
	Behavioural response[1]	Scenario A		Scenario B		Scenario C		Scenario D	
		TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)
Low-frequency cetaceans	11.8 (SPL)	41.9 (SEL_{24h})	5.07 (SEL_{24h})	35.4 (SEL_{24h})	4.55 (SEL_{24h})	20.5 (SEL_{24h})	2.43 (SEL_{24h})	28.6 (SEL_{24h})	1.00 (SEL_{24h})
High-frequency cetaceans		0.05 (SEL_{24h})	–	0.05 (SEL_{24h})	–	0.03 (SEL_{24h})	–	0.04 (SEL_{24h})	–
Very high-frequency cetaceans		0.82 (PK)	0.41 (PK)	0.82 (PK)	0.41 (PK)	0.79 (PK)	0.39 (PK)	0.71 (PK)	0.37 (PK)
Otariid Pinnipeds		0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.05 (SEL_{24h})	–

Noise exposure criteria: [1] NOAA (2019) and [2] Southall et al. (2019).
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Animal Movement Modelling

The exposure ranges predicted using animat modelling are more realistic, due to the incorporation of species-specific realistic movements, rather than a conservative approach of calculating ranges using the maximum-over-depth sound fields and receivers which are stationary for 24 hours. In particular, the exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving and movement parameters.

Animal movement modelling ('animat modelling') focussed on feeding pygmy blue whales, migrating southern right whales, and reproducing southern right whales. Animat simulations were run with unrestricted animat seeding, and, if applicable, with seeding restricted to relevant BIAs (southern right whales were restricted to their reproduction BIA and pygmy blue whales were restricted to their foraging BIA). Southern right whales were not additionally restricted to the southern right whale migration BIA as this BIA completely encompassed the modelling area. Pygmy blue whales were additionally restricted to be on the shelf.

- Exposure ranges ($ER_{95\%}$) for single exposure metrics, such as the SPL behavioural response criterion, are typically comparable to the predicted acoustic ranges. Apart from reproducing southern right whales restricted to their reproduction BIA, all scenarios resulted in exposures above the behavioural response threshold (NOAA (2019)). Of these, the maximum $ER_{95\%}$ to the marine mammal behavioural response threshold was 9.83 km, with an associated probability of exposure of 76%. These results are summarised in Table 2.

- Exposure ranges from animal movement modelling for PTS and TTS criteria are typically shorter than those predicted using acoustic propagation modelling because the moving animats have a shorter time ('dwell time') to accumulate sound energy. There were exposures above PTS and TTS threshold for all considered scenarios and species, except for southern right whales when they were restricted to their respective reproductive BIA. The maximum $ER_{95\%}$ to PTS and TTS thresholds (Southall et al. 2019) were 1.98 and 22.5 km, respectively, with probabilities of exposure of 58% and 56%.

Table 2. Summary of animat simulation results for PTS, TTS and SPL behavioural response criteria for pygmy blue whales and southern right whales. Maximum exposure ranges show $ER_{95\%}$ (km) first and associated probability of exposure of animats travelling within the maximum $ER_{95\%}$ (P_{exp} (%)) in parentheses.

Species	Scenario	Behavioural response (SPL)[4]	TTS (SEL_{24h})[3]	PTS (SEL_{24h})[3]
		160[2]	168[1]	183[1]
Pygmy blue whale	A	9.83 (76%)	22.5 (56%)	1.98 (58%)
	B	9.54 (77%)	18.9 (57%)	1.73 (50%)
	C	8.38 (45%)	10.8 (35%)	0.83 (36%)
	D	6.69 (63%)	8.85 (59%)	0.37 (59%)
Southern right whale	A	9.51 (83%)	14.2 (1%)	1.40 (52%)
	B	8.97 (73%)	11.3 (64%)	1.22 (44%)
	C	7.39 (47%)	7.10 (35%)	0.69 (26%)
	D	6.84 (63%)	6.23 (58%)	0.24 (51%)

1 LF-weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)
2 SPL (L_p; dB re 1 µPa²)
3 Southall et al. (2019) criteria for marine fauna.
4 NOAA (2019) recommended unweighted behavioural threshold for marine mammals.

Sea Turtles

- The PK sea turtle injury criteria of 232 dB re 1 µPa for PTS and 226 dB re 1 µPa for TTS from Finneran et al. (2017) were exceeded at a distance up to 40 m and 80 m from the acoustic centre of the source, respectively.
- The maximum distance to the SEL_{24h} metrics of 204 dB re 1 µPa²s for PTS and 189 dB re 1 µPa²s for TTS (summarised in Table 3) for all scenarios was 0.07 km for PTS onset and 3.35 km for TTS onset for the 2820 in³ seismic source (Finneran et al. 2017). As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that sea turtles travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.
- Table 3 summarises the distances to where the criterion for behavioural response of turtles to 166 dB re 1 µPa² (SPL) and the 175 dB re 1 µPa² (SPL) threshold for behavioural disturbance (McCauley et al. 2000) could be exceeded.

Table 3. Summary of maximum horizontal distances (in km) from the sound source within which the turtle behavioural response criteria, temporary threshold shift (TTS), and permanent threshold shift (PTS), are exceeded.

Hearing group	Maximum modelled distance to effect threshold (R_{max})									
	Behavioural response[1]	Behavioural disturbance[1]	Scenario A		Scenario B		Scenario C		Scenario D	
			TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]
Sea Turtles	6.30 (SPL)	2.62 (SPL)	3.35 (SEL_{24h})	0.07 (SEL_{24h})	3.20 (SEL_{24h})	0.07 (SEL_{24h})	1.67 (SEL_{24h})	0.07 (SEL_{24h})	0.60 (SEL_{24h})	0.07 (SEL_{24h})

Noise exposure criteria: [1] McCauley et al. (2000), and [2] Finneran et al. (2017)

Penguins

- The maximum distance within which the OCW-weighted penguin TTS SEL_{24h} threshold of 188 dB re 1 μPa^{2}s was reached was 0.06 km for all scenarios. PTS and PK thresholds were not resolved within the modelled resolution of 20 m. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that a penguin underwater travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.
- The maximum distance within which the OCW-weighted penguin behavioural response threshold of 120 dB re 1 μPa^2 (SPL) for impulsive noise could be exceeded varied between 10.4 and 77.0 km for the 2820 in^3 seismic source, depending on modelled site.

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality and potential mortal injury as well as impairment in the following groups:
    - Fish without a swim bladder (also appropriate for sharks in the absence of other information),
    - Fish with a swim bladder that do not use it for hearing,
    - Fish that use their swim bladders for hearing,
    - Fish eggs and fish larvae.
- Table 4 summarises maximum distances within which effect criteria for fish, fish eggs, and fish larvae were exceeded along with the relevant metric. Received sound levels at the seafloor were assessed at a set of representative depths related to the planned acquisition lines ranging from 40 to 170 m.

Table 4. Summary of maximum fish, fish eggs, and larvae injury and temporary threshold shift (TTS) onset distances for single-impulse and 24 hour sound exposure level (SEL_{24h}) criteria.

Relevant hearing group	Effect criteria	Water column	
		Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Mortality and Potential Mortal Injury	PK	0.11
	Recoverable injury	PK	0.11
	TTS	SEL_{24h}	8.35
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Mortality and Potential Mortal Injury	PK	0.21
	Recoverable injury	PK	0.23
	TTS	SEL_{24h}	8.35
Fish eggs, and larvae (relevant to plankton)	Mortality and Potential Mortal Injury	PK	0.23

Benthic invertebrates

To assist with assessing the potential effects on these receptors, the following results were determined:

- Crustaceans: The sound level of 202 dB re 1 μPa PK-PK from Payne et al. (2008), which is representative of no effects, was considered for seafloor sound levels; the sound level was reached at ranges between 322 and 715 m for the 2820 in^3 source.
- Bivalves: For comparison to relevant criteria in Day et al. (2016a), the distance where a particle acceleration of 37.57 ms^{-2} at the seafloor could occur was calculated. This particle acceleration was reached at a range of 4 m for a water depth of 50 m, and was not reached at any greater water depth.
- Sponges and coral: The PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 μPa PK for sponges and corals (Heyward et al. 2018); the threshold was not reached in water depths greater than 50 m.

Divers and Swimmers

An SPL human health assessment of 145 dB re 1 μPa^2 (SPL; L_P) derived from (Parvin 2005) was considered for recreational swimmers and divers. This criterion was considered for all single-impulse modelled sites and cumulative scenarios, and specifically at 14 coastal sensitive receiver locations. The human health assessment threshold was predicted to be exceeded at Deen Maar (Lady Julia Percy Island), Middle Island, Port Fairy Lighthouse, Killarney Beach and Merri Sanctuary. Maximum received sound levels varied between154.8–150.6 dB re 1 μPa^2 (SPL; L_P) at predicted at Deen Maar and Killarney Beach respectively.

1. Introduction

JASCO Applied Sciences (JASCO) performed a numerical estimation study of underwater sound levels associated with the planned Regia Marine Seismic Survey (MSS) to assist in understanding the potential acoustic effect on receptors including marine mammals, fish, sea turtles, benthic invertebrates, plankton, and divers.

This study considered a 2820 in^3 seismic source array. JASCO's specialised Airgun Array Source Model (AASM) was used to predict acoustic signatures and spectra (see Section 3.2). AASM accounts for individual airgun volumes, airgun bubble interactions, and array geometry to yield accurate source predictions.

Complementary underwater acoustic propagation models were used in conjunction with the array signature and spectra to estimate sound levels considering site-specific environmental influences. Single-impulse sound fields were predicted at 15 unique geographic locations linked to the considered survey line plans and four representative scenarios for accumulated SEL modelling were considered. Accumulated sound exposure fields were predicted for each representative scenario for likely survey operations over 24 hours (see Section 0).

The modelling methodology considered source directivity and range-dependent environmental properties. Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), zero-to-peak pressure levels (PK, L_{pk}), peak-to-peak pressure levels (PK-PK; $L_{pk\text{-pk}}$), and either single-impulse (i.e., per-pulse) or accumulated sound exposure levels (SEL, L_E) as appropriate for different noise effect criteria.

The planned seismic acquisition area overlaps the pygmy blue whale (*Balaenoptera musculus brevicauda*) foraging BIA and the migration BIA for southern right whales (*Eubalaena australis*). The southern right whale reproduction BIA lies inshore of the proposed survey lines. The acoustic modelling results were used in conjunction with animal movement modelling ('animat modelling') simulations to predict the distance at which feeding pygmy blue whales, migrating and reproducing southern right whales are expected to be exposed above threshold criteria for PTS, TTS, and behavioural response. Estimates of sound exposure distribution were determined by moving large numbers of simulated animals (animats) through a modelled time-evolving sound field, computed using acoustic models. This approach provides the most realistic prediction of the maximum expected SPL and SEL_{24h} for comparison against the relevant thresholds.

Section 2 explains the metrics used to represent underwater acoustic fields and the effect criteria considered. Section 3 details the methodology for predicting the source levels and modelling the sound propagation, including the specifications of the seismic source and all environmental parameters the propagation models require. Section 3 also describes the methodology used in the animal movement and exposure modelling simulations. Section 4 presents the results, which are then discussed and summarised in Section 5.

1.1. Iterative Approach

This report, labelled version 2.0, presents a second iteration of modelling undertaken to assess the risks and impacts of underwater noise for the proposed Regia MSS. This second iteration incorporates additional modelled sites and updated survey line plans. The updated survey line plans focused on moving the survey to deeper water depths and increasing the separation from Deen Maar. The acoustic modelling considers an increased number of single-impulse modelling sites to enhance the resolution of predictions at sensitive receiver locations. The labelling of sites and scenarios are similar to the original version 1.0 report. However, identically labelled sites and scenarios are not necessarily equivalent, any comparisons should be done with the careful consideration and attention to detail.

1.2. Modelling Scenarios

Four nominal 24-hour acquisition scenarios were considered for both acoustic modelling and animal movement modelling. Acoustic modelling consisted of both source and propagation modelling and was conducted at 15 individual single-impulse sites for SEL and SPL while water column PK was assessed at eight sites. The locations of the modelled sites are provided in Table 6 and the acquisition lines for the scenarios are shown in Figure 1. The current iteration of the proposed line plan for the survey has included a provision to not survey over bathymetry less than 50 m. The modelling conducted herein was based on a line plan which had some lines extending over bathymetry that was marginally less than 50 m. For the purposes of acoustic and animal movement modelling very little difference is expected if the modelled lines were terminated at the 50 m bathymetric contour. The sites in Table 6 are representative of the geographic and bathymetric extents of the survey.

This study considered a 2820 in^3 seismic source towed in a triple array configuration at a speed of 4.5 knots with an impulse interval (inter-pulse interval) of 12.5 m and a crossline array separation of 37.5 m. The acoustic propagation modelling utilised the sound speed profile for June, as this month is likely to be the most supportive of sound propagation conditions across all months.

The single-impulse sites and the accumulated SEL scenarios were determined based on proposed survey line plans with lines orientated at 113/293°. The single-impulse sites and accumulated SEL scenarios were chosen to be representative of the range of water depths and the potential sound propagation characteristics of the considered line plans. Near-field sea-floor PK and PK-PK sound levels were assessed considering 10 water depths chosen to represent the depth range encompassed by the considered line plans (50 – 170 m). Particle motion modelling was also performed for these representative water depths.

Table 5 summarises the total number of impulses and the period of acquisition within each of the four 24-hour scenarios. The total assessment period for accumulated sound exposure level was 24 h and during line turns, the seismic source was not operating for modelling purposes. The time surveying and time on turns combine to a total 24 h period.

Table 5. Key parameters of the four accumulated sound exposure level (SEL) scenarios.

Scenario	Array	Impulse interval (m)	Tow direction (°)	Total impulses	Acquisition period (h)
A	Triple 2820 in^3 seismic source	12.5	113/293	8000	11.9
B				8116	12.46
C				13508	20.26
D				13248	20.16

Table 6. Location details for the single-impulse modelled sites. Each site was modelled for both tow directions applicable to the modelling of the scenarios of 24 hour operation.

Site	Scenario(s)	Tow directions (°)	Latitude (°S)	Longitude (°E)	MGA[1] Zone 54		Water depth (m)
					X (m)	Y (m)	
1	A, B	113/293	38° 32' 14.47"	142° 13' 18.17"	606478	5733855	49.1
2			38° 34' 46.30"	142° 18' 36.24"	614112	5729068	54.8
3			38° 37' 42.81"	142° 25' 11.06"	623581	5723485	63.9
4	C, D		38° 47' 44.74"	142° 29' 15.08"	629180	5704837	81.0
5	B, C, D		38° 39' 09.22"	142° 03' 04.80"	591481	5721254	61.9
6			38° 42' 40.30"	142° 13' 44.82"	606865	5714555	71.1
7	C, D		38° 54' 13.43"	142° 24' 11.18"	621664	5692971	124.9
8	D		38° 50' 31.49"	142° 12' 53.35"	605428	5700047	173.6
9			38° 46' 28.15"	142° 00' 39.98"	587832	5707763	166.5
10	C		38° 50' 59.78"	142° 52' 42.94"	663020	5698199	67.4
11			38° 46' 49.37"	142° 39' 47.20"	644460	5706281	72.0
12	C, D		38° 53' 08.30"	142° 39' 59.06"	644533	5694594	84.0
13			38° 58' 41.40"	142° 37' 18.31"	640477	5684395	99.0
14	A, B, C		38° 41' 11.94"	142° 26' 08.44"	624867	5717017	69.2
15			38° 34' 10.45"	142° 01' 12.89"	588879	5730494	51.6

[1] Map grid of Australia (MGA)

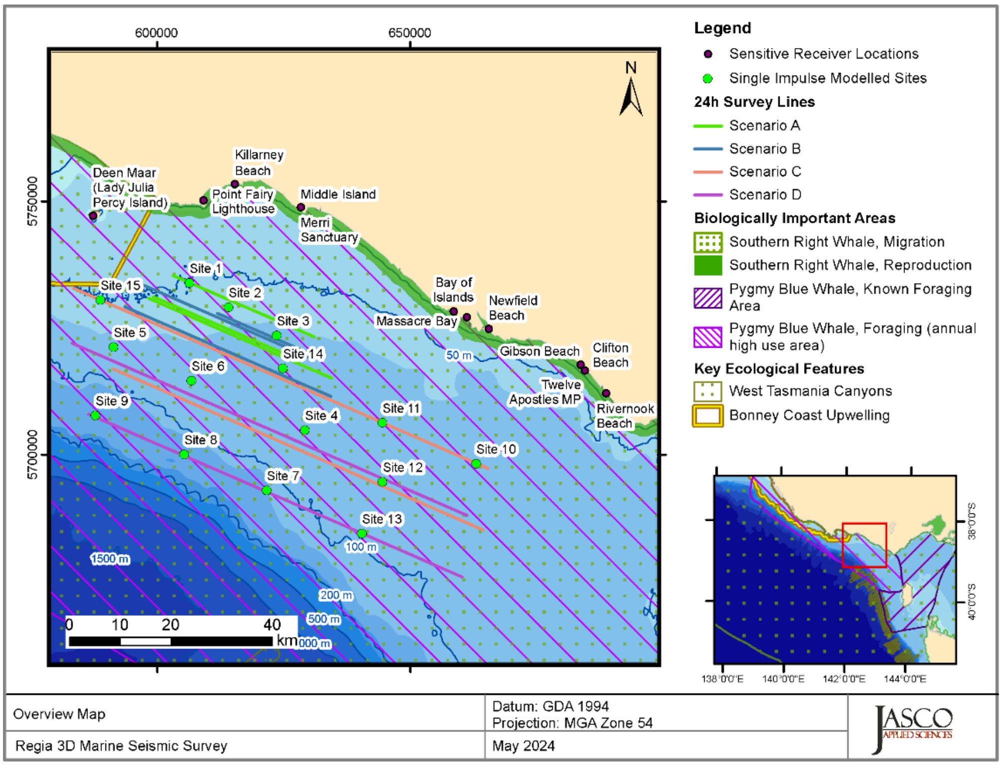

Figure 1. Overview of the single-impulse modelled sites, acquisition lines in the modelled scenarios, and features relevant to the Regia Marine Seismic Survey.

Animal movement modelling ('animat modelling') was undertaken considering the four nominal 24-hour nominal acquisition scenarios and focussed on feeding pygmy blue whales, migrating southern right whales, and reproducing southern right whales.

In unrestricted scenarios, animats were randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2) within the species preferred depth range. During the simulation, if an animat's movement takes it outside of its preferred depth range, it will begin to make movements (while still following the parameters within its species behaviour file) back towards its preferred depth range.

Animat simulations were also run with seeding restricted to relevant BIAs (southern right whales were restricted to their reproduction BIA and pygmy blue whales were restricted to their foraging BIA). Southern right whales were not additionally restricted to the southern right whale migration BIA as this BIA completely encompassed the modelling area. Pygmy blue whales were additionally restricted to be on the shelf.

Animats were seeded at a nominal horizontal sampling density of 4 animats/km^2 for all simulations, except those in which southern right whale animats were restricted to their reproduction BIA, in which case the density was increased to 6 animats/km^2 to account for the relatively small area. Each of the animat simulations were run for a representative 24 h duration.

Figure 2 shows the spatial extent of animat seeding for the four modelled scenarios.

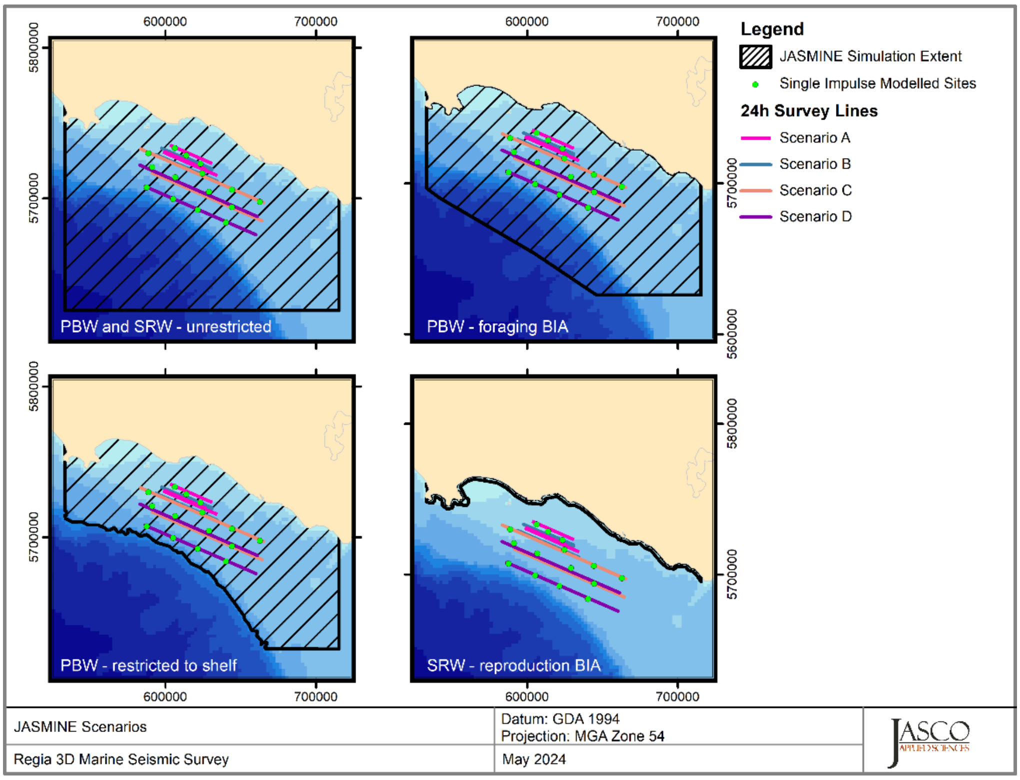

Figure 2. Overview maps of the seeding areas and restrictions for animal movement modelling.

1.3. Sensitive receivers

The Regia MSS lies within a foraging BIA for pygmy blue whales and the migration BIA for southern right whales. In addition, there are several swimming, diving and surfing beaches that are within proximity of the survey area. Deen Maar (Lady Julia Percy Island) is also an important sensitive location. The modelled received sound levels at 14 specific receiver locations have been calculated and are presented in Section 4.2.1.4. The sensitive receiver locations have been labelled 1–14 and are summarised in Table 7 along with the nature of the receptor(s) present at each location.

Table 7. Location details for the sensitive receiver sites.

Receiver ID	Sensitive receiver location	Receptors	Latitude (S)	Longitude (E)	MGA[1] Zone 54	
					X (m)	Y (m)
1	Deen Maar (Lady Julia Percy Island)	No Specific Receptors	38° 25' 37.22"	142° 00' 20.52"	587784	5746327
2	Middle Island	Divers Recreational Swimmers Little Penguins	38° 24' 20.63"	142° 28' 02.65"	628124	5748147
3	Apollo Marine Park	No Specific Receptors	38° 58' 48.00"	143° 30' 36.00"	717421	5682446
4	Portland	Divers Recreational Swimmers	38° 20' 30.71"	141° 41' 33.53"	560529	5756027
5	Port Fairy Lighthouse	Divers Recreational Swimmers	38° 23' 26.44"	142° 15' 26.76"	609813	5750089
6	Killarney Beach	Divers Recreational Swimmers	38° 22' 03.69"	142° 19' 11.50"	615302	5752563
7	Merri Sanctuary	Divers Recreational Swimmers	38° 24' 20.56"	142° 27' 58.42"	628022	5748151
8	Rivernook Beach	Divers Recreational Swimmers	38° 43' 16.44"	143° 10' 08.65"	688568	5711924
9	Clifton Beach	Divers Recreational Swimmers	38° 40' 48.00"	143° 07' 12.00"	684408	5716600
10	Gibson Beach	Divers Recreational Swimmers	38° 40' 22.24"	143° 06' 25.43"	683301	5717420
11	Newfield Beach	Divers Recreational Swimmers	38° 37' 06.28"	142° 53' 49.25"	665151	5723861
12	Bay of Islands	Divers Recreational Swimmers	38° 35' 03.15"	142° 48' 53.68"	658078	5727801
13	Massacre Bay	Divers Recreational Swimmers	38° 35' 55.07"	142° 50' 36.59"	660536	5726151
14	Twelve Apostles MP	Divers Recreational Swimmers	38° 40' 48.00"	143° 07' 12.00"	684408	5716600

[1] Map Grid of Australia (MGA)

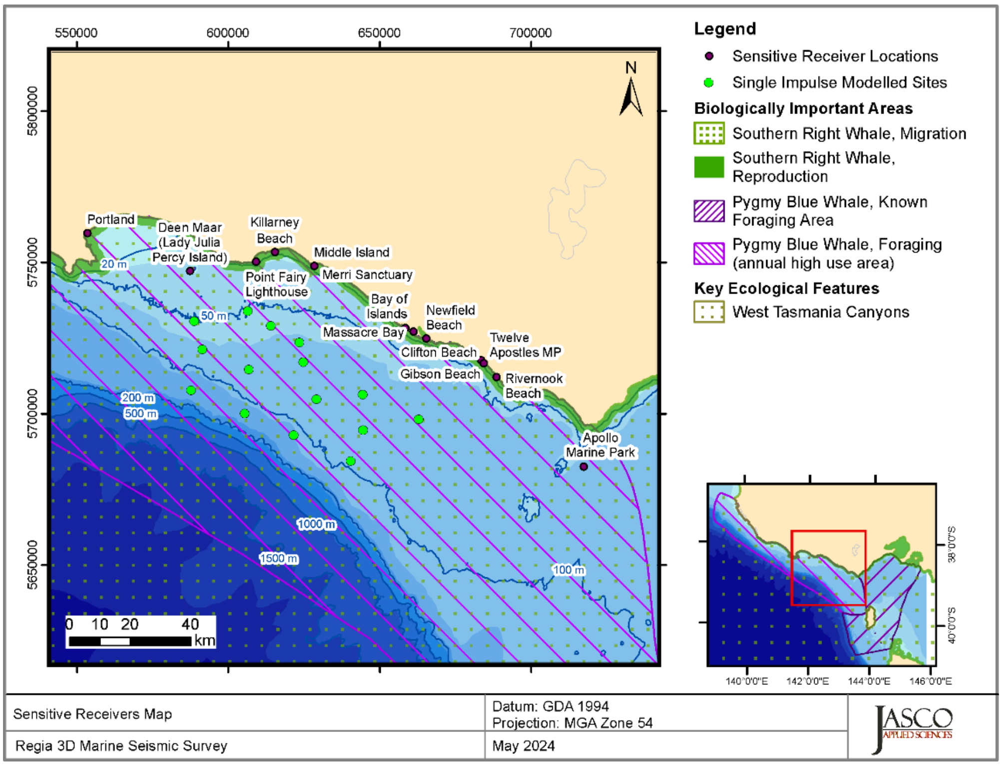

Figure 3. Sensitive receiver locations and single-impulse modelled sites

2. Noise Effect Criteria

The perceived loudness of sound, especially impulsive sound such as that from seismic airguns, is not generally proportional to the instantaneous acoustic pressure. Rather, perceived loudness depends on the pulse rise-time and duration, and the frequency content. Several sound level metrics, such as PK, SPL, and SEL, are commonly used to evaluate sound and its effects on marine life (Appendix A). The period of accumulation associated with SEL is defined, with this report referencing either a "per pulse" assessment or over 24 h. The acoustic metrics in this report reflect the updated ISO standard for acoustic terminology, ISO/DIS 18405:2017 (2017).

Whether acoustic exposure levels might injure or disturb marine mammals is an active research topic. Since 2007, several expert groups have developed SEL-based assessment approaches for evaluating auditory injury, with key works including Southall et al. (2007), Finneran and Jenkins (2012), Popper et al. (2014), United States National Marine Fisheries Service (NMFS 2018) and Southall et al. (2019). The number of studies that have investigated the level of behavioural disturbance to marine fauna by anthropogenic sound has also increased substantially.

The following noise criteria and sound levels for this study were chosen because they include standard thresholds, thresholds suggested by the best available science, and sound levels presented in literature for species with no suggested thresholds (Sections 2.1–2.5 and Appendix A):

1. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from (Southall et al. 2019) for the onset of Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) in marine mammals.
2. Marine mammal behavioural threshold based on the current US National Oceanic and Atmospheric Administration (NOAA 2019) criterion for marine mammals of 160 dB re 1 µPa^2 (SPL; L_p) for impulsive sound sources.
3. Sound exposure guidelines for fish, fish eggs and larvae (including plankton) (Popper et al. 2014).
4. Peak pressure levels (PK; L_{pk}) and frequency-weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Finneran et al. (2017) for the onset of permanent threshold shift (PTS) and temporary threshold shift (TTS) in turtles.
5. Sea turtle behavioural response threshold of 166 dB re 1 µPa^2 (SPL; L_p), (McCauley et al. 2000) as cited in the Recovery Plan for Marine Turtles in Australia (Department of the Environment and Energy et al. 2017), along with a sound level associated with behavioural disturbance 175 dB re 1 µPa^2 (SPL; L_p) (McCauley et al. 2000)
6. Diving birds (penguins):
   - Thresholds for otariid pinnipeds are used as a proxy (Section 2.4): Peak pressure levels (PK; L_{pk}) and frequency–weighted accumulated sound exposure levels (SEL; $L_{E,24h}$) from Southall et al. (2019) for the onset of PTS and TTS in otariids.
   - Behavioural response to impulsive sound of 120 dB re 1 µPa^2 (SPL; L_p) for diving birds based on information from Sørensen et al. (2020).
7. Peak-peak pressure levels (PK-PK; $L_{pk\text{-}pk}$) and particle acceleration (ms^{-2}) at the seafloor to help assess effects of noise on crustaceans through comparing to results in Day et al. (2016a), Day et al. (2019), Day et al. (2016b), Day et al. (2017) and Payne et al. (2008).
8. A sound level of 226 dB re 1 µPa (PK; L_{pk}) for comparison to Heyward et al. (2018) for sponges and corals.
9. An SPL human health assessment threshold of 145 dB re 1 µPa^2 (SPL; L_p) for sound exposure to people swimming and diving derived from Parvin (2005), and considering Ainslie (2008).

Additionally, to assess the size of the low-power zone required under the Australian Environment Protection and Biodiversity Conservation (EPBC) Act Policy Statement 2.1, Department of the

Environment, Water, Heritage and the Arts (DEWHA 2008), the distance to an unweighted per-pulse SEL of 160 dB re 1 µPa^2·s (L_E) is reported.

The following subsections (Sections 2.1–2.5, along with Appendix A.4 and A.5), expand on the thresholds, guidelines and sound levels for marine mammals, fish, fish eggs, fish larvae, sea turtles, and benthic invertebrates.

2.1. Marine Mammals

There are two categories of auditory threshold shifts or hearing loss: permanent threshold shift (PTS), a physical injury to an animal's hearing organs; and Temporary Threshold Shift (TTS), a temporary reduction in an animal's hearing sensitivity as the result of receptor hair cells in the cochlea becoming fatigued.

To help assess the potential for the possible injury and hearing sensitivity changes in marine mammals, this report applies the criteria recommended by Southall et al. (2019), considering both PTS and TTS. These criteria, along with the applied behavioural criterion (NOAA 2019), are summarised in Table 8, with descriptions included in Appendix A.4.1 (auditory impairment) and Appendix A.4.2 (behavioural response), with frequency weighting explained in Appendix A.5. Of particular note, whilst the newly published Southall et al. (2021) provides recommendations and discusses the nuances of assessing behavioural response, the authors do not recommend new numerical thresholds for onset of behavioural responses for marine mammals.

Table 8. Unweighted sound pressure level (SPL), 24-hour sound exposure level (SEL_{24h}), and peak pressure (PK) thresholds for acoustic effects on marine mammals.

Hearing group	NOAA (2019)	Southall et al. (2019)			
	Behaviour	PTS onset thresholds[1] (received level)		TTS onset thresholds[1] (received level)	
	SPL (L_p; dB re 1 µPa^2)	Weighted SEL (L_E; dB re 1 µPa^2 s)	PK (L_{pk}; dB re 1 µPa)	Weighted SEL (L_E; dB re 1 µPa^2 s)	PK (L_{pk}; dB re 1 µPa)
Low-frequency cetaceans (baleen whales)	160	183	219	168	213
High-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)		185	230	170	224
Very-high-frequency cetaceans (*Kogia*, cephalorhynchid, and *L. australis*)		155	202	140	196
Pinnipeds[2] (Australian sea lion, Australian fur seal, New Zealand fur seal)		203	232	188	226

[1] Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS and TTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
[2] Listed as pinnipeds but equivalent to other marine carnivores in water in the Southall et al. (2019) criteria. Also equivalent to Otariid pindipeds listed in NMFS (2018).
L_p denotes sound pressure level and has a reference value of 1 µPa^2.
$L_{pk, flat}$ peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24-hour period and has a reference value of 1 µPa^{2}s.

2.2. Fish, Fish Eggs, and Fish Larvae

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to continue developing noise exposure criteria for fish and turtles, work begun by a panel convened by NOAA two years earlier. The resulting guidelines included specific thresholds for different levels of effects and for different groups of species (Popper et al. 2014). These guidelines defined quantitative thresholds for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- TTS.

Masking and behavioural effects can be assessed qualitatively, by assessing relative risk rather than by specific sound level thresholds. However, as these depend upon activity-based subjective ranges, these effects are not addressed in this report and are included in Table 9 for completeness only. Because the presence or absence of a swim bladder has a role in hearing, fish's susceptibility to injury from noise exposure varies depending on the species and the presence and possible role of a swim bladder in hearing. Thus, different thresholds were proposed for fish without a swim bladder (also appropriate for sharks and applied to whale sharks in the absence of other information), fish with a swim bladder not used for hearing, and fish that use their swim bladders for hearing. Turtles, fish eggs, and fish larvae are considered separately. Table 9 lists relevant effects thresholds from Popper et al. (2014).

The SEL metric integrates noise intensity over some period of exposure. Because the period of integration for regulatory assessments is not well defined for sounds that do not have a clear start or end time, or for very long-lasting exposures, it is required to define a time. Popper et al. (2014) recommend applying a standard period, where this is either defined as a justified fixed period or the duration of the activity; however, Popper et al. (2014) also included caveats about how long the fish will be exposed because they can move (or remain in location) and so can the source. Popper et al. (2014) summarises that in all TTS studies considered, fish that showed TTS recovered to normal hearing levels within 18–24 hours. Due to this, a period of accumulation of 24 hours has been applied in this study for SEL, which is similar to that applied for marine mammals in NMFS (2016, 2018).

In the discussion of the criteria, Popper et al. (2014) discuss the complications in determining a relevant period of mobile seismic surveys, as the received levels at the fish change between impulses because the source is moving, and that in reality a revised guideline based on the closest PK or the per-pulse SEL might be more useful than one based on accumulated SEL. This is because exposures at the closest point of approach (CPA) are the primary exposures contributing to a receiver's accumulated level (Gedamke et al. 2011). Additionally, several important factors determine the likelihood and duration a receiver is expected to be in close proximity to a sound source (i.e., overlap in space and time between the source and receiver). For example, accumulation time for fast moving (relative to the receiver) mobile sources is driven primarily by the characteristics of the source (i.e., speed, duty cycle; NMFS 2016, 2018).

As discussed in Popper (2018), many fish species move around, some over large distances. The author suggests that it is reasonable to think that if the sound of a seismic source becomes too loud, the fish will move away from the source because they are able to determine the direction of a sound source. If the fish moves away, the amount of energy to which it is exposed is likely to be one or a few seismic pulses, and these would not likely be loud enough to result in any effect because the fish would move away at a much lower level signal than could cause harm. Data on TTS for fish are very limited, with the only study that examined recovery from seismic impulses being Popper et al. (2005). Popper (2018) states that if this study had been conducted on wild, free-swimming fish instead of caged ones, there would have been no effect whatsoever because they were likely to have moved away from the source as it approached them, as would happen with normally free-moving demersal and pelagic fish species associated with a 3-D seismic survey in northern Australian waters, extrapolating from the Bethany 3-D assessed in Popper (2018).

Therefore, the time over which energy should be accumulated in each individual fish in the survey area should be limited to the time over which fish receives the maximum exposure, and 24 h is likely too long a period for calculating the accumulation of energy in determining potential harm (e.g., damage or TTS) (Popper 2018). Even if fish do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses. Based on very limited data, recovery within 24 h (or less) is very likely. If TTS does occur, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, energy accumulating over longer periods than a few hours is probably inappropriate (Popper 2018).

Table 9. Criteria for seismic noise exposure for fish, adapted from Popper et al. (2014).

Type of animal	Mortality and Potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Fish: No swim bladder (particle motion detection)	>219 dB SEL_{24h} or >213 dB PK	>216 dB SEL_{24h} or >213 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder not involved in hearing (particle motion detection)	210 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	>>186 dB SEL_{24h}	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low
Fish: Swim bladder involved in hearing (primarily pressure detection)	207 dB SEL_{24h} or >207 dB PK	203 dB SEL_{24h} or >207 dB PK	186 dB SEL_{24h}	(N) Low (I) Low (F) Moderate	(N) High (I) High (F) Moderate
Fish eggs and fish larvae (relevant to plankton)	>210 dB SEL_{24h} or >207 dB PK	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Peak sound level (PK) dB re 1 µPa; SEL_{24h} dB re 1µPa^2·s. All criteria are presented as sound pressure, even for fish Without swim bladders, since no data for particle motion exist. Relative risk (high, moderate, or low) is given for animals at three distances from the source defined in relative terms as near (N), intermediate (I), and far (F).

2.3. Sea Turtles

There is a paucity of data regarding responses of turtles to acoustic exposure, and no studies of hearing loss due to exposure to loud sounds. Popper et al. (2014) suggested thresholds for onset of mortal injury (including PTS) and mortality for sea turtles and, in absence of taxon-specific information, adopted the levels for fish that do not hear well (suggesting that this likely would be conservative for sea turtles).

Finneran et al. (2017) presented revised thresholds for sea turtle injury and hearing impairment (TTS and PTS). Their rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol and Ketten 2006, Dow Piniak et al. 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fishes than to marine mammals (Popper et al. 2014).

McCauley et al. (2000) observed the behavioural response of caged sea turtles—green (*Chelonia mydas*) and loggerhead (*Caretta caretta*)—to an approaching seismic airgun. For received levels above 166 dB re 1 µPa^2 (SPL), the sea turtles increased their swimming activity, and above 175 dB re 1 µPa^2 they began to behave erratically, which was interpreted as an agitated state. The

Recovery Plan for Marine Turtles in Australia (Department of the Environment and Energy et al. 2017) acknowledges the 166 dB re 1 µPa² SPL reported (McCauley et al. 2000) as the level that may result in a behavioural response to marine turtles. The 175 dB re 1 µPa² level from McCauley et al. (2000) is recommended as a criterion for behavioural disturbance. These thresholds are shown in Table 10.

Table 10. Acoustic effects of impulsive noise on sea turtles: Unweighted sound pressure level (SPL), 24 hour sound exposure level (SEL_{24h}), and peak pressure (PK) thresholds

Effect type	Criterion	SPL (L_p; dB re 1 µPa²)	Weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	PK (L_{pk}; dB re 1 µPa)
Behavioural response	McCauley et al. (2000)	166	NA	
Behavioural disturbance		175		
PTS onset thresholds[1] (received level)	Finneran et al. (2017)	NA	204	232
TTS onset thresholds[1] (received level)			189	226

[1] Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS and TTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.
L_p denotes sound pressure level and has a reference value of 1 µPa².
$L_{pk,flat}$ denotes peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa.
L_E denotes cumulative sound exposure over a 24 h period and has a reference value of 1 µPa²s.

2.4. Diving Birds

There are no regulatory thresholds with regard to onset of hearing impairment for penguins, any other bird species, or phylogenetically or anatomically related species. The only scientifically robust thresholds in this context exist for marine mammals. To allow for assessing the noise–induced impact risk of impulsive airgun signals on penguins, the least sensitive marine mammal hearing group, other carnivores in water (OCW), from Southall et al. (2019), is recommended as a proxy. This hearing group has been selected due to similar hearing sensitivity in the frequency band of underwater hearing for diving birds and otariid pinnipeds, which are included in the group. This provides a conservative approach, as otariids are considered more sensitive to underwater sound at higher frequencies than penguins.

There are also no regulatory thresholds or criteria established to assess potential behavioural responses by penguins or flying seabirds to underwater noise. To allow for assessing the potential for such impacts, an onset criterion for behavioural responses of penguins and flying seabirds of 120 dB re 1 µPa² (SPL) for impulsive sources was chosen based on information from Sørensen et al. (2020). They exposed gentoo penguins (*Pygoscelis papua*) in a controlled exposure experiment to underwater noise bursts (impulsive signals) and demonstrated that the animals show a graded reaction depending on received sound levels. For consistency with the approach to assess PTS and TTS, the behavioural response threshold is applied as OCW weighted.

2.5. Invertebrates

2.5.1. Benthic Invertebrates

Research is ongoing into the relationship between sound and its effects on crustaceans, including the relevant metrics for both effect and impact. Available literature suggests particle motion, rather than sound pressure, is a more important factor for crustacean and bivalve hearing. Water depth and seismic source size are related to the particle motion levels at the seafloor, with larger arrays and shallower water being related to higher particle motion levels, more likely relevant to effects on crustaceans and bivalves.

At the seafloor interface, crustaceans and bivalves are subject to particle motion stimuli from several acoustic or acoustically induced waves. These include the particle motion associated with an impinging sound pressure wave in the water column (the incident, reflected, and transmitted portions), substrate acoustic waves, and interface waves of the Scholte type. However, it is unclear which aspect(s) of these waves is/are most relevant to the animals, either when they normally sense the environment or their physiological responses to loud sounds so there is not enough information to establish similar criteria and thresholds as done for marine mammals and fish. Including recent research, such as Day et al. (2016b), current literature does not clearly define an appropriate metric or identify relevant levels (pressure or particle motion) for an assessment. This includes the consideration of what particle motion levels lead to a behavioural response, or mortality. Therefore, at this stage, we cannot propose authoritative thresholds to inform the impact assessment. However, levels can be determined for pressure metrics presented in literature to assist the assessment.

The pressure and acceleration examples provided in Day et al. (2016a) (Figures 11 and 12) indicate that the acceleration and pressure signals occurred simultaneously, which was interpreted as an indication that the waterborne sounds were responsible for the accelerations measured by the geophones. For clarity, it is important to distinguish that the acceleration from waterborne sound energy is *not* ground roll, which Day et al. (2016a) correctly define as the sound that propagates along the interface at a speed lower than the shear wave speed of the sediment. However, the report subsequently uses ground roll for all further discussions of particle acceleration. While Day et al. (2016a) discuss that they chose the simplest measure of ground roll, it should have been referring to as ‘the acceleration from waterborne sound energy’, or ‘waterborne acceleration’ for short.

For crustaceans, a PK-PK sound level of 202 dB re 1 µPa (Payne et al. 2008) is considered to be associated with no effect, and therefore applied in the assessment. Additionally for context related to different levels of potential impairment, the PK-PK sound levels determined for crustaceans in Day et al. (2016b), 209–212 dB re 1 µPa and 213 dB re 1 µPa from Day et al. (2019), are also included.

For bivalves, PK-PK sound levels of 212 and 213 dB re 1 µPa are presented to allow comparison to the maximum sound levels measured in Day et al. (2016a) and Day et al. (2017) for scallops and pearl shell oyster.

A sound level of 226 dB re 1 µPa (PK; L_{pk}) has been considered for comparison to Heyward et al. (2018) for sponges and corals.

Particle acceleration from the seismic source has been presented to allow for comparison with the results in Table 7 of Day et al. (2016a). The maximum particle acceleration assessed by Day et al. (2016a) for scallops was 37.57 ms^{-2}.

2.5.2. Plankton

To assess effects on plankton, there are only a few studies to base threshold criteria on. Popper et al. (2014) cites many of the references and studies on potential impacts of noise emissions on fish eggs and larvae prior to 2014. Results presented in Day et al. (2016b) for embryonic lobsters and Fields et al. (2019) for copepods align with those presented in Popper et al. (2014), which is that mortality and sub-lethal injury are limited to within tens of metres of seismic sources. Additionally, the Popper et al. (2014) criteria (Table 9), are extrapolated from simulated pile driving signals which have a more rapid rise time and greater potential for trauma than pulses from a seismic source.

Other research, such as McCauley et al. (2017), has indicated the potential for effects at longer range and at levels of 178 dB PK-PK, however, Fields et al. (2019) noted that it was difficult to reconcile the high mortality reported by McCauley et al. (2017) with the low mortalities reported in the greater previous body of earlier research and their experiment. They recommended further research into whether it is the sound pulse itself (i.e., the energy, peak pressures, or particle acceleration), the (turbulent) fluid flow occurring more slowly (i.e., not related to the sound pulse), or other effects such as the bubble cloud that which might cause higher mortality near the seismic source.

2.6. Human Health Assessment Threshold

Underwater, the human ear is about 20 dB less sensitive than it is in air at low frequencies (20 Hz), increasing to 40 dB at mid–frequencies (less than 1 kHz), and increasing to 70–80 dB less sensitive at higher frequencies (Parvin 1998). Divers who wear neoprene hoods have even higher hearing thresholds (lower sensitivity) above 500 Hz because the hood material absorbs high–frequency sounds (Sims et al. 1999). Exposure studies related to divers have typically focused on military sonar exposure, with little information on seismic surveys, and as such care is required when considering thresholds for recreational divers and swimmers, particularly for impulsive sounds such as seismic surveys (Ainslie 2008).

The auditory threshold of hearing under water was lowest at 1 kHz (70 dB re 1 µPa SPL) and increased for lower and higher frequencies to around 120 dB re 1 µPa at 20 Hz and at 20 kHz (Parvin 1998). Fothergill et al. (2000) and Fothergill et al. (2001) conducted controlled acoustic exposure experiments on military divers under fully controlled conditions at a US Ocean Simulation Facility and an US Open water test facility; in all tests, the diver were covered with soft or hard shell dive suits and their position and distance relative to sound source, signal characteristics and received levels were controlled and documented (Pestorius et al. 2009). A total of 89 male Navy divers were exposed to pure tone signals and sweeps between 160–320 Hz at SPLs up to 160 dB re 1 µPa. The divers were exposed to these sounds over 100 seconds at depths from 10 to 40 metres. The divers rated the sounds on a severity scale. For frequencies between 100 and 500 Hz, at a received SPL of 130 dB re 1 µPa, divers and swimmers detected body vibration. None of the divers tested rated levels of 140 dB re 1 µPa as “very severe”; however, at 157 dB re 1 µPa, sound was rated as “very severe” 19 per cent of the time. No physiological damage was observed at the highest levels tested: 160 dB re 1 µPa (Fothergill et al. 2001). In a subsequent study, recreational divers were exposed to tonal signals or 30 Hz–sweeps at frequencies between 100 and 500 Hz at received levels of 130–157 dB re 1 µPa (Pestorius et al. 2009). Each exposure lasted for seven seconds. Nine female and 17 male scuba divers were tested, all wearing full body neoprene wetsuits. Diver aversion and perception of body vibration were used as test parameters. The results showed no sex–specific differences. The results differed as a function of frequency – while test results showed a strong overall variation between subjects, signals at 100 Hz elicited the strongest aversion in all tests and even at 148 dB a few diver ratings indicated extreme aversion. Due to this and the strong variation between test subjects, the following exposure limit for both military and recreational divers was suggested as a conservative measure: For frequencies between 100 and 500 Hz, the maximum SPL should be 145 dB re 1 µPa over a maximum continuous exposure of 100 seconds or with a maximum duty cycle of 20 per cent and a maximum daily cumulative total of three hours. The trading relation between the maximum SPL and duration was 4 dB per doubling of duration (e.g. 141 dB SPL for a 200 second exposure) (Pestorius et al. 2009).

Considering only frequencies between 100 and 500 Hz, Parvin (2005) suggested 145 dB re 1 µPa as a safety criterion for recreational divers and swimmers. Piling impulses are broadband sources, and therefore, to be precautionary, the 145 dB re 1 µPa SPL suggested by Fothergill et al. (2001) and Parvin (2005) has been applied in this study as a broadband SPL and as a human health assessment threshold for recreational divers and swimmers. This does not imply that this level is associated with the onset of injury.

3. Methods

3.1. Parameter Overview

The specifications of the seismic sources and the environmental parameters used in the propagation models are described in additional detail in Appendix D. A single sound speed profile for June was considered in this modelling study (Appendix D.3.2). This was identified as the month that would likely provide the farthest propagation by comparing the sound speed profile across all months.

The modelled single-impulse sites spanned water depths of 49–174 m. Three geological profiles were defined to represent the different geo-acoustic properties across the area encompassed by the considered line plans, and are representative of the different zones within the entire Survey Area (Appendix D.3.3). In water depths less than 120 m, the seabed geological profile was characterised as layered limestone, variably cemented. In the shallowest modelled water depths, less than 65 m and within 20 km of the coast, the geological profile also included a thin layer of overlying sand. For sites in deeper water, greater than 120 m, the seabed geologic profile was characterised as a thick package of unconsolidated sediments.

3.2. Acoustic Source Model

The pressure signature of the individual airguns and the composite decidecade-band point-source equivalent directional levels (i.e., source levels) of the 2820 in^3 seismic source were modelled with JASCO's Airgun Array Source Model (AASM). Although AASM accounts for notional pressure signatures of each seismic source with respect to the effects of surface-reflected signals on bubble oscillations and inter-bubble interactions, the surface-reflected signal (known as surface ghost) is not included in the far-field source signatures. The acoustic propagation models account for those surface reflections, which are a property of the propagating medium rather than the source.

AASM considers:

- Array layout.
- Volume, tow depth, and firing pressure of each airgun.
- Interactions between different airguns in the array.

All seismic sources considered were modelled over AASMs full frequency range, up to 25 kHz. Appendix B.1 details this model.

3.3. Sound Propagation Models

Three sound propagation models were used to predict the acoustic field around the seismic source:

- Combined range-dependent parabolic equation and Gaussian beam acoustic ray-trace model (MONM-BELLHOP, 10 Hz to 25 kHz).
- Full Waveform Range-dependent Acoustic Model (FWRAM, 10 to 1024 Hz).
- Wavenumber integration model (VSTACK, 10 to 1024 Hz).

The models were used in combination to characterise the acoustic fields at short and long ranges in terms of SEL, SPL, PK, and PK-PK. Appendix C details each model. MONM-BELLHOP was used to calculate SEL of a 360° area around each source location. FWRAM was used to model synthetic seismic pulses and to generate a generalised range-dependent SEL to SPL conversion function for a sub-set of the considered modelled sites. The range-dependent conversion function was applied to predicted per-pulse SEL results from MONM-BELLHOP to estimate SPL values. FWRAM was also used to calculate water column PK and PK-PK levels.

VSTACK was used to calculate near field PK and PK-PK levels along 4 transects at the seafloor along the endfire and broadside directions considering a set of 11 unique water depths at 40, 50, 60, 70, 80, 90, 100, 120, 140, 160 and 170 m. This model was also used to model the peak particle acceleration magnitude considering the same 11 unique water depths. For modelled sites where the seabed is likely to be composed of outcropping limestone (Appendix D.3.3), an additional correction factor was applied to predictions to better estimate loss characteristics of the seabed (see Appendix C.3.2).

3.4. Geometry and Modelled Regions

To predict sound levels with MONM-BELLHOP was used to calculate propagation losses up to distances of 100 km from the source, with a horizontal separation of 20 m between receiver points along all modelled radials. The sound fields were modelled with a horizontal angular resolution of $\Delta\theta$ = 2.5° for a total of N = 144 radial planes. Receiver depths were chosen to span the entire water column over the modelled area, from 2 m to a maximum of 2700 m, with step sizes that increased with depth. To supplement the MONM results, high-frequency results for propagation loss were modelled using BELLHOP for frequencies from 1.25 to 25 kHz. The MONM and Bellhop results were combined to produce results for the full frequency range of interest.

FWRAM was run to 100 km along four radials (fore and aft endfire, and port and starboard broadside) for computational efficiency. This was done to compute SEL-to-SPL conversions (Appendix D.2) and also to quantify water column PK and PK-PK. The horizontal range step begins at 20 m and increases with range from the source.

The maximum modelled range for VSTACK was 1000 m, and a variable receiver range increment that increased away from the source was used, which increased from 10 to 25 m. The final tabulated distances were obtained through interpolating predicted received levels. Received levels were computed for receivers at 5 and 50 cm above the seafloor to assist in the assessment on invertebrates and fish respectively.

3.5. Accumulated SEL

New sound energy is introduced into an environment with each pulse from the seismic source. While some impact criteria are based on the per-pulse energy released, others, such as the marine mammal and fish SEL criteria (Section 2), account for the total acoustic energy marine fauna is subjected to over a specified duration, defined in this report as 24 h. An accurate assessment of the accumulated sound energy depends not only on the parameters of each seismic impulse but also on the number of impulses delivered in a duration and the relative positions of the impulses.

When there are many seismic impulses, it becomes computationally prohibitive to perform sound propagation modelling for every single event. The distance between the consecutive seismic impulses is small enough, such that the environmental parameters that influence sound propagation are virtually the same for many impulse points. The acoustic fields can, therefore, be modelled for a subset of seismic pulses and estimated at several adjacent ones. After sound fields from representative impulse locations are calculated, they are adjusted to account for the source position for nearby impulses.

Although estimating the cumulative sound field with the described approach is not as precise as modelling sound propagation at every impulse location, small-scale, site-specific sound propagation features tend to blur and become less relevant when sound fields from adjacent impulses are summed. Larger scale sound propagation features, primarily dependent on water depth, dominate the cumulative field. The accuracy of the present method acceptably reflects those large-scale features, thus providing a meaningful estimate of a wide area SEL field in a computationally feasible framework.

To produce the map of accumulated received sound level distributions and calculate distances to specified sound level thresholds, the maximum-over-depth were calculated at each sampling point within the modelled region. The radial grids of maximum-over-depth sound levels for each impulse were then resampled (by linear triangulation) to produce a regular Cartesian grid. The sound field grids from all impulses were summed (see Equation A-5) to produce the cumulative sound field grid with cell sizes of 20 m. The contours and threshold ranges were calculated from these flat Cartesian projections of the modelled acoustic fields.

The unweighted (fish) and frequency-weighted SEL_{24h} results were rendered as contour maps, including contours that focus on the relevant criteria-based thresholds. Only contours at ranges larger than the nearfield of the seismic source were rendered.

3.6. Per-pulse Levels at Receivers

The received acoustic levels at 14 sensitive receiver locations have been calculated; sensitive receiver locations are summarised in Table 7. To determine whether per-pulse levels at these receivers exceed relevant thresholds, modelling was undertaken to estimate the sound level at a given receiver from any shot within the survey.

The method utilised to calculate per-pulse levels at receivers is similar to the method described in Section 3.5 to calculate accumulated received levels. The per-pulse sound fields modelled for the fifteen single-impulse modelled sites were translated to each impulse location on the survey lines based on the closest, most appropriate single-impulse modelled site. For computational efficiency purposes, every 50th impulse was considered in this method. Modelling every shot on the survey lines would be computationally prohibitive.

After translation the maximum-over-depth received level at a given location was extracted. In such a fashion, a sequence of received levels at a given location can be tabulated for impulses in the survey. In order to obtain per-pulse received levels, the received levels were not summed for this analysis, unlike the calculation for accumulated received levels (Section 3.5).

3.7. Animal Movement and Exposure Modelling

3.7.1. Methodology

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was used to predict the exposure of animats to sound arising from the seismic activity. JASMINE integrates the predicted sound field with biologically meaningful movement rules for each marine mammal species (pygmy blue whales and southern right whales for the current analysis) that results in an exposure history for each animat in the model. An overview of the exposure modelling process using JASMINE is shown in Figure 4.

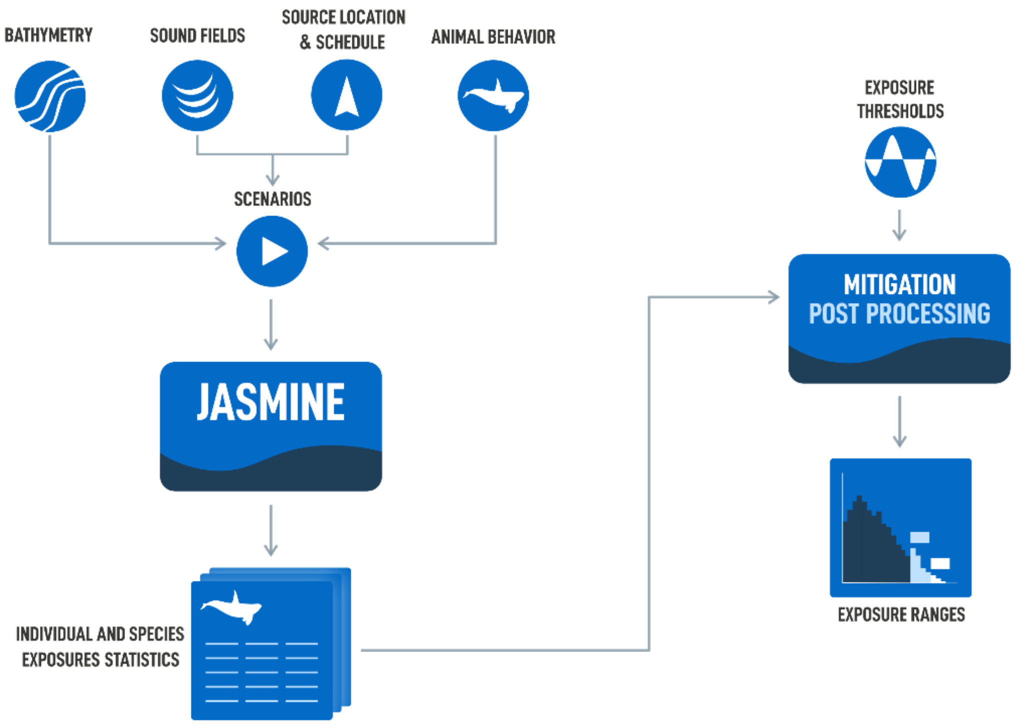

Figure 4. Exposure modelling process overview.

In JASMINE, the sound received by the animats is determined by the proposed seismic operations. As illustrated in Figure 5, animats are programmed to behave like the marine animals that may be present in the modelling area. The parameters used for forecasting realistic behaviours (e.g., diving and foraging depth, swim speed, surface times) are determined and interpreted from marine mammal studies (e.g., tagging studies) where available, or reasonably extrapolated from related or comparable species. For the assessment of cumulative criteria, an individual animats sound exposure levels are summed over a 24 h duration to determine its total received energy, and then compared to the relevant threshold criteria. For single-exposure metrics, the maximum exposure is evaluated against threshold criteria for each 24 h period. For additional information on JASMINE, see Appendix D.4.

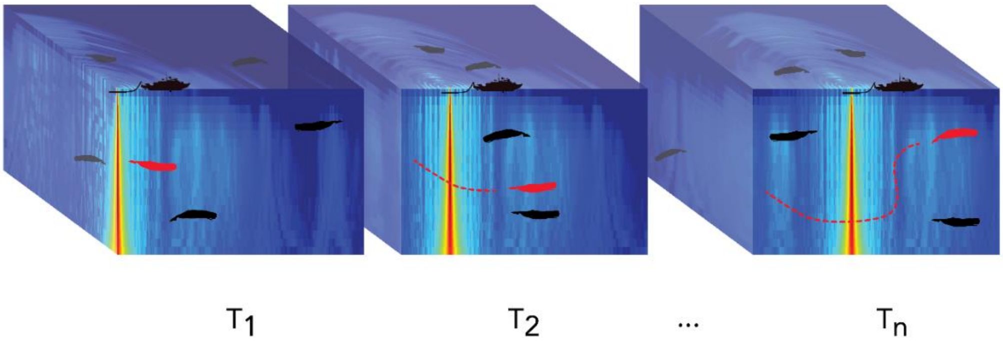

Figure 5. Depiction of animats in a moving sound field. Example animat (red) shown moving with each time step (T_n). The acoustic exposure of each animat is determined by where it is in the sound field, and its exposure history is accumulated as the simulation steps through time.

The exposure criteria for impulsive sounds (described in Section 2) were used to determine the number of animats that exceeded thresholds. To generate statistically reliable probability density functions, model simulations were run with animat sampling densities of 4 animats/km^2, except those in which southern right whale animats were restricted to their reproduction BIA, in which case the density was increased to 6 animats/km^2 to account for the relatively small area. The modelling results are not related to real-world density estimates for pygmy blue whales and southern right whales within BIAs or the wider area, as animal density in the area is unknown. To evaluate PTS, TTS and behavioural response, exposure results were obtained using detailed behavioural information for pygmy blue whales and southern right whales (described in Sections 3.7.3.1 and 3.7.3.2).

The seismic source was modelled as a vessel towing an airgun array at a speed of 4.5 knots, with an impulse interval of 12.5 m. The simulated source tracks followed a racetrack configuration with acquisition not occurring on turns. At the time and location of each seismic pulse, the modelled source location with the closest distance was selected for exposure modelling. The track lines along with the acoustic modelling locations are shown in Figure 1.

Figure 6 shows an example animat track (generated for information purposes only and not related to the results presented in this report) with associated received levels from a stationary point source. The top panel displays the animat track relative to the point source, and the bottom panel displays the accumulation of SEL_{24h} for TTS and PTS criteria. At approximately 50 seconds, the animat is exposed so that the TTS threshold is exceeded, and at approximately 700 seconds the animat is exposed so that the PTS threshold is exceeded.

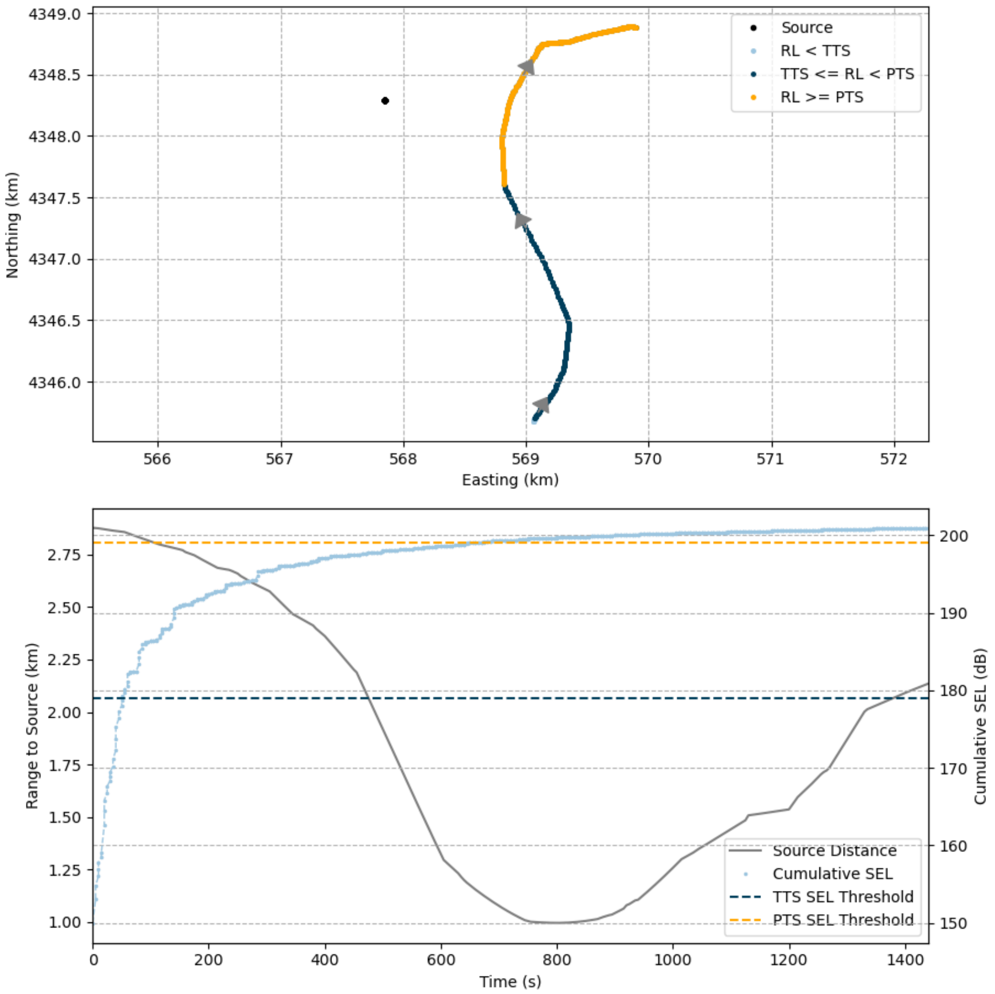

Figure 6. Animat track from an example simulation showing northward movement over a 1400 s duration. The upper panel shows a plan view of both a stationary point source and a foraging animat. Animat steps are coloured to indicate whether the accumulated sound energy at that point has exceeded either TTS or PTS threshold criteria. The lower panel shows horizontal distance in kilometres to the source (grey line; left y-axis) and cumulative 24-h SEL ($L_{E,24h}$, dB re 1 µPa²·s; right y-axis) as a function of time. Note that this example does not use data from the current study.

3.7.2. Exposure–based Radial Distance Estimation

The results from the animal movement and exposure modelling provided a way to estimate radial distances to effect thresholds. The distance to the closest point of approach (CPA) for each of the animats was recorded. The $ER_{95\%}$ (95% Exposure Range) is the horizontal distance that includes 95% of the animat CPAs that exceeded a given effect threshold (see Section 2). Within the $ER_{95\%}$, there is generally some proportion of animats that do not exceed threshold criteria. This occurs for several reasons, including the spatial and temporal characteristics of the sound field and the way in which animats sample the sound field over time, both vertically and horizontally. The sound field varies as a function of range, depth, and azimuth based on a variety of factors such as bathymetry, sound speed profile, and geoacoustic parameters. The way the animats sample the sound field depends upon species-typical swimming and diving characteristics (e.g., swim speed, dive depth, surface intervals, and reversals). Furthermore, even within a particular species definition, these characteristics vary with behavioral state (e.g., feeding, migrating). As this results in some animats not exceeding threshold criteria even within the $ER_{95\%}$, the probability that an animat within that distance was exposed above threshold within the $ER_{95\%}$ was also computed (P_{exp}) to provide additional context.

Acoustic ranges are reported for both $R_{95\%}$ and R_{max}, however, exposure ranges are reported for $ER_{95\%}$ only since, statistically, ER_{max} is not defined. JASMINE is a Monte Carlo simulation, and the results are probabilistic in nature. This is in contrast with acoustic modelling, where there is a specific maximum isopleth range for a given source/environment setup.

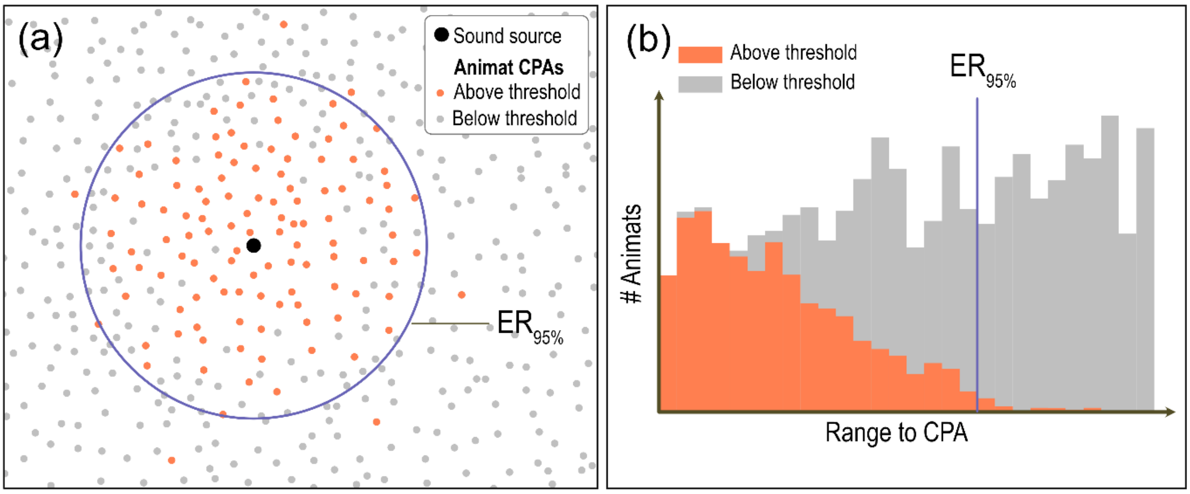

Figure 7. Example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animats near a sound source. Panel (b) shows the distribution of distances to animat CPAs. The 95% exposure range ($ER_{95\%}$) is indicated in both panels.

3.7.3. Species Specific Behaviour Profile Parameterisation

3.7.3.1. Pygmy Blue Whale Behaviour Profile

The project area overlaps with a known foraging BIA for pygmy blue whales (DoE (AU) 2015-2025). Therefore, only foraging behaviours were considered in the species profile.

Data on fine-scale foraging behaviour are not currently available for pygmy blue whales. Therefore, data from multi-sensor tags deployed on blue whales from the North Pacific were used to inform the feeding behaviours. Irvine et al. (2019) used intermediate-duration archival tags (SPLASH MK10) attached to eight blue whales off the coast of California and was able to determine two feeding modes based on depth: shallow and deep. These two feeding behaviours differed further between males and females, with females generally diving deeper than males during both shallow and deep feeding. In order to account for these differences, female and male pygmy blue whales were modelled separately, with values derived from Irvine et al. (2019). Most remaining parameters for feeding behaviour were sourced from Goldbogen et al. (2011), who deployed 25 multi-sensor suction cup tags (DTAGs) on blue whales off the coast of California. Finally, travel speed was derived from satellite tags deployed on pygmy blue whales off southern Australia (Möller et al. 2020), and surface interval was derived from a satellite tag deployed on a pygmy blue whale off western Australia (Davenport et al. 2022).

3.7.3.2. Southern Right Whale Behaviour Profile

The project area is located in the migration BIA for southern right whales, and the reproduction BIA for this species lies inshore of the proposed survey lines. Animals of all demographics use these areas, including mothers with new calves. The behaviour of southern right whale mother/calf pairs can be dramatically different from other demographics, particularly in regards to the amount of time spent resting at the surface (Cusano et al. 2019, Nielsen et al. 2019). Therefore, separate behavioural profiles were modelled for mother/calf pairs and for all other demographics. Accordingly, a total of four behavioural profiles were considered for southern right whales: migrating mother with calf, migrating adult with no calf, reproducing adult with calf, reproducing adult with no calf. Migration profiles are applicable to the migration BIA, and reproducing profiles are applicable to the reproduction BIA.

The behaviour of migrating southern right whales was modelled to reflect animats transiting through the migration BIA on a 293º track to correspond with the tow direction. This reflects the animals migrating along the southern coast of Australia in a westerly or counter-clockwise direction (Burnell et al. 2001). Fine-scale behavioural data on southern right whales are limited, however migrating travel speed was derived from satellite-tagged southern right whales (Mackay et al. 2020). The remaining parameters used for the migrating species profiles were primarily sourced from multi-sensor tags (DTAGs and/or TDRs) deployed on North Atlantic right whales (Baumgartner and Mate 2003) (Dombroski et al. 2021).

Reproductive BIAs for southern right whales act as aggregation areas for mothers with new calves and for other demographics. For the reproducing behavioural profiles, behaviours reflect those observed in North Atlantic right whales on calving grounds due to limited data availability for southern right whales. Behavioural states comprise resting, travelling, and surface active. Additionally, the mother/calf profile includes nursing behaviour. The parameters used for the reproducing species profiles were again primarily sourced from North Atlantic right whales with the exception of behavioural probabilities, which were available from studies of southern right whales in South America (Thomas et al. 1984 and Lundquist et al. 2008).

4. Results

4.1. Acoustic Source Levels and Directivity

AASM (Section 3.2) was used to predict the horizontal and vertical overpressure signatures and corresponding power spectrum levels for the seismic sources, with results provided in Appendix B.3 along with the horizontal directivity plots for the selected source.

Table 11 shows the PK and per-pulse SEL source levels in the horizontal-plane broadside (perpendicular to the tow direction), endfire (along the tow direction), and vertical directions for the modelled array signature (2820 in^3 source). The vertical source level that accounts for the "surface ghost" (the out of phase reflected pulse from the water surface) is also presented to make it easier to compare the output of other seismic source models.

Figure B-2 in Appendix B.3 shows the broadside, endfire, and vertical overpressure signature and corresponding power spectrum levels for the source. The signature consists of a strong primary peak, related to the initial release of high-pressure air, followed by a series of pulses associated with bubble oscillations. Most energy was produced at frequencies below 500 Hz. Frequency-dependent peaks and nulls in the spectrum result from interference among airguns in the source and correspond with the volumes and relative locations of the airguns to each other.

Table 11. Far-field source level specifications for 2820 in^3 source, for 7 m tow depth. Source levels are for a point-like acoustic source with equivalent far-field acoustic output in the specified direction. Sound level metrics are per-pulse and unweighted.

Direction	Peak source pressure level ($L_{S,pk}$; dB re 1 µPa m)	Per-pulse source SEL ($L_{S,E}$; dB 1 µPa²m²s)	
		10–2000 Hz	2000–25000 Hz
Broadside	249.0	224.3	185.8
Endfire	244.9	222.6	186.4
Vertical	255.1	228.0	194.0
Vertical (surface affected source level)	255.1	230.8	197.0

4.2. Per-pulse Sound Fields

This section presents the per-pulse sound fields in terms of maximum-over-depth SPL, SEL, PK, and seafloor PK and PK-PK. The different metrics are presented for the following reasons:

- SPL sound fields were used to determine the distances to marine mammal and turtle behavioural thresholds (see Sections 2.1 and 2.3).
- Received per-pulse SPL at the considered receiver locations are presented in Table 19, as well as maps showing which impulses result in levels above the human health assessment threshold (Figure 38).
- Per-pulse SEL sound fields are used as inputs into the 24 h SEL scenario and to provide context for the range to 160 dB re 1 µPa²·s, relevant for the EPBC Act Policy Statement 2.1 (DEWHA 2008).
- PK metrics within the water column are relevant to thresholds and guidelines for marine mammals, sea turtles, fish, fish eggs and larvae (as well as plankton; Sections 2.1–2.3).

- PK metrics at the seafloor are relevant to guidelines for fish, fish eggs and larvae (Section 2.3) and the sound level for no effect on corals and sponges.
- PK-PK metrics at the seafloor are relevant to sound levels used in the assessment of effect on benthic invertebrates (Section 2.5.1).

The maximum and 95% distances to per-pulse SEL and SPL metrics are presented in Tables 12–13. The SPL sound fields, and distances to relevant isopleths can be visualised on the contour maps presented in Figures 8–22. Where indicated in the table captions, distances to maximum and 95% distance were calculated considering both survey directions (tow directions); the largest resultant distances were reported. The SPL sound fields are also presented as vertical slices for selected azimuths along the endfire and broadside directions out to 50 km, with the airgun array in the centre (Figures 23–27).

Maximum horizontal distances to maximum-over-depth water column PK thresholds were calculated for eight modelled single-impulse sites, Sites 1, 2, 5, 8, 10, 12, 14 and 15. This metric was calculated for the sites where FWRAM was applied to enable the SEL to SPL conversion (Appendix C.2 and D.2). PK results are presented in Table 15.

Seafloor sound levels were assessed considering ten different representative water depths (50, 60, 70, 80, 90, 100, 120, 140, 160 and 170 m). Tables 16 and 17 present the PK and PK-PK results. Particle motion was also calculated considering these water depths, results are presented in Table 18.

Table 19 provides a summary of whether or not the 145 dB re 1 µPa SPL human health assessment threshold was exceeded at each of the 14 sensitive receiver sites identified in Section 1.3 from any impulse location on the survey lines. Figures 38 to 43 indicate which modelled impulses on the seismic survey lines result in these exceedances.

4.2.1. Tabulated Results

4.2.1.1. Entire Water Column

Table 12. *Sites 1-15, 2820 in^3 source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to modelled maximum-over-depth unweighted per-pulse sound exposure level (SEL) isopleths from the modelled single-impulse sites. Water depth at each site is indicated. The results presented are the maxima considering either of the two tow directions modelled for each site.

Per-pulse SEL (L_E; dB re 1 µPa²·s)	Site 1 (49.1 m)		Site 2 (54.8 m)		Site 3 (63.9 m)		Site 4 (81.0 m)		Site 5 (61.9 m)		Site 6 (71.1 m)		Site 7 (124.9 m)		Site 8 (173.6 m)		Site 9 (166.5 m)		Site 10 (67.4 m)		Site 11 (72.0 m)		Site 12 (84.0 m)		Site 13 (99.0 m)		Site 14 (69.2 m)		Site 15 (51.6 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
190	0.06	0.05	0.06	0.05	0.06	0.05	0.05	0.05	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.06	0.05
180	0.38	0.34	0.40	0.34	0.38	0.34	0.27	0.23	0.29	0.25	0.27	0.23	0.17	0.16	0.15	0.13	0.15	0.13	0.29	0.24	0.26	0.22	0.29	0.25	0.27	0.23	0.28	0.23	0.39	0.34
170	1.91	1.66	1.97	1.68	1.96	1.67	0.68	0.57	0.72	0.63	0.68	0.60	0.97	0.73	0.79	0.65	0.80	0.66	0.74	0.58	0.68	0.59	0.69	0.60	0.70	0.61	0.71	0.58	1.95	1.59
162[1]	4.81	3.90	4.81	4.03	4.88	4.06	1.50	1.17	1.50	1.32	1.41	1.14	3.38	2.60	2.99	2.43	2.93	2.46	1.53	1.23	1.39	1.12	1.51	1.21	1.41	1.26	1.36	1.16	4.70	3.91
160	5.69	4.71	5.65	4.8	5.85	4.91	1.61	1.43	1.77	1.44	1.76	1.37	3.92	3.26	3.95	3.10	3.77	3.22	1.76	1.50	1.53	1.35	1.66	1.48	1.75	1.58	1.74	1.42	5.65	4.67
150	13.5	10.8	13.5	10.9	14.0	11.1	4.09	3.32	4.18	3.33	3.45	2.81	11.0	8.43	9.02	7.16	9.84	7.82	3.88	3.11	3.61	2.84	4.24	3.30	4.57	3.56	3.67	2.91	14.2	10.8
140	32.7	24.7	30.7	24.4	33.3	25.7	9.01	6.84	7.87	6.34	8.03	6.28	35.3	25.1	40.3	26.1	42.7	29.3	7.84	6.26	8.27	6.5	9.09	6.58	9.02	7.42	8.3	6.27	30.7	25.1
130	61.6	45.4	63.4	48.3	75.7	46.5	19.0	14.3	13.7	10.7	14.5	12.2	>100	/	>100	/	>100	/	14.1	11.4	16.9	13.3	18.0	14.2	18.4	14.5	15.9	12.8	72.9	46.8

[1] Startle response level for squid (Fewtrell and McCauley 2012).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 13. *Sites 1-15, 2820 in³ source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to modelled maximum-over-depth per-pulse sound pressure level (SPL) isopleths from the modelled single-impulse sites. Water depth at each site is indicated. The results presented are the maxima considering either of the two tow directions modelled for each site.

SPL (L_p; dB re 1 µPa²)	Site 1 (49.1 m)		Site 2 (54.8 m)		Site 3 (63.9 m)		Site 4 (81.0 m)		Site 5 (61.9 m)		Site 6 (71.1 m)		Site 7 (124.9 m)		Site 8 (173.6 m)		Site 9 (166.5 m)		Site 10 (67.4 m)		Site 11 (72.0 m)		Site 12 (84.0 m)		Site 13 (99.0 m)		Site 14 (69.2 m)		Site 15 (51.6 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}
200	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06	0.05
190	0.32	0.29	0.36	0.31	0.35	0.28	0.23	0.21	0.27	0.23	0.23	0.20	0.15	0.13	0.13	0.12	0.13	0.12	0.25	0.21	0.23	0.20	0.27	0.23	0.25	0.22	0.24	0.21	0.32	0.29
180	1.50	1.21	1.50	1.24	1.52	1.25	0.61	0.52	0.68	0.56	0.65	0.54	0.70	0.59	0.73	0.61	0.72	0.60	0.62	0.52	0.65	0.54	0.64	0.54	0.66	0.52	0.65	0.53	1.56	1.24
175[1]	2.38	1.99	2.62	2.12	2.50	2.10	0.91	0.82	0.93	0.83	0.93	0.81	1.78	1.49	1.56	1.25	1.58	1.27	0.99	0.82	0.91	0.80	0.98	0.85	1.00	0.88	0.98	0.80	2.45	2.06
170	4.14	3.46	4.13	3.51	4.11	3.51	1.47	1.16	1.49	1.31	1.40	1.15	3.43	2.77	3.09	2.54	3.29	2.58	1.51	1.22	1.33	1.13	1.34	1.20	1.39	1.24	1.35	1.16	4.00	3.39
166[2]	6.30	5.02	6.02	5.05	6.13	5.07	1.88	1.54	2.04	1.65	1.84	1.52	4.91	4.05	4.94	3.95	4.65	4.04	1.96	1.64	1.84	1.49	2.00	1.60	2.09	1.68	1.95	1.63	5.88	4.95
160[3]	11.7	9.30	11.3	9.09	11.8	9.29	3.43	2.68	3.43	2.82	3.10	2.43	9.28	7.05	7.74	5.99	8.27	6.70	3.13	2.58	3.01	2.39	3.35	2.65	3.58	2.90	2.91	2.39	11.6	9.11
150	29.9	22.1	29.1	23.1	29.9	23.3	8.27	6.00	7.21	5.81	7.17	5.70	32.1	21.9	29.2	20.0	31.0	18.6	7.32	5.39	7.34	5.62	7.26	5.78	8.39	6.66	6.89	5.48	28.9	23.0
145[4]	42.2	33.2	42.2	33.7	40.8	33.1	11.6	8.75	9.18	7.51	10.7	8.60	88.7	55.9	77.0	57.1	84.3	62.7	9.82	7.87	10.6	8.60	11.4	8.82	11.3	8.96	9.93	8.27	38.7	30.4
140	57.5	42.6	57.8	44.9	58.8	42.9	16.9	13.1	13.2	10.2	14.0	11.7	>100	/	>100	/	>100	/	12.8	10.4	15.2	12.2	16.6	12.8	17.3	13.2	14.8	11.9	63.9	41.8

[1] Threshold for turtle behavioural disturbance from impulsive noise (McCauley et al. 2000).
[2] Threshold for turtle behavioural response to impulsive noise (McCauley et al. 2000).
[3] Marine mammal behavioural threshold for impulsive sound sources (NOAA 2019).
[4] Human health assessment threshold derived from (Parvin 2005).
A slash indicates that $R_{95\%}$ radius to threshold is not reported when the R_{max} is greater than the maximum modelling extent.

Table 14. *Sites 1-15, Penguin behavioural threshold, SPL, 2820 in^3 source*: Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to modelled maximum-over-depth per-pulse sound pressure level (SPL) isopleths from the modelled single-impulse sites. Water depth at each site is indicated. The results presented are the maxima considering either of the two tow directions modelled for each site.

SPL (L_p; dB re 1 µPa^2)	Site 1 (49.1 m)		Site 2 (54.8 m)		Site 3 (63.9 m)		Site 4 (81.0 m)		Site 5 (61.9 m)		Site 6 (71.1 m)		Site 7 (124.9 m)		Site 8 (173.6 m)		Site 9 (166.5 m)		Site 10 (67.4 m)		Site 11 (72.0 m)		Site 12 (84.0 m)		Site 13 (99.0 m)		Site 14 (69.2 m)		Site 15 (51.6 m)	
	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$	R_{max}	$R_{95\%}$
120 [a]	72.6	52.5	73.9	54.9	66.0	49.6	13.0	9.54	12.3	9.64	11.9	9.35	64.7	44.2	60.3	39.6	57.1	42.0	10.4	8.25	12.1	9.32	13.4	9.63	13.8	11.1	11.4	8.81	77.0	50.4

[a] Penguin behavioural response threshold (weighted) for impulsive noise (Sørensen et al. (2020)).

Table 15. *2820 in^3 source*: Maximum (R_{max}) horizontal distances (in km) to modelled maximum-over-depth peak pressure level (PK) thresholds for eight modelled sites. Thresholds are based on Southall et al. (2019) for marine mammals, Popper et al. (2014) for fish and Finneran et al. (2017) for sea turtles. Water depth at each site is indicated. The results presented are the maxima considering either of the two tow directions modelled for each site.

Hearing group	PK threshold (L_{pk}; dB re 1 µPa)	Distance R_{max} (km)							
		Site 1 (49.1 m)	Site 2 (54.8 m)	Site 5 (61.9 m)	Site 7 (124.9 m)	Site 10 (67.4 m)	Site 12 (84.0 m)	Site 14 (69.2 m)	Site 15 (51.6 m)
Low-frequency cetaceans (PTS)	219	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Low-frequency cetaceans (TTS)	213	0.06	0.06	0.07	0.07	0.06	0.07	0.06	0.09
High-frequency cetaceans (PTS)	230	–	–	–	–	–	–	–	–
High-frequency cetaceans (TTS)	224	–	–	–	–	–	–	–	–
Very-high-frequency cetaceans (PTS)	202	0.38	0.41	0.35	0.22	0.36	0.37	0.37	0.39
Very-high-frequency cetaceans (TTS)	196	0.82	0.76	0.70	0.40	0.66	0.71	0.71	0.79
Otariid Pinnipeds (PTS) Also applied to Penguins	232	–	–	–	–	–	–	–	–
Otariid Pinnipeds (TTS) Also applied to Penguins	226	–	–	0.03	0.03	0.03	0.03	0.03	–
Sea turtles (PTS)	232	–	–	0.04	0.04	0.04	0.04	0.04	–
Sea turtles (TTS)	226	–	–	0.08	0.07	0.07	0.08	0.07	–
Fish: No swim bladder (also applied to sharks)[1]	213	0.06	0.06	–	–	–	–	–	0.09
Fish: Swim bladder not involved in hearing[1], Swim bladder involved in hearing[1] Fish eggs, and larvae[2]	207	0.23	0.23	–	–	–	–	–	0.23

[1] Mortality and potential mortal injury, and recoverable injury threshold
[2] Mortality and potential mortal injury threshold
A dash indicates the threshold is not reached within the limits of the modelling resolution (20 m).

4.2.1.2. Seafloor

Ranges presented for seafloor receptors are provided in Tables 16 and 17 for receiver depths of 50 and 5 cm above the seafloor. The seafloor PK results in Table 16 differ from the maximum-over-depth modelled results presented in Table 15. This is because the model used for the water column results, calculated using FWRAM do not represent the maximum sound levels at the seafloor close to the array. FWRAM is based on a wide-angle parabolic equation (PE) algorithm which is valid to only approximately 70° down angle from the horizontal, and while it provides accurate predictions in the horizontal direction, it cannot predict sound levels directly under the array. VSTACK was used to determine the levels at the seafloor directly under the array and is valid in the very nearfield directly under the source.

Table 16. *2820 in³ source*: Maximum (R_{max}) horizontal distances (in m) from the seismic source to modelled seafloor (receiver located 50 cm above seafloor) peak pressure level thresholds (PK) at ten representative water depths.

Hearing group/animal type	PK threshold (L_{pk}; dB re 1 µPa)	Water Depth									
		50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
		Distance R_{max} (m)									
Sound levels for sponges and corals[1]	226	*	*	*	*	*	*	*	*	*	*
Fish: No swim bladder (also applied to sharks)	213	113	78	74	72	69	66	56	49	16	*
Fish: Swim bladder not involved in hearing, Swim bladder involved in hearing Fish eggs, and larvae	207	197	207	150	154	157	155	152	153	131	124

1 Heyward et al. (2018)
An asterisk indicates that the sound level was not reached.

Table 17. 2820 *in³ source*: Maximum (R_{max}) horizontal distances (in m) from the seismic source to modelled seafloor (receiver located 5 cm above seafloor) peak-peak pressure levels (PK-PK) at ten representative water depths. Results included in relation to benthic invertebrates.

PK-PK ($L_{pk\text{-}pk}$; dB re 1 µPa)	Water Depth									
	50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
	Distance R_{max} (m)									
213[1,2,3]	176	188	143	149	153	152	151	150	127	119
212[2,3]	186	199	153	162	168	171	171	171	156	147
210[1,2]	216	232	176	183	191	198	212	217	217	218
209[1,2]	296	251	187	195	203	212	230	240	238	241
202[4]	639	702	322	338	351	370	391	396	630	638

1 Day et al. (2019), lobster
2 Day et al. (2016a), lobster and scallops
3 Day et al. (2017), scallops.
4 Payne et al. (2008), lobster

4.2.1.3. Particle Motion Metrics

Particle motion was modelled at a depth of 5 cm above the seafloor for an associated assessment for invertebrates. The maximum distances in metres to a peak particle acceleration magnitude of 37.57 ms^{-2} are presented in Table 18 for ten considered water depths. This particle acceleration threshold was assessed for invertebrates by Day et al. (2016a).

Table 18. 2820 *in*^{3} *source*: Maximum (R_{max}) horizontal distances (in m) from the 2820 in^3 to particle motion level: Peak acceleration magnitude level (m/s^2), 5 cm above the seafloor. Results included in relation to benthic invertebrates (Section 2.5.1).

Hearing group/animal type	Peak Acceleration Magnitude (m/s^2)	Water Depth									
		50 m	60 m	70 m	80 m	90 m	100 m	120 m	140 m	160 m	170 m
		Distance R_{max} (m)									
Benthic invertebrates	37.57	4	*	*	*	*	*	*	*	*	*

An asterisk indicates that the particle motion level was not reached.

4.2.1.4. Sound Levels at Sensitive Receiver Locations

Table 19 provides a summary of whether or not the 145 dB re 1 µPa SPL human health assessment threshold was exceeded at each of the 14 sensitive receiver sites identified in Section 1.3 from any impulse location on the survey lines.

Table 19. Exceedances of the human health assessment threshold (145 dB re 1 µPa) at each the sensitive receivers outlined in Section 1.3.

Receiver ID	Sensitive receiver	Exceedance of 145 dB re 1 µPa SPL human health assessment threshold?	Minimum Received Level (dB re 1 µPa)†	Maximum Received Level (dB re 1 µPa
1	Deen Maar (Lady Julia Percy Island)	Yes	145.0	154.8
2	Middle Island	Yes	145.0	151.8
3	Apollo Marine Park	No	*	*
4	Portland	No	*	*
5	Port Fairy Lighthouse	Yes	145.6	154.6
6	Killarney Beach	Yes	145.0	150.6
7	Merri Sanctuary	Yes	145.0	151.8
8	Rivernook Beach	No	*	*
9	Clifton Beach	No	*	*
10	Gibson Beach	No	*	*
11	Newfield Beach	No	*	*
12	Bay of Islands	No	*	*
13	Massacre Bay	No	*	*
14	Twelve Apostles MP	No	*	*

†Minimum received level above the stated threshold or criteria.
An asterisk indicates that the level did not exceed the stated threshold or criteria.

4.2.2. Sound Field Maps and Graphs

The SPL sound fields, and distances to relevant isopleths can be visualised for the 113° tow direction on the contour maps presented in Figures 8–22. Equivalent maps for the 293° tow direction are included in Appendix F.

The SPL sound fields are also presented as vertical slices for selected azimuths along the endfire and broadside directions out to 50 km, with the airgun array in the centre (Figures 23–27).

Section 4.2.2.3 includes maps showing which modelled impulses on the seismic survey lines result in exceedances of the human health assessment threshold for the sensitive receptor locations outlined in Section 1.3.

4.2.2.1. Sound Level Contour Maps

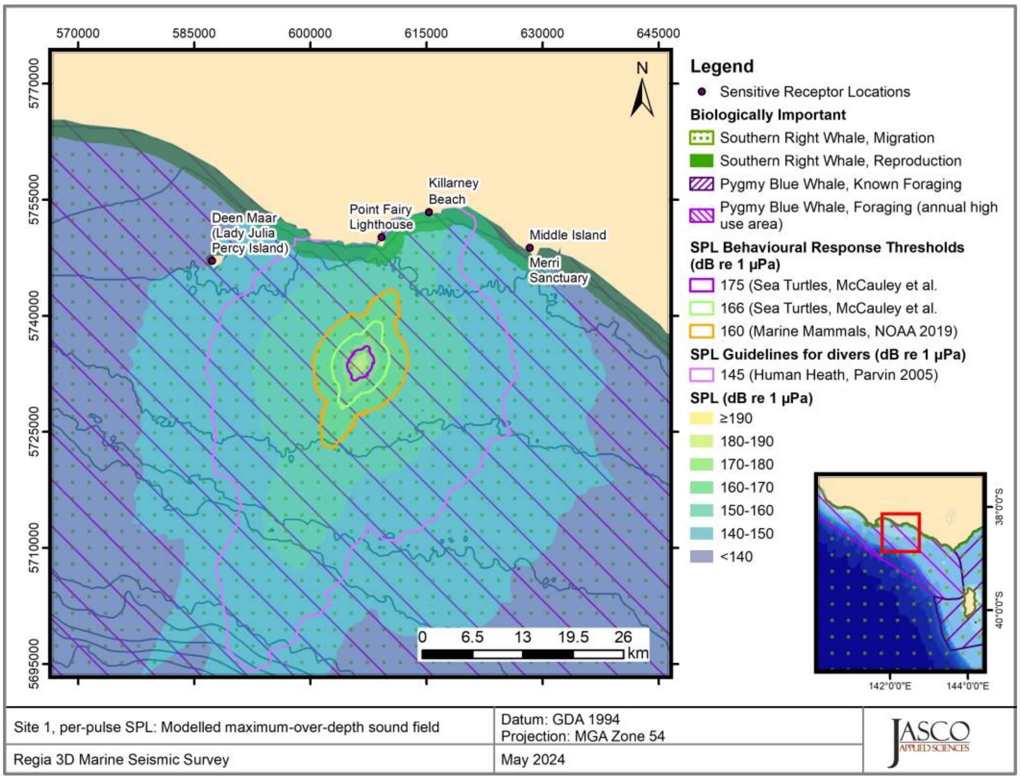

Figure 8. *Site 1, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

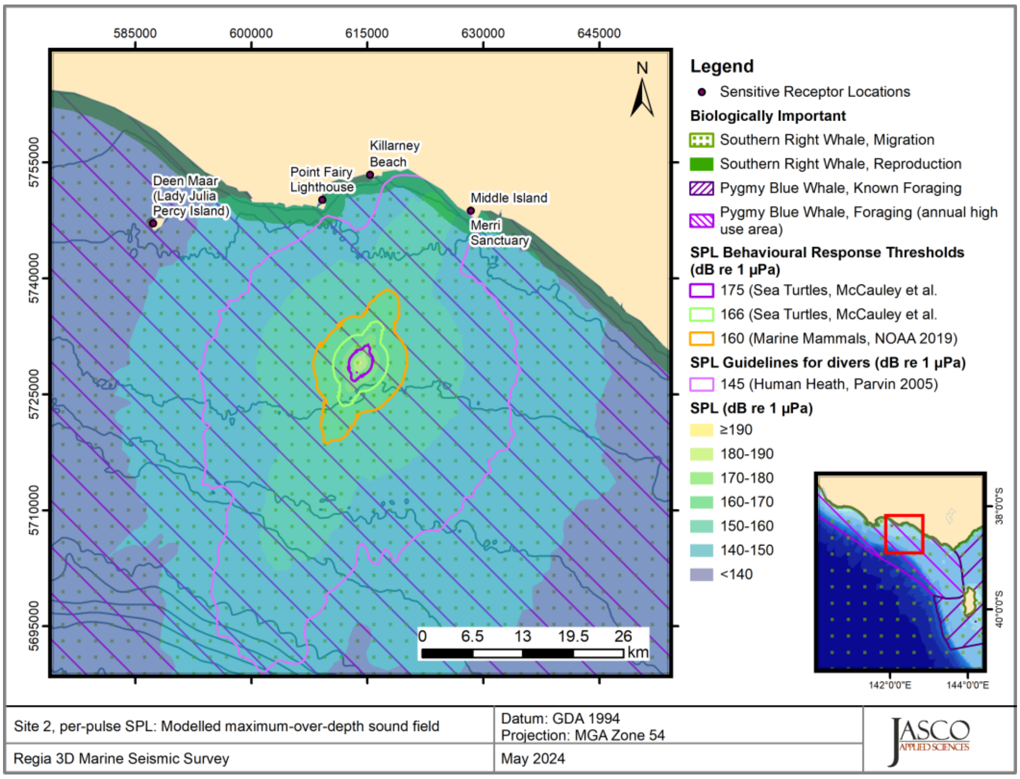

Figure 9. *Site 2, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

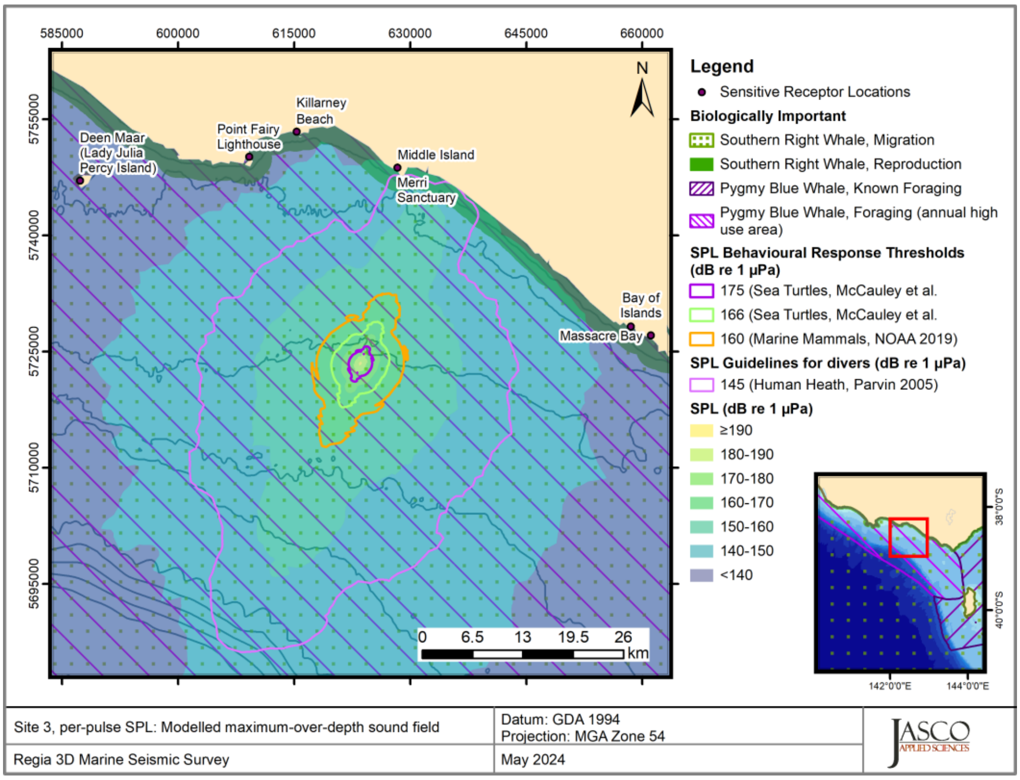

Figure 10. *Site 3, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

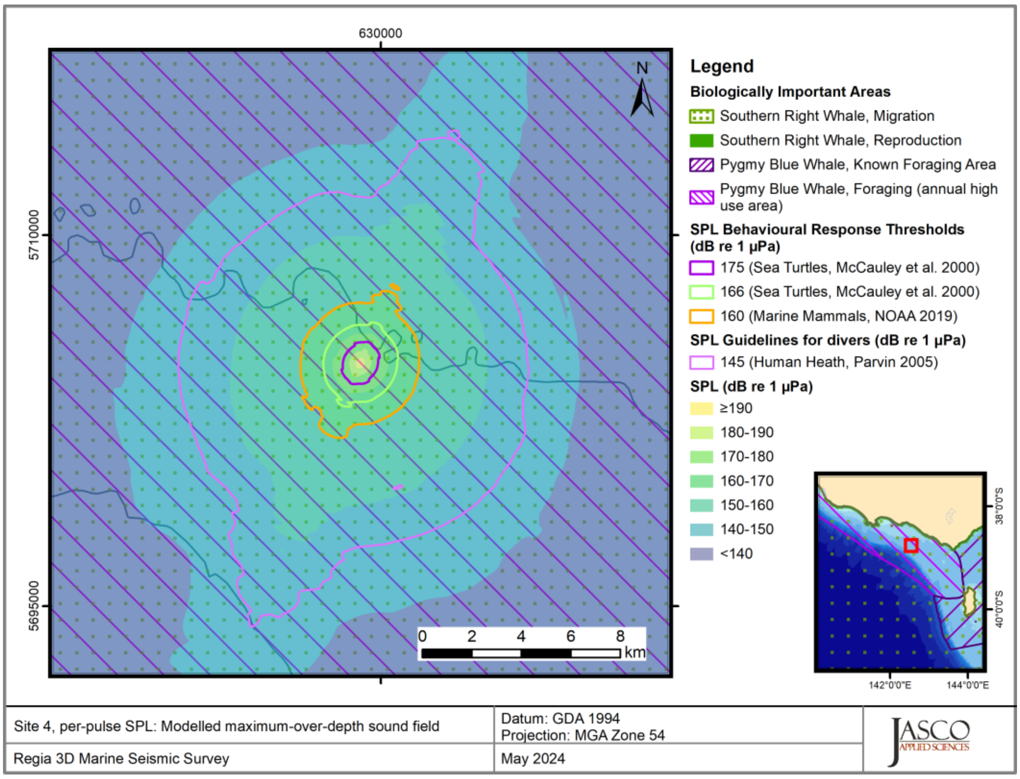

Figure 11. *Site 4, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

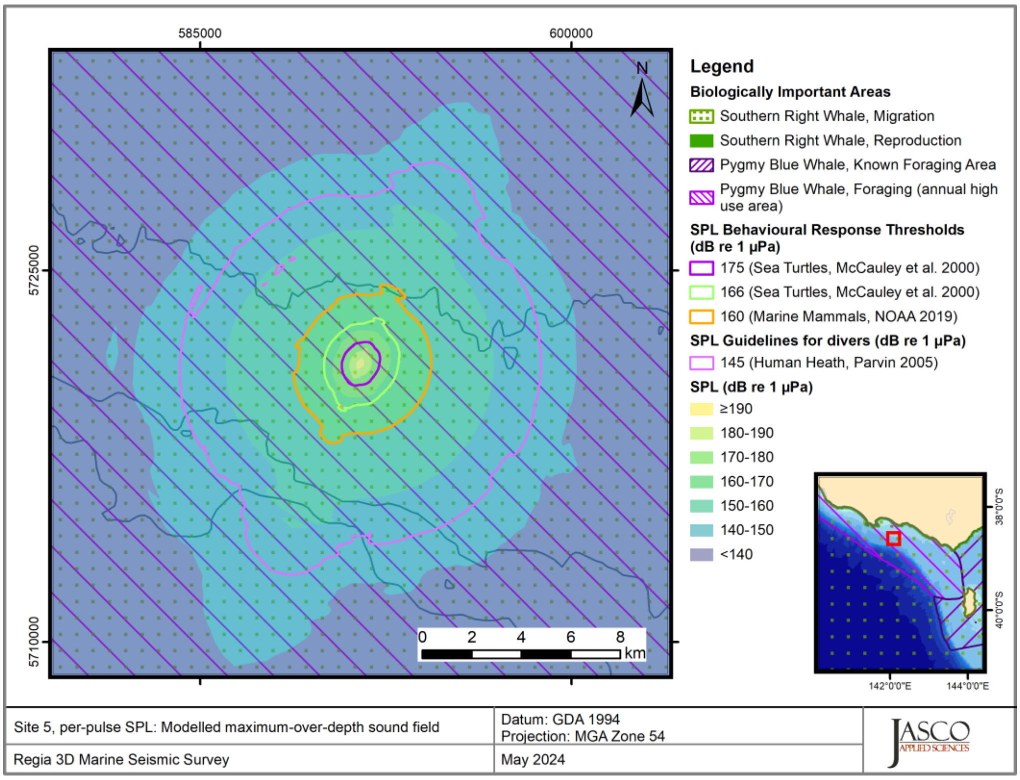

Figure 12. *Site 5, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

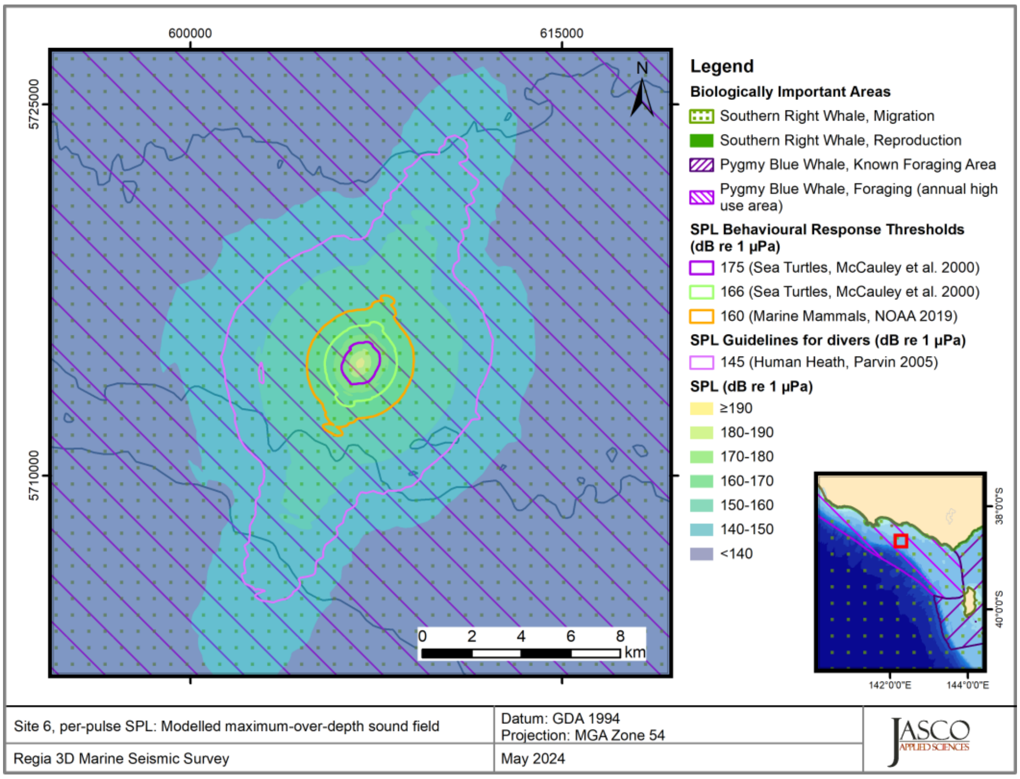

Figure 13. *Site 6, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

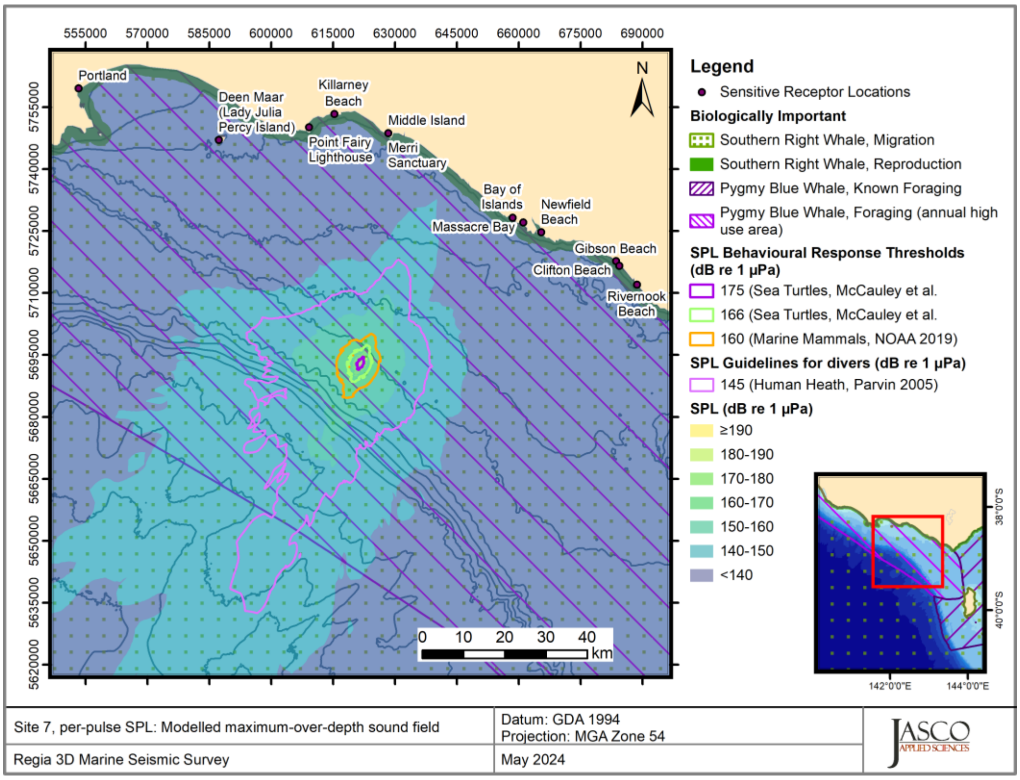

Figure 14. *Site 7, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

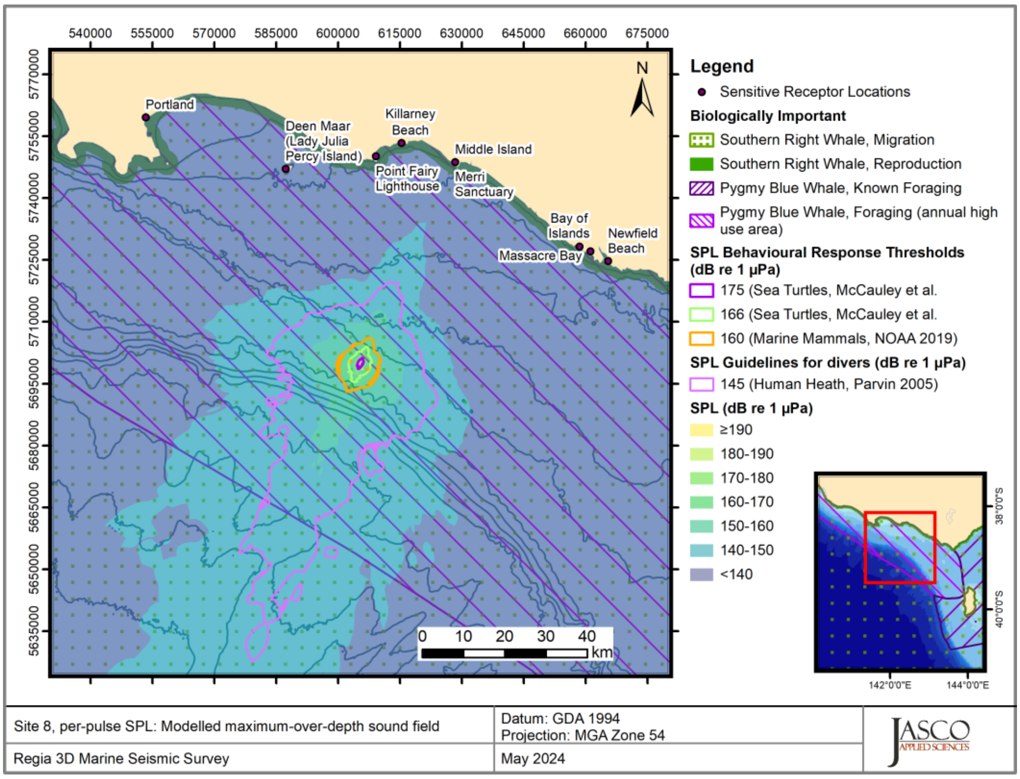

Figure 15. *Site 8, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

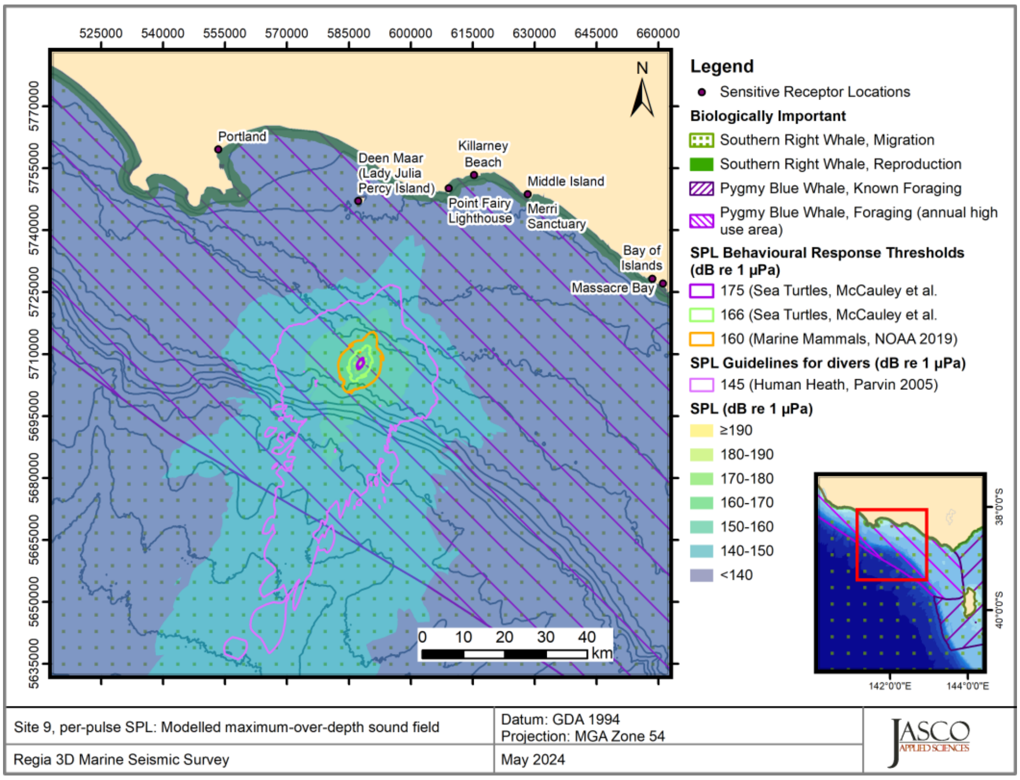

Figure 16. *Site 9, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

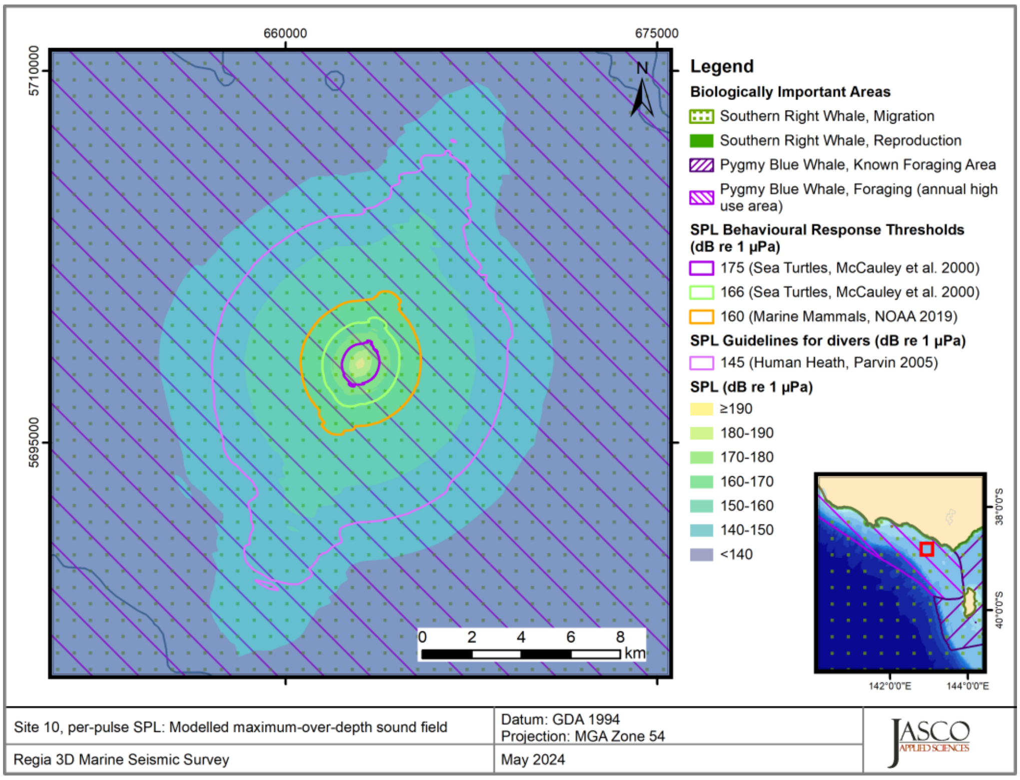

Figure 17. *Site 10, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

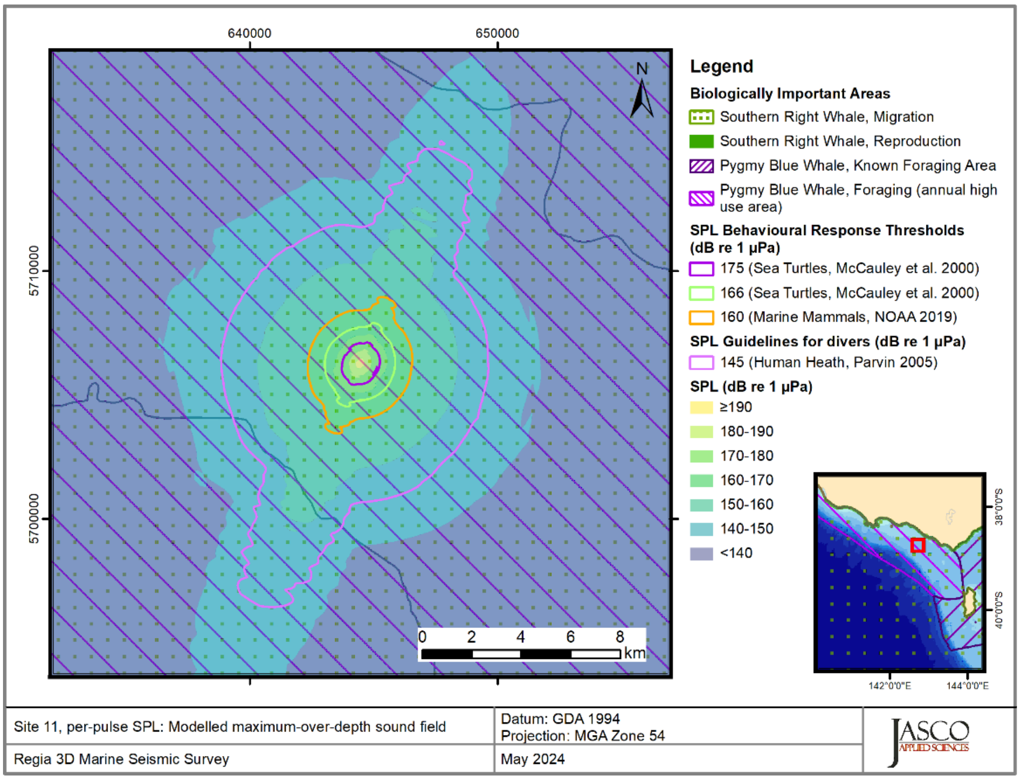

Figure 18. *Site 11, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

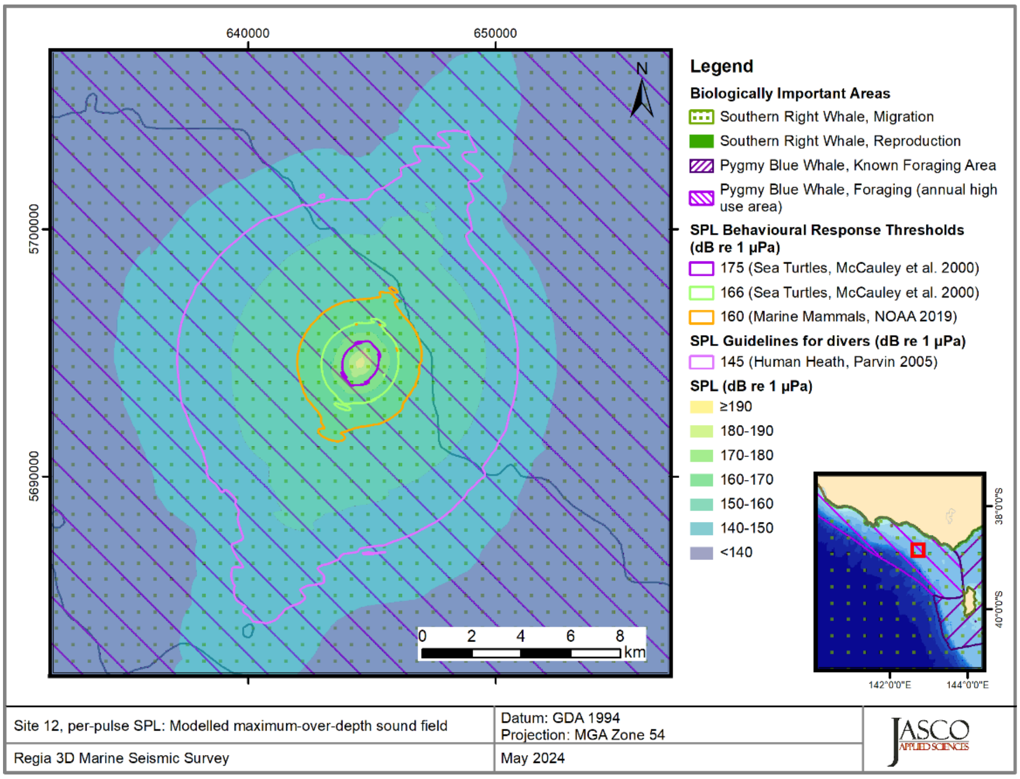

Figure 19. *Site 12, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

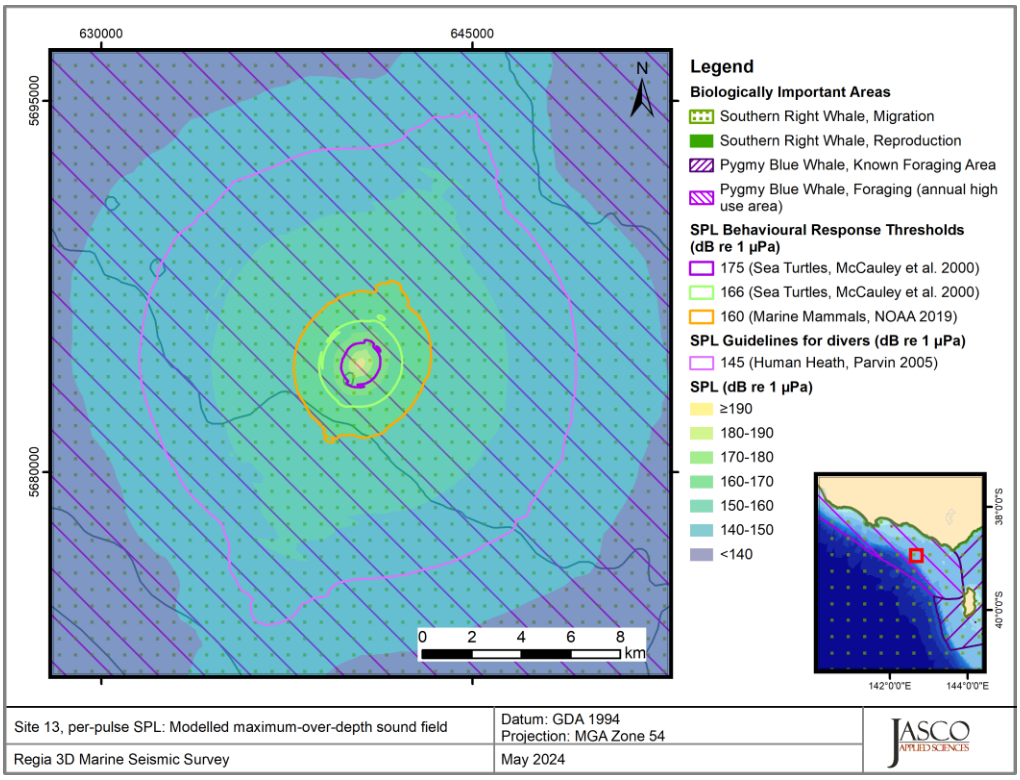

Figure 20. *Site 13, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

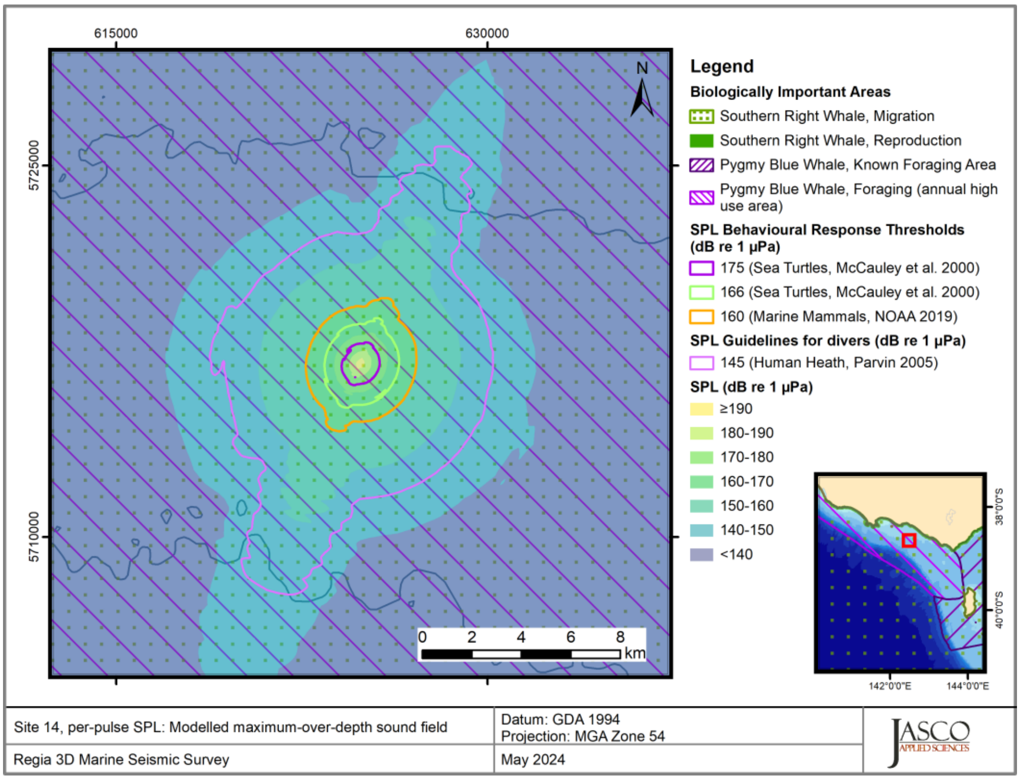

Figure 21. *Site 14, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

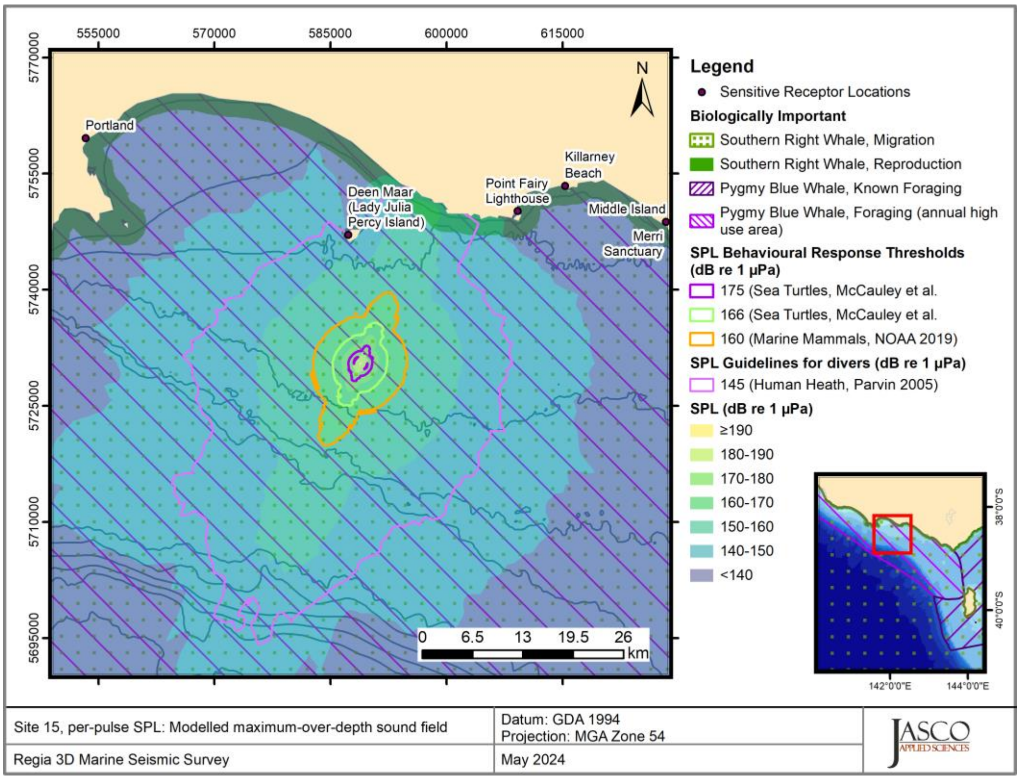

Figure 22. *Site 15, SPL, 2820 in³ source, tow direction 113°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

4.2.2.2. Vertical Slices of Modelled Sound Fields

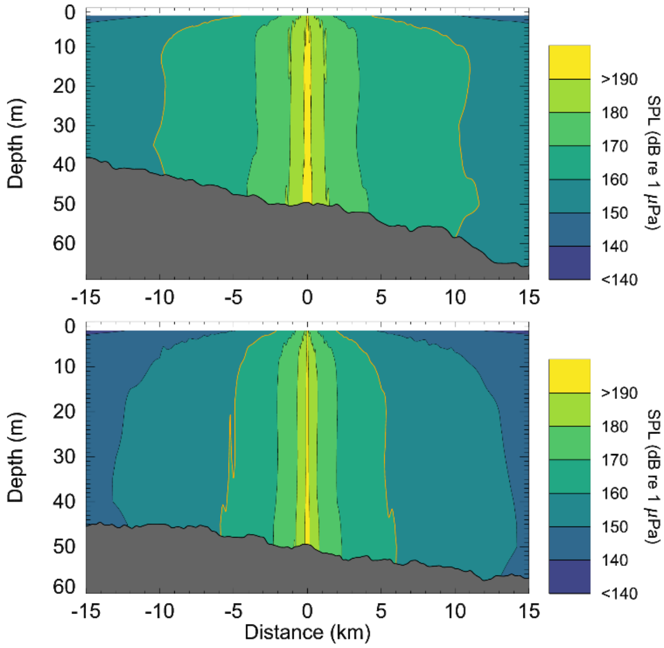

Figure 23. *Site 1, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

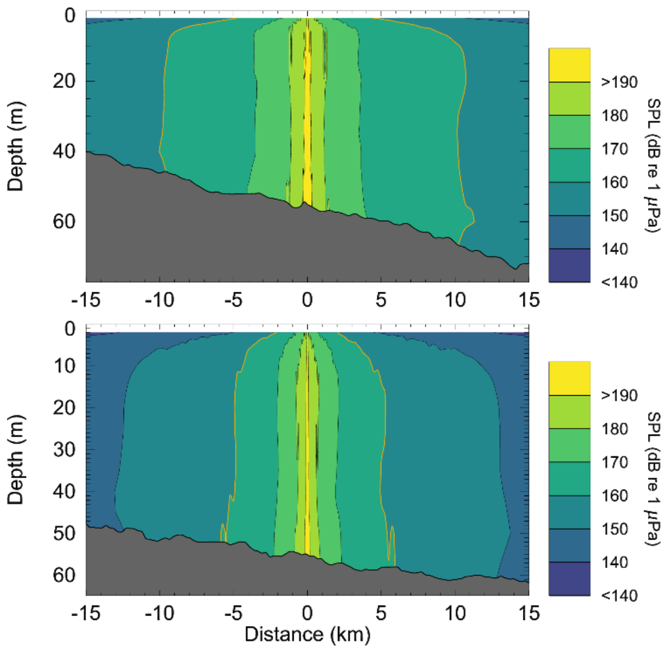

Figure 24. *Site 2, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

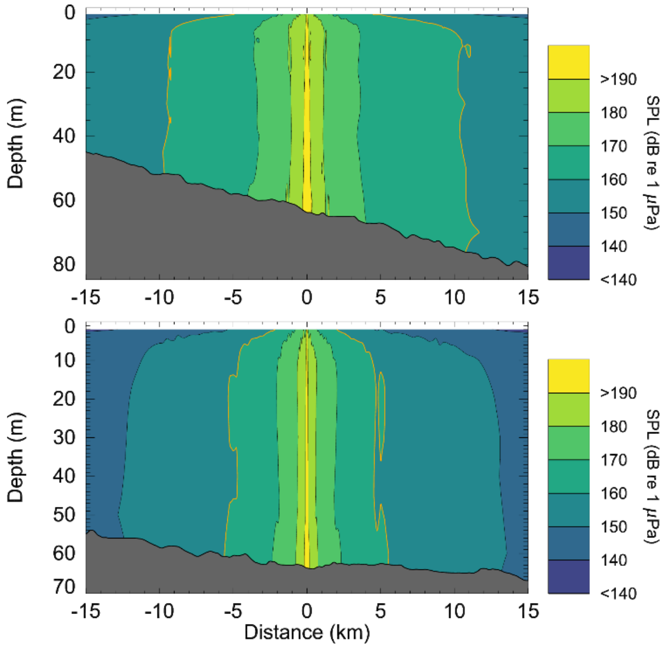

Figure 25. *Site 3, SPL, 2820 in^3 source, tow direction 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

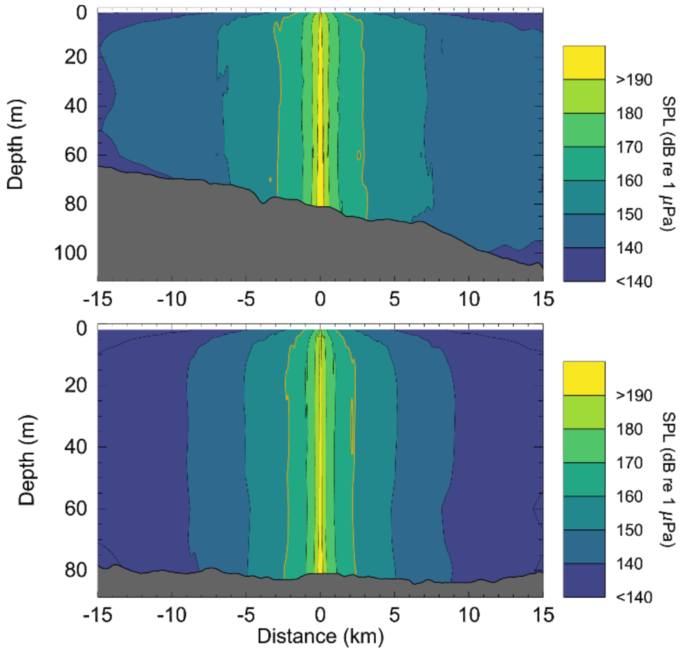

Figure 26. *Site 4, SPL, 2820 in^3 source, tow direction 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

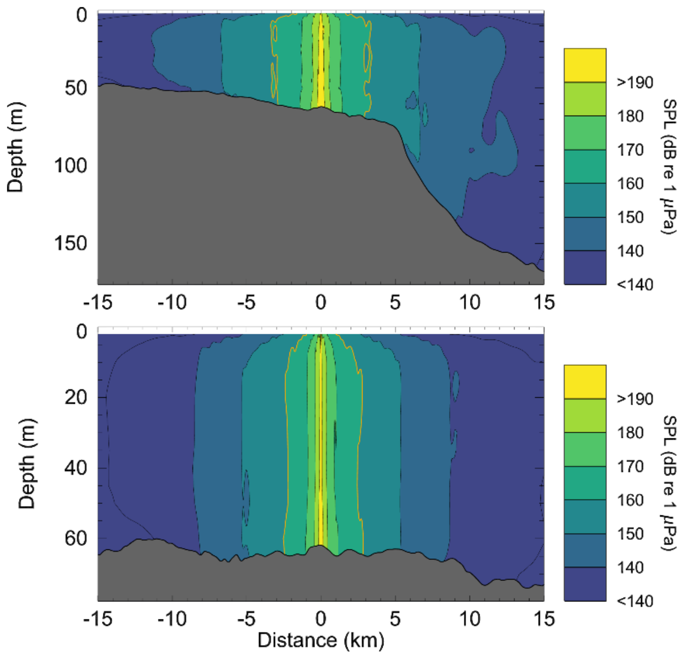

Figure 27. *Site 5, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

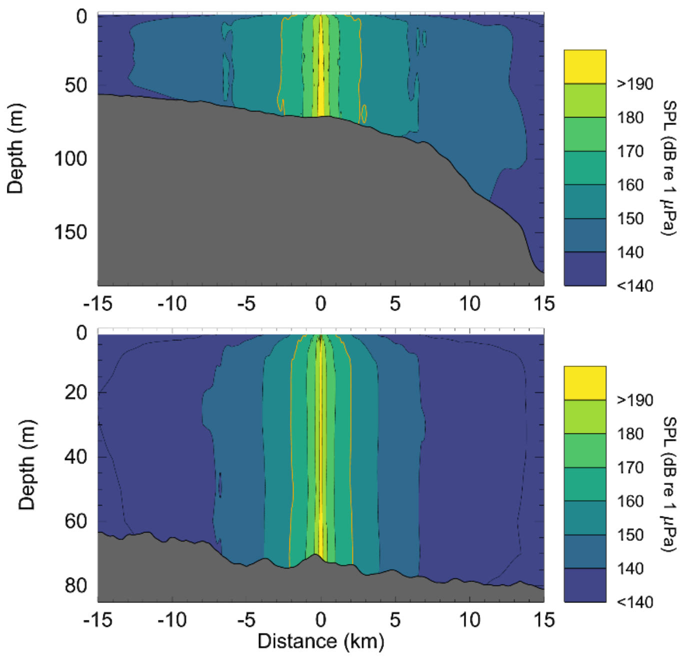

Figure 28. *Site 6, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

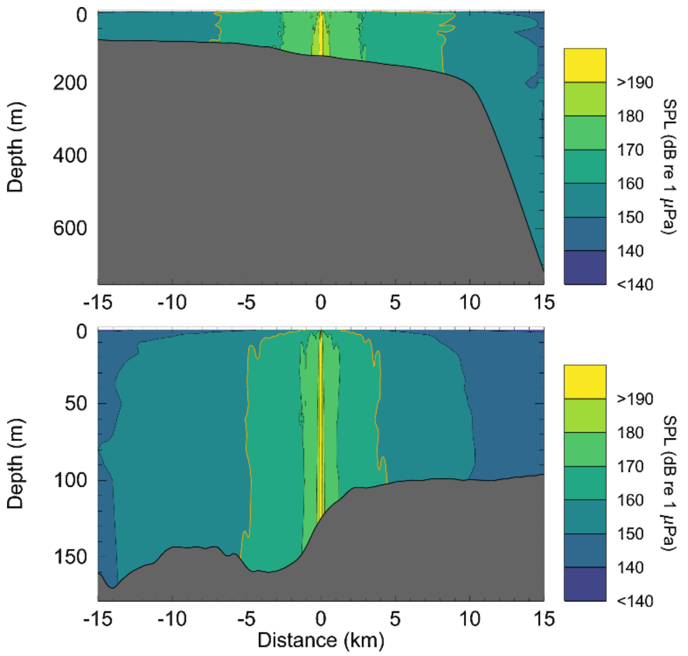

Figure 29. *Site 7, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

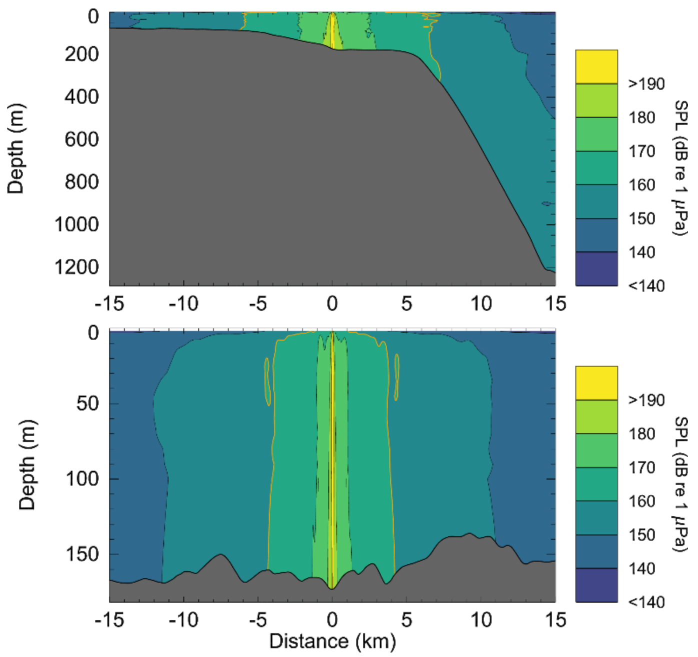

Figure 30. *Site 8, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

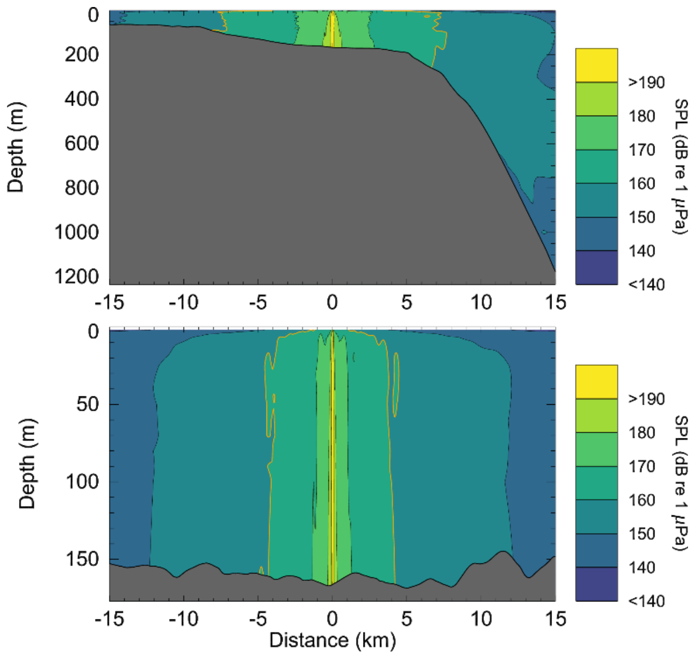

Figure 31. *Site 9, SPL, 2820 in^3 source, tow direction 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

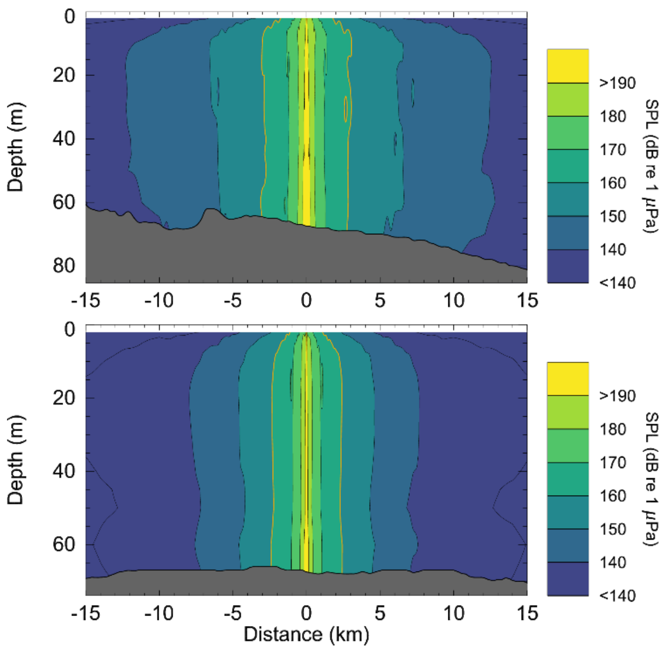

Figure 32. *Site 10, SPL, 2820 in^3 source, tow direction 113*°: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

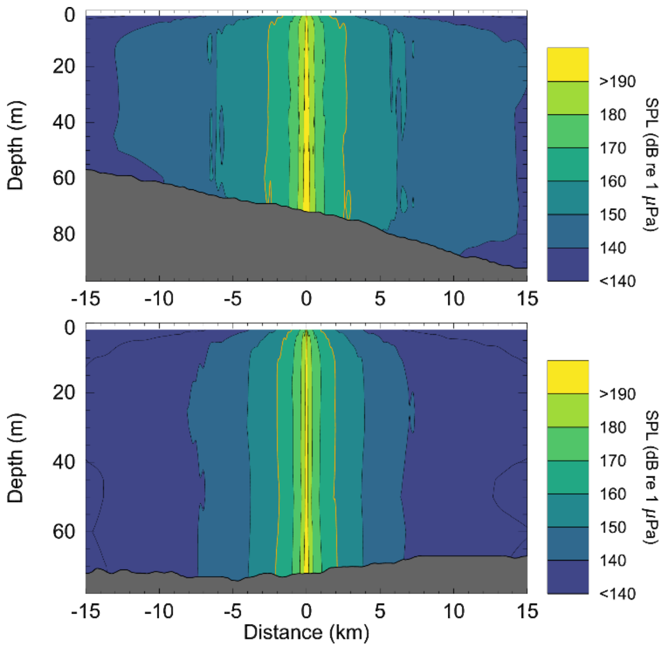

Figure 33. *Site 11, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

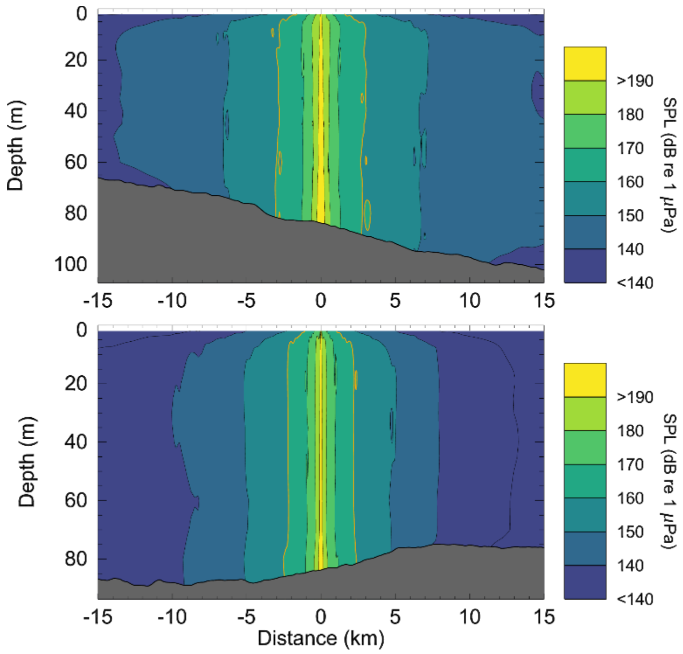

Figure 34. *Site 12, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

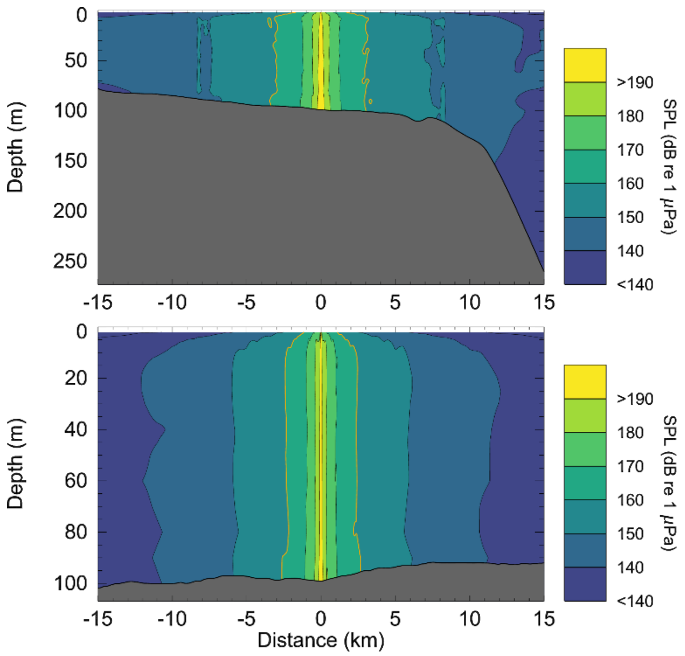

Figure 35. *Site 13, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

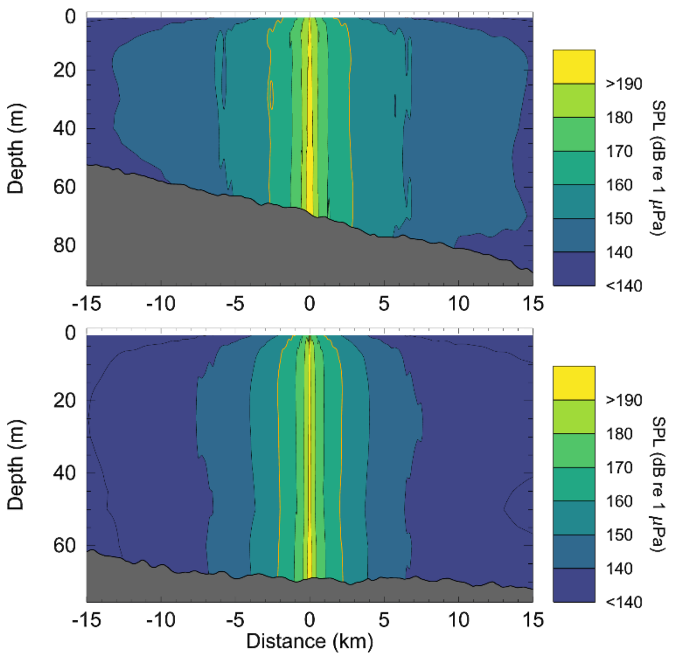

Figure 36. *Site 14, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

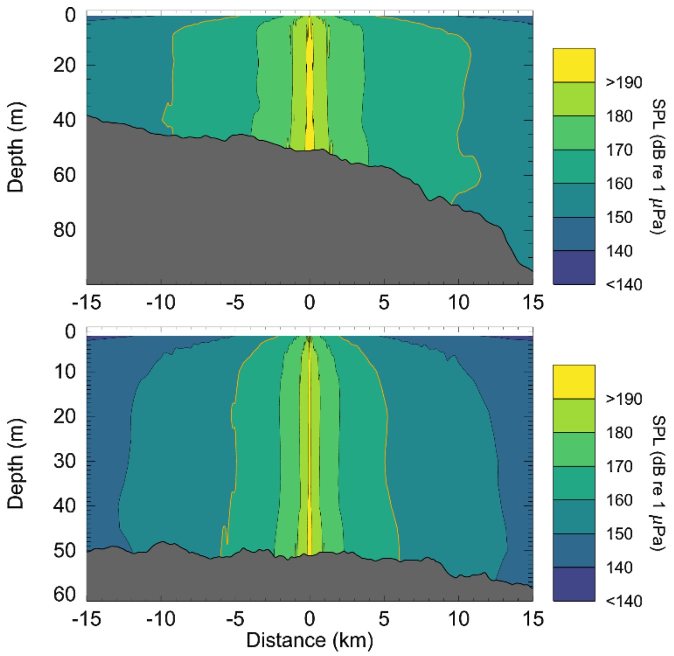

Figure 37. *Site 15, SPL, 2820 in³ source, tow direction 113°*: Sound level contours in vertical slice of the sound field, perpendicular to (broadside, top) and along the tow direction (endfire, bottom). The positive distance direction in each slice is 90° clockwise from the tow direction for broadside, and the tow direction for the endfire slice.

4.2.2.3. Sensitive Receiver Maps

Figure 38 indicates which modelled impulses on the seismic survey lines result in an exceedance in the human health assessment threshold for any of the 14 sensitive receiver locations outlined in Section 1.3.

Figures 39 – 43 indicate which modelled impulses result in an exceedance in the human health assessment threshold for specific sensitive receiver locations. Maps for all other specific sensitive receiver locations where exceedances did not occur are included in Appendix G.

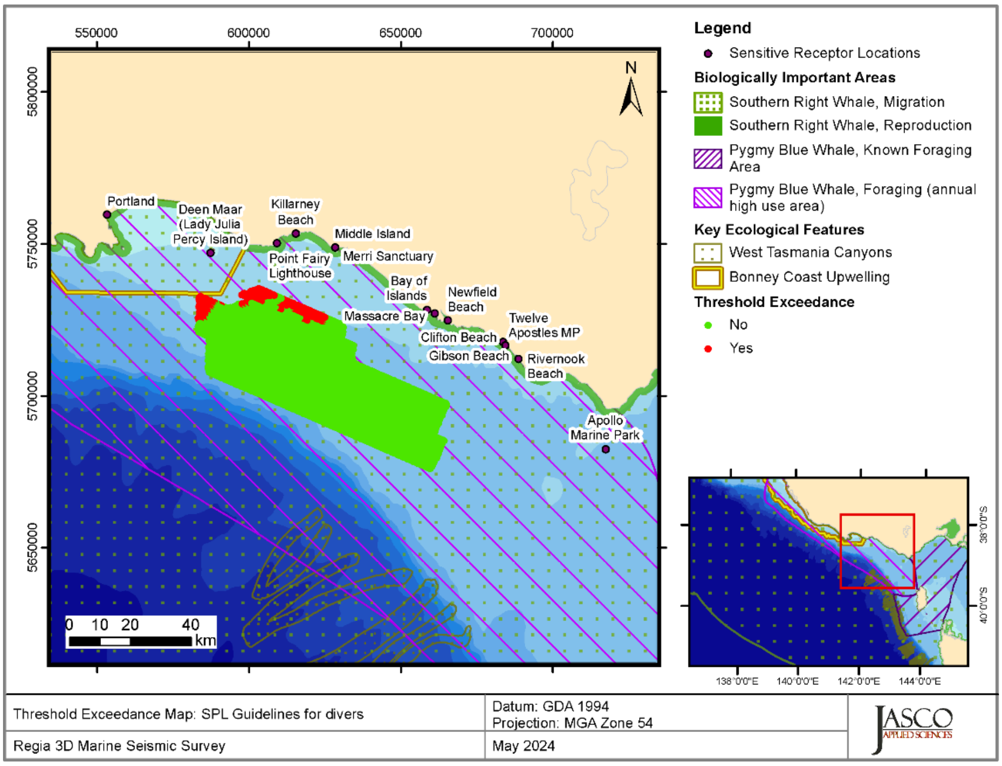

Figure 38. *SPL, 2820 in³ source,* seismic single-impulse locations where the human health assessment threshold at any sensitive receivers is exceeded.

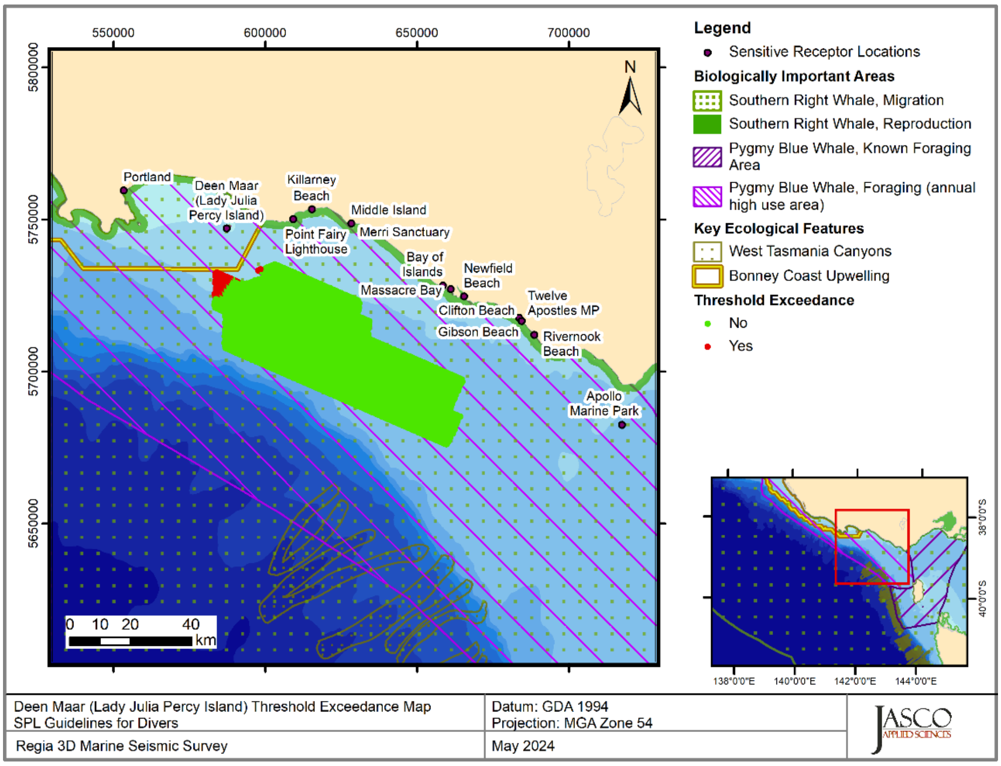

Figure 39. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Deen Maar (Lady Julia Percy Island) is exceeded.

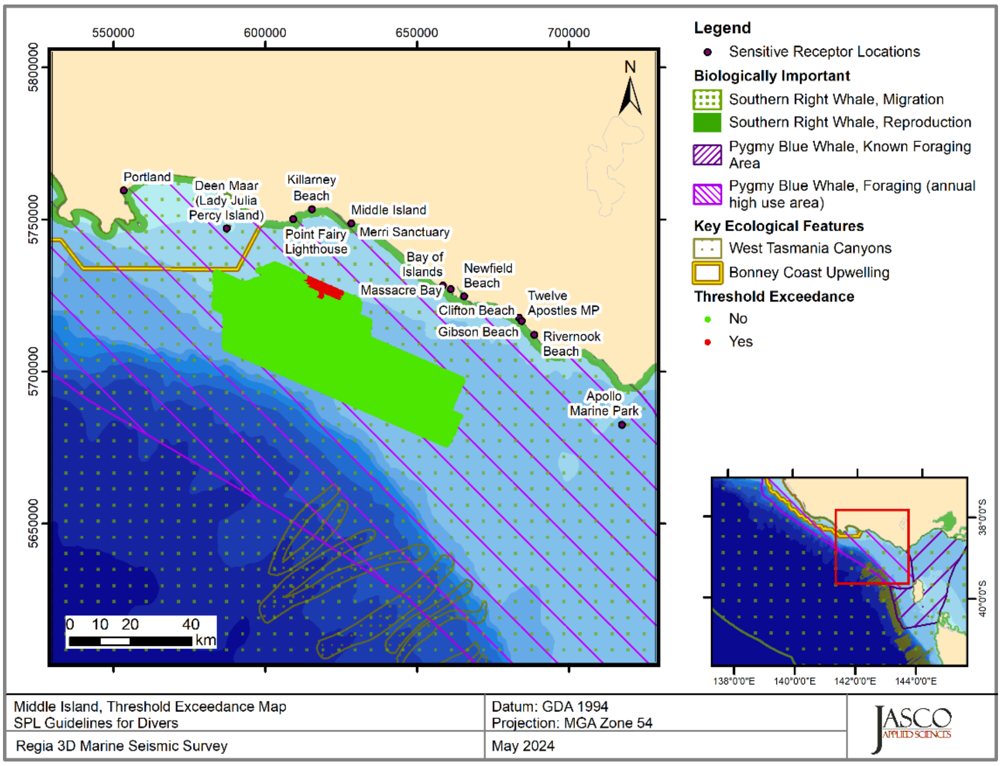

Figure 40. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Middle Island is exceeded.

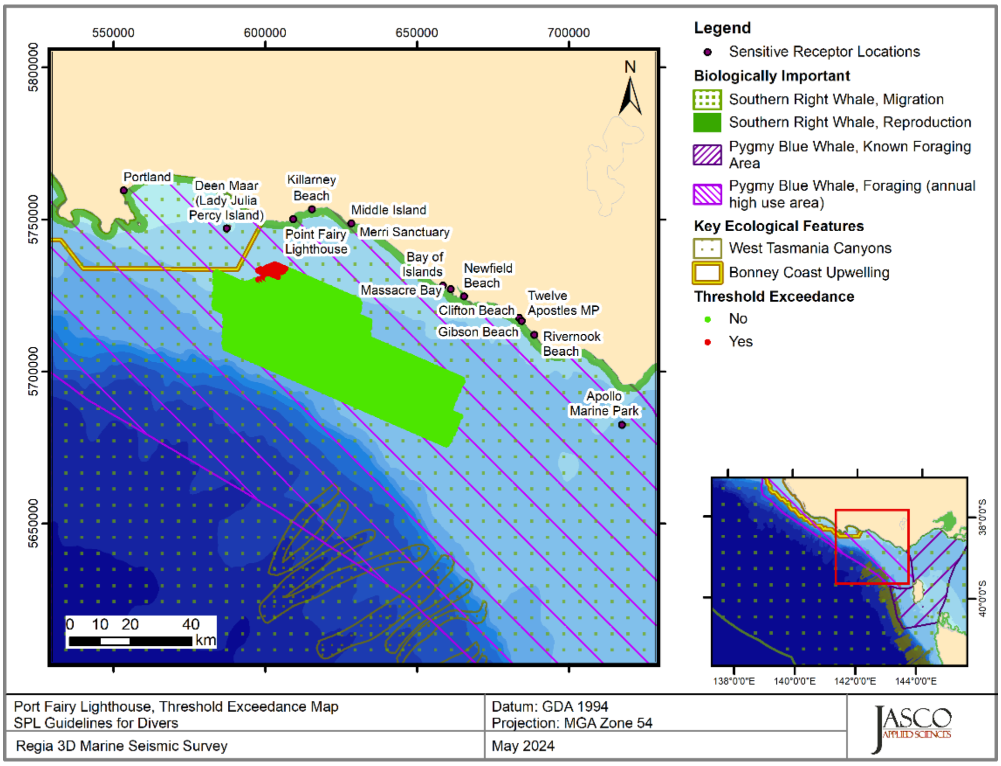

Figure 41. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Port Fairy Lighthouse is exceeded.

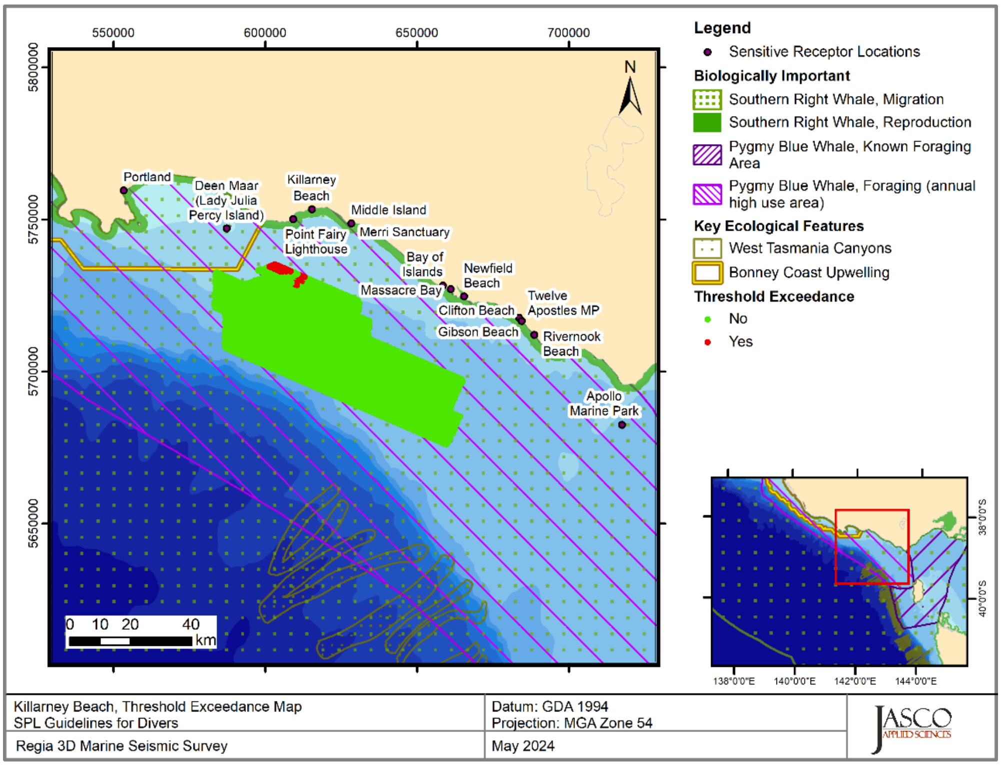

Figure 42. *SPL, 2820 in^3 source,* seismic impulse locations where the human health assessment threshold at Killarney Beach is exceeded.

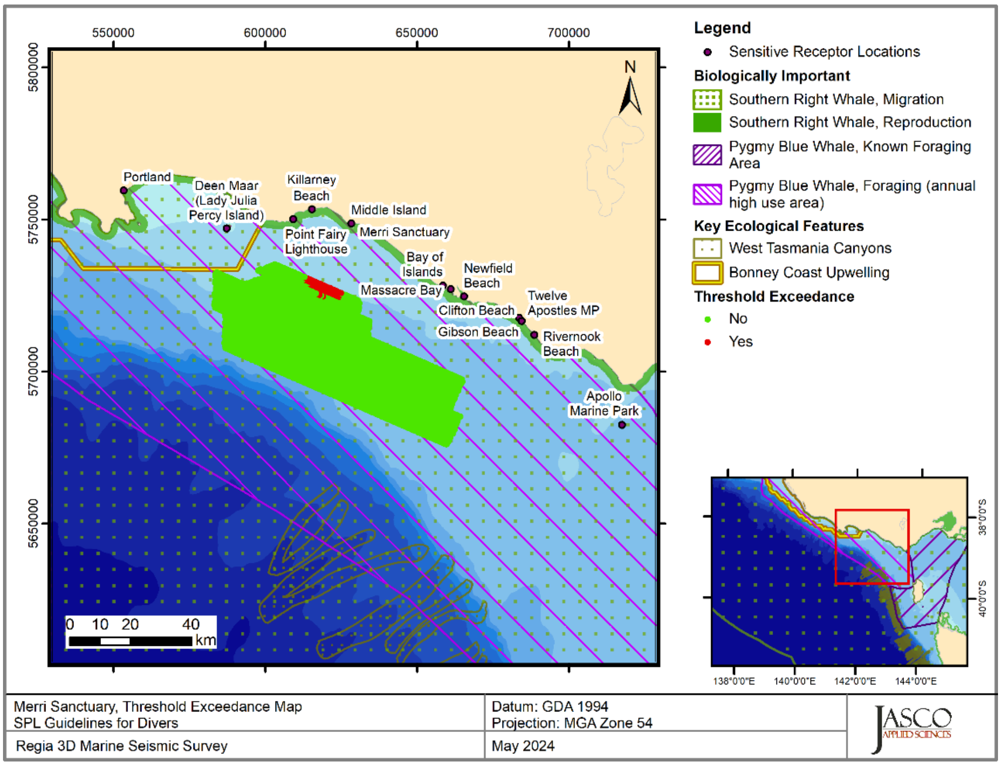

Figure 43. *SPL, 2820 in^3 source,* seismic impulse locations where the human health assessment threshold at Merri Sanctuary is exceeded.

4.3. Multiple Source Fields

This section presents the sound fields in terms of SEL accumulated over 24 h for the modelled scenarios (Section 0). Frequency-weighted SEL_{24h} sound fields were used to estimate the maximum horizontal distances (R_{max}) to marine mammal and sea turtle PTS and TTS thresholds (listed in Table 20), and to estimate maximum distance and the area for injury and TTS guidelines for fish (Table 21).

The SEL_{24h} sound fields are presented as contour maps in Figures 44–46. These figures present the unweighted SEL_{24h} in 10 dB steps, as well as the isopleths corresponding to thresholds or guidelines that are large enough to be resolved on a map.

4.3.1. Tabulated Results

Table 20. Maximum-over-depth horizontal distances (R_{max}, in km) to frequency-weighted 24 h sound exposure level (SEL_{24h}) marine mammal and turtle thresholds, and the corresponding area ensonified above the respective threshold (in km^2). Thresholds provided are based on permanent threshold shift (PTS) and temporary threshold shift (TTS) for marine mammals (Southall et al. 2019) and sea turtles (Finneran et al. 2017).

Hearing group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Scenario A		Scenario B		Scenario C		Scenario D	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
PTS									
LF cetaceans	183	5.07	438.2	4.55	385.4	2.43	215.4	1.00	200.1
HF cetaceans	185	–	–	–	–	–	–	–	–
VHF cetaceans	155	0.07	6.91	0.07	7.96	0.07	16.4	0.07	15.6
Otariid Pinnipeds	203	–	–	–	–	–	–	–	–
Penguins	203	–	–	–	–	–	–	–	–
Sea turtles	204	0.07	7.17	0.07	8.22	0.07	16.5	0.07	15.6
TTS									
LF cetaceans	168	41.9	3230	35.4	2991	20.5	2148	28.6	2916
HF cetaceans	170	0.05	1.55	0.05	0.80	0.03	0.06	0.04	0.09
VHF cetaceans	140	0.35	56.0	0.34	50.9	0.23	59.5	0.19	50.7
Otariid Pinnipeds	188	0.06	2.16	0.06	1.79	0.06	2.02	0.05	1.97
Penguins	188	0.06	2.16	0.06	1.79	0.06	2.02	0.05	1.97
Sea turtles	189	3.35	340.0	3.20	275.2	1.67	168.3	0.60	149.6

A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Table 21. Maximum-over depth horizontal distances (R_{max}, in km) to 24 h sound exposure level (SEL_{24h}) fish thresholds, and the corresponding area ensonified above the respective threshold (in km^2). Thresholds provided are based on injury and temporary threshold shift (TTS) (Popper et al., 2014).

Hearing group	Threshold for SEL_{24h} ($L_{E,24h}$; dB re 1 µPa²·s)	Scenario A		Scenario B		Scenario C		Scenario D	
		R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)	R_{max} (km)	Area (km²)
Mortality and potential mortal injury									
Fish I	219	0.06	4.57	0.06	5.33	0.06	8.88	0.06	8.45
Fish II, fish eggs and fish larvae	210	0.07	7.24	0.07	8.40	0.07	17.2	0.07	15.6
Fish III	207	0.07	7.66	0.07	8.95	0.07	17.7	0.07	15.6
Fish recoverable injury									
Fish I	216	0.06	5.11	0.06	6.6	0.06	14.1	0.06	12.0
Fish II, III	203	0.12	15.3	0.11	13.7	0.07	19.0	0.07	16.7
Fish TTS									
Fish I, II, III	186	8.35	665.3	7.22	622.4	4.90	468.9	3.9	584.1

Fish I–No swim bladder; Fish II–Swim bladder not involved with hearing; Fish III–Swim bladder involved with hearing.

4.3.2. Sound Level Contour Maps

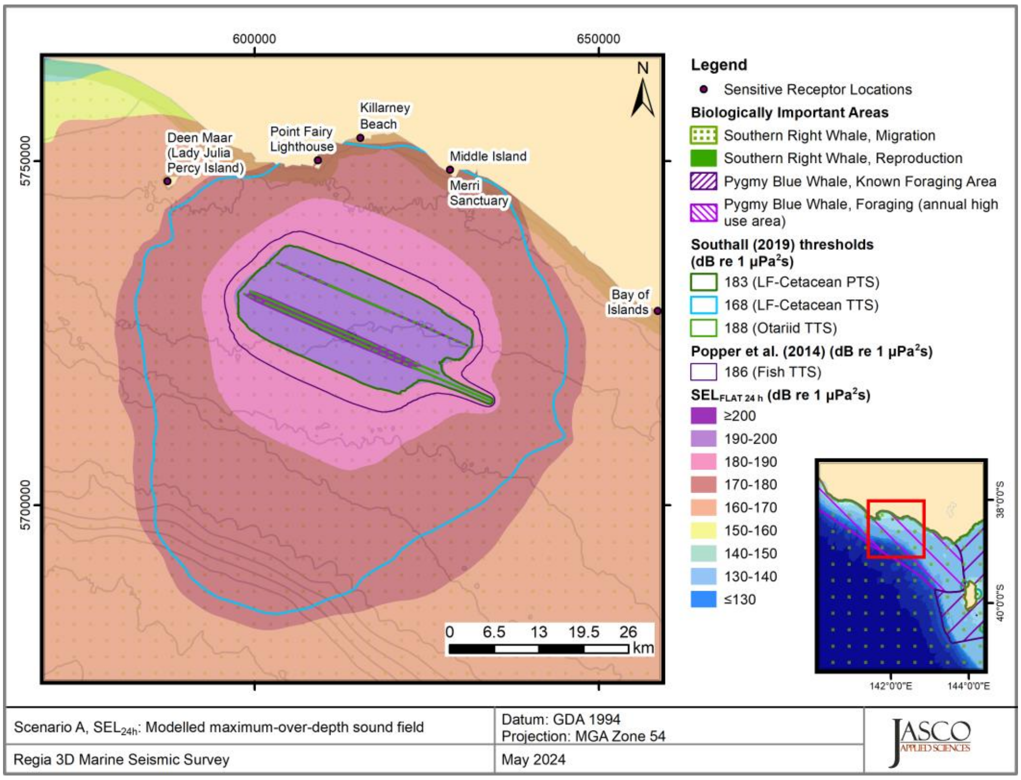

Figure 44. *Scenario A*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

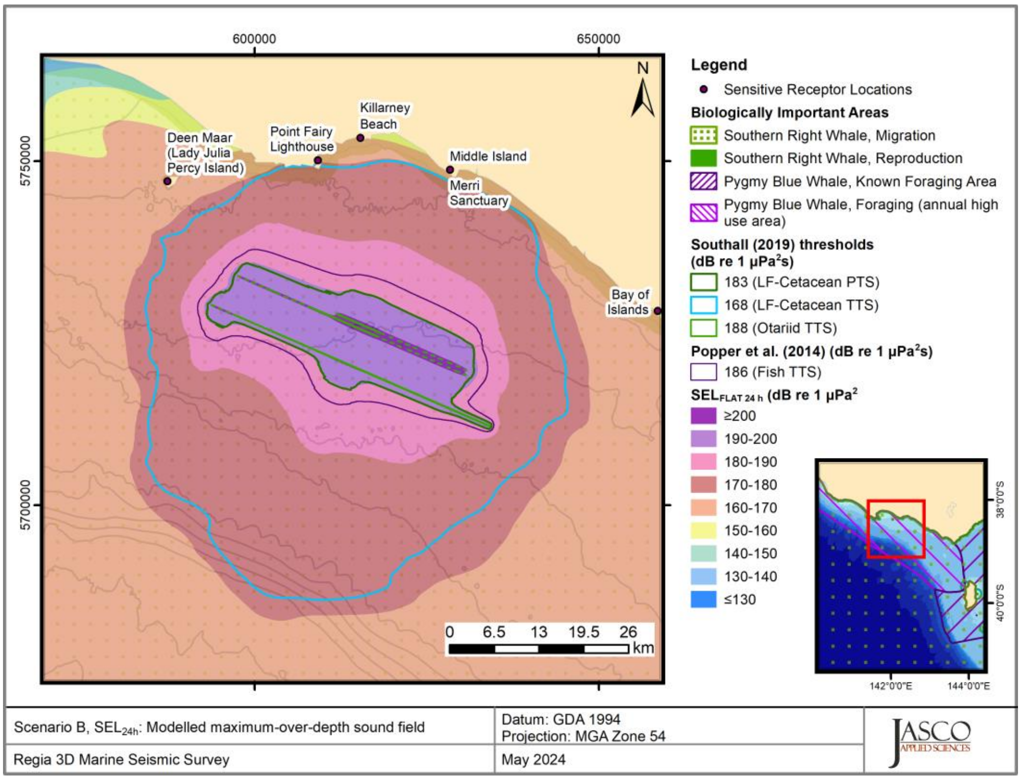

Figure 45*. Scenario B*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

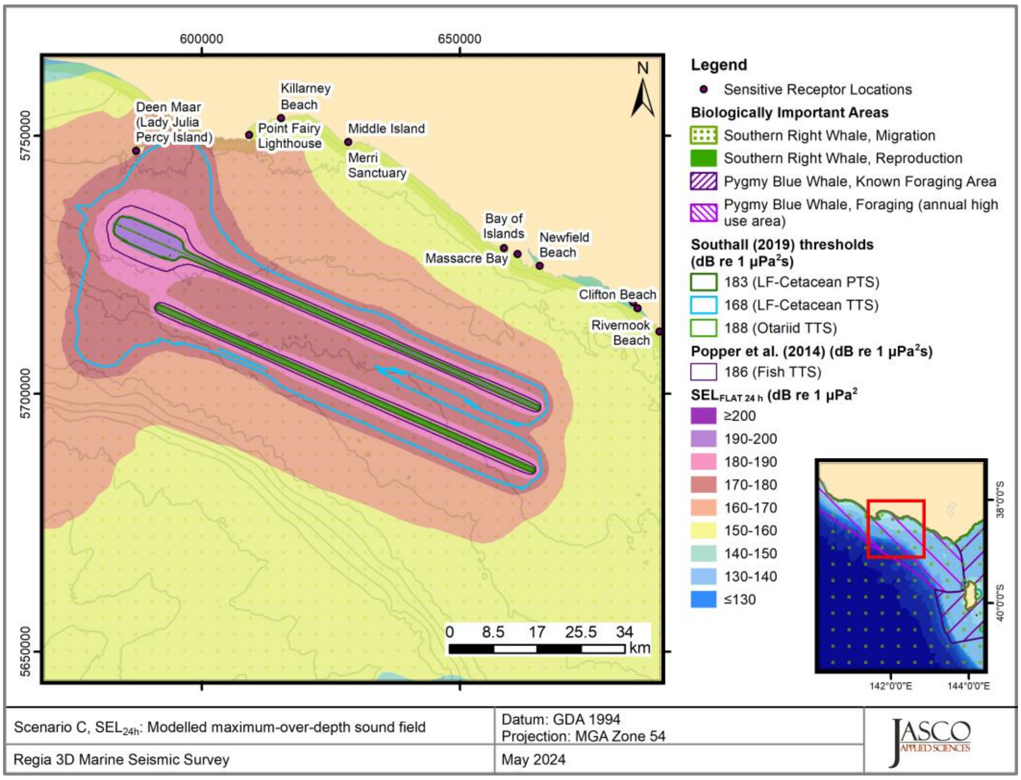

Figure 46*. Scenario C*, sound level contour map of unweighted maximum-over-depth SEL_{24h} results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

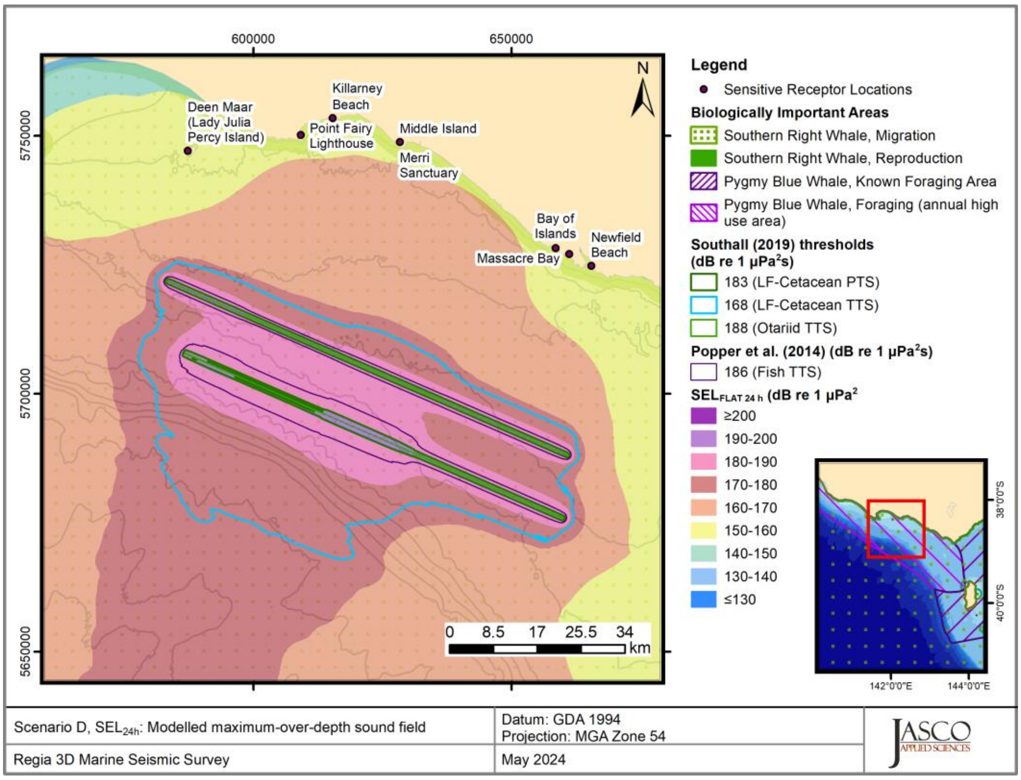

Figure 47. *Scenario D*, sound level contour map of unweighted maximum-over-depth SEL24h results, along with isopleths for marine mammals and fish. Thresholds omitted here were not reached or not large enough to display graphically. Refer to Tables 20 and 21 for threshold distances.

4.4. Animal Movement Exposure Ranges

A summary of radial distances to exposure thresholds for pygmy blue whales and southern right whales, along with probability of exposure for each modelled scenario (Section 0), are included below. Table 22 shows results for scenarios with pygmy blue whale animats with unrestricted seeding, seeding restricted to their foraging BIA, and seeding restricted to the shelf. Tables 23 and 24 show results for scenarios with southern right whale animats within their migration BIA (which is equivalent to unrestricted seeding) and within their reproduction BIA (both unrestricted and restricted seeding), respectively. Reproducing southern right whales restricted to the reproduction BIA were not exposed above any of the three thresholds (PTS, TTS or behavioural response), except in scenario A where SRWs (without a calf) restricted to the reproduction BIA were exposed within 14.2 km with a probability of exposure of 1%. Results include $ER_{95\%}$ exposure ranges calculated for the 160 dB behavioural response threshold and SEL_{24h} thresholds for both TTS and PTS, and the probability of an animat being exposed above the threshold within the $ER_{95\%}$.

Exposure ranges for TTS and PTS PK thresholds were not included in the exposure analysis since acoustic modelling predicted the PK exceedance distances are small and close to the source (see Table 15) such that only minor differences are expected between acoustic and animat exposure predictions.

Sections 4.4.1 and 4.4.2 include histograms of CPA ranges to SEL_{24h} PTS, TTS, and the behavioural response threshold for Scenario A. Additional histograms for the remaining scenarios can be found in Appendix F.

Table 22. Summary of animat simulation results for pygmy blue whales. The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A				Scenario B				Scenario C				Scenario D			
	Female		Male		Female		Male		Female		Male		Female		Male	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
Unrestricted seeding																
PTS (SEL_{24h})[1]	1.98	58	1.88	59	1.67	52	1.60	57	0.70	43	0.82	34	0.33	65	0.33	65
TTS (SEL_{24h})[2]	21.6	57	20.9	58	18.3	59	18.0	59	10.8	35	10.1	36	8.85	59	8.84	57
Behavioural response (SPL)[3]	9.63	77	9.67	78	9.54	77	9.40	77	8.13	47	8.38	45	6.68	64	6.79	63
Seeding restricted to PBW foraging BIA																
PTS (SEL_{24h})[1]	1.88	61	1.93	59	1.62	55	1.71	51	0.79	38	0.83	36	0.33	68	0.34	65
TTS (SEL_{24h})[2]	21.7	57	21.3	57	18.2	60	17.8	60	10.4	36	10.2	36	8.79	59	8.73	59
Behavioural response (SPL)[3]	9.78	77	9.83	76	9.51	76	9.45	77	8.08	46	8.16	46	6.81	63	6.69	63
Seeding restricted to shelf																
PTS (SEL_{24h})[1]	1.90	62	1.91	60	1.73	50	1.61	55	0.68	45	0.67	45	0.37	59	0.33	64
TTS (SEL_{24h})[2]	22.5	56	21.6	57	18.9	57	18.3	59	10.3	36	10.4	36	8.15	62	8.23	60
Behavioural response (SPL)[3]	9.63	78	9.72	77	9.49	78	9.53	77	8.37	45	8.11	46	6.44	66	6.40	66

[1] LF-weighted SEL_{24h} (183 dB re 1 μPa²·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 μPa²·s) (Southall et al.)
[3] SPL (160 dB re 1 μPa²) (NOAA (2019))

Table 23. Summary of animat simulation results for migrating southern right whales. The 95th percentile exposures ranges ($ER_{95\%}$) in km and probability of animats being exposed above threshold within the $ER_{95\%}$ (P_{exp} (%)) are provided.

Noise Effect Criteria Description	Scenario A				Scenario B				Scenario C				Scenario D			
	with calf		without calf		with calf		without calf		with calf		without calf		with calf		without calf	
	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)	$ER_{95\%}$ (km)	P_{exp} (%)
Unrestricted seeding																
PTS (SEL_{24h})[1]	1.40	52	0.88	50	1.22	44	0.89	48	0.50	34	0.69	26	0.22	48	0.24	51
TTS (SEL_{24h})[2]	13.2	64	10.3	78	11.3	64	10.3	64	6.21	39	5.82	39	5.81	62	6.23	58
Behavioural response (SPL)[3]	9.38	79	9.51	83	8.86	72	8.91	73	5.85	52	5.35	57	6.60	62	6.84	63

[1] LF-weighted SEL_{24h} (183 dB re 1 μPa²·s) (Southall et al. (2019))
[2] LF-weighted SEL_{24h} (168 dB re 1 μPa²·s) (Southall et al. 2019)
[3] SPL (160 dB re 1 μPa²) (NOAA (2019))

Table 24. Summary of animat simulation results for aggregating southern right whales. The 95th percentile exposures ranges (ER$_{95\%}$) in km and probability of animats being exposed above threshold within the ER$_{95\%}$ (P$_{exp}$ (%)) are provided.

Noise Effect Criteria Description	Scenario A				Scenario B				Scenario C				Scenario D			
	with calf		without calf		with calf		without calf		with calf		without calf		with calf		without calf	
	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)	ER$_{95\%}$ (km)	P$_{exp}$ (%)
Unrestricted seeding																
PTS (SEL$_{24h}$)[1]	1.26	55	1.25	60	1.09	48	1.08	53	0.41	40	0.42	41	0.19	53	0.20	46
TTS (SEL$_{24h}$)[2]	13.2	61	13.2	61	11.1	64	11.3	64	7.10	35	6.83	36	6.13	57	6.14	57
Behavioural response (SPL)[3]	9.14	73	9.38	74	8.85	73	8.97	74	7.33	44	7.39	47	6.44	59	6.55	62
Seeding restricted to SRW reproduction BIA																
PTS (SEL$_{24h}$)[1]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TTS (SEL$_{24h}$)[2]	0	0	14.2	1	0	0	0	0	0	0	0	0	0	0	0	0
Behavioural response (SPL)[3]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

[1] LF-weighted SEL$_{24h}$ (183 dB re 1 µPa^2·s) (Southall et al. (2019))
[2] LF-weighted SEL$_{24h}$ (168 dB re 1 µPa^2·s) (Southall et al.)
[3] SPL (160 dB re 1 µPa^2) (NOAA (2019))

4.4.1. Exposure Range Histograms: Pygmy Blue Whales

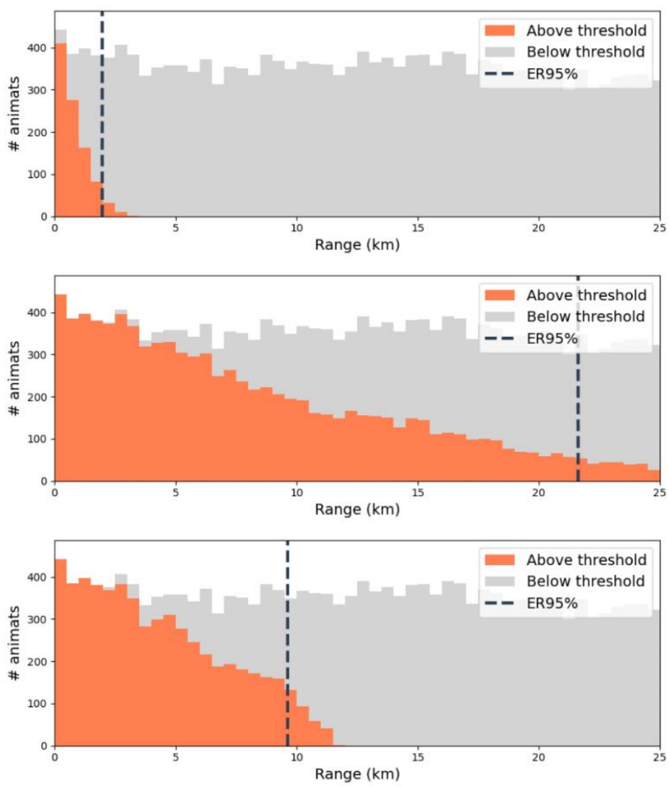

Figure 48. *Scenario A, female pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL$_{24h}$ PTS threshold (top panel), SEL$_{24h}$ TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

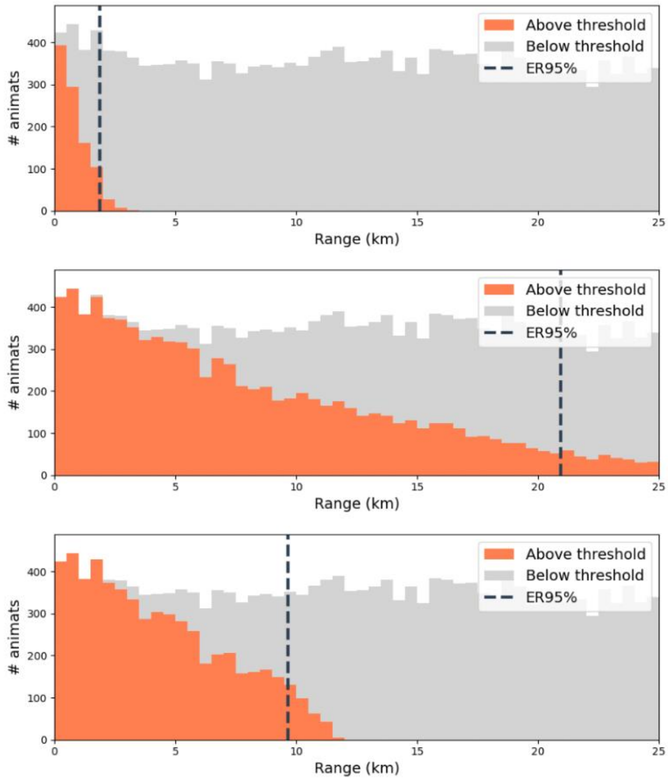

Figure 49. *Scenario A, male pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

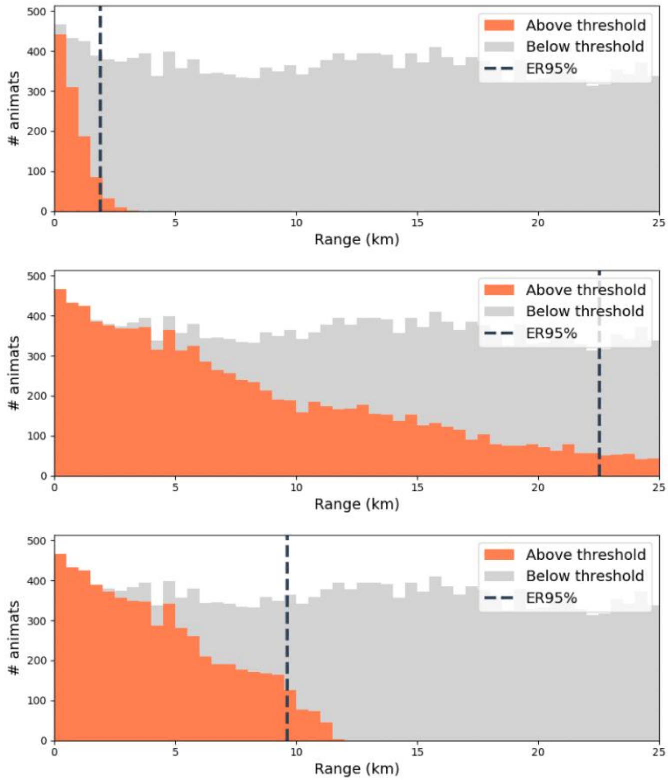

Figure 50. *Scenario A, female pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

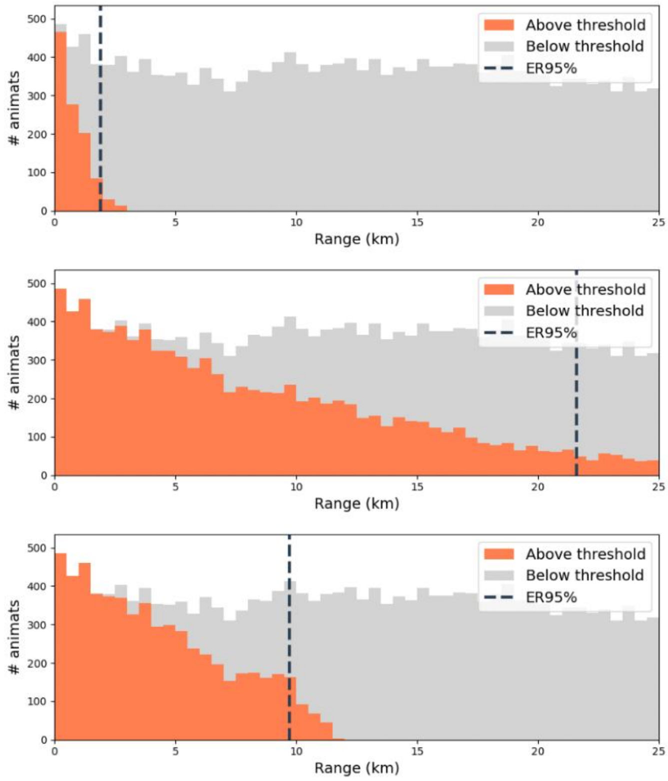

Figure 51. *Scenario A, male pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

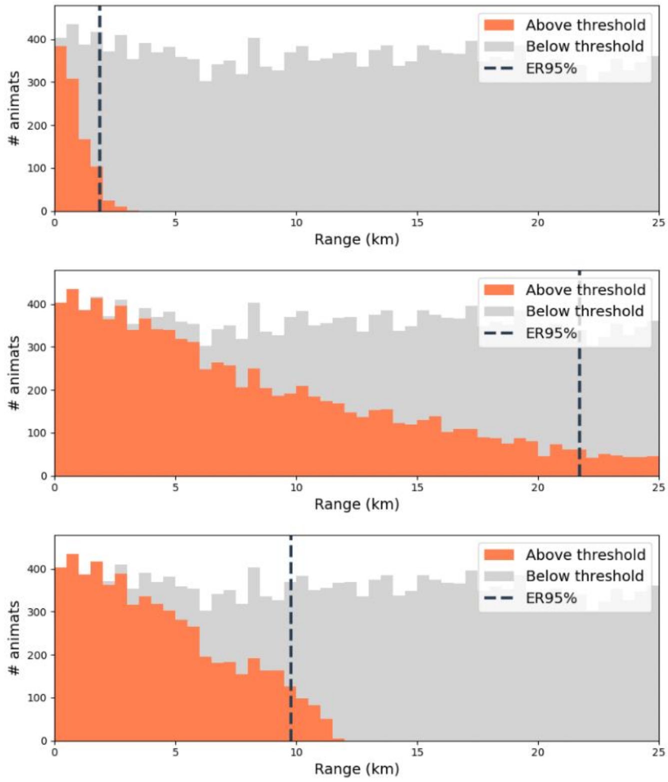

Figure 52. *Scenario A, female pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

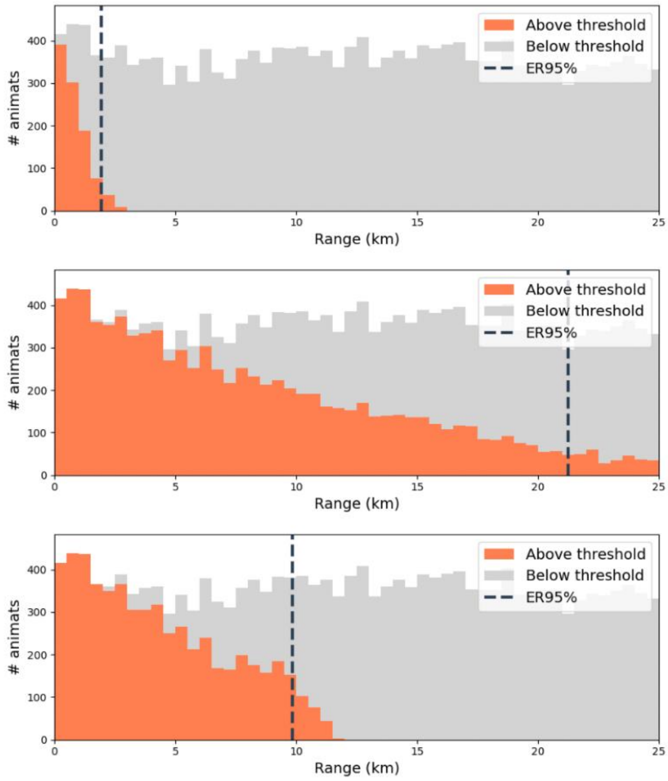

Figure 53. *Scenario A, male pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

4.4.2. Exposure Range Histograms: Southern Right Whales

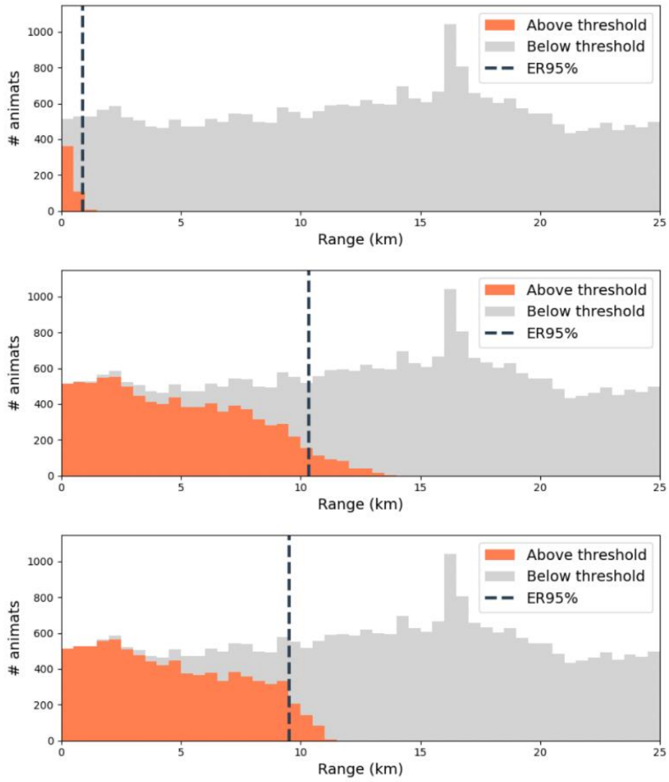

Figure 54. *Scenario A, migrating southern right whale animats, no calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

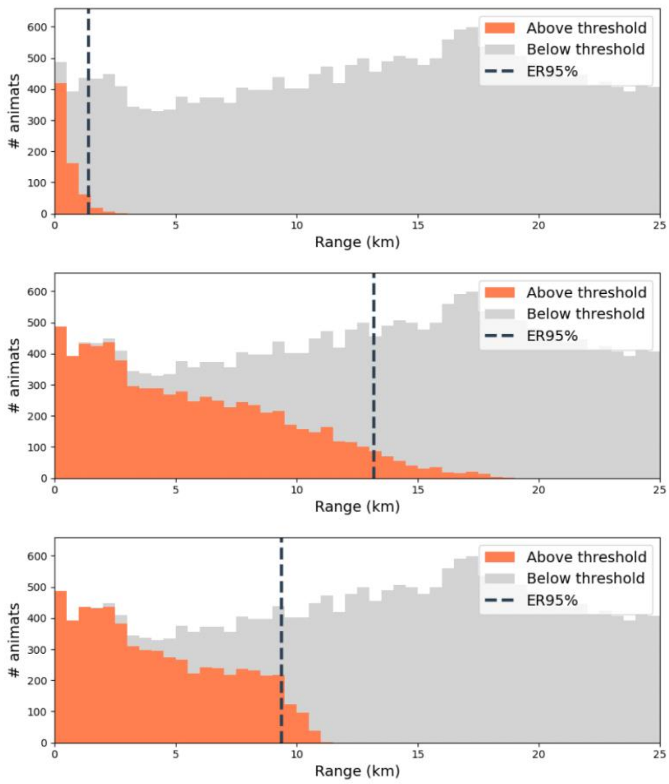

Figure 55. *Scenario A, migrating southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

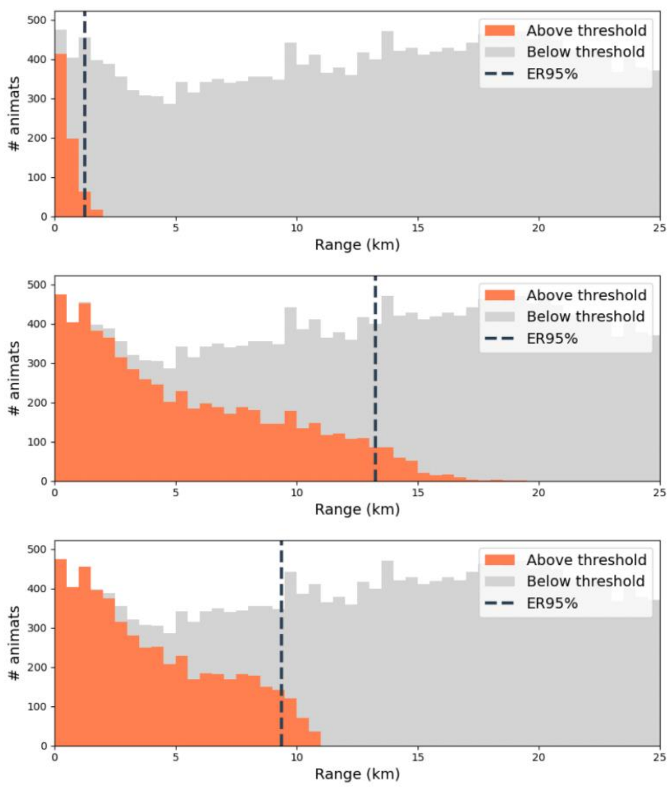

Figure 56. *Scenario A, reproducing southern right whale animats, no calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

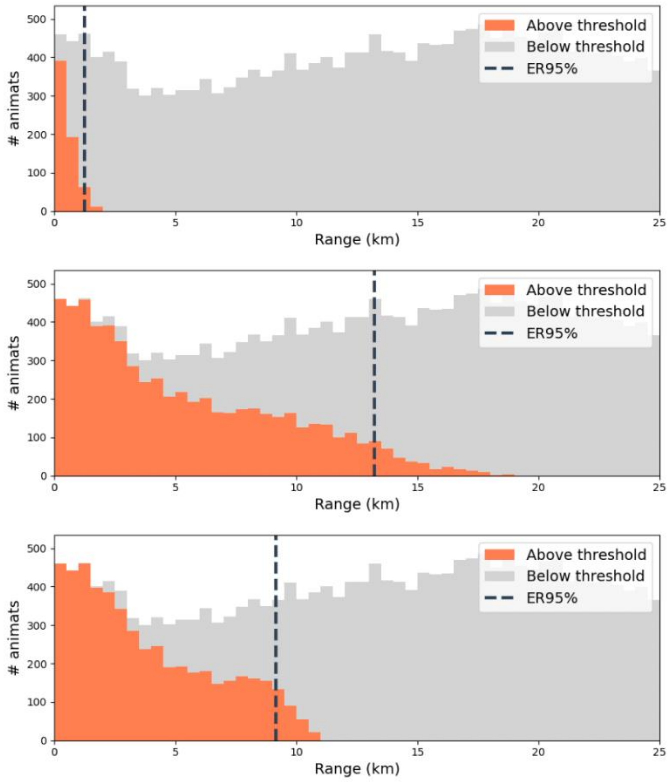

Figure 57. *Scenario A, reproducing southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

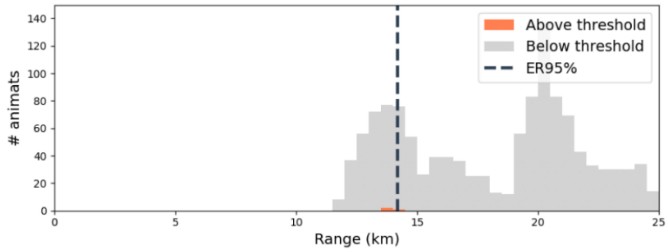

Figure 58. *Scenario A, reproducing southern right whale animats, no calf, restricted to reproduction BIA*: CPA range histogram for animats, SEL_{24h} TTS threshold. Bar colours indicate whether the animats exceeded the threshold.

5. Discussion and Summary

The modelling study predicted underwater sound levels associated with the planned Regia MSS. The underwater sound field from a 2820 in^3 seismic source was modelled (Appendix B.2). An analysis of seasonal sound speed profiles and associated sensitivity comparison indicated that June was likely to be the month most conductive to sound propagation, and hence was selected to ensure a conservative estimation of distances to received sound level (Appendix D.3.2). Modelling also accounted for site-specific bathymetric variations (Appendix D.3.1) and local geoacoustic properties (Appendix D.3.3).

Most acoustic energy from a seismic source is output at lower frequencies, in the tens to hundreds of hertz. The modelled array had a pronounced broadside directivity for decidecade bands between ~100 to 400 Hz (Appendix B.3), which caused a noticeable axial bulge in the modelled acoustic footprints. The overall broadband (10–25000 Hz) unweighted per-pulse SEL and peak pressure source levels of the seismic source operating at 7 m depth are detailed in Table 11.

5.1. Per-Pulse Sound Fields

The single-impulse modelled sites span water depths of 49–174 m across three different geological regions. The bathymetry within the vicinity of the survey varied between approximately 20–150 m; however, along a south-westward transect the environment generally transitions from shallower water of the Otway Shelf to the significantly deeper waters of the continental slope and abyssal plane (>1000 m). The frequency content of the seismic sources coupled with the bathymetry had a considerable effect on propagation at longer distances, with larger lobes of sound energy extending into the deeper waters. The maximum-over-depth sound footprint maps and vertical slice plots (Sections 4.2.2.1 and 4.2.2.2) assist in demonstrating the influence of the bathymetry and seabed composition on the sound field.

The geological profile for single-impulse modelled sites in water depths less than 65 m, consisted of a sand layer underlain by variably cemented limestone (calcarenite). Literature suggests that the sand layer likely begins to thin as water depths increase in an offshore direction, and for water depths greater than 65 m it was considered absent with only the variably cemented calcarenite present at the seafloor interface. Modelled sites located in environments where the seabed was modelled as bare calcarenite generally displayed higher rates of loss with distance away from the source as compared to sites where a layer of sand overlies calcarenite.

The presence of unconsolidated coarse sand overlying semi-cemented calcarenite led to a more reflective seabed which is associated with large isopleths for low level thresholds. This is most evident for the marine mammal behavioural threshold of 160 dB re 1 µPa^2 (SPL) for impulsive sound sources. However, the distribution of a sand layer is not well known and if the thickness of the sand layer is not as uniform as modelled then this variability could potentially lead to smaller radii. It is possible to model a transitioning seabed type, where the sand layer mentioned above thins with distance; however, sufficient information was not available to make that discrimination to develop reliable model inputs.

The array directionality and frequency content coupled with the bathymetry had a considerable effect on propagation at longer distances, with larger lobes of sound energy extending into the deeper waters for all modelled sites. This is particularly evident for modelled Sites 8 and 9 which are situated along the continental shelf break and continental slope. For source locations close to the continental shelf break modelling indicates that significant amounts of energy reflected from the seabed slope can be trapped in the deep sound channel and propagate for large distances within the ocean interior. This phenomenon is evident in the slice plots showing the sound field in the broadside direction, where greater ranges to all isopleths are predicted to occur in the downward sloping offshore direction. The vertical slice plots in Section 4.2.2.2 assist in demonstrating the influence of the sloping bathymetry on the sound field.

5.2. Multiple Pulse Sound Fields

The accumulated SEL over 24 hours of survey operation was modelled considering four acoustic scenarios and four animal movement modelling scenarios, each with a realistic acquisition pattern based on provided survey designs. The modelling predicted the accumulation of sound energy, considering the change in location and the tow direction of the source at each pulse point, which was used to assess possible injury in marine mammals and the SEL_{24h} based fish criteria. The results were presented as maps of the accumulated exposure levels and tabulated values of ranges to threshold levels and exposure areas for the given effects criteria (Section 2).

The footprints and range maxima for all accumulated SEL thresholds are influenced by the seabed compositions along acquisition lines. The discussion above regarding ranges to isopleths also applies to the accumulated SEL calculations. The farthest ranges to thresholds for PTS and TTS were driven by the source orientation and bathymetry, particularly in the broadside and offshore directions.

5.3. Acoustic Results Summary

This section presents a summary of the distances to the noise effect criteria applied in this study (Section 2) as relevant to the impact assessment. The effect criteria for impairment of marine mammals, fish and sea turtles use dual metrics (PK and SEL_{24h}), and the longest distance associated with either metric is required to be applied, and thus is presented in this summary.

The SEL_{24h} is a cumulative metric that reflects the dosimetric effect of noise levels within 24 h based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. Where the corresponding SEL_{24h} radii are larger than those for peak pressure criteria, they often represent an unlikely worst-case scenario. More realistically, marine mammals, fish, and sea turtles would not remain in the same location for 24 hours, but rather a shorter period, depending upon their behaviour, the proximity and movements of the source. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be impaired, but rather that an animal could be exposed to the sound level associated with impairment (either PTS or TTS) if it remained in that location for 24 h. A more realistic representation of the potential exposures was undertaken using animal movement modelling (‘animat modelling’), with the results summarised separately below.

A summary of predicted distances to criteria from acoustic modelling are presented below.

Marine Mammals

Table 25 summarises the distances to where effect criteria for marine mammals are no longer exceeded. Full results for PK levels were presented in Table 15, while SEL_{24h} results were presented in Table 20.

Table 25. Summary of maximum (R_{max}) horizontal distances (in km) from modelled sites or scenarios to behavioural response thresholds and temporary threshold shift (TTS) and permanent threshold shift (PTS) for marine mammals. Maximum extents are in the broadside direction of the 2820 in^3 seismic source.

Hearing group	Maximum modelled distance to effect threshold (R_{max})								
	Behavioural response[1]	Scenario A		Scenario B		Scenario C		Scenario D	
		TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)	TTS[2] (km)	PTS[2] (km)
Low-frequency cetaceans	11.8 (SPL)	41.9 (SEL_{24h})	5.07 (SEL_{24h})	35.4 (SEL_{24h})	4.55 (SEL_{24h})	20.5 (SEL_{24h})	2.43 (SEL_{24h})	28.6 (SEL_{24h})	1.00 (SEL_{24h})
High-frequency cetaceans		0.05 (SEL_{24h})	–	0.05 (SEL_{24h})	–	0.03 (SEL_{24h})	–	0.04 (SEL_{24h})	–
Very high-frequency cetaceans		0.82 (PK)	0.41 (PK)	0.82 (PK)	0.41 (PK)	0.79 (PK)	0.39 (PK)	0.71 (PK)	0.37 (PK)
Otariid Pinnipeds		0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.06 (SEL_{24h})	–	0.05 (SEL_{24h})	–

Noise exposure criteria: [1] NOAA (2019) and [2] Southall et al. (2019).
A dash indicates the threshold was not reached within the limits of the modelling resolution (20 m).

Sea Turtles

Table 26 summarises the distances to where effect criteria for sea turtles are no longer exceeded, with the results for behavioural thresholds presented in Table 3 while SEL_{24h} results are in Table 20.

Table 26. Summary of horizontal distances (in km) to turtle behavioural response criteria, temporary threshold shift (TTS), and permanent threshold shift (PTS).

Hearing group	Maximum modelled distance to effect threshold (R_{max})									
	Behavioural response[1]	Behavioural disturbance[1]	Scenario A		Scenario B		Scenario C		Scenario D	
			TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]	TTS[2]	PTS[2]
Sea Turtles	6.30 (SPL)	2.62 (SPL)	3.35 (SEL_{24h})	0.07 (SEL_{24h})	3.20 (SEL_{24h})	0.07 (SEL_{24h})	1.67 (SEL_{24h})	0.07 (SEL_{24h})	0.60 (SEL_{24h})	0.07 (SEL_{24h})

Noise exposure criteria: [1] McCauley et al. (2000), and [2] Finneran et al. (2017)

Penguins

- The maximum distance to where the OCW-weighted penguin TTS SEL_{24h} threshold of 188 dB re 1 µPa^{2}s was no longer exceeded was 0.06 km for scenarios A–C and 0.05 km for scenario D. PTS and PK thresholds were not resolved within the modelled resolution of 20 m. As is the case with marine mammals, a reported radius for SEL_{24h} criteria does not mean that a penguin underwater travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with either PTS or TTS if it remained in that location for 24 hours.

- The maximum distance where the OCW-weighted penguin behavioural response threshold of 120 dB re 1 μPa^2 (SPL) for impulsive noise could be exceeded varied between 10.4 and 77.0 km for the 2820 in^3 seismic source, depending on modelled site.

Fish, fish eggs, and fish larvae

- This modelling study assessed the ranges for quantitative criteria based on Popper et al. (2014) and considered both PK (seafloor and water column) and SEL_{24h} metrics associated with mortality and potential mortal injury as well as impairment in the following groups:
  - Fish without a swim bladder (also appropriate for sharks in the absence of other information),
  - Fish with a swim bladder that do not use it for hearing,
  - Fish that use their swim bladders for hearing,
  - Fish eggs and fish larvae.
- Table 27 summarises distances to effect criteria for fish, fish eggs, and fish larvae along with the relevant metric. Results for PK are presented in Tables 15 whilst SEL_{24h} results are in Tables 21.

Table 27. Summary of maximum fish, fish eggs, and larvae injury and temporary threshold shift (TTS) onset distances for single impulse and 24 hr sound exposure level (SEL_{24h}) modelled scenarios.

Relevant hearing group	Effect criteria	Water column	
		Metric associated with longest distance to criteria	R_{max} (km)
Fish: No swim bladder	Mortality and Potential Mortal Injury	PK	0.11
	Recoverable injury	PK	0.11
	TTS	SEL_{24h}	8.35
Fish: Swim bladder not involved in hearing and Swim bladder involved in hearing	Mortality and Potential Mortal Injury	PK	0.21
	Recoverable injury	PK	0.23
	TTS	SEL_{24h}	8.35
Fish eggs, and larvae (relevant to plankton)	Mortality and Potential Mortal Injury	PK	0.23

Benthic invertebrates

To assist with assessing the potential effects on these receptors, the following results were determined:

- Crustaceans: The sound level of 202 dB re 1 μPa PK-PK from Payne et al. (2008), which is representative of no effects, was considered for seafloor sound levels; the sound level was reached at ranges between 322 and 715 m for the 2820 in^3 source.
- Bivalves: The distance where a particle acceleration of 37.57 ms^{-2} at the seafloor could occur was determined for comparing to results presented in Day et al. (2016a). This particle acceleration was

reached at a range of 4 m for a water depth of 50 m, and was not reached at any greater water depth.

- Sponges and coral: The PK sound level at the seafloor directly underneath the seismic source was estimated at all modelled sites and compared to the sound level of 226 dB re 1 µPa PK for sponges and corals (Heyward et al. 2018); the threshold was not reached in water depths greater than 50

Divers and Swimmers

An SPL human health assessment of 145 dB re 1 µPa^2 (SPL; L_P) derived from (Parvin 2005) was considered for recreational swimmers and divers. This criterion was considered for all single-impulse modelled sites and cumulative scenarios, and specifically at 14 coastal sensitive receiver locations. The human health assessment threshold was predicted to be exceeded at Deen Maar (Lady Julia Percy Island), Middle Island, Port Fairy Lighthouse, Killarney Beach and Merri Sanctuary. It is important to review the provided contour maps (Section 4.2.2.1) and sensitive receiver maps (Section 4.2.2.3, Appendix G) to contextualise levels at coastal areas and understand which portions of the survey may result in the human health assessment level being exceeded.

5.4. Animal Movement Modelling

The estimated sound fields produced by source and propagation models for the planned Regia MSS were incorporated into animat sound exposure models for pygmy blue whales and southern right whales to estimate the radial distances within which 95% of exposure exceedances occur ($ER_{95\%}$), along with the probability that an animat with the closest point of approach within that distance would be exposed above the relevant threshold (P_{exp}).

For the exposure analysis, all four acquisition scenarios were run with multiple animat seeding approaches (see Figure 2). Survey lines from all nominal acquisition scenarios overlap with the foraging BIA for pygmy blue whales and migrating BIA for southern right whales. The reproduction BIA for southern right whales lies inshore of the nominal acquisition scenarios.

Sections 5.4.1 and 5.4.2 summarise the PTS, TTS, and behavioural exposure range results, with all tabulated results presented in Tables 22 to 24. Table 28 summarises the maximum exposure range results for pygmy blue whales and southern right whales across the different species profiles and seeding regimes considered. Figure 59 summarises results for each modelled scenario, species profile and seeding regime. Reproducing southern right whales restricted to the reproduction BIA were not exposed above any of the three considered thresholds (PTS, TTS or behavioural response).

Table 28. Summary of animat simulation results for PTS, TTS and SPL behavioural response criteria for pygmy blue whales and southern right whales Maximum exposure ranges show $ER_{95\%}$ (km) first and associated probability of exposure of animats travelling within maximum $ER_{95\%}$ (P_{exp} (%)) in parentheses.

Species	Scenario	Behavioural response (SPL)[4]	TTS (SEL_{24h})[3]	PTS (SEL_{24h})[3]
		160[2]	168[1]	183[1]
Pygmy blue whale	A	9.83 (76%)	22.5 (56%)	1.98 (58%)
	B	9.54 (77%)	18.9 (57%)	1.73 (50%)
	C	8.38 (45%)	10.8 (35%)	0.83 (36%)
	D	6.69 (63%)	8.85 (59%)	0.37 (59%)
Southern right whale	A	9.51 (83%)	14.2 (1%)	1.40 (52%)
	B	8.97 (73%)	11.3 (64%)	1.22 (44%)
	C	7.39 (47%)	7.10 (35%)	0.69 (26%)
	D	6.84 (63%)	6.23 (58%)	0.24 (51%)

1 LF-weighted SEL_{24h} ($L_{E,24h}$; dB re 1 µPa^2·s)
2 SPL (L_p; dB re 1 µPa^2)
3 Southall et al. (2019) criteria for marine fauna.
4 NOAA (2019) recommended unweighted behavioural threshold for marine mammals.

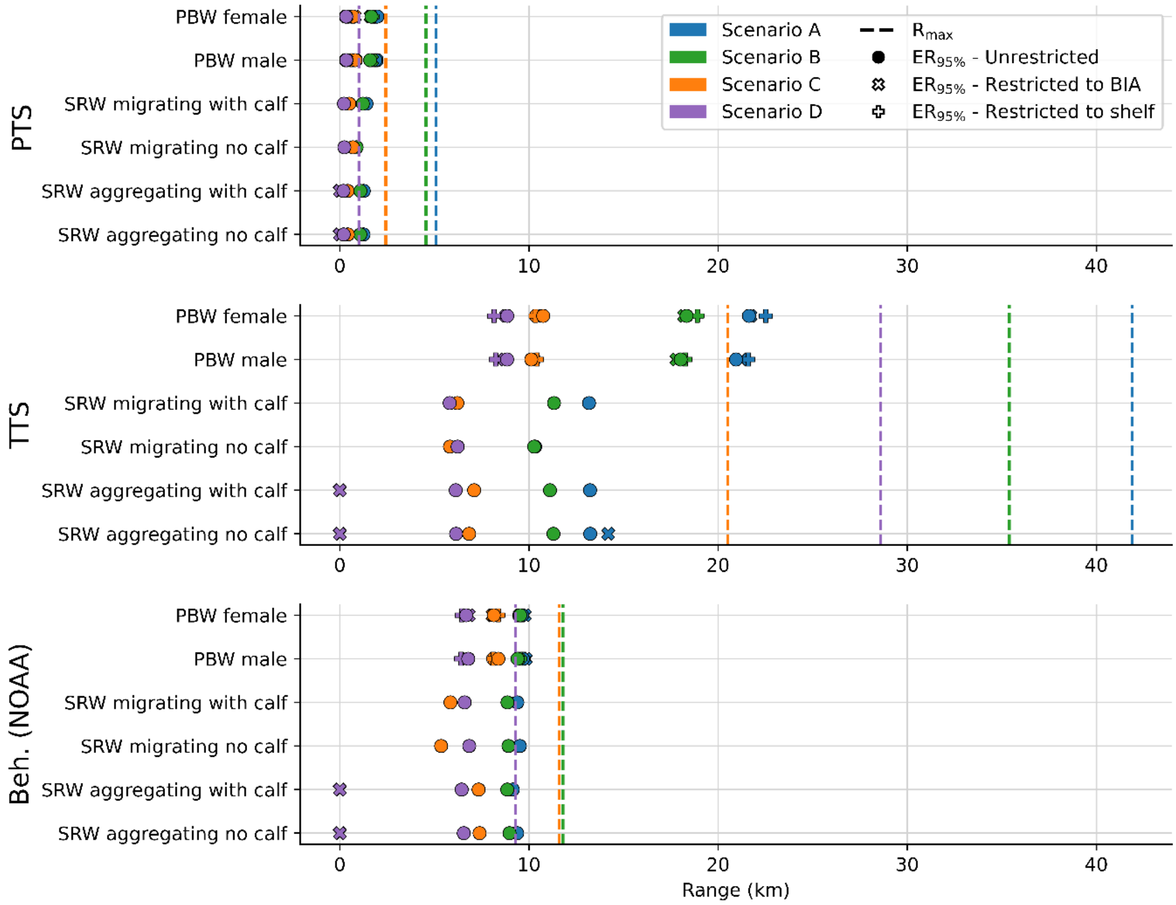

Figure 59. Acoustic (R_{max}) and exposure ranges ($ER_{95\%}$) for PTS, TTS and the behavioural thresholds, shown for each species. Colour represents the acoustic modelled scenario. The "restricted to BIA" sub-set refers to the pygmy blue whale foraging BIA and southern right whale reproduction BIA for pygmy blue whales and southern right whales respectively, presented in Figure 2. The "restricted to shelf" sub-set refers to pygmy blue whales, presented in Figure 2.

5.4.1. PTS and TTS

Exposure ranges from animal movement modelling for PTS and TTS criteria are typically shorter than those predicted using acoustic propagation modelling because of the generally shorter time ('dwell time') for moving animats to accumulate sound energy. In this study, PTS and TTS exposure ranges were substantially shorter than acoustic ranges to threshold, as shown in Figure 59.

All considered scenarios resulted in exposures above the PTS and TTS thresholds with the exception of scenarios B, C and D for reproducing southern right whales restricted to the reproduction BIA.

The maximum $ER_{95\%}$ for pygmy blue whale scenarios was 22.5 and 1.98 km for TTS and PTS, respectively. The associated probability of exposure above threshold within these $ER_{95\%}$ was 56% and 58%, respectively. For southern right whales, the maximum $ER_{95\%}$ for TTS and PTS were 14.2 and 1.40 km, respectively, with associated probabilities of exposure above threshold of 1% and 52%. The fact that some, but not all, animats that travelled within the 95th percentile range were exposed above threshold is because animats alter their horizontal position in the modelling area as well as their vertical position in the water column, thus potentially limiting the length of time they are within ensonified areas. For example, an animat might travel within the predicted exposure range but if they are traveling more quickly on average than other animats, they may not accumulate as much exposure, or they may be spending more time at depths with quieter sound levels.

Female pygmy blue whale scenarios did not result in significantly or consistently different exposure ranges than the corresponding male pygmy blue whale scenarios. Based on the vertical distribution of the sound field (see Section 4.2.2.2), the sound fields are relatively constant with depth, and hence female pygmy blue whale animats accumulated similar exposure as the males even though females generally dive deeper than males (Section 3.7.3.1).

Exposure ranges are not significantly affected by seeding restrictions for pygmy blue whales. This is due to the survey being located within the boundaries of the restricted scenarios (pygmy blue whales foraging BIA and restricted to the shelf). Exposure ranges from the seismic survey were generally comparable or less than the distance to the edge of the restrictions, therefore restricted scenarios resulted in similar exposure ranges as unrestricted scenarios.

No southern right whales restricted to the reproduction BIA were exposed above PTS, TTS or behavioural threshold, except for limited exposures above TTS in scenario A. The SRW reproduction BIA is both narrow and close to shore, and in comparison with the modelled acoustic ranges, relatively little sound energy reaches the BIA. Sufficient sound energy from scenario A reaches the SRW reproduction BIA to result in TTS exposures, however, very few animats were exposed above this threshold (1% probability of exposure above the TTS criterion, Table 24).

The animat modelling was included in the scope of work to provide context to possible exposures to pygmy blue and southern right whales over an entire day. The distances to isopleths associated with the effect thresholds for PTS and TTS are more realistic than those from the static sound fields as they consider potential animal movements passing through the operational region.

5.4.2. Behavioural Effects

Exposure ranges ($ER_{95\%}$) for single exposure metrics, such as the SPL behavioural response criteria, are typically comparable to the predicted acoustic ranges. Maximum acoustic ranges (e.g., R_{max}) are conservatively calculated using the maximum-over-depth sound fields and assuming static receivers, while exposure ranges account for animats sampling the sound field vertically and horizontally based on species-specific diving parameters, so exposure ranges are generally slightly lower than the R_{max} acoustic ranges. In this case, exposure ranges were slightly shorter than acoustic ranges to threshold for most modelled scenarios (Figure 59).

Overall, ranges were longest for Scenario A. For all considered pygmy blue whale scenarios, the $ER_{95\%}$ to behavioural threshold ranged from 6.40 to 9.83 km for pygmy blue whales, with associated P_{exp} of 66 and 76%. For southern right whales, the $ER_{95\%}$ to behavioural threshold ranged from 5.35 to 9.51 km, with associated P_{exp} of 57 and 83%, notwithstanding reproducing southern right whales restricted to the reproduction BIA which were not exposed above the behavioural response threshold.

Glossary

Unless otherwise stated in an entry, these definitions are consistent with ISO 80000-3 (2017).

1/3-octave

One third of an octave. *Note*: A one-third octave is approximately equal to one decidecade (1/3 oct ≈ 1.003 ddec).

1/3-octave-band

Frequency band whose bandwidth is one one-third octave. *Note*: The bandwidth of a one-third octave-band increases with increasing centre frequency.

A-weighting

Frequency-selective weighting for human hearing in air that is derived from the inverse of the idealized 40-phon equal loudness hearing function across frequencies.

absorption

The reduction of acoustic pressure amplitude due to acoustic particle motion energy converting to heat in the propagation medium.

attenuation

The gradual loss of acoustic energy from absorption and scattering as sound propagates through a medium.

auditory frequency weighting

The process of applying an auditory frequency weighting function. In human audiometry, C-weighting is the most commonly used function, an example for marine mammals are the auditory frequency weighting functions published by Southall et al. (2007).

auditory frequency weighting function

Frequency weighting function describing a compensatory approach accounting for a species' (or functional hearing group's) frequency-specific hearing sensitivity. Example hearing groups are low-, mid-, and high-frequency cetaceans, phocid and otariid pinnipeds.

azimuth

A horizontal angle relative to a reference direction, which is often magnetic north or the direction of travel. In navigation it is also called bearing.

bandwidth

The range of frequencies over which a sound occurs. Broadband refers to a source that produces sound over a broad range of frequencies (e.g., seismic airguns, vessels) whereas narrowband sources produce sounds over a narrow frequency range (e.g., sonar) (ANSI S1.13-2005 (R2010)).

bar

Unit of pressure equal to 100 kPa, which is approximately equal to the atmospheric pressure on Earth at sea level. 1 bar is equal to 10^5 Pa or 10^{11} µPa.

boxcar averaging

A signal smoothing technique that returns the averages of consecutive segments of a specified width.

broadband level

The total level measured over a specified frequency range.

broadside direction

Perpendicular to the travel direction of a source. Compare with endfire direction.

cetacean

Any animal in the order Cetacea. These are aquatic species and include whales, dolphins, and porpoises.

compressional wave

A mechanical vibration wave in which the direction of particle motion is parallel to the direction of propagation. Also called primary wave or P-wave.

conductivity-temperature-depth (CTD)

Measurement data of the ocean's conductivity, temperature, and depth; used to compute sound speed and salinity.

decade

Logarithmic frequency interval whose upper bound is ten times larger than its lower bound (ISO 80000-3:2006).

decidecade

One tenth of a decade. *Note*: An alternative name for decidecade (symbol ddec) is "one-tenth decade". A decidecade is approximately equal to one third of an octave (1 ddec ≈ 0.3322 oct) and for this reason is sometimes referred to as a "one-third octave".

decidecade band

Frequency band whose bandwidth is one decidecade. *Note*: The bandwidth of a decidecade band increases with increasing centre frequency.

decibel (dB)

Unit of level used to express the ratio of one value of a power quantity to another on a logarithmic scale. Unit: dB.

duty cycle

The time when sound is periodically recorded by an acoustic recording system.

endfire direction

Parallel to the travel direction of a source. Also see **broadside direction**.

energy source level

A property of a sound source obtained by adding to the sound exposure level measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 $\mu Pa^2 m^2 s$.

energy spectral density source level

A property of a sound source obtained by adding to the energy spectral density level of the sound pressure measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 $\mu Pa^2 m^2 s/Hz$.

ensonified

Exposed to sound.

far field

The zone where, to an observer, sound originating from an array of sources (or a spatially distributed source) appears to radiate from a single point.

Fourier transform (or Fourier synthesis)

A mathematical technique which, although it has varied applications, is referenced in the context of this report as a method used in the process of deriving a spectrum estimate from time-series data (or the reverse process, termed the inverse Fourier transform). A computationally efficient numerical algorithm for computing the Fourier transform is known as fast Fourier transform (FFT).

flat weighting

Term indicating that no frequency weighting function is applied. Synonymous with unweighted.

frequency

The rate of oscillation of a periodic function measured in cycles-per-unit-time. The reciprocal of the period. Unit: hertz (Hz). Symbol: f. 1 Hz is equal to 1 cycle per second.

frequency weighting

The process of applying a frequency weighting function.

frequency-weighting function

The squared magnitude of the sound pressure transfer function. For sound of a given frequency, the frequency weighting function is the ratio of output power to input power of a specified filter, sometimes expressed in decibels. Examples include the following:

- *Auditory frequency weighting function*: compensatory frequency weighting function accounting for a species' (or functional hearing group's) frequency-specific hearing sensitivity.
- *System frequency weighting function*: frequency weighting function describing the sensitivity of an acoustic acquisition system, typically consisting of a hydrophone, one or more amplifiers, and an analogue to digital converter.

geoacoustic

Relating to the acoustic properties of the seabed.

harmonic

A sinusoidal sound component that has a frequency that is an integer multiple of the frequency of a sound to which it is related. For example, the second harmonic of a sound has a frequency that is double the fundamental frequency of the sound.

hearing group

Category of animal species when classified according to their hearing sensitivity and to the susceptibility to sound. Examples for marine mammals include very low-frequency (VLF) cetaceans, low-frequency (LF) cetaceans, mid-frequency (MF) cetaceans, high-frequency (HF) cetaceans, very high-frequency (VHF) cetaceans, otariid pinnipeds in water (OPW), phocid pinnipeds in water (PPW), sirenians (SI), other marine carnivores in air (OCA), and other marine carnivores in water (OCW) (NMFS 2018, Southall et al. 2019). See **auditory frequency weighting functions**, which are often applied to these groups. Examples for fish include species for which the swim bladder is involved in hearing, species for which the swim bladder is not involved in hearing, and species without a swim bladder (Popper et al. 2014).

hearing threshold

The sound pressure level for any frequency of the hearing group that is barely audible for a given individual for specified background noise during a specific percentage of experimental trials.

hertz (Hz)

A unit of frequency defined as one cycle per second.

high-frequency (HF) cetacean

See **hearing group**.

intermittent sound

A sound whose level abruptly drops below the background noise level several times during an observation period.

impulsive sound

Qualitative term meaning sounds that are typically transient, brief (less than 1 second), broadband, with rapid rise time and rapid decay. They can occur in repetition or as a single event. Examples of impulsive sound sources include explosives, seismic airguns, and impact pile drivers.

isopleth

A line drawn on a map through all points having the same value of some quantity.

knot

One nautical mile per hour. Symbol: kn.

level

A measure of a quantity expressed as the logarithm of the ratio of the quantity to a specified reference value of that quantity. Examples include sound pressure level, sound exposure level, and peak sound pressure level. For example, a value of sound exposure level with reference to 1 μPa^2 s can be written in the form x dB re 1 μPa^2 s.

low-frequency (LF) cetacean

See **hearing group**.

median

The 50th percentile of a statistical distribution.

mid-frequency (MF) cetacean

See **hearing group**.

M-weighting

See **auditory frequency weighting function** (as proposed by Southall et al. 2007).

mysticete

A suborder of cetaceans that use baleen plates to filter food from water. Members of this group include rorquals (Balaenopteridae), right whales (Balaenidae), and grey whales (*Eschrichtius robustus*).

non-impulsive sound

Sound that is not an impulsive sound. A non-impulsive sound is not necessarily a continuous sound.

octave

The interval between a sound and another sound with double or half the frequency. For example, one octave above 200 Hz is 400 Hz, and one octave below 200 Hz is 100 Hz.

otariid

A common term used to describe members of the Otariidae, eared seals, commonly called sea lions and fur seals. Otariids are adapted to a semi-aquatic life; they use their large fore flippers for propulsion. Their ears distinguish them from phocids. Otariids are one of the three main groups in the superfamily Pinnipedia; the other two groups are phocids and walrus.

otariid pinnipeds in water (OPW)

See **hearing group**.

other marine carnivores in air (OCA)

See **hearing group**.

other marine carnivores in water (OCW)

See **hearing group**.

parabolic equation method

A computationally efficient solution to the acoustic wave equation that is used to model propagation loss. The parabolic equation approximation omits effects of back-scattered sound, simplifying the computation of propagation loss. The effect of back-scattered sound is negligible for most ocean-acoustic propagation problems.

particle acceleration, particle displacement, particle motion, particle velocity

See sound particle acceleration, sound particle displacement, sound particle motion, and sound particle velocity.

peak sound pressure level (zero-to-peak sound pressure level)

The level ($L_{p,pk}$ or L_{pk}) of the squared maximum magnitude of the sound pressure (p_{pk}^2). Unit: decibel (dB). Reference value (p_0^2) for sound in water: 1 μPa².

$$L_{p,\mathrm{pk}} := 10 \log_{10}\left(p_{\mathrm{pk}}^2 / p_0^2\right) \mathrm{dB} \; = 20 \log_{10}\left(p_{\mathrm{pk}} / p_0\right) \mathrm{dB}$$

The frequency band and time window should be specified. Abbreviation: PK or L_{pk}.

peak-to-peak sound pressure

The difference between the maximum and minimum sound pressure over a specified frequency band and time window. Unit: pascal (Pa).

permanent threshold shift (PTS)

An irreversible loss of hearing sensitivity caused by excessive noise exposure. PTS is considered auditory injury.

phocid

A common term used to describe all members of the family Phocidae. These true/earless seals are more adapted to in-water life than are otariids, which have more terrestrial adaptations. Phocids use their hind flippers to propel themselves. Phocids are one of the three main groups in the superfamily Pinnipedia; the other two groups are otariids and walrus.

phocid pinnipeds in water (PPW)

See **hearing group**.

pinniped

A common term used to describe all three groups that form the superfamily Pinnipedia: phocids (true seals or earless seals), otariids (eared seals or fur seals and sea lions), and walrus.

point source

A source that radiates sound as if from a single point.

pressure, acoustic

The deviation from the ambient pressure caused by a sound wave. Also called sound pressure.
Unit: pascal (Pa).

pressure, hydrostatic

The pressure at any given depth in a static liquid that is the result of the weight of the liquid acting on a unit area at that depth, plus any pressure acting on the surface of the liquid. Unit: pascal (Pa).

propagation loss (PL)

Difference between a source level (SL) and the level at a specified location, PL(x) = SL − L(x). Also see **transmission loss**.

received level

The level measured (or that would be measured) at a defined location. The type of level should be specified.

reference values

standard underwater references values used for calculating sound **levels**, e.g., the reference value for expressing sound pressure level in decibels is 1 µPa.

Quantity	Reference value
Sound pressure	1 µPa
Sound exposure	1 μPa^2 s
Sound particle displacement	1 pm
Sound particle velocity	1 nm/s
Sound particle acceleration	1 $\mu m/s^2$

rms

abbreviation for root-mean-square.

shear wave

A mechanical vibration wave in which the direction of particle motion is perpendicular to the direction of propagation. Also called a secondary wave or S-wave. Shear waves propagate only in solid media, such as sediments or rock. Shear waves in the seabed can be converted to compressional waves in water at the water-seabed interface.

sound

A time-varying disturbance in the pressure, stress, or material displacement of a medium propagated by local compression and expansion of the medium.

sound exposure

Time integral of squared sound pressure over a stated time interval. The time interval can be a specified time duration (e.g., 24 hours) or from start to end of a specified event (e.g., a pile strike, an airgun pulse, a construction operation). Unit: Pa^2 s.

sound exposure level

The level (L_E) of the sound exposure (E). Unit: decibel (dB). Reference value (E_0) for sound in water: 1 µPa^2 s.

$$L_E := 10 \log_{10}(E/E_0)\,\text{dB} \; = 20 \log_{10}\left(E^{1/2}/E_0^{1/2}\right)\,\text{dB}$$

The frequency band and integration time should be specified. Abbreviation: SEL.

sound exposure spectral density

Distribution as a function of frequency of the time-integrated squared sound pressure per unit bandwidth of a sound having a continuous spectrum. Unit: Pa^2 s/Hz.

sound field

Region containing sound waves.

sound intensity

Product of the sound pressure and the sound particle velocity. The magnitude of the sound intensity is the sound energy flowing through a unit area perpendicular to the direction of propagation per unit time.

sound particle acceleration

The rate of change of sound particle velocity. Unit: metre per second squared (m/s^2). Symbol: *a*.

sound particle motion

smallest volume of a medium that represents its mean physical properties.

sound particle displacement

Displacement of a material element caused by the action of sound, where a material element is the smallest element of the medium that represents the medium's mean density.

sound particle velocity

The velocity of a particle in a material moving back and forth in the direction of the pressure wave. Unit: metre per second (m/s). Symbol: *v*.

sound pressure

The contribution to total pressure caused by the action of sound.

sound pressure level (rms sound pressure level)

The level ($L_{p,\mathrm{rms}}$) of the time-mean-square sound pressure (p_{rms}^2). Unit: decibel (dB). Reference value (p_0^2) for sound in water: 1 μPa².

$$L_{p,\mathrm{rms}} := 10\log_{10}(p_{\mathrm{rms}}^2/p_0^2)\ \mathrm{dB}\ = 20\log_{10}(p_{\mathrm{rms}}/p_0)\ \mathrm{dB}$$

The frequency band and averaging time should be specified. Abbreviation: SPL or Lrms.

sound speed profile

The speed of sound in the water column as a function of depth below the water surface.

soundscape

The characterization of the ambient sound in terms of its spatial, temporal, and frequency attributes, and the types of sources contributing to the sound field.

source level (SL)

A property of a sound source obtained by adding to the sound pressure level measured in the far field the propagation loss from the acoustic centre of the source to the receiver position. Unit: decibel (dB). Reference value: 1 μPa²m².

spectrum

An acoustic signal represented in terms of its power, energy, mean-square sound pressure, or sound exposure distribution with frequency.

surface duct

The upper portion of a water column within which the sound speed profile gradient causes sound to refract upward and therefore reflect off the surface resulting in relatively long-range sound propagation with little loss.

temporary threshold shift (TTS)

Reversible loss of hearing sensitivity. TTS can be caused by noise exposure.

thermocline

The depth interval near the ocean surface that experiences temperature gradients due to warming or cooling by heat conduction from the atmosphere and by warming from solar heating.

transmission loss (TL)

The difference between a specified level at one location and that at a different location, TL(x1,x2) = L(x1) − L(x2). Also see **propagation loss**.

unweighted

Term indicating that no frequency weighting function is applied. Synonymous with flat weighting.

very high-frequency (VHF) cetacean

See **hearing group**.

very low-frequency (VLF) cetacean

See **hearing group**.

wavelength

Distance over which a wave completes one cycle of oscillation. Unit: metre (m). Symbol: λ.

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Appendix A. Acoustic Metrics

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 μPa. Because the perceived loudness of sound, especially pulsed sound such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate sound and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow the American National Standard Institute and International Organization for Standardization definitions and symbols for sound metrics (e.g., ISO 2017, ANSI R2013), but these standards are not always consistent.

The zero-to-peak sound pressure, or peak sound pressure (PK or $L_{p,pk}$; dB re 1 μPa), is the decibel level of the maximum instantaneous acoustic pressure in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{p,\mathrm{pk}} = 10\log_{10}\frac{\max|p^2(t)|}{p_0^2} = 20\log_{10}\frac{\max|p(t)|}{p_0} \tag{A-1}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of an acoustic event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure (PK-PK or $L_{p,pk\text{-}pk}$; dB re 1 μPa) is the difference between the maximum and minimum instantaneous sound pressure, possibly filtered in a stated frequency band, attained by an impulsive sound, $p(t)$:

$$L_{p,\mathrm{pk\text{-}pk}} = 10\log_{10}\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2} \tag{A-2}$$

The sound pressure level (SPL or L_p; dB re 1 μPa^2) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (T; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt \Big/ p_0^2\right) \tag{A-3}$$

where $g(t)$ is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying SPL function. For short acoustic events, such as sonar pulses and marine mammal vocalizations, it is important to choose an appropriate time window that matches the duration of the signal. For in-air studies, when evaluating the perceived loudness of sounds with rapid amplitude variations in time, the time weighting function $g(t)$ is often set to a decaying exponential function that emphasizes more recent pressure signals. This function mimics the leaky integration nature of mammalian hearing. For example, human-based fast time-weighted SPL ($L_{p,fast}$) applies an exponential function with time constant 125 ms. A related simpler approach used in underwater acoustics sets $g(t)$ to a boxcar (unity amplitude) function of width 125 ms; the results can be referred to as $L_{p,boxcar\ 125ms}$. Another approach, historically used to evaluate SPL of impulsive signals underwater, defines $g(t)$ as a boxcar function with edges set to the times corresponding to 5% and 95% of the cumulative square pressure function encompassing the duration of an impulsive acoustic event. This calculation is applied individually to each impulse signal, and the results are referred to as 90% SPL ($L_{p,90\%}$).

The sound exposure level (SEL or L_E; dB re 1 µPa²·s) is the time-integral of the squared acoustic pressure over a duration (T):

$$L_E = 10\log_{10}\left(\int_T p^2(t)\,dt \Big/ T_0 p_0^2\right) \quad \text{(A-4)}$$

where T_0 is a reference time interval of 1 s. SEL continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered for its relevance to impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to pulsed sounds, SEL can be calculated by summing the SEL of the N individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the N individual events:

$$L_{E,N} = 10\log_{10}\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}} \quad \text{(A-5)}$$

If applied, the frequency weighting of an acoustic event should be specified, as in the case of weighted SEL (e.g., $L_{E,LF,24h}$; see Appendix A.5) or auditory-weighted SPL ($L_{p,ht}$). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should also be specified.

A.2. Particle Acceleration and Velocity Metrics

Since sound is a mechanical wave, it can also be measured in terms of the vibratory motion of fluid particles. Particle motion can be measured in terms of three different (but related) quantities: displacement, velocity, or acceleration. Acoustic particle velocity is the time derivative of particle displacement, and likewise acceleration is the time derivative of velocity. For the present study, acoustic particle motion has been reported in terms of acceleration and velocity.

The particle velocity (v) is the physical speed of a particle in a material moving back and forth in the direction of the pressure wave. It can be derived from the pressure gradient and Euler's linearised momentum equation where ρ_0 is the density of the medium:

$$v = -\int \nabla p(t)dt/\rho_0 \quad \text{(A-6)}$$

The particle acceleration (a) is the rate of change of the velocity with respect to time, and it can be obtained from equation A-6 as:

$$a = \frac{dv}{dt} = -\frac{\nabla p(t)}{\rho_0} \quad \text{(A-7)}$$

Unlike sound pressure, particle motion is a vector quantity, meaning that it has both magnitude and direction: at any given point in space, acoustic particle motion has three different time-varying components (x, y, and z). Given the particle velocity in the x, y, and z, directions, v_x, v_y, and v_z, the particle velocity magnitude $|v|$ is computed per the Pythagorean equation:

$$|v| = \sqrt{v_x + v_y + v_z} \quad \text{(A-8)}$$

The magnitude of particle acceleration is calculated similarly from the particle acceleration in the *x*, *y*, and *z* directions.

A.3. Decidecade Band Analysis

The distribution of a sound's power with frequency is described by the sound's spectrum. The sound spectrum can be split into a series of adjacent frequency bands. Splitting a spectrum into 1 Hz wide bands, called passbands, yields the power spectral density of the sound. This splitting of the spectrum into passbands of a constant width of 1 Hz, however, does not represent how animals perceive sound.

Because animals perceive exponential increases in frequency rather than linear increases, analysing a sound spectrum with passbands that increase exponentially in size better approximates real-world scenarios. In underwater acoustics, a spectrum is commonly split into decidecade bands, which are one tenth of a decade wide. They are approximately one third of an octave (base 2) wide and are therefore often referred to as 1/3-octave-bands. Each octave represents a doubling in sound frequency. The centre frequency of the ith band, $f_c(i)$, is defined as:

$$f_c(i) = 10^{\frac{i}{10}}\ \text{kHz} \tag{A-9}$$

and the low (f_{lo}) and high (f_{hi}) frequency limits of the ith decade band are defined as:

$$f_{lo,i} = 10^{\frac{-1}{20}} f_c(i) \quad \text{and} \quad f_{hi,i} = 10^{\frac{1}{20}} f_c(i) \tag{A-10}$$

The decidecade bands become wider with increasing frequency, and on a logarithmic scale the bands appear equally spaced (Figure A-1). The acoustic modelling spans from band 7 (f_c (7) = 5 Hz) to band 44 ($f_c(44)$ = 25 kHz).

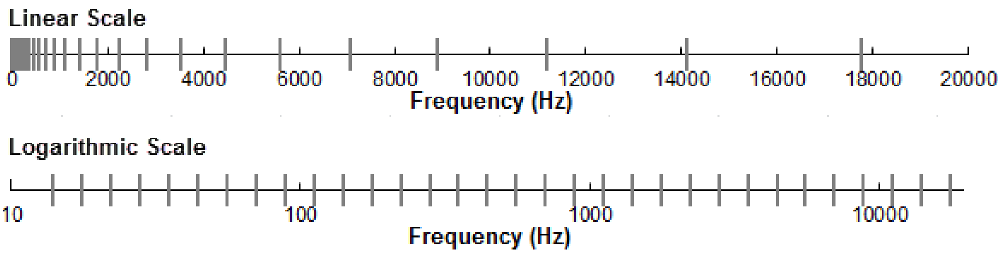


Figure A-1. Decidecade frequency bands (vertical lines) shown on a linear frequency scale and a logarithmic scale.

The sound pressure level in the ith band ($L_{p,i}$) is computed from the spectrum $S(f)$ between $f_{lo,i}$ and $f_{hi,i}$:

$$L_{p,i} = 10 \log_{10} \int_{f_{lo,i}}^{f_{hi,i}} S(f)\, df \tag{A-11}$$

Summing the sound pressure level of all the bands yields the broadband sound pressure level:

$$\text{Broadband SPL} = 10 \log_{10} \sum_{i} 10^{\frac{L_{p,i}}{10}} \tag{A-12}$$

Figure A-2 shows an example of how the decidecade band sound pressure levels compare to the sound pressure spectral density levels of an ambient noise signal. Because the decidecade bands are wider with increasing frequency, the decidecade band SPL is higher than the spectral levels at higher frequencies. Acoustic modelling of decidecade bands requires less computation time than 1 Hz bands and still resolves the frequency-dependence of the sound source and the propagation environment.

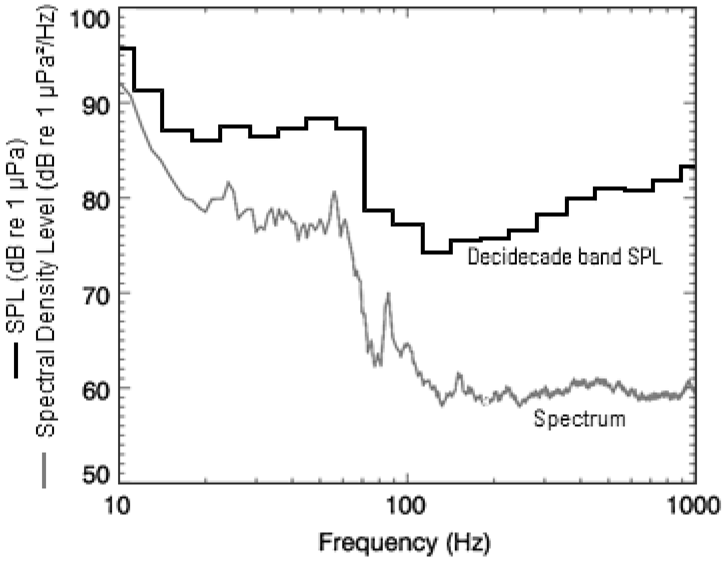


Figure A-2. Sound pressure spectral density levels and the corresponding decidecade band sound pressure levels of example ambient noise shown on a logarithmic frequency scale.

A.4. Marine Mammal Impact Criteria

It has been long recognised that marine mammals can be adversely affected by underwater anthropogenic noise. For example, Payne and Webb (1971) suggested that communication distances of fin whales are reduced by shipping sounds. Subsequently, similar concerns arose regarding effects of other underwater noise sources and the possibility that impulsive sources—primarily airguns used in seismic surveys—could cause auditory injury. This led to a series of workshops held in the late 1990s, conducted to address acoustic mitigation requirements for seismic surveys and other underwater noise sources (NMFS 1998, ONR 1998, Nedwell and Turnpenny 1998, HESS 1999, Ellison and Stein 1999). In the years since these early workshops, a variety of thresholds have been proposed for both injury and disturbance. The following sections summarize the recent development of thresholds; however, this field remains an active research topic.

A.4.1. Injury

In recognition of shortcomings of the SPL-only based injury criteria, in 2005 NMFS sponsored the Noise Criteria Group to review literature on marine mammal hearing to propose new noise exposure criteria. Some members of this expert group published a landmark paper (Southall et al. 2007) that suggested assessment methods similar to those applied for humans. The resulting recommendations introduced dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted 24h refers to the accumulation period for calculating SEL. The peak pressure level criterion is not frequency weighted whereas the SEL_{24h} is frequency weighted according to one of four marine mammal species hearing groups: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively) and Pinnipeds in Water (PINN). These weighting functions are referred to as M-weighting filters (analogous to the A-weighting filter for human; Appendix A.5). The SEL_{24h} thresholds were obtained by extrapolating measurements of onset levels of Temporary Threshold Shift (TTS) in belugas by the amount of TTS required to produce Permanent Threshold Shift (PTS) in chinchillas. The Southall et al. (2007) recommendations do not specify an exchange rate, which suggests that the thresholds are the same regardless of the duration of exposure (i.e., it implies a 3 dB exchange rate).

Wood et al. (2012) refined Southall et al.'s (2007) thresholds, suggesting lower injury values for LF and HF cetaceans while retaining the filter shapes. Their revised thresholds were based on TTS-onset levels in harbour porpoises from Lucke et al. (2009), which led to a revised impulsive sound PTS threshold for HF cetaceans of 179 dB re 1 μPa^2·s. Because there were no data available for baleen whales, Wood et al. (2012) based their recommendations for LF cetaceans on results obtained from MF cetacean studies. In particular they referenced Finneran and Schlundt (2010) research, which found mid-frequency cetaceans are more sensitive to non-impulsive sound exposure than Southall et al. (2007) assumed. Wood et al. (2012) thus recommended a more conservative TTS-onset level for LF cetaceans of 192 dB re 1 μPa^2·s.

As of present, an optimal approach is not apparent. There is consensus in the research community that an SEL-based method is preferable either separately or in addition to an SPL-based approach to assess the potential for injuries. In August 2016, after substantial public and expert input into three draft versions and based largely on the above-mentioned literature (NOAA 2013, 2015, 2016), NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes injury criteria with new thresholds and frequency weighting functions for the five hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018; with the criteria defined in NMFS (2018). The latest criteria are from Southall et al. (2019) which is applied in this report.

A.4.2. Behavioural Response

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. However, it is recognised that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison and Frankel 2012, Southall et al. 2016).

For impulsive noise, NMFS currently uses step function thresholds of 160 dB re 1 μPa^2 SPL (unweighted) to assess and regulate noise-induced behavioural impacts for marine mammals (NOAA 2018, NOAA 2019). The threshold for impulsive sound is derived from the High-Energy Seismic Survey (HESS) panel (HESS 1999) report that, in turn, is based on the responses of migrating mysticete whales to airgun sounds (Malme et al. 1984). The HESS team recognised that behavioural responses to sound may occur at lower levels, but significant responses were only likely to occur above a SPL of 140 dB re 1 μPa^2. Southall et al. (2007) found varying responses for most marine mammals between a SPL of 140 and 180 dB re 1 μPa^2, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit step functions.

A.5. Marine Mammal Frequency Weighting

The potential for noise to affect animals depends on how well the animals can hear it. Noises are less likely to disturb or injure an animal if they are at frequencies that the animal cannot hear well. An exception occurs when the sound pressure is so high that it can physically injure an animal by non-auditory means (i.e., barotrauma). For sound levels below such extremes, the importance of sound components at particular frequencies can be scaled by frequency weighting relevant to an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007).

A.5.1. Marine Mammal Frequency Weighting Functions

In 2015, a US Navy technical report by Finneran (2015) recommended new auditory weighting functions. The overall shape of the auditory weighting functions is similar to human A-weighting functions, which follows the sensitivity of the human ear at low sound levels. The new frequency-weighting function is expressed as:

$$G(f) = K + 10\log_{10}\left[\left(\frac{(f/f_{lo})^{2a}}{\left[1+(f/f_{lo})^2\right]^a\left[1+(f/f_{hi})^2\right]^b}\right)\right] \tag{A-13}$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively), phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses acoustic impacts on marine mammals (NMFS 2018), and in the latest guidance by Southall (2019). The updates did not affect the content related to either the definitions of frequency-weighting functions or the threshold values. Table A-1 lists the frequency-weighting parameters for each hearing group. Figure A-3 shows the resulting frequency-weighting curves.

Table A-1. Parameters for the auditory weighting functions used in this project as recommended by Southall et al. (2019).

Hearing group	a	b	f_{lo} (Hz)	f_{hi} (kHz)	K (dB)
Low-frequency cetaceans (baleen whales)	1.0	2	200	19,000	0.13
High-frequency cetaceans (dolphins, plus toothed, beaked, and bottlenose whales)	1.6	2	8,800	110,000	1.20
Very-high-frequency cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* and *L. australis*)	1.8	2	12,000	140,000	1.36
Other marine carnivores in water (Australian sea lion, Australian fur seal, New Zealand fur seal, Penguins)	2.0	2	940	25,000	0.64

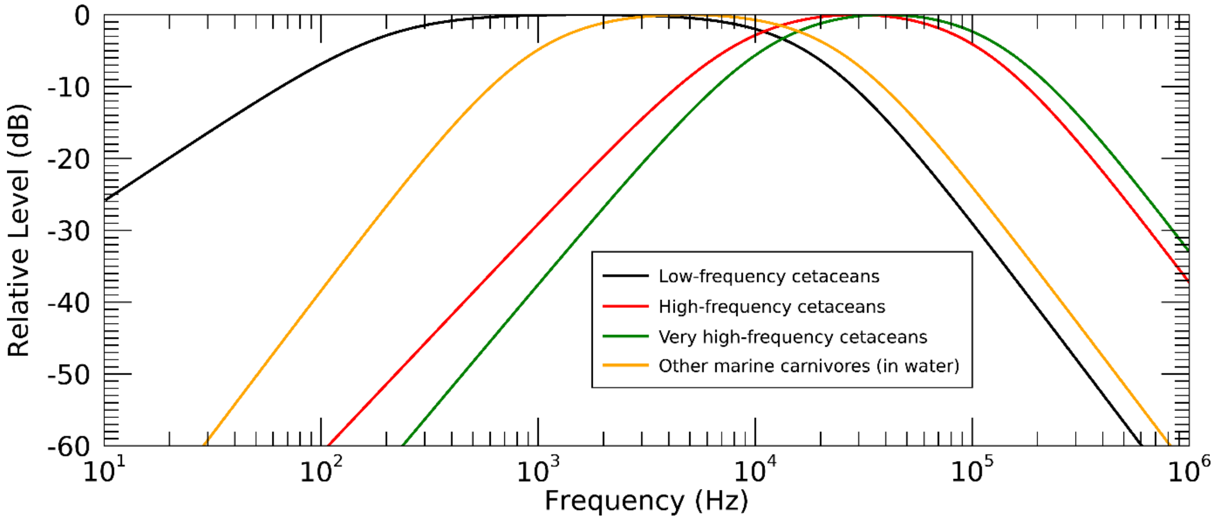


Figure A-3. Auditory weighting functions for functional marine mammal hearing groups used in this project as recommended by Southall et al. (2019).

Appendix B. Acoustic Source Model

B.1. Airgun Array Source Model

The source levels and directivity of the seismic source were predicted with JASCO's Airgun Array Source Model (AASM). AASM includes low- and high-frequency modules for predicting different components of the seismic source spectrum. The low-frequency module is based on the physics of oscillation and radiation of airgun bubbles, as originally described by Ziolkowski (1970), that solves the set of parallel differential equations that govern bubble oscillations. Physical effects accounted for in the simulation include pressure interactions between airguns, port throttling, bubble damping, and generator-injector (GI) gun behaviour discussed by Dragoset (1984), Laws et al. (1990), and Landrø (1992). A global optimisation algorithm tunes free parameters in the model to a large library of airgun source signatures.

While airgun signatures are highly repeatable at the low frequencies, which are used for seismic imaging, their sound emissions have a large random component at higher frequencies that cannot be predicted using a deterministic model. Therefore, AASM uses a stochastic simulation to predict the high-frequency (800−25,000 Hz) sound emissions of individual airguns, using a data-driven multiple-regression model. The multiple-regression model is based on a statistical analysis of a large collection of high quality seismic source signature data recently obtained from the Joint Industry Program (JIP) on Sound and Marine Life (Mattsson and Jenkerson 2008). The stochastic model uses a Monte-Carlo simulation to simulate the random component of the high-frequency spectrum of each airgun in an array. The mean high-frequency spectra from the stochastic model augment the low-frequency signatures from the physical model, allowing AASM to predict airgun source levels at frequencies up to 25,000 Hz.

AASM produces a set of "notional" signatures for each array element based on:

- Array layout
- Volume, tow depth, and firing pressure of each airgun
- Interactions between different airguns in the array

These notional signatures are the pressure waveforms of the individual airguns at a standard reference distance of 1 m; they account for the interactions with the other airguns in the array. The signatures are summed with the appropriate phase delays to obtain the far-field source signature of the entire array in all directions. This far-field array signature is filtered into decidecade-bands to compute the source levels of the array as a function of frequency band and azimuthal angle in the horizontal plane (at the source depth), after which it is considered a directional point source in the far field.

A seismic array consists of many sources and the point source assumption is invalid in the near field where the array elements add incoherently. The maximum extent of the near field of an array (R_{nf}) is:

$$R_{\mathrm{nf}} < \frac{l^2}{4\lambda} \tag{B-1}$$

where λ is the sound wavelength and l is the longest dimension of the array (Lurton 2002, §5.2.4). For example, a seismic source length of l = 21 m yields a near-field range of 147 m at 2 kHz and 7 m at 100 Hz. Beyond this R_{nf} range, the array is assumed to radiate like a directional point source and is treated as such for propagation modelling.

The interactions between individual elements of the array create directionality in the overall acoustic emission. Generally, this directionality is prominent mainly at frequencies in the mid-range between tens of hertz to several hundred hertz. At lower frequencies, with acoustic wavelengths much larger than the inter-airgun separation distances, the directionality is small. At higher frequencies, the pattern of lobes is too finely spaced to be resolved and the effective directivity is less.

B.2. Seismic Source

The layout of the 2820 in^3 seismic sources used for modelling in this study is provided in Figure B-1. Details of the airgun parameters are provided in Table B-1.

For the modelled array, the layout is presented in a nominal cartesian coordinate system. In this coordinate system the direction of vessel travel determines the relative position of the array elements as plotted and tabulated. The layout used for acoustic modelling was produced by transforming the coordinates of client supplied layouts such that the resultant layouts correspond to a vessel travel direction along the positive X-axis and the array is centred on the X-Y origin. When used with an acoustic model the positive X-axis in this nominal coordinate system aligns with the vessel tow direction or survey line azimuth.

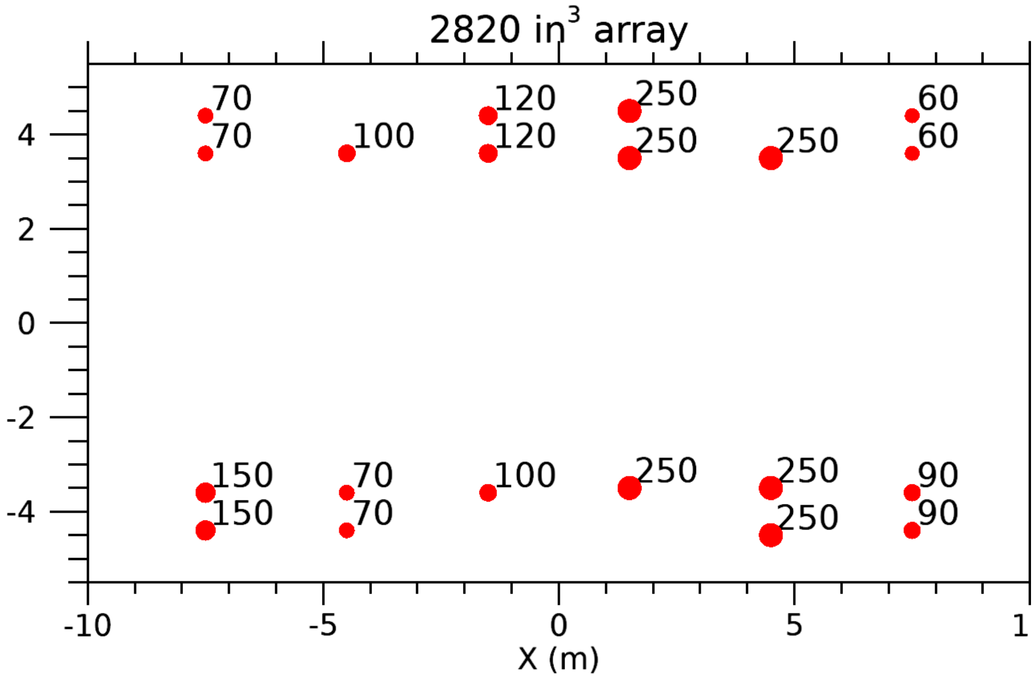


Figure B-1. Layout of the modelled 2820 in^3 seismic source where the plotted layout is such that the array is centred on the origin and vessel travel direction is in the positive x-direction. Tow depth was 7 m. The labels indicate the firing volume (in cubic inches) for each airgun. Also see Table B-1.

Table B-1. Layout of the modelled 2820 in^3 seismic source. Tow depth was 7 m. Firing pressure for all guns was 2000 psi. Greyed out values indicate spares. Also see Figure B-1.

String	Gun	*x* (m)	*y* (m)	*z* (m)	Vol (in^3)	String	Gun	*x* (m)	*y* (m)	*z* (m)	Vol (in^3)
1	1	7.5	-4.4	7	90	2	13	7.5	3.6	7	60
	2	7.5	-3.6	7	90		14	7.5	4.4	7	60
	3	4.5	-4.5	7	250		15	4.5	3.5	7	250
	4	4.5	-3.5	7	250		16	4.5	4.5	7	220
	5	1.5	-4.5	7	250		17	1.5	3.5	7	250
	6	1.5	-3.5	7	250		18	1.5	4.5	7	250
	7	-1.5	-4.4	7	100		19	-1.5	3.6	7	120
	8	-1.5	-3.6	7	100		20	-1.5	4.4	7	120
	9	-4.5	-4.4	7	70		21	-4.5	3.6	7	100
	10	-4.5	-3.6	7	70		22	-4.5	4.4	7	100
	11	-7.5	-4.4	7	150		23	-7.5	3.6	7	70
	12	-7.5	-3.6	7	150		24	-7.5	4.4	7	70

B.3. Array Source Levels and Directivity

Figure B-2 shows the broadside (perpendicular to the tow direction), endfire (parallel to the tow direction) and vertical overpressure signature and corresponding power spectrum levels for the 2820 in^3 seismic source (Appendix B.2). Horizontal decidecade-band source levels are shown as a function of band centre frequency and azimuth in Figure B-3.

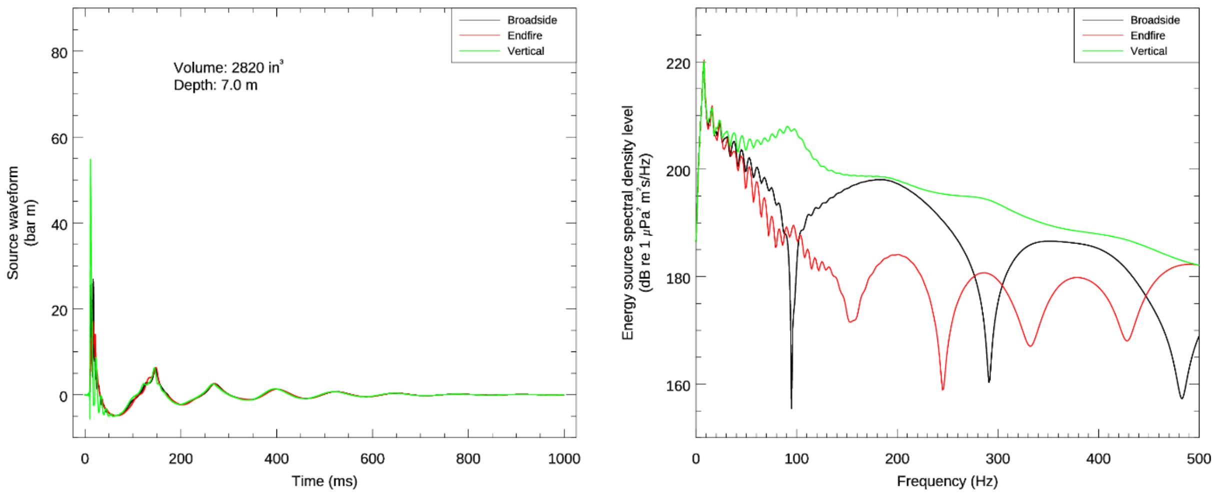


Figure B-2. Predicted source level details for the 2820 in^3 seismic source with a 7 m tow depth. (Left) the overpressure signature and (right) the power spectrum for in-plane horizontal (broadside), perpendicular (endfire), and vertical directions (no surface ghost).

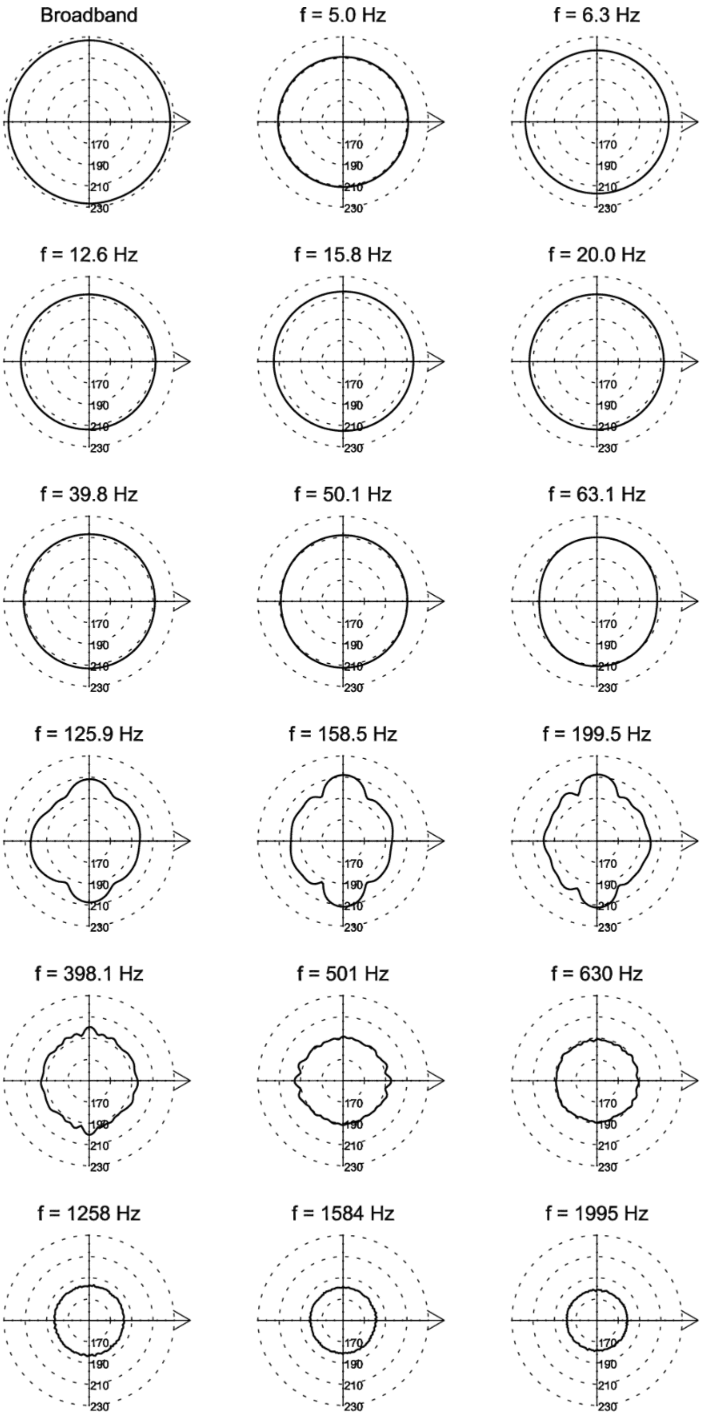


Figure B-3. Directionality of the predicted horizontal source levels for the 2820 in^3 seismic source, 5 Hz to 2 kHz. Source levels (in dB re 1 µPa^2·s m^2) are shown as a function of azimuth for the centre frequencies of the decidecade bands modelled; frequencies are shown above the plots. The perpendicular direction to the frame is to the right. Tow depth was 7 m (see Table B-1).

Appendix C. Sound Propagation Models

C.1. MONM-BELLHOP

Long-range sound fields were computed using JASCO's Marine Operations Noise Model (MONM). Compared to VSTACK, MONM less accurately predicts steep-angle propagation for environments with higher shear speed but is well suited for effective longer-range estimation. This model computes sound propagation at frequencies of 5 Hz to 1 kHz via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the US Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995). MONM computes sound propagation at frequencies >1 kHz via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). MONM accounts for the additional reflection loss at the seabed, which results from partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

This version of MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is significant for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results.

MONM computes acoustic fields in three dimensions by modelling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure C-1).

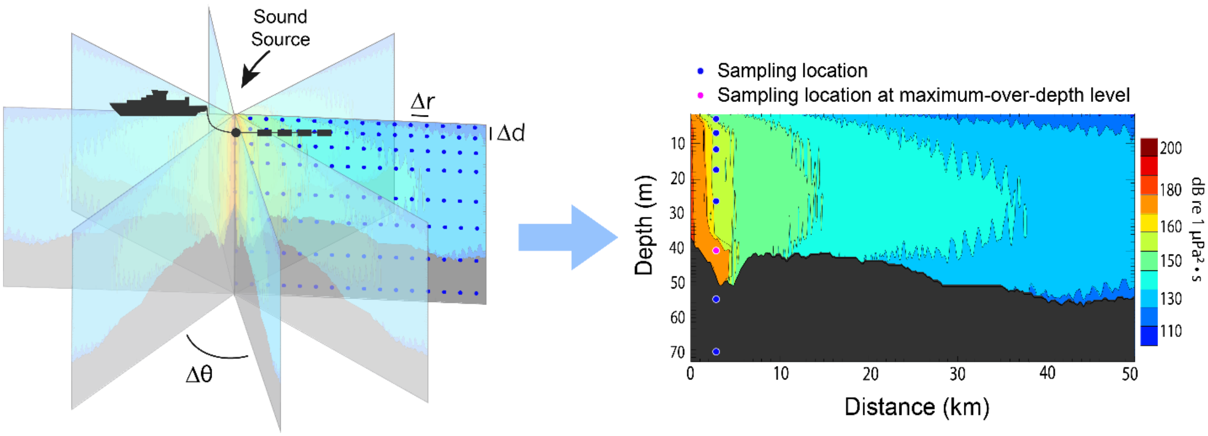


Figure C-1. The N×2-D and maximum-over-depth modelling approach used by MONM.

MONM treats frequency dependence by computing acoustic transmission loss at the centre frequencies of decidecade bands. Sufficiently many decidecade bands, starting at 5 Hz, are modelled to include most of the acoustic energy emitted by the source. At each centre frequency, the transmission loss is modelled within each of the N vertical planes as a function of depth and range from the source. The decidecade band received per-pulse SEL are computed by subtracting the band transmission loss values from the directional source level in that frequency band. Composite broadband received per-pulse SEL are then computed by summing the received decidecade band levels.

The received per-pulse SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. The maximum received per-pulse SEL at many sampling depths are taken over all samples within the water column, i.e., the maximum-over-depth received per-pulse SEL. These maximum-over-depth per-pulse SEL are presented as contours around the source.

C.2. Full Waveform Range-dependent Acoustic Model: FWRAM

For impulsive sounds from the seismic source, time-domain representations of the pressure waves generated in the water are required to calculate SPL and PK. Furthermore, the seismic source must be represented as a distributed source to accurately characterise vertical directivity effects in the near-field zone. For this study, synthetic pressure waveforms were computed using FWRAM, which is a time-domain acoustic model based on the same wide-angle parabolic equation (PE) algorithm as MONM. FWRAM computes synthetic pressure waveforms versus range and depth for range-varying marine acoustic environments, and it takes the same environmental inputs as MONM (bathymetry, water sound speed profile, and seafloor geoacoustic profile). Unlike MONM, FWRAM computes pressure waveforms via Fourier synthesis of the modelled acoustic transfer function in closely spaced frequency bands. FWRAM employs the array starter method to accurately model sound propagation from a spatially distributed source (MacGillivray and Chapman 2012).

Besides providing direct calculations of the PK and SPL, the synthetic waveforms from FWRAM can also be used to convert the SEL values from MONM to SPL.

C.3. Wavenumber Integration Model

Sound pressure levels near the seismic source were modelled using JASCO's VSTACK wavenumber integration model. VSTACK computes synthetic pressure waveforms versus depth and range for arbitrarily layered, range-independent acoustic environments using the wavenumber integration approach to solve the exact (range-independent) acoustic wave equation. This model is valid over the full angular range of the wave equation and can fully account for the elasto-acoustic properties of the sub-bottom. Wavenumber integration methods are extensively used in the field of underwater acoustics and seismology where they are often referred to as reflectivity methods or discrete wavenumber methods. VSTACK computes sound propagation in arbitrarily stratified water and seabed layers by decomposing the outgoing field into a continuum of outward-propagating plane cylindrical waves. Seabed reflectivity in the model is dependent on the seabed layer properties: compressional and shear wave speeds, attenuation coefficients, and layer densities. The output of the model can be post-processed to yield estimates of the SEL, SPL, and PK.

VSTACK accurately predicts steep-angle propagation in the proximity of the source, but it is computationally slow at predicting sound pressures at large distances due to the need for smaller wavenumber steps with increasing distance. Additionally, VSTACK assumes range-invariant bathymetry with a horizontally stratified medium (i.e., a range-independent environment) which is azimuthally symmetric about the source. VSTACK is thus best suited to modelling the sound field near the source.

C.3.1. Particle Motion

VSTACK was also used to compute estimates of particle acceleration and velocity at four sites for the 2820 in^3 seismic source. Particle motion waveforms were modelled, and pulse metrics were computed from the time-domain traces. VSTACK uses the wavenumber integration approach to solve the exact acoustic wave equation for arbitrarily layered range-independent acoustic environments.

The VSTACK model setup for the particle velocity scenarios was identical to that for the peak pressure scenarios (Section 4.2.1.2) in terms of source treatment, frequency range and environmental model. The particle acceleration and velocity waveforms were computed to a maximum distance of 1000 m in the broadside and endfire directions from the centre of the airgun array for a receiver 5 cm above the seafloor.

As discussed above in Appendix A.2, particle velocity (v) is the physical speed of a particle in a material. It can be derived from the pressure gradient and Euler's linearised momentum equation where ρ_0 is the density of the medium. Since the wavenumber integration kernel is a product of analytic expressions in terms of range and depth, VSTACK computes particle velocity by computing the spatial gradient of the pressure field analytically in the frequency domain. Fourier synthesis is applied to compute time series synthetic pressure and/or velocity waveforms at depth and range receivers by convolving the source waveforms with the impulse response of the waveguide. Particle velocity metrics at each receiver location were calculated from the modelled particle motion along three perpendicular axes (horizontal and along the source-receiver path, horizontal and perpendicular to the source-receiver path, and vertical).

The particle velocity results were converted to acceleration by time differentiation. The peak particle acceleration and velocity were calculated from the maximum of the predicted acceleration and velocity magnitude, defined as "peak magnitude".

C.3.2. Limestone Seabed Propagation Loss

For all modelled sites, an additional broadband correction was applied to the propagation loss results from MONM to better account for the additional propagation loss associated with a calcarenite/limestone seabed. The differences between the broadband per-pulse SEL from MONM and VSTACK were extracted at the same modelled ranges and depths for corresponded range independent environments. The 90th percentile of the resultant dB differences in range bins were selected to generate a correction function for representative sites to be modelled. The conversion functions were applied after to the summed decidecade band levels from MONM, but before gridding, and radii calculations for each modelled site in each modelled scenario considered.

Appendix D. Methods and Parameters

D.1. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) R_{max}, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure D-1).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure D-1(a). In cases such as this, where relatively few points are excluded in any given direction, R_{max} can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure D-1(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases R_{max} might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between R_{max} and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.

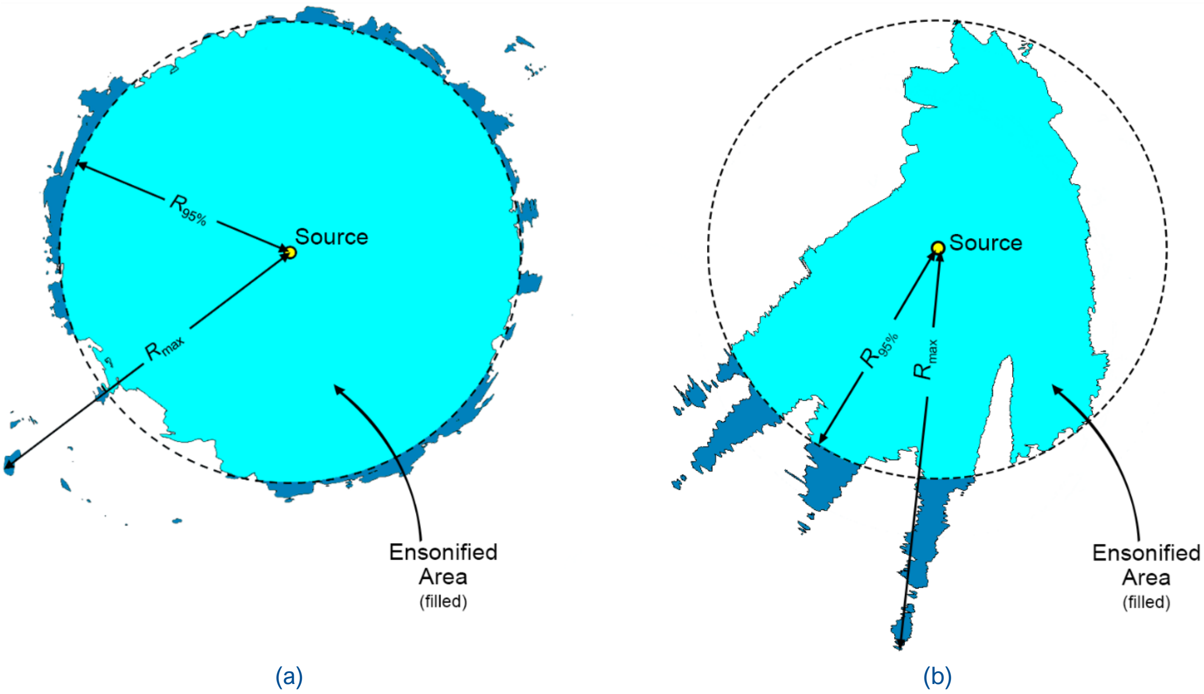


Figure D-1. Sample areas ensonified to an arbitrary sound level with R_{max} and $R_{95\%}$ ranges shown for two scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine R_{max}.

D.2. Estimating SPL from Modelled SEL Results

The per-pulse SEL of sound pulses is an energy-like metric related to the dose of sound received over a pulse's entire duration. The pulse SPL on the other hand, is related to its intensity over a specified time interval. Seismic pulses typically lengthen in duration as they propagate away from their source, due to seafloor and surface reflections, and other waveguide dispersion effects. The changes in pulse length, and therefore the time window considered, affect the numeric relationship between SPL and SEL. This study has applied a fixed window duration to calculate SPL (T_{fix} = 125 ms; see Appendix A.1), as implemented in Martin et al. (2017b). Full-waveform modelling was used to estimate SPL, but this type of modelling is computationally intensive, and can be prohibitively time consuming when run at high spatial resolution over large areas.

For the current study, FWRAM (Appendix C.2) was used to model synthetic seismic pulses over the frequency range 5–1024 Hz. This was performed along all broadside and endfire radials at five sites. FWRAM uses Fourier synthesis to recreate the signal in the time domain so that both the SEL and SPL from the source can be calculated. The differences between the SEL and SPL were extracted for all ranges and depths that corresponded to those generated from the high spatial-resolution results from MONM. A 125 ms fixed time window positioned to maximize the SPL over the pulse duration was applied. The resulting SEL-to-SPL offsets were averaged in 0.02 km range bins along each modelled radial and depth, and the 90th percentile was selected at each range to generate a generalised range-dependent conversion function for each site. The range-dependent conversion function was applied to predicted per-pulse SEL results from MONM to model SPL values. Figures D-2 to D-6 show the conversion offsets for Sites 2, 3, 5, 8, and 10 with the 2820 in^3 array; the spatial variation is caused by changes in the received airgun pulse as it propagates from the source. The conversion to SPL from SEL was conducted considering the water depth and seabed geology at a given modelled site.

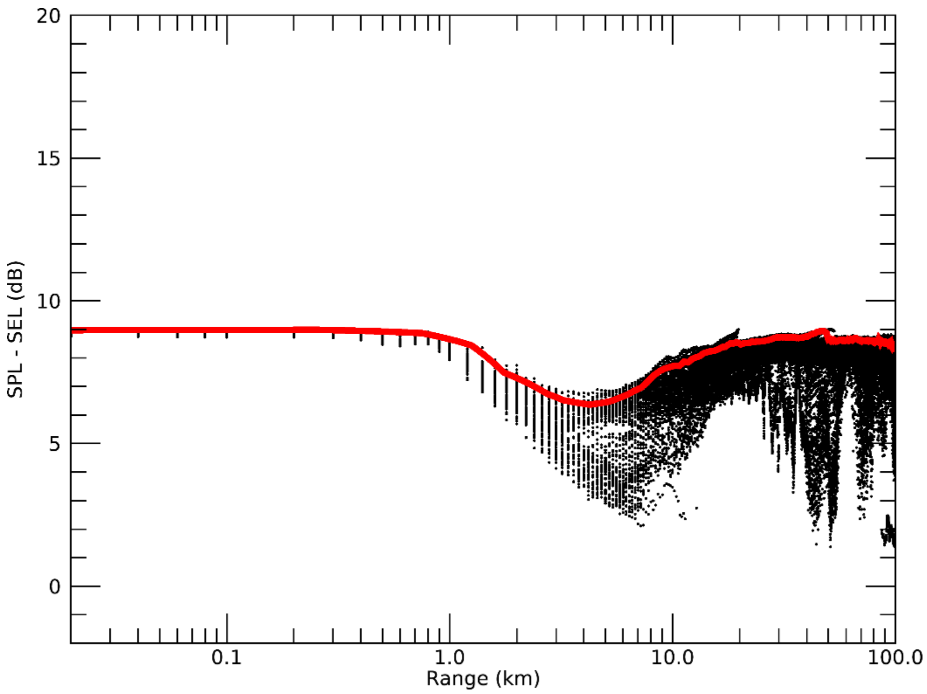


Figure D-2. *Site 2 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

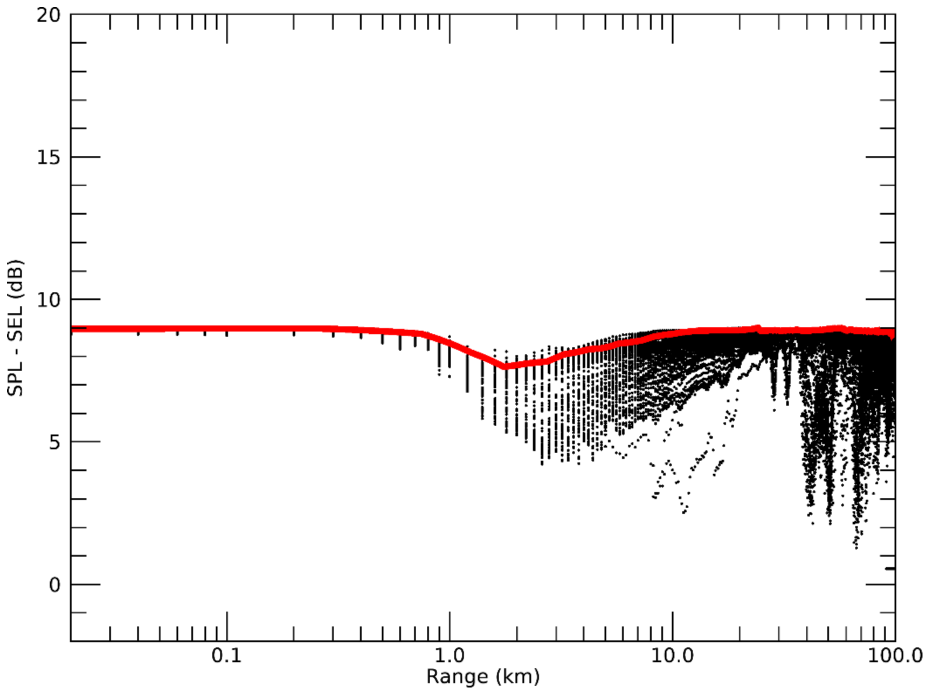


Figure D-3. *Site 3 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

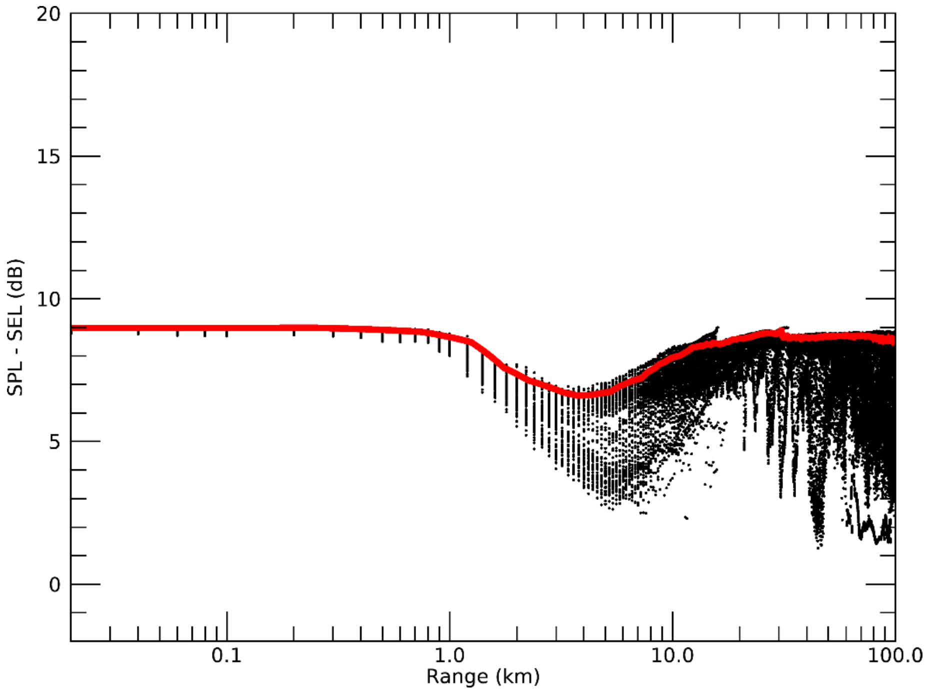


Figure D-4. *Site 5 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

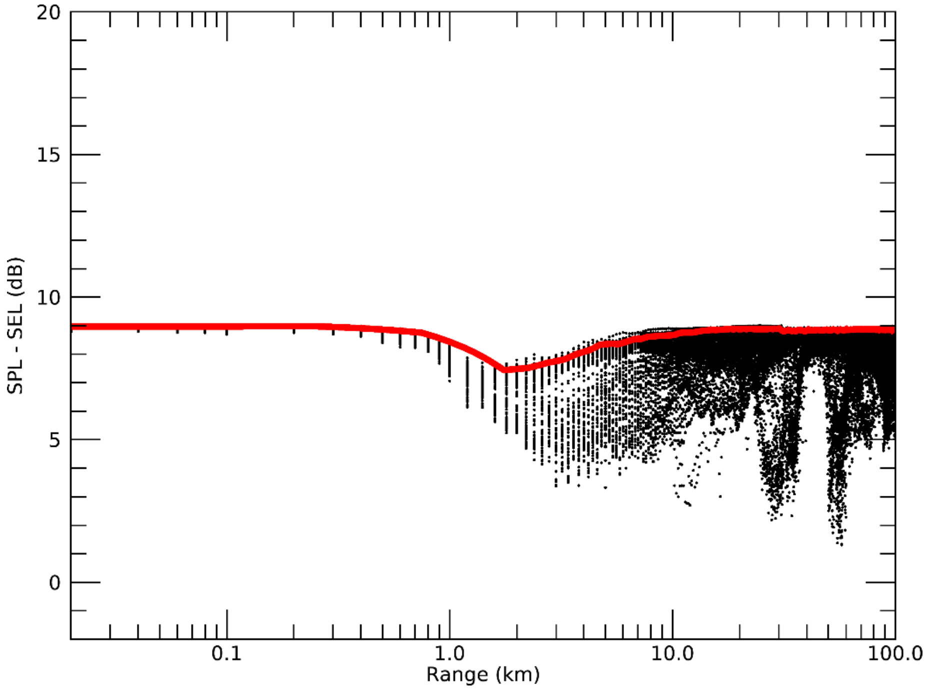


Figure D-5. *Site 8 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

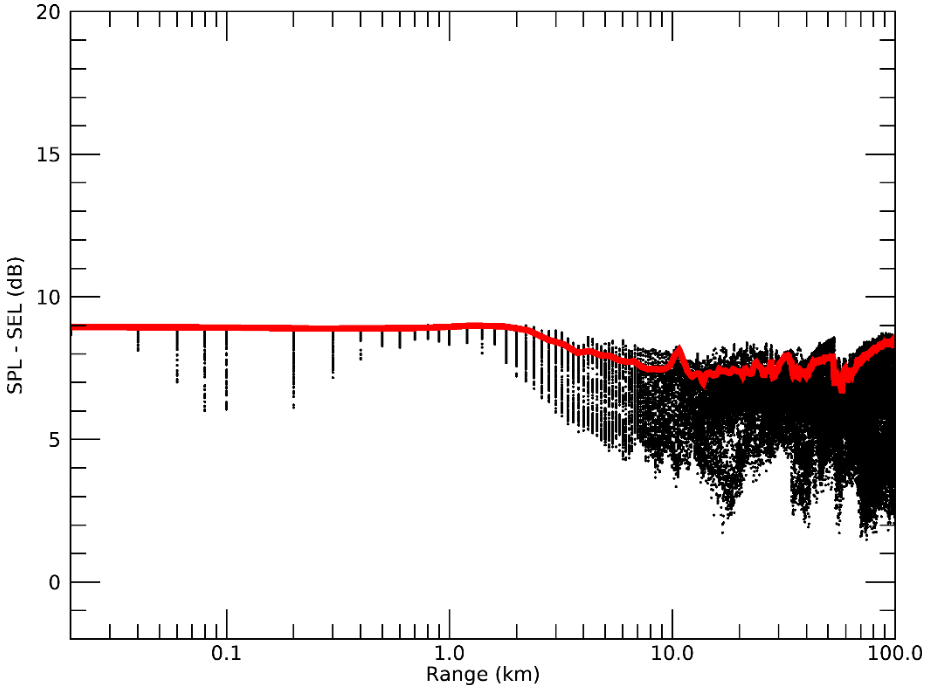


Figure D-6. *Site 10 tow direction 113°*: Range-and-depth-dependent conversion offsets for converting sound exposure level (SEL) to sound pressure level (SPL) for seismic pulses. Slices are shown for the 2820 in^3 seismic source. Black lines are the modelled differences between SEL and SPL across different radials and receiver depths; the solid red line is the 90th percentile of the modelled differences at each range.

D.3. Environmental Parameters

D.3.1. Bathymetry

Water depths throughout the modelled area were extracted from Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009). Bathymetry data was extracted and re-gridded onto a Map Grid of Australia (MGA) coordinate projection (Zone 54) with a regular grid spacing of 200 × 200 m to generate the bathymetry in Figure D-7.

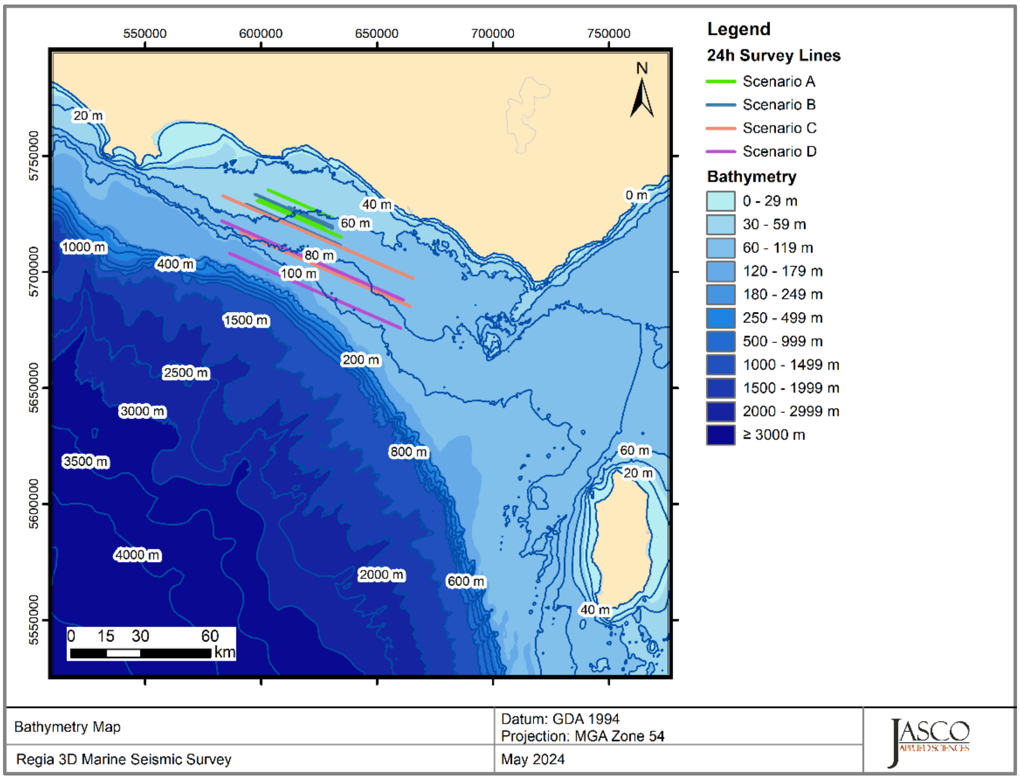


Figure D-7. Bathymetry map of the modelling area for the Regia Marine Seismic Survey.

D.3.2. Sound Speed Profile

The sound speed profiles for the modelled sites were derived from temperature and salinity profiles from the US Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the US Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles within a 100 km box radius encompassing all modelled sites. The June sound speed profile is expected to be most favourable to longer-range sound propagation due its upward refracting profile. As such, June was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. Figure D-8 shows the resulting profile used as input to the sound propagation modelling.

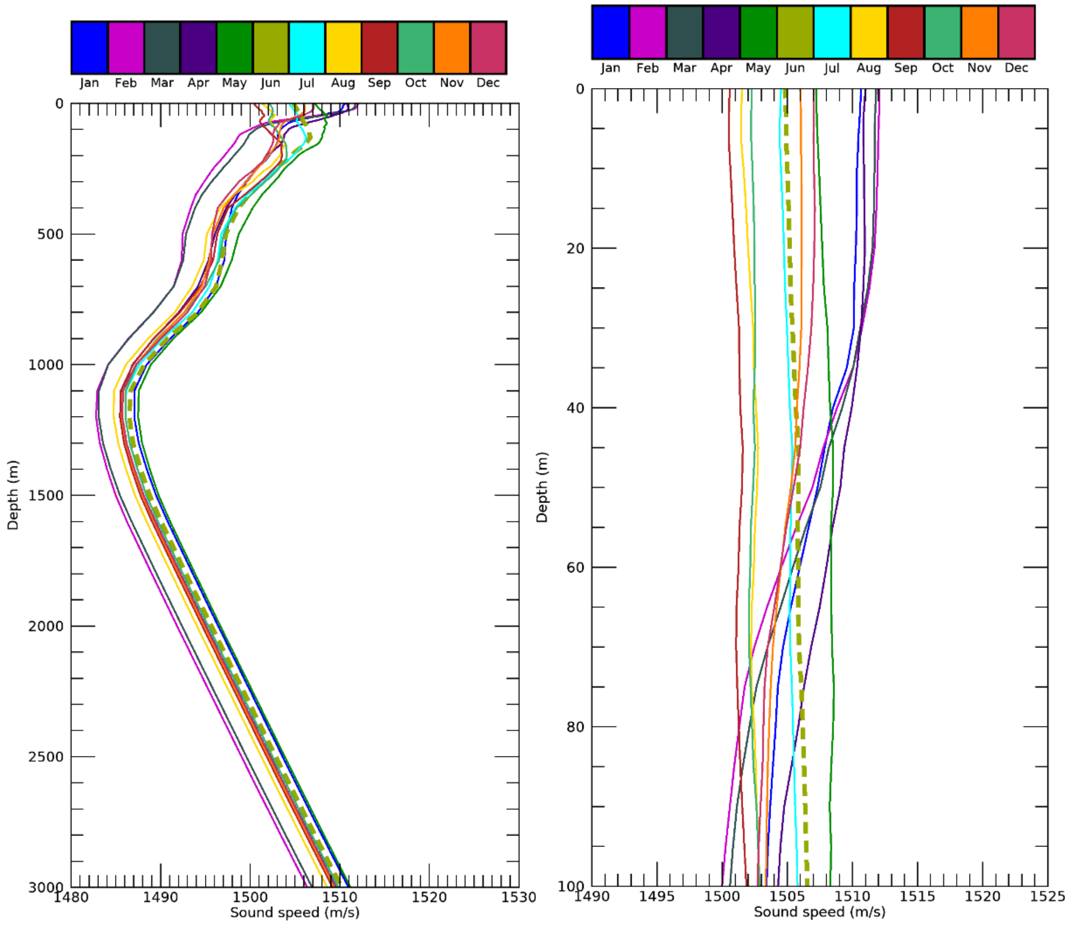


Figure D-8. The sound speed profile (June) used for all modelling, showing the entire water column (left) and the top 100 m within the profile (right). Profiles are calculated from temperature and salinity profiles from GDEM V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

D.3.3. Geoacoustics

The geoacoustic parameters used for modelling have been sourced from previous public reports completed by JASCO for modelling projects in the surrounding area. Similar to previous modelling studies in the region (Wood and McPherson 2018, Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021), several seabed types were considered for modelling. These seabed profiles are indicative of a benthic environment located on the continental shelf and upper slope and are consistent with larger scale geological data and interpretations of the Australian continental shelf environment (James and Bone 2010) within the Otway region.

For the sites modelled in shallow water (less than 65 m depth) the seabed was modelled as a sand layer underlain by variably cemented calcarenite. Literature and public reports suggest that this layer likely begins to thin as water depths increase in an offshore direction (Koessler et al. 2020, Matthews et al. 2020, McPherson et al. 2021), and for water depths greater than 65 m it was considered absent with only the variably cemented calcarenite present at the seafloor interface. These two seabed profiles are consistent with profiles described in association with measurement data (McCauley et al. 2016), and other modelling studies in the region (AIMS 2018).

Sites located above the calcarenite seabed generally displayed higher rates of loss at distance away from the source as compared to sites where a layer of sand overlies calcarenite (Duncan et al. 2009) and as such precises modelled was conducted to account for the loss associated with exposed calcarenite (see Appendix C.3.2). For sites located in water along the shelf, geoacoustic parameters considered for modelling are provided in Tables D-1 and D-2

Table D-1. Geoacoustic profile used in the acoustic propagation models for sites in less than 65 m water depth. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-5	Fine Carbonate Sand	2.1	1634-1803	0.09-0.73	315	3.65
5-25	Increasingly cemented calcarenite	2.2	2000-2120	0.30-0.34		
25-45		2.3	2120-2240	0.34-0.38		
45-65		2.4	2240-2360	0.38-0.42		
65-85		2.5	2360-2480	0.42-0.46		
85-105		2.6	2480-2600	0.46-0.50		
>105	Well-cemented calcarenite	2.7	2600	0.50		

Table D-2. Geoacoustic profile used in the acoustic propagation models for between 65 m and 120 m water depth.Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Material	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	S-wave speed (m/s)	S-wave attenuation (dB/λ)
0-1	Well-cemented carbonate caprock	2.7	2600	0.5	500	0.4
1-20	Increasingly cemented calcarenite	2.2	2000-2120	0.30-0.34		
20-40		2.3	2120-2240	0.34-0.38		
40-60		2.4	2240-2360	0.38-0.42		
60-80		2.5	2360-2480	0.42-0.46		
80-10		2.6	2480-2600	0.46-0.50		
>100	Well-cemented calcarenite	2.7	2600	0.50		

For sites located along the shelf break/upper continental slope, the geoacoustic parameters used for modelling was derived from sedimentary grain size measurements from the Australian Government's Marine Sediments (MARS) database (Heap 2009). On average, the surficial grain size indicates silty carbonate sand is present. Information on the deeper geological structure was sparse, as such the seabed was assumed to consist of a thick package of unconsolidated sediments. However, this is consistent with the "shaved shelf" model of the discussed in James and Bone 2010, where sediments are transported and deposited from the shelf onto the slope. Representative grain sizes and porosity were used in the grain-shearing model proposed by Buckingham (2005) to estimate the geoacoustic parameters required by the sound propagation models. Table D-3 lists the geoacoustic parameters used for modelling for sites in water depths greater than 120 m.

Table D-3. Geoacoustic profile used in the acoustic propagation models for all modelled sites greater than 120 m water depth. Within each depth range, each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm^3)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–10	Silty carbonate sand to semi-cemented carbonate	1.88	1605–1700	0.35–0.70	255	3.65
10–20		1.88–1.89	1700–1755	0.70–0.85		
20–50		1.89–1.90	1755–1850	0.85–1.15		
50–100		1.90–1.92	1850–1950	1.15–1.35		
100–200		1.92–1.96	1950–2100	1.35–1.60		
200–500		1.96–2.05	2100–2355	1.60–1.95		
>500		2.05	2355	1.95		

D.4. Animal Movement and Exposure Modelling

Animal movement and exposure modelling considers the movement of both sound sources and animals over time. Acoustic source and propagation modelling are used to generate 3-D sound fields that vary as a function of distance to source, depth, and azimuth. Sound sources are modelled at representative sites and the resulting sound fields are assigned to source locations using the minimum Euclidean distance. The sound received by an animal at any given time depends on its location relative to the source. Because the true locations of the animals within the sound fields are unknown, realistic animal movements are simulated using repeated random sampling of various behavioural parameters. The Monte Carlo method of simulating many animals within the operations area is used to estimate the sound exposure history of the population of simulated animals (animats).

Monte Carlo methods provide a heuristic approach for determining the probability distribution function (PDF) of complex situations, such as animals moving in a sound field. The probability of an events occurrence is determined by the frequency with which it occurs in the simulation. The greater the number of random samples, in this case the more simulated animats, the better the approximation of the PDF. Animats are randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2). Higher densities provide a finer PDF estimate resolution but require more computational resources. To ensure good representation of the PDF, the animat density is set as high as practical allowing for computation time. The animat density is typically much higher than the real-world density to ensure good representation of the PDF. The resulting PDF can be scaled using real-world animal density when this information is available.

Several models for marine mammal movement have been developed (Ellison et al. 1987, Frankel et al. 2002, Houser 2006). These models use an underlying Markov chain to transition from one state to another based on probabilities determined from measured swimming behaviour. The parameters may represent simple states, such as the speed or heading of the animal, or complex states, such as likelihood of participating in foraging, play, rest, or travel. Attractions and aversions to variables like anthropogenic sounds and different depth ranges can be included in the models.

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was based on the open-source marine mammal movement and behaviour model (3MB, Houser 2006) and used to predict the exposure of animats to sound arising from the anthropogenic activities. Animats are programmed to behave like the species likely to be present in the survey area. The parameters used for forecasting realistic behaviours (e.g., diving, foraging, aversion, surface times, etc.) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. An individual animats modelled sound exposure levels are summed over the total simulation duration to determine its total received energy, and then compared to the assumed threshold criteria.

JASMINE uses the same animal movement algorithms as 3MB (Houser, 2006), but has been extended to be directly compatible with JASCO's Marine Operations Noise Model (MONM) and Full Waveform Range-dependent Acoustic Model (FRAWM) acoustic field predictions, for inclusion of source tracks, and importantly for animats to change behavioural states based on time and space dependent modelled variables such as received levels for aversion behaviour, although aversion was not considered in this study.

D.4.1. Animal Movement Parameters

JASMINE uses previously measured behaviour to forecast behaviour in new situations and locations. The parameters used for forecasting realistic behaviour are determined (and interpreted) from marine species studies (e.g., tagging studies). Each parameter in the model is described as a probability distribution. When limited or no information is available for a species parameter, a Gaussian or uniform distribution may be chosen for that parameter. For the Gaussian distribution, the user determines the mean and standard deviation of the distribution from which parameter values are drawn. For the uniform distribution, the user determines the maximum and minimum distribution from which parameter values are drawn. When detailed information about the movement and behaviour of a species are available, a user-created distribution vector, including cumulative transition probabilities, may be used (referred to here as a vector model; Houser 2006). Different sets of parameters can be defined for different behaviour states. The probability of an animat starting out in or transitioning into a given behaviour state can in turn be defined in terms of the animats current behavioural state, depth, and the time of day. In addition, each travel parameter and behavioural state has a termination function that governs how long the parameter value or overall behavioural state persists in simulation.

The parameters used in JASMINE describe animal movement in both the vertical and horizontal planes. The parameters relating to travel in these two planes are briefly described below.

Travel sub-models

- **Direction**– determines an animats choice of direction in the horizontal plane. Sub-models are available for determining the heading of animats, allowing for movement to range from strongly biased to undirected. A random walk model can be used for behaviours with no directional preference, such as feeding and playing. In a random walk, all bearings are equally likely at each parameter transition time step. A correlated random walk can be used to smooth the changes in bearing by using the current heading as the mean of the distribution from which to draw the next heading. An additional variant of the correlated random walk is available that includes a directional bias for use in situations where animals have a preferred absolute direction, such as migration. A user-defined vector of directional probabilities can also be input to control animat heading. For more detailed discussion of these parameters, see Houser (2006) and Houser and Cross (1999).
- **Travel rate**–defines an animats rate of travel in the horizontal plane. When combined with vertical speed and dive depth, the dive profile of the animat is produced.

Dive sub-models

- **Ascent rate**–defines an animats rate of travel in the vertical plane during the ascent portion of a dive.
- **Descent rate**–defines an animats rate of travel in the vertical plane during the descent portion of a dive.
- **Depth**–defines an animats maximum dive depth.
- **Reversals**–determines whether multiple vertical excursions occur once an animat reaches the maximum dive depth. This behaviour is used to emulate the foraging behaviour of some marine mammal species at depth. Reversal-specific ascent and descent rates may be specified.
- **Surface interval**–determines the duration an animat spends at, or near, the surface before diving again.

D.4.2. Exposure Integration Time

The interval over which acoustic exposure (L_E) should be integrated and maximal exposure (L_p) determined is not well defined. Both Southall et al. (2007) and the NMFS (2018) recommend a 24 h baseline accumulation period, but state that there may be situations where this is not appropriate (e.g., a high-level source and confined population). Resetting the integration after 24 h can lead to overestimating the number of individual animals exposed because individuals can be counted multiple times during an operation. The type of animal movement engine used in this study simulates realistic movement using swimming behaviour collected over relatively short periods (hours to days) and does not include large-scale movement such as migratory circulation patterns. For this study, a representative 24-hour period was simulated.

Ideally, a simulation area is large enough to encompass the entire range of a population so that any animal that could approach the source during an operation is included. However, there are limits to the simulation area, and computational overhead increases with area. For practical reasons, the simulation area is limited. In the simulation, every animat that reaches a border is replaced by another animat entering at the opposing border—e.g., an animat crossing the northern border of the simulation is replaced by one entering the southern border at the same longitude. When this action places the animat in an inappropriate water depth, the animat is randomly placed on the map at a depth suited to its species definition. The exposures of all animats (including those leaving the simulation and those entering) are kept for analysis. This approach maintains a consistent animat density and allows for longer integration periods with finite simulation areas.

D.4.3. Seeding Density and Scaling

Seeding density refers to the spatial sample rate, in units of animats/km^2, used in the simulation. It is not related to the real-world animal density, but rather is a model parameter that controls how samples are drawn from the model space. The minimum required seeding density for any given project depends on several factors such as bathymetry, source characteristics, and the behavioural profile of the animats, with the main constraint being computation time and resources. Seeding density is adjusted as needed based on model conditions specific to a project or project area.

In the present study, the exposure criteria for impulsive sounds were used to determine the number of animats exceeding exposure thresholds. To generate statistically reliable probability density functions, all simulations were seeded with an animat density of 4 animat/km^2 over the entire simulation area, except those in which southern right whale animats were restricted to their reproduction BIA, in which case the density was increased to 6 animats/km^2 to account for the relatively small area. The modelling results are not related to real-world animal densities as animal density in the area is unknown.

Appendix E. Model Validation Information

Predictions from JASCO's Airgun Array Source Model (AASM) and propagation models (MONM, FWRAM and VSTACK) have been validated against experimental data from a number of underwater acoustic measurement programs conducted by JASCO globally, including the United States and Canadian Artic, Canadian and southern United States waters, Greenland, Russia and Australia (Hannay and Racca 2005, Aerts et al. 2008, Funk et al. 2008, Ireland et al. 2009, O'Neill et al. 2010, Warner et al. 2010, Racca et al. 2012a, Racca et al. 2012b, Matthews and MacGillivray 2013, Martin et al. 2015, Racca et al. 2015, Martin et al. 2017a, Martin et al. 2017b, Warner et al. 2017, MacGillivray 2018, McPherson et al. 2018, McPherson and Martin 2018).

In addition, JASCO has conducted measurement programs associated with a significant number of anthropogenic activities which have included internal validation of the modelling (including McCrodan et al. 2011, Austin and Warner 2012, McPherson and Warner 2012, Austin and Bailey 2013, Austin et al. 2013, Zykov and MacDonnell 2013, Austin 2014, Austin et al. 2015, Austin and Li 2016, Martin and Popper 2016).

Appendix F. Supplemental Modelling Results

The SPL sound fields, and distances to relevant isopleths, can be visualised for the 293° tow direction on the contour maps presented below. Equivalent maps for the 113° tow direction are included in Section 4.2.2.1.

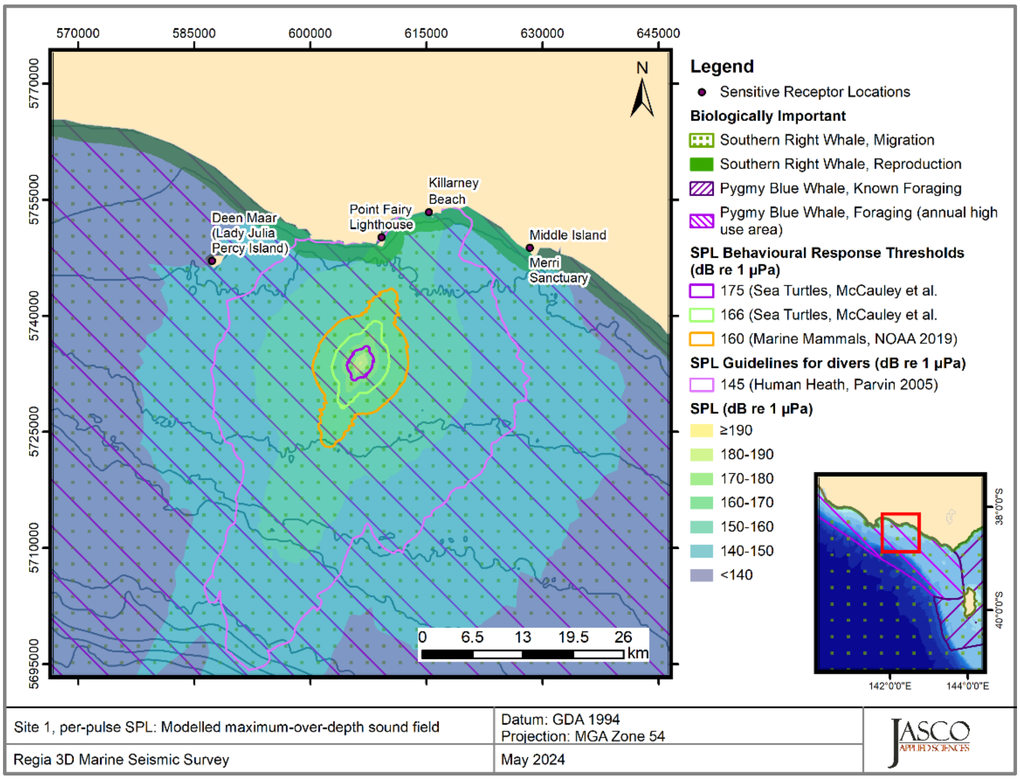


Figure F-1. *Site 1, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

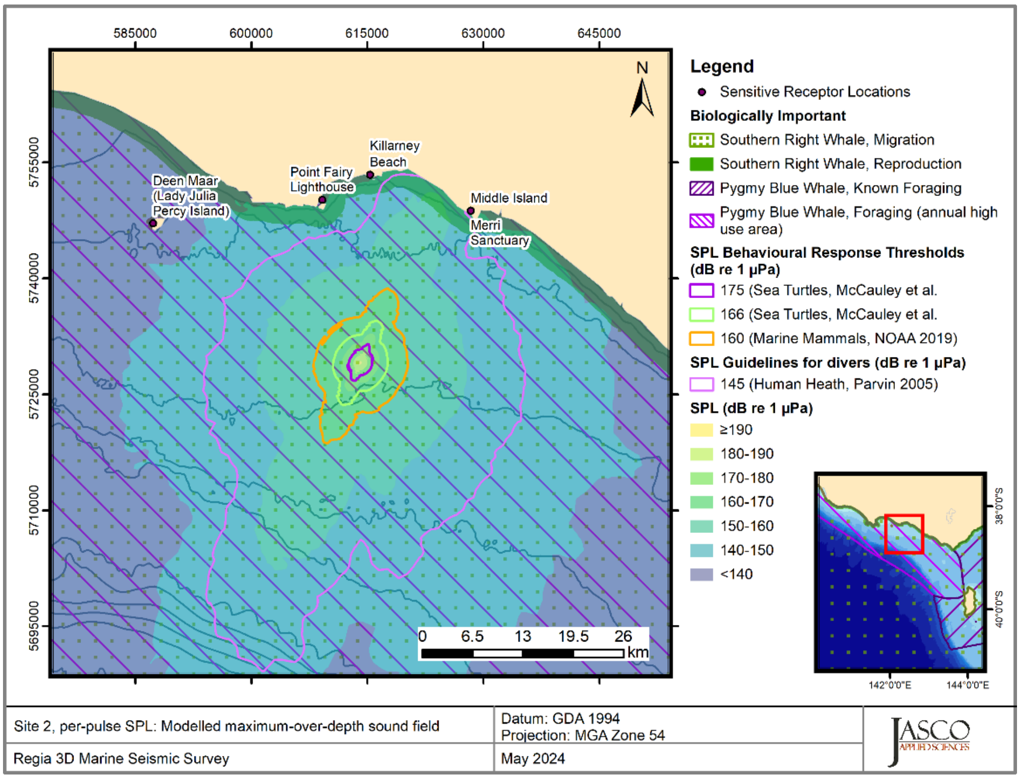


Figure F-2. *Site 2, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

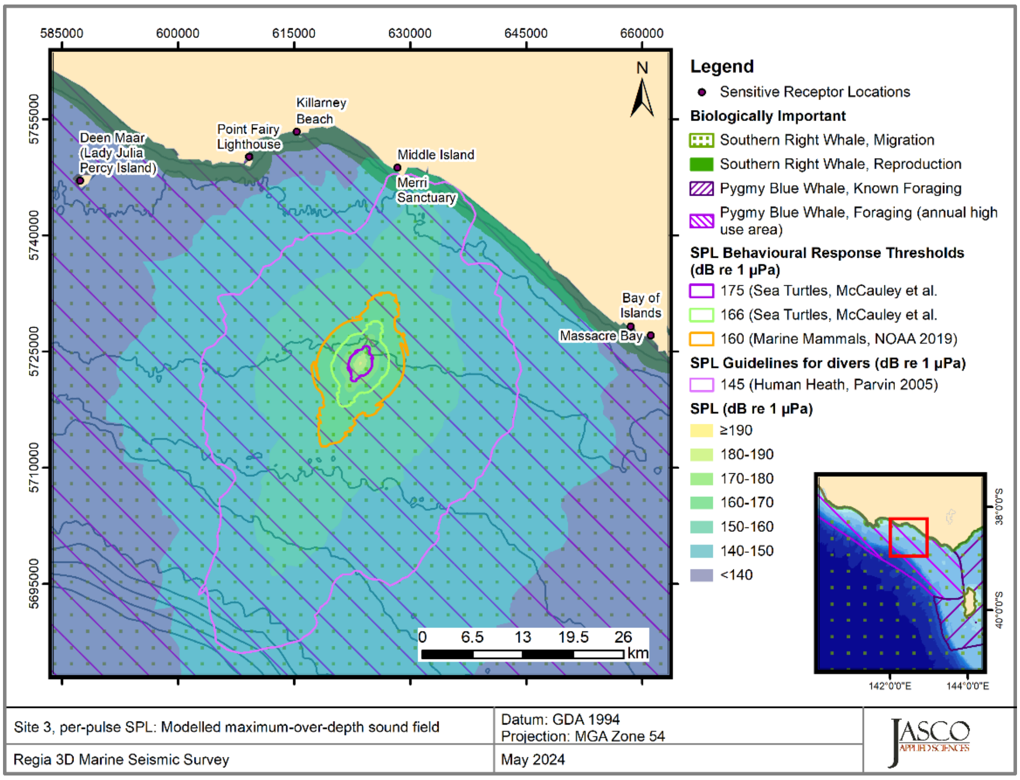


Figure F-3. *Site 3, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

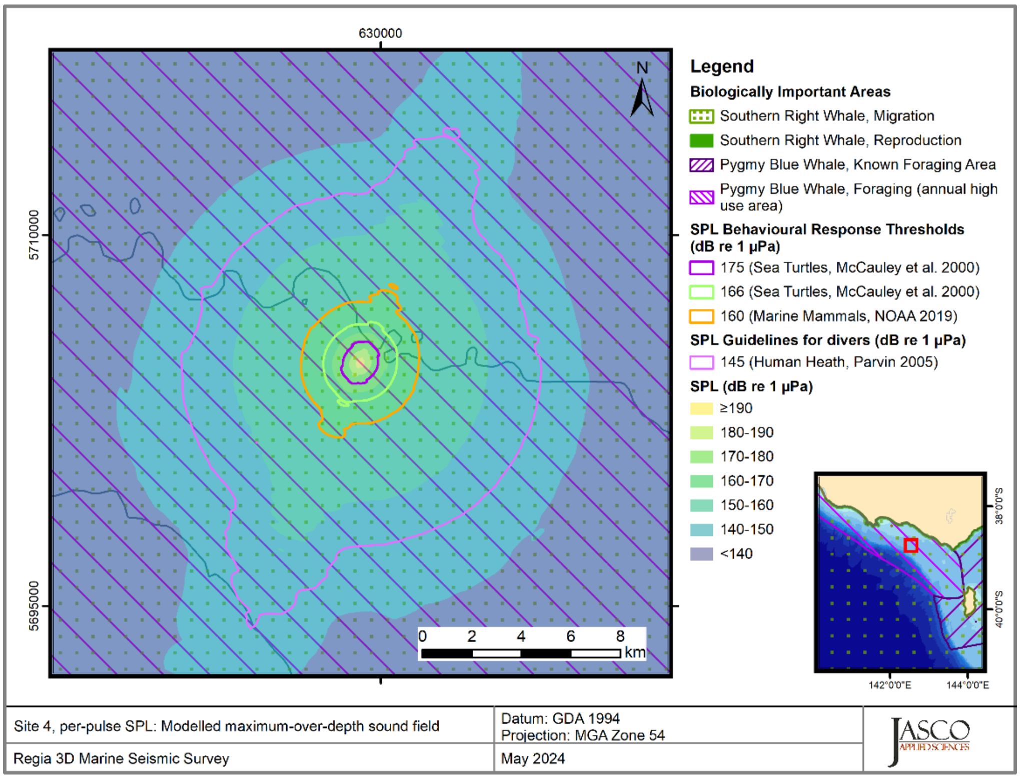


Figure F-4. *Site 4, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

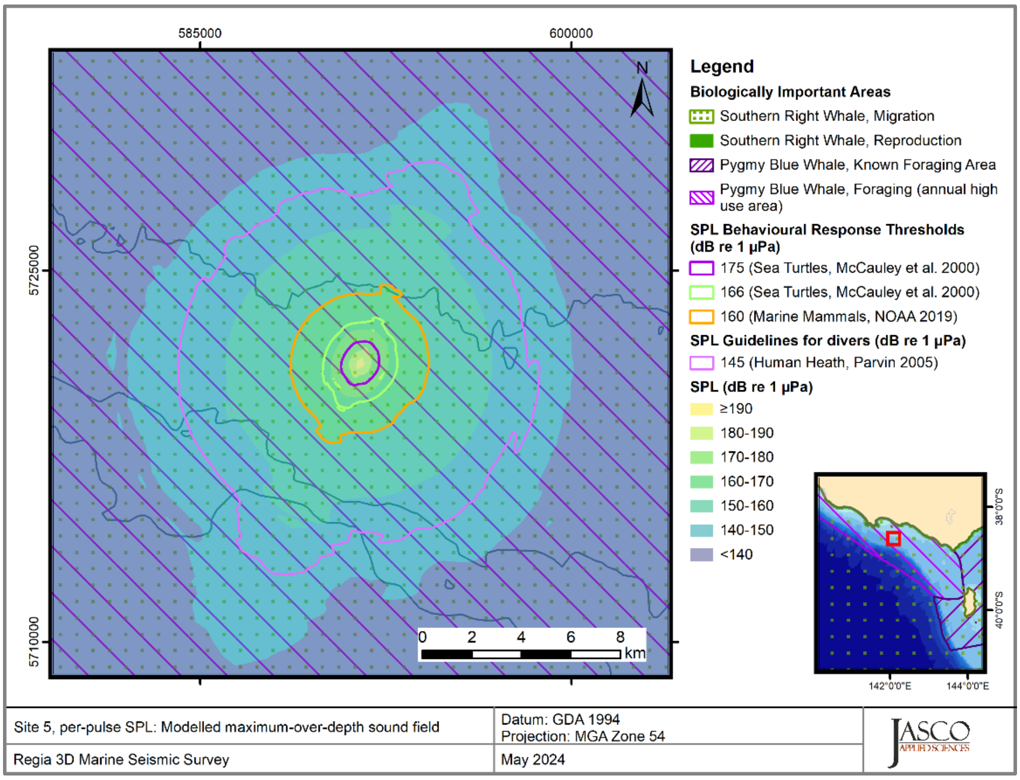


Figure F-5. *Site 5, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

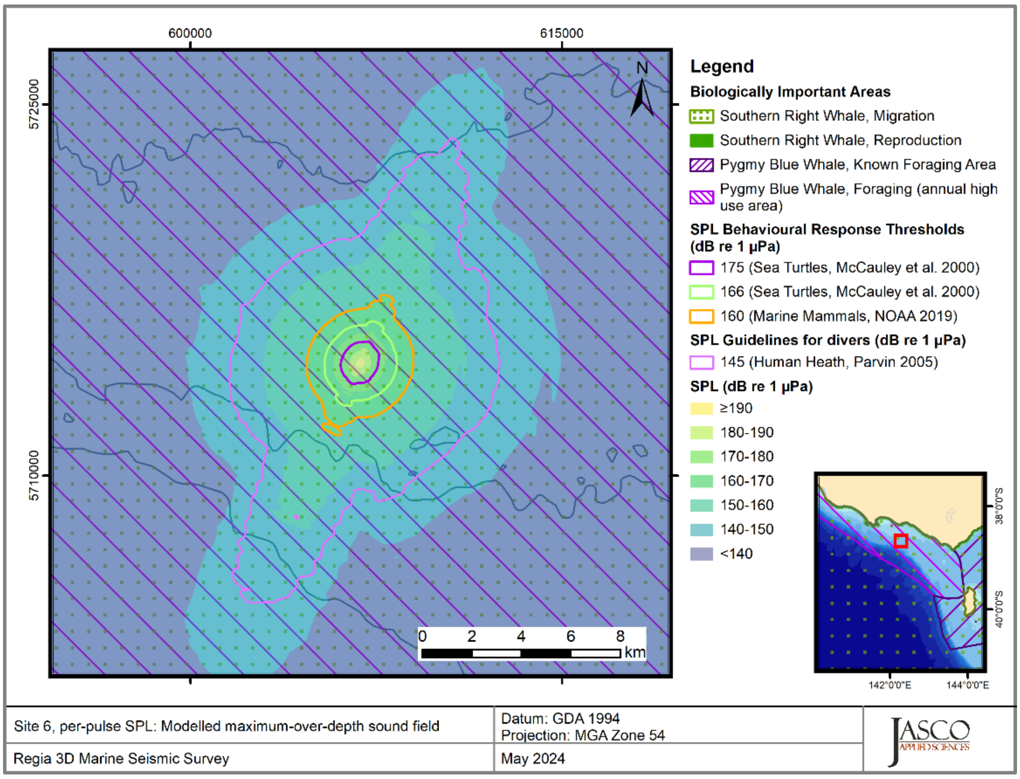


Figure F-6. *Site 6, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

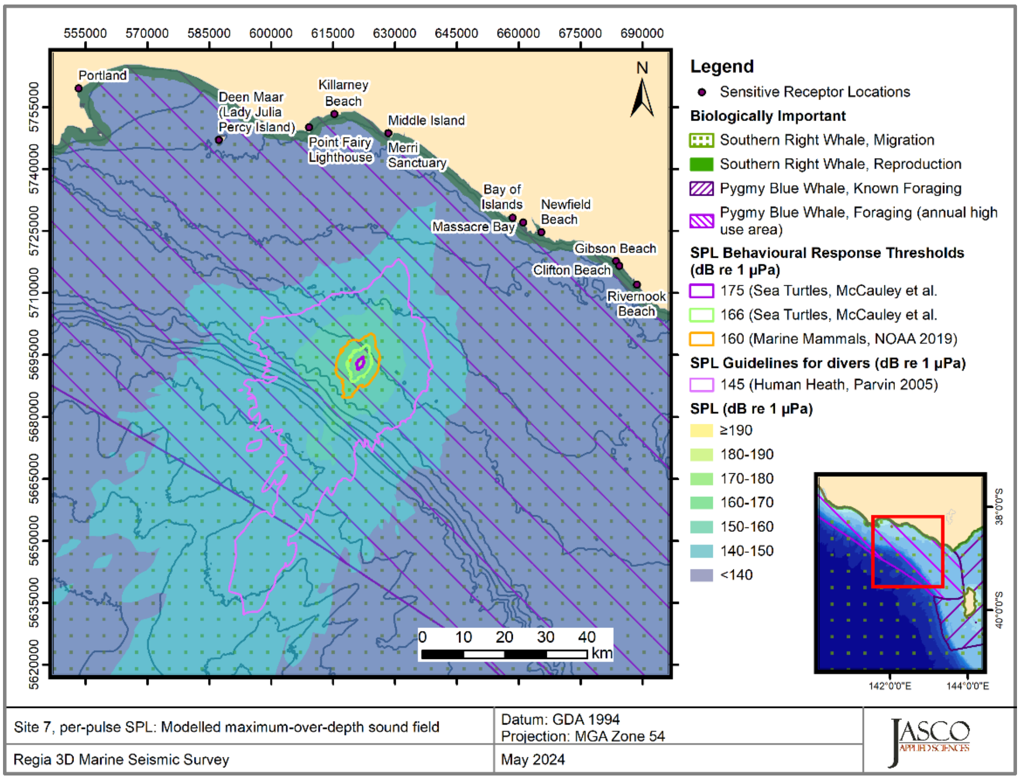


Figure F-7. *Site 7, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

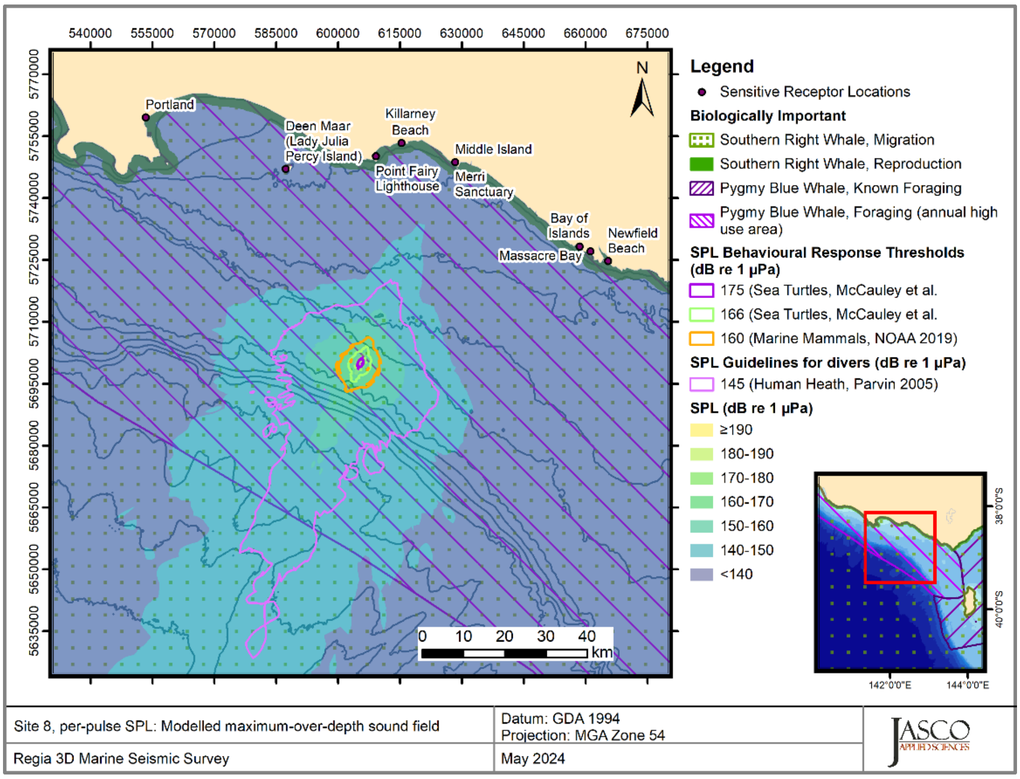


Figure F-8. *Site 8, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

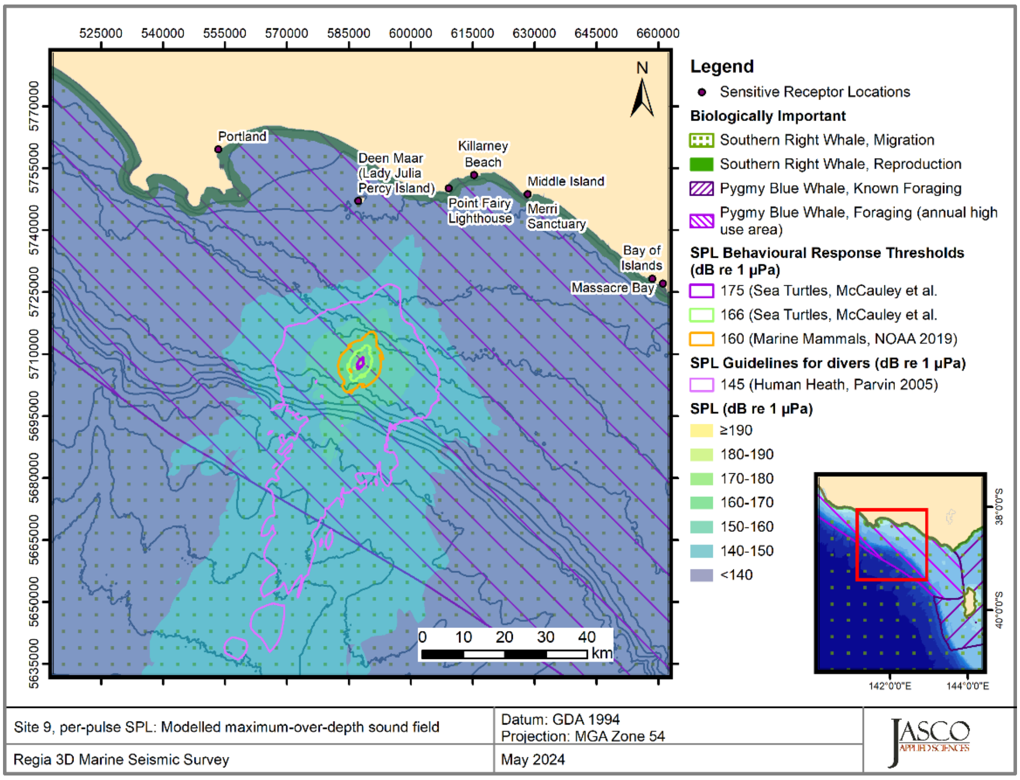


Figure F-9. *Site 9, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

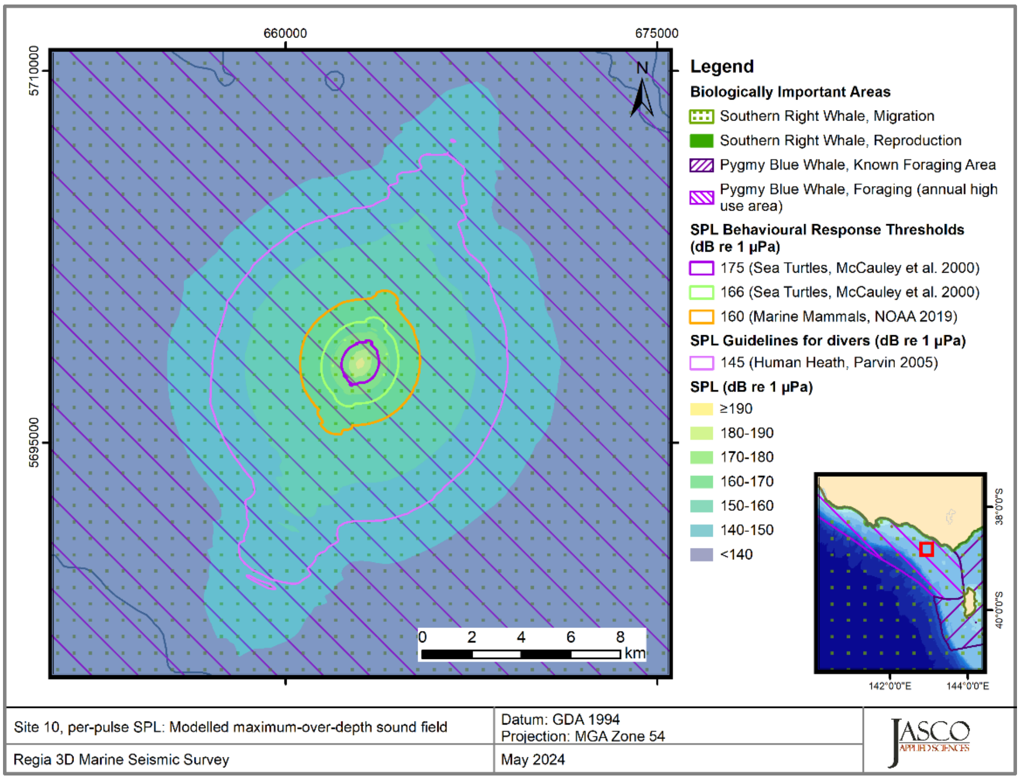


Figure F-10. *Site 10, SPL, 2820 in³ source, tow direction 293*°: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

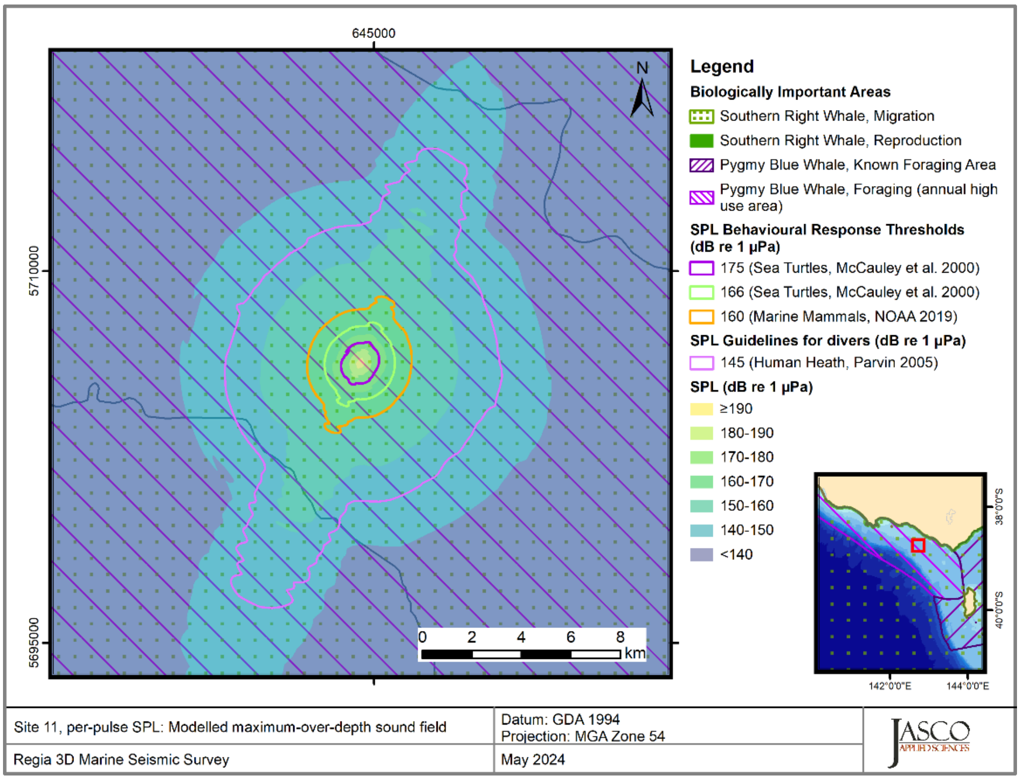


Figure F-11. *Site 11, SPL, 2820 in³ source, tow direction 293*°: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

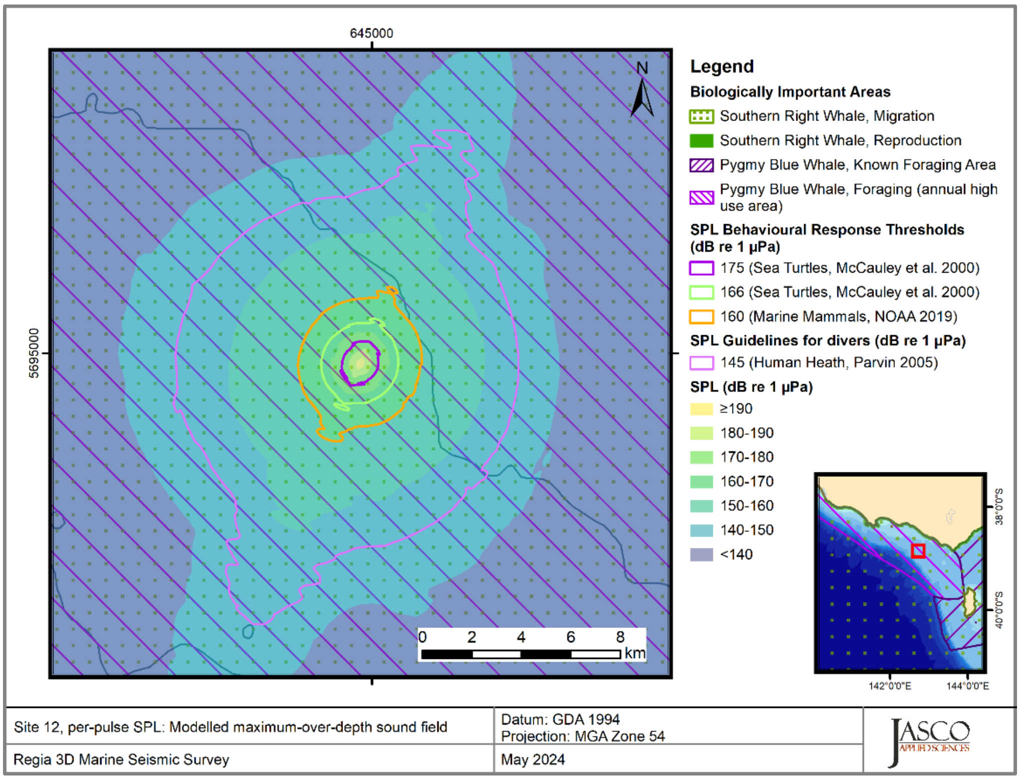


Figure F-12. *Site 12, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

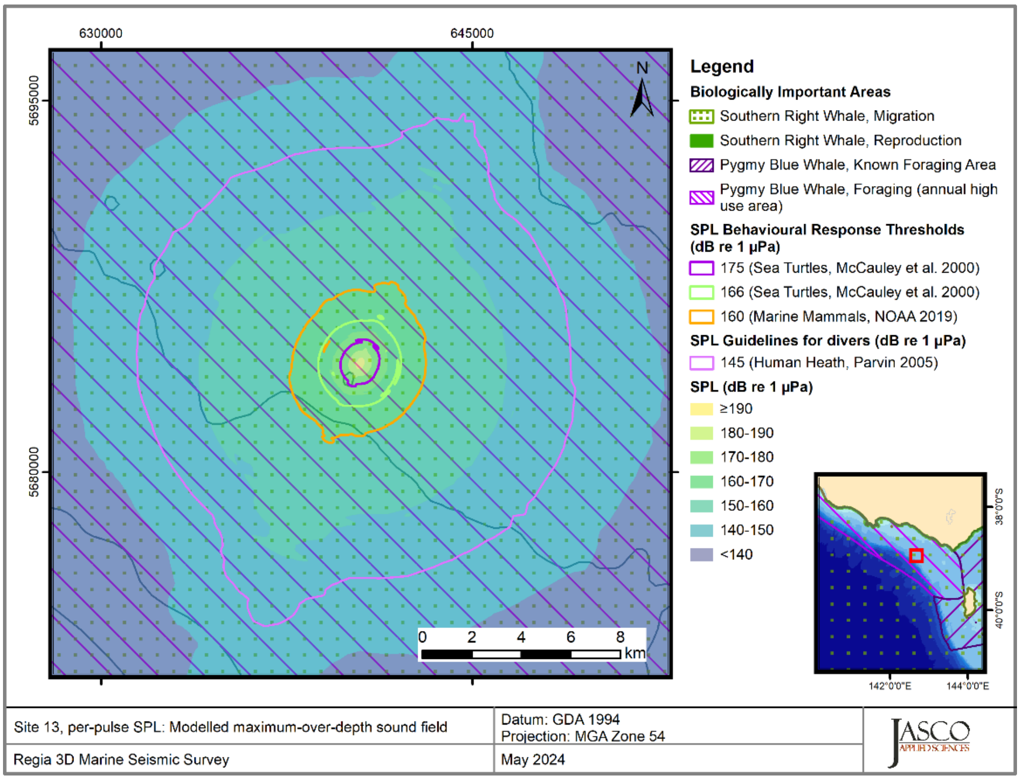


Figure F-13. *Site 13, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

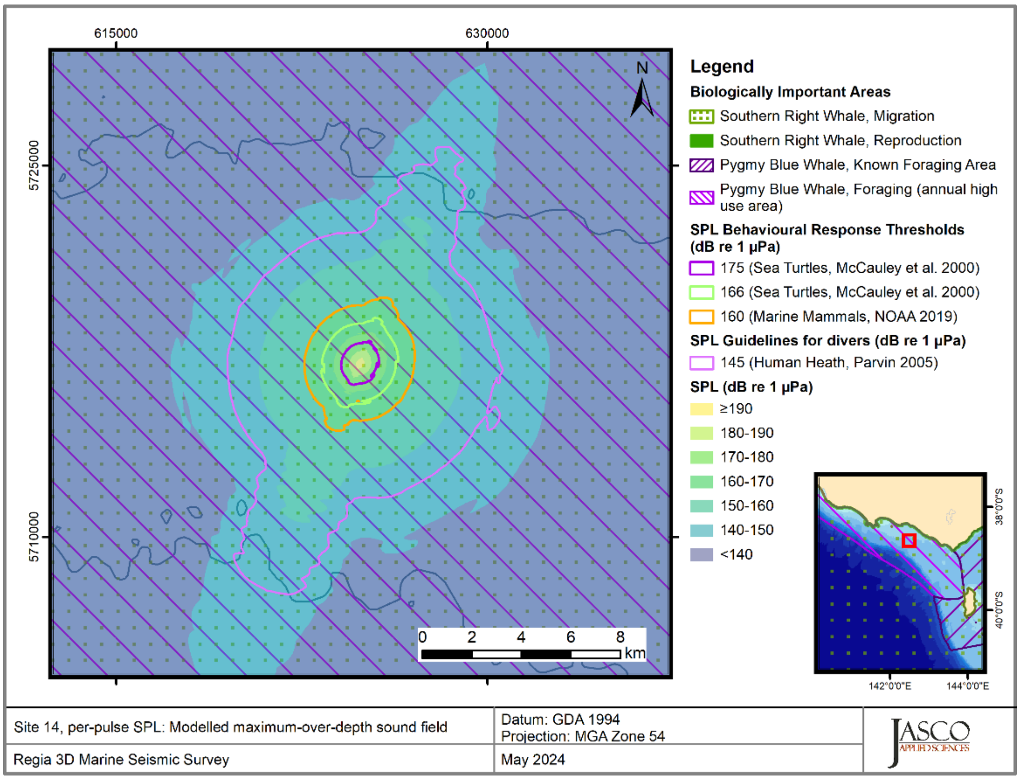


Figure F-14. *Site 14, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

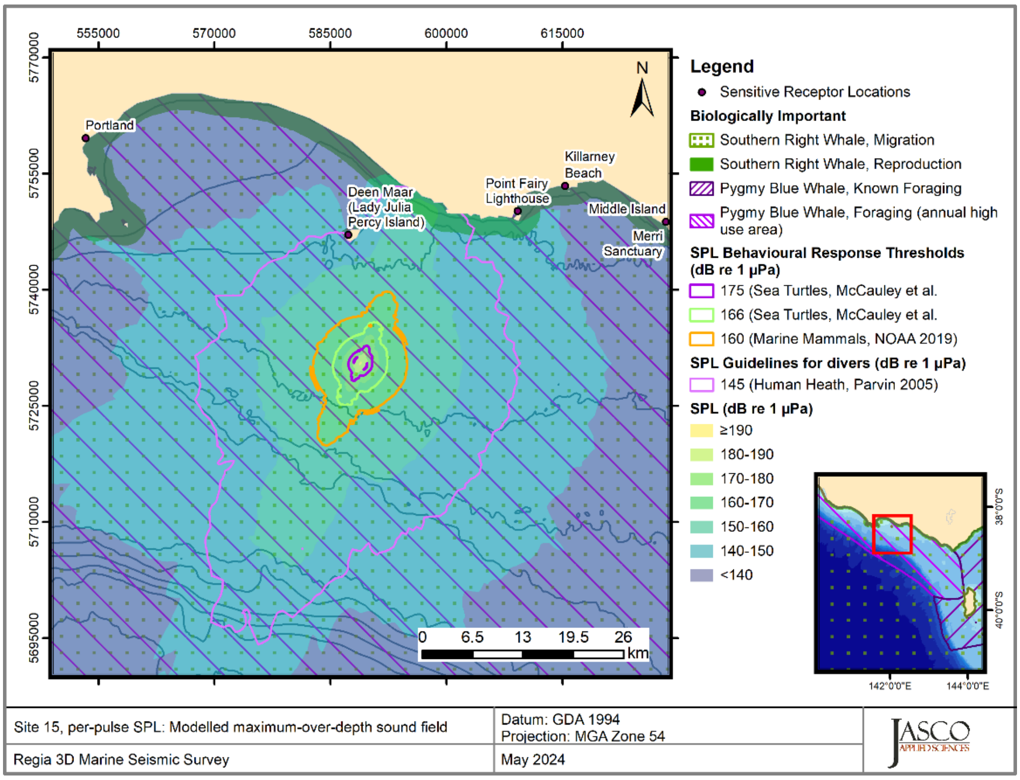


Figure F-15. *Site 15, SPL, 2820 in³ source, tow direction 293°*: Sound level contour map of unweighted maximum-over-depth sound field in 10 dB steps, and the isopleths for behavioural response thresholds for marine mammals, sea turtles and the human health assessment threshold.

Appendix G. Sensitive Receiver Maps

Maps showing which impulses result in levels above the human health assessment threshold. Each map shows which impulse if any result in an exceedance in the human health assessment threshold at the location listed in the figure caption.

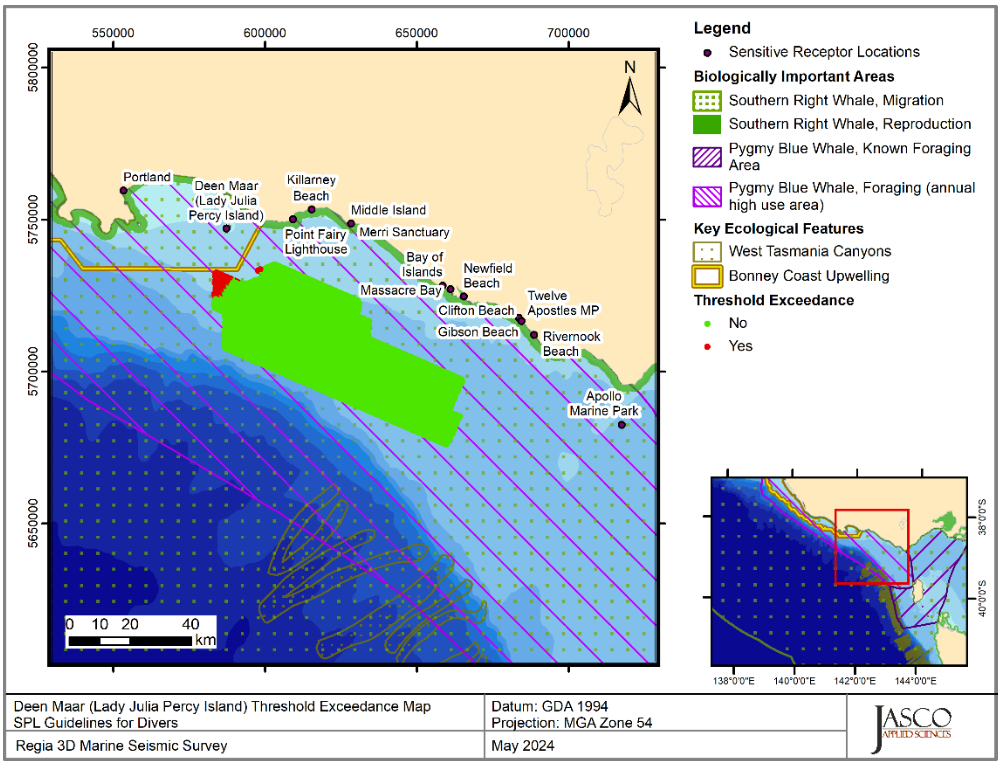


Figure G-1. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Deen Maar (Lady Julia Percy Island) is exceeded.

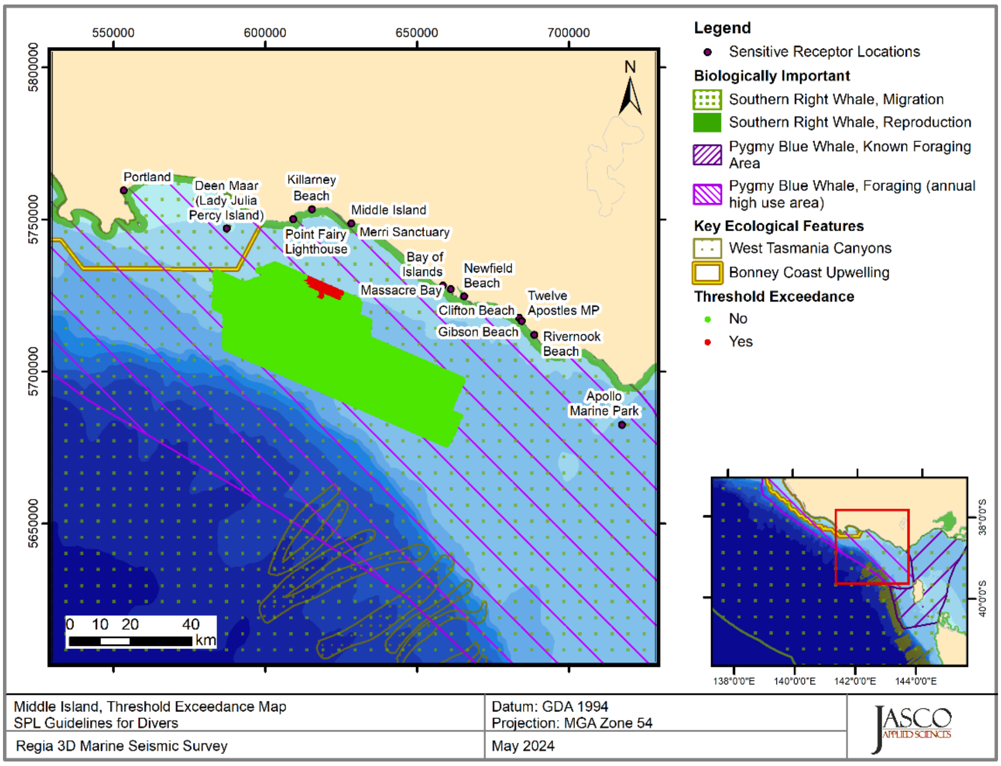


Figure G-2. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Middle Island is exceeded.

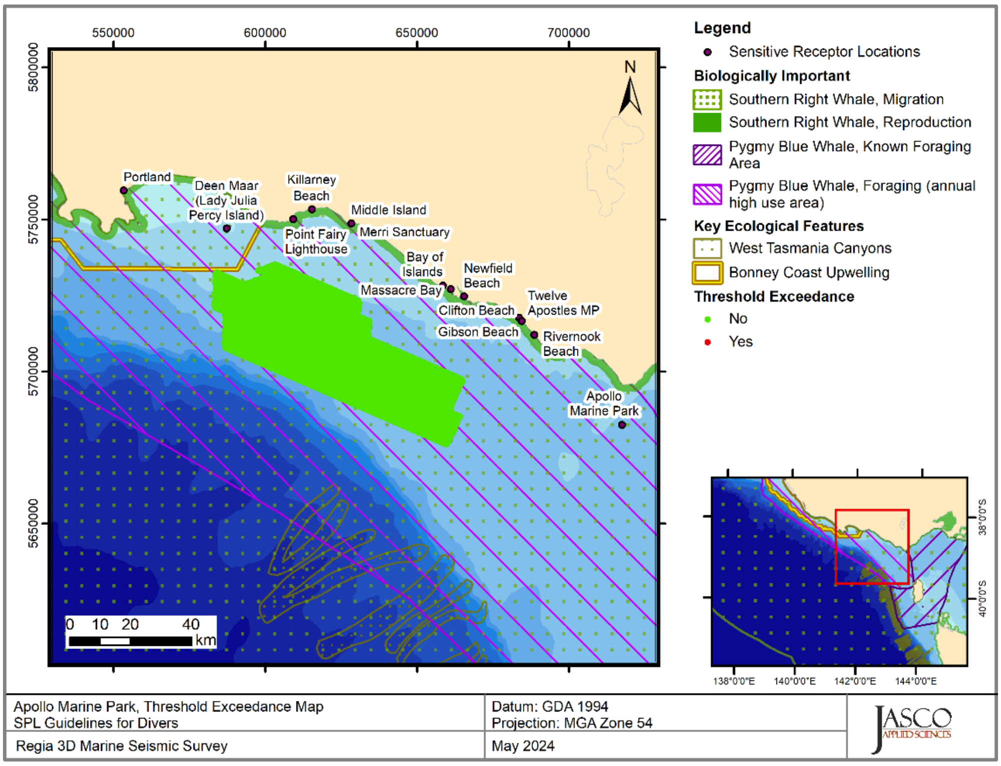


Figure G-3. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Apollo Marine Park is exceeded.

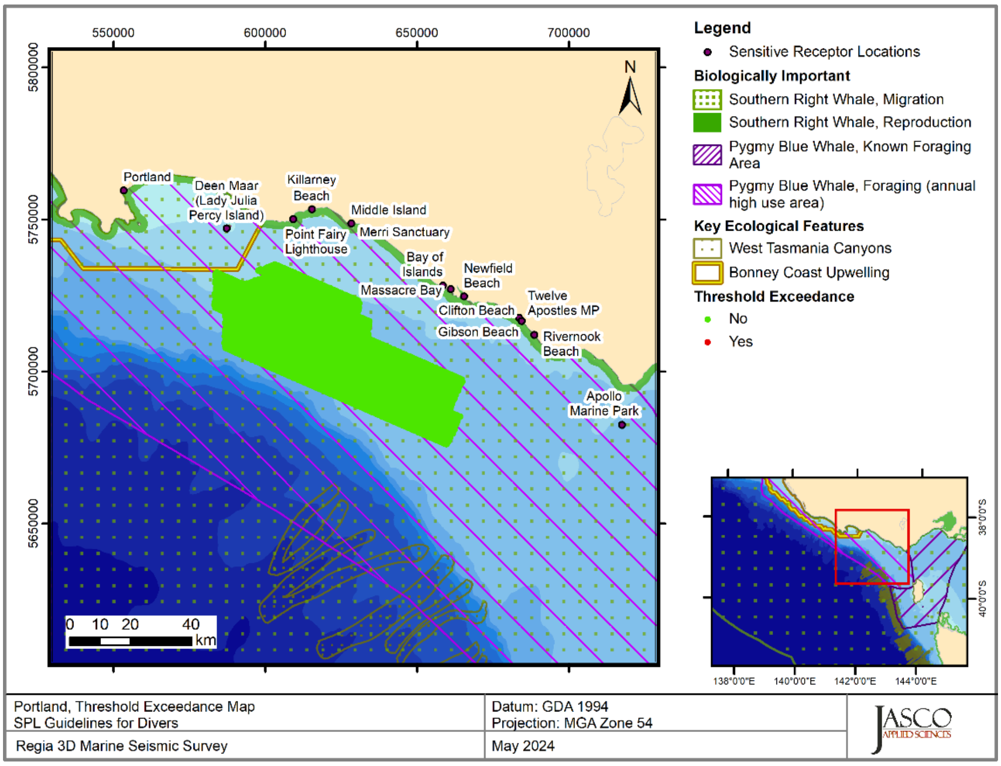


Figure G-4. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Portland is exceeded.

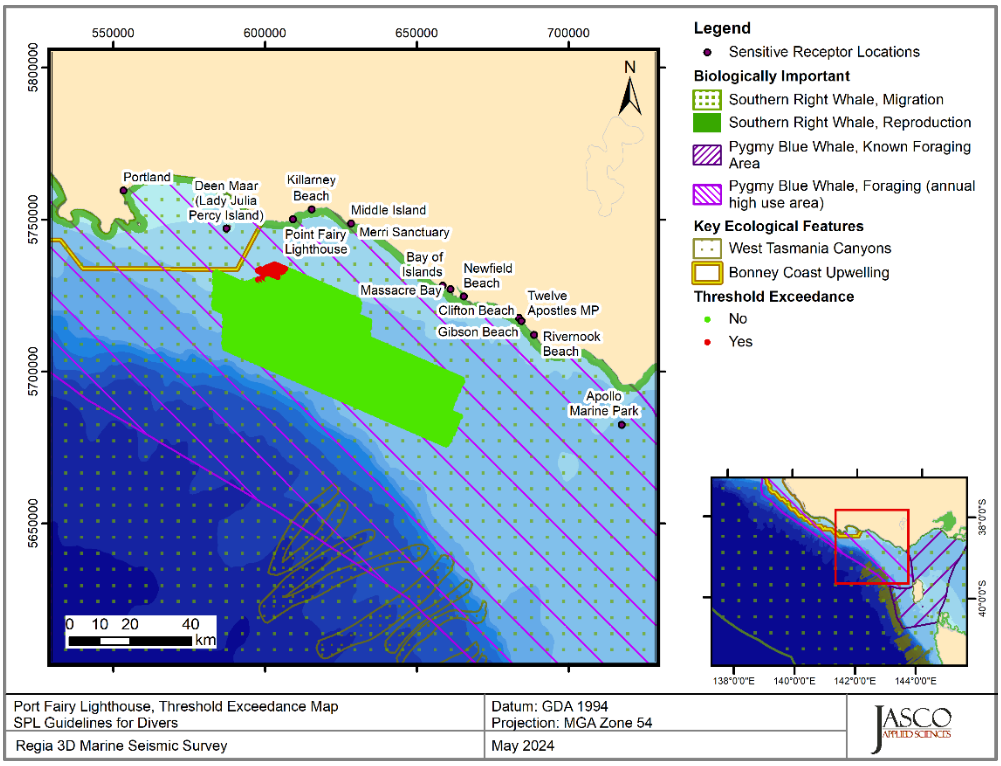


Figure G-5. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Port Fairy Lighthouse is exceeded.

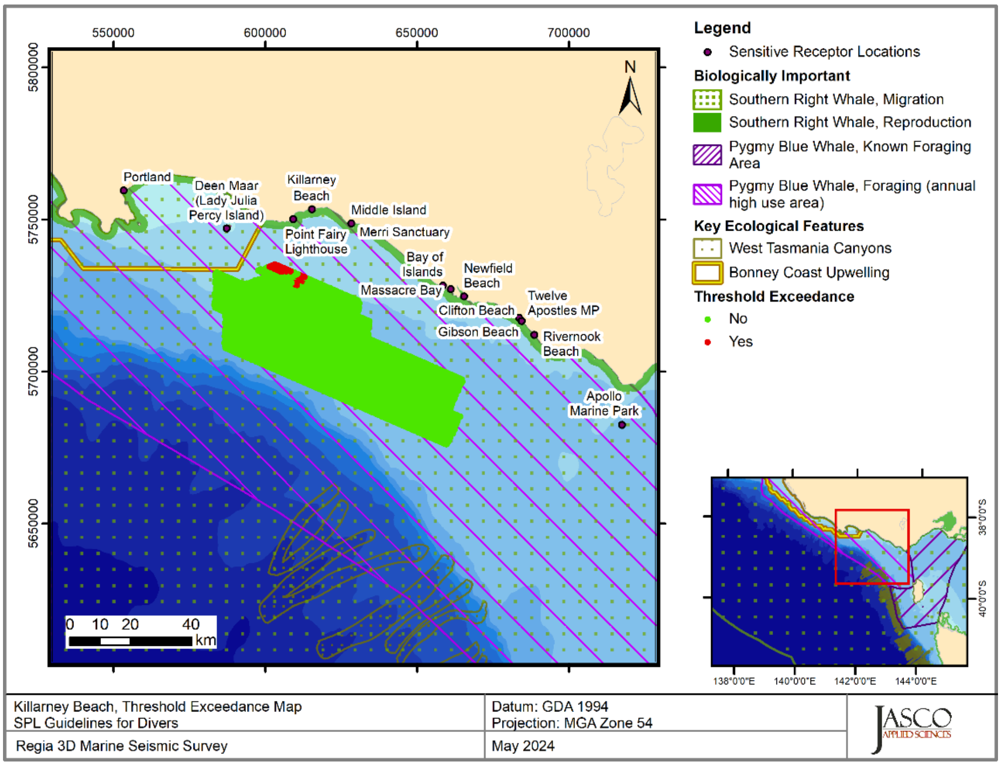


Figure G-6. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Killarney Beach is exceeded.

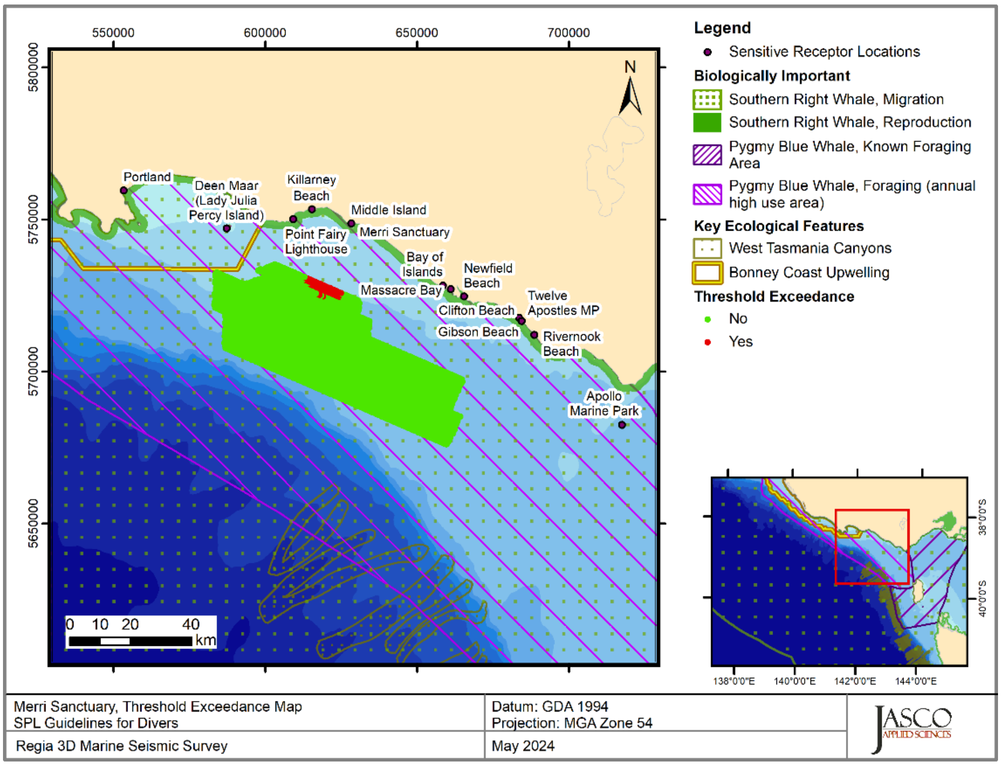


Figure G-7. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Merri Sanctuary is exceeded.

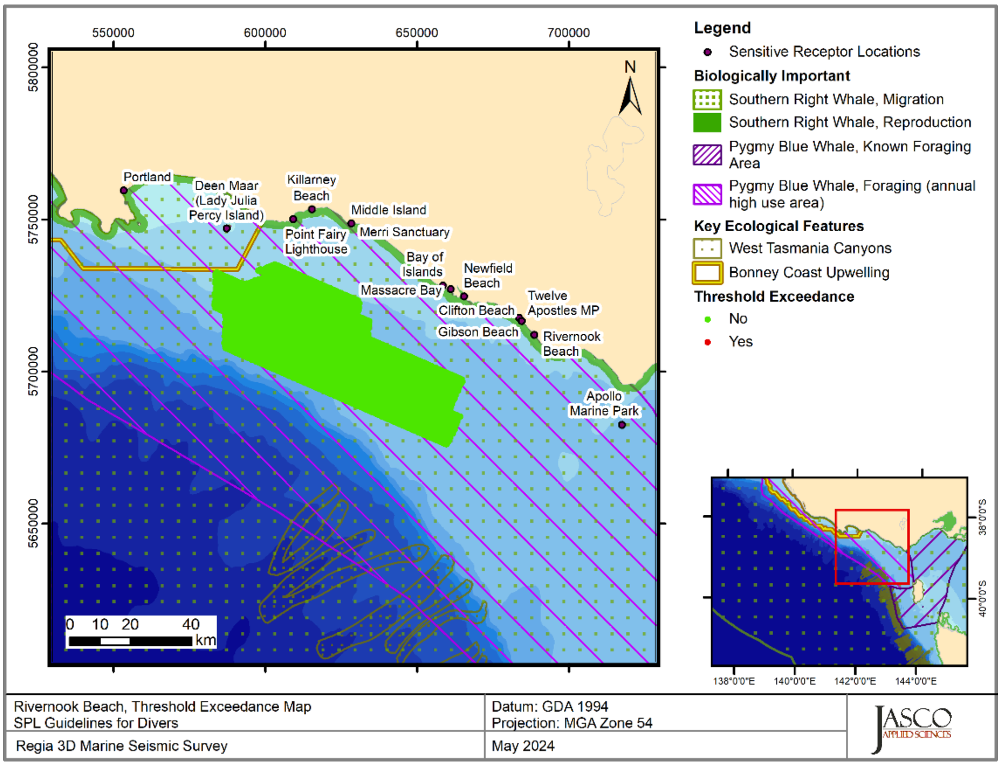


Figure G-8. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Rivernook Beach is exceeded.

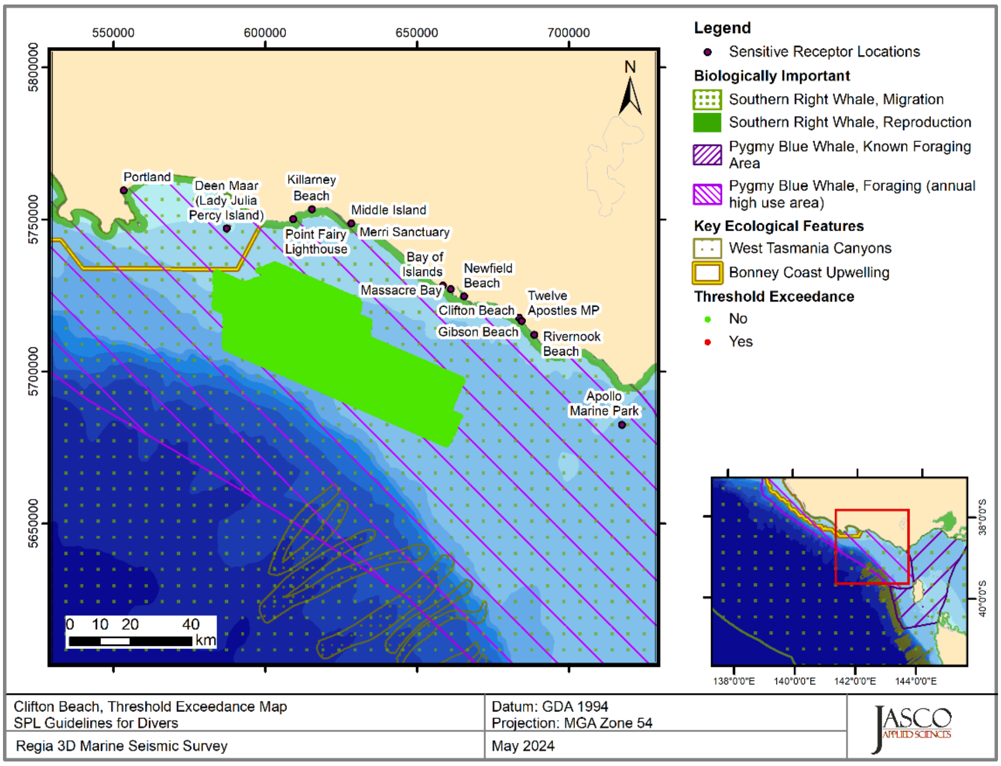


Figure G-9. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Clifton Beach is exceeded.

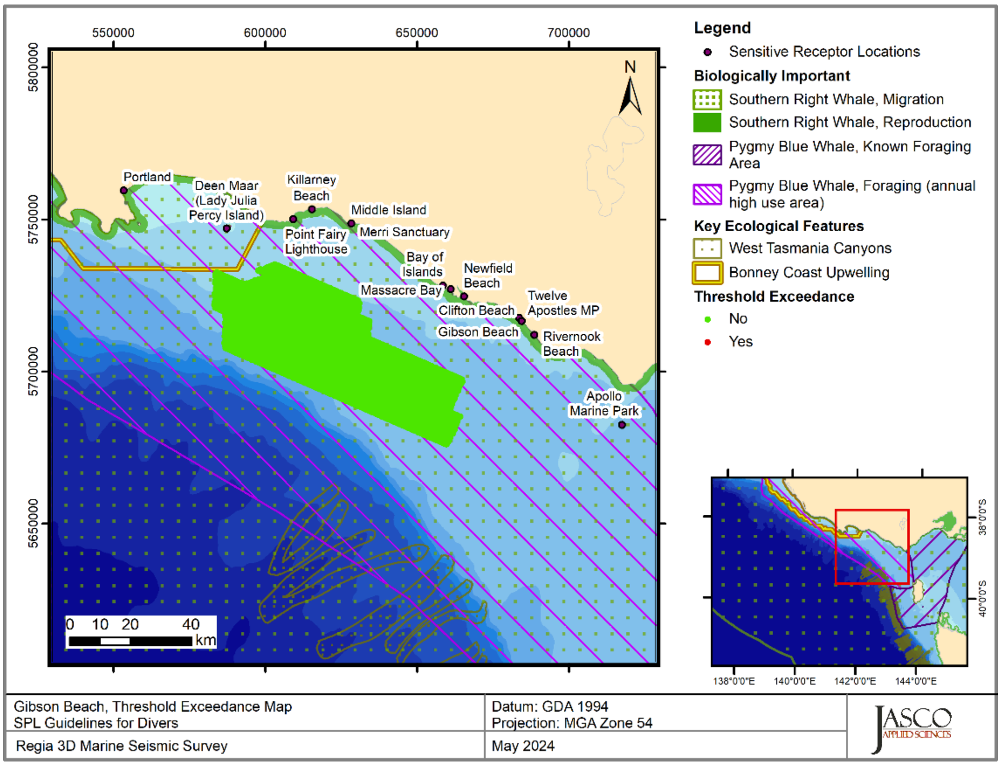


Figure G-10. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Gibson Beach is exceeded.

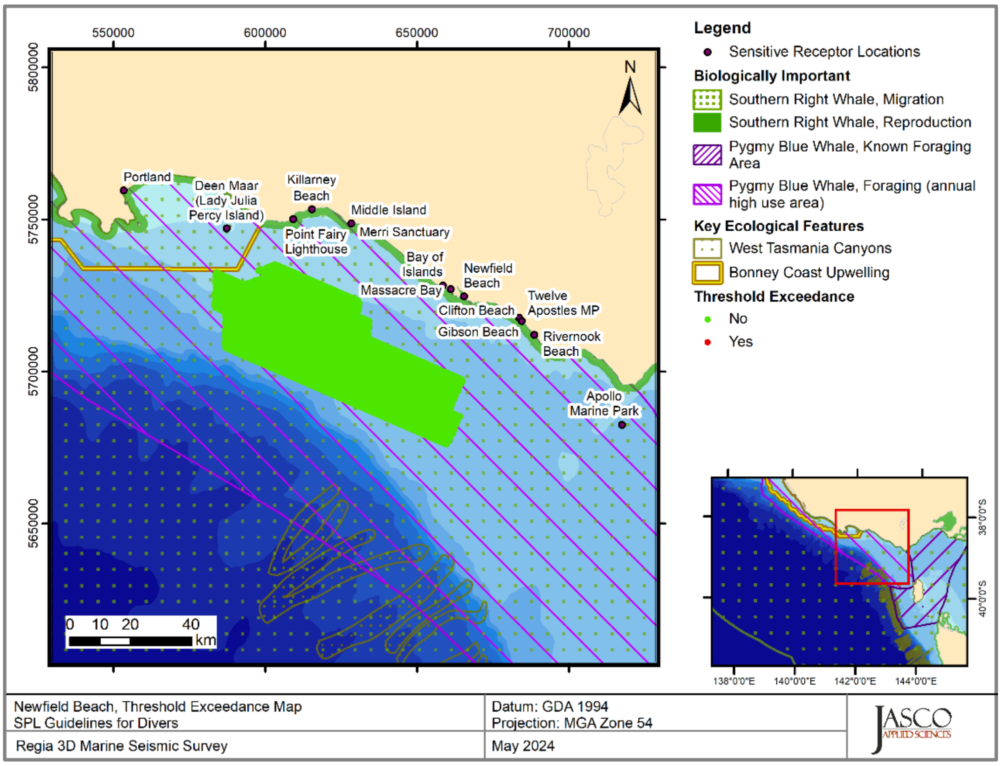


Figure G-11. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Newfield Beach is exceeded.

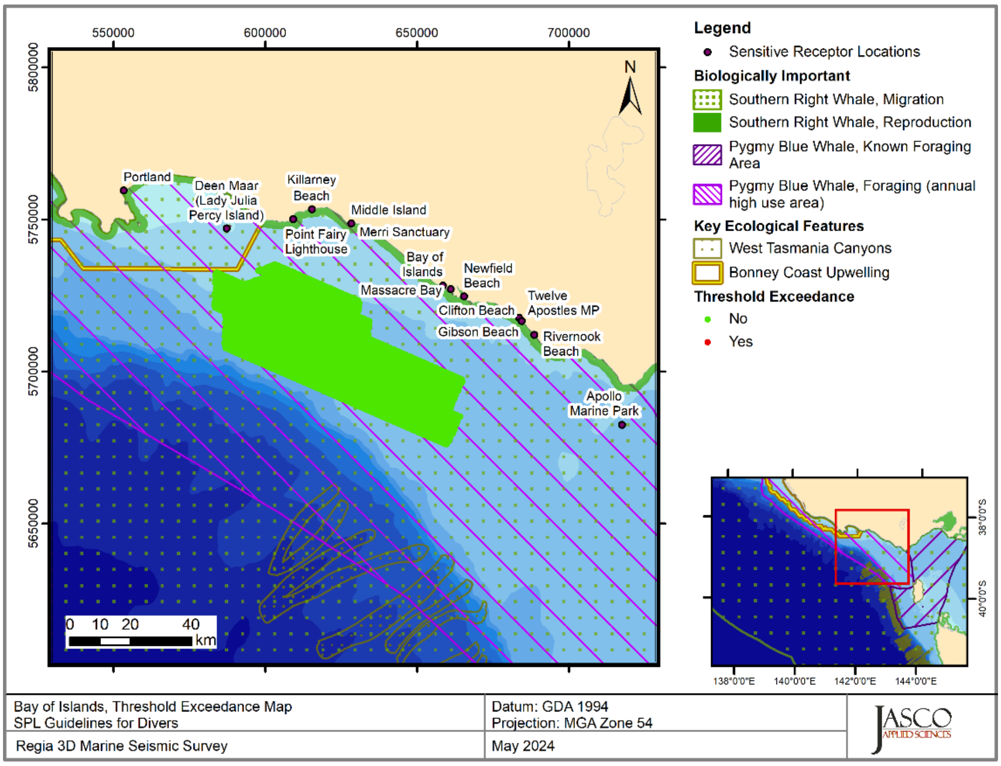


Figure G-12. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Bay of Islands is exceeded.

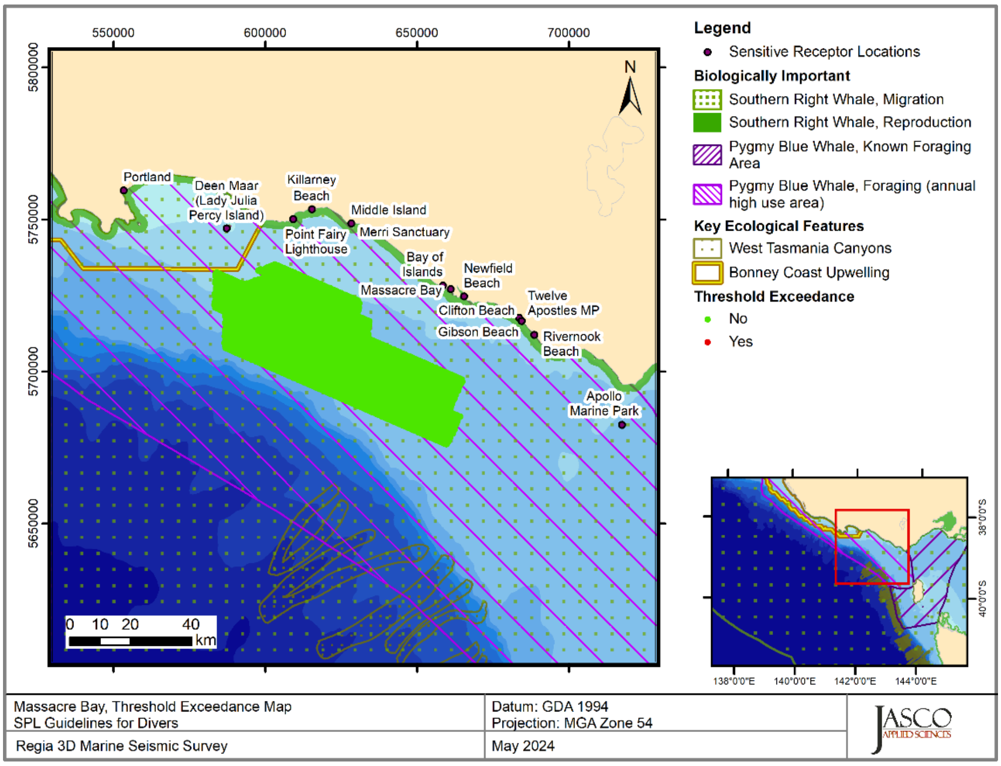


Figure G-13. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Massacre Bay is exceeded.

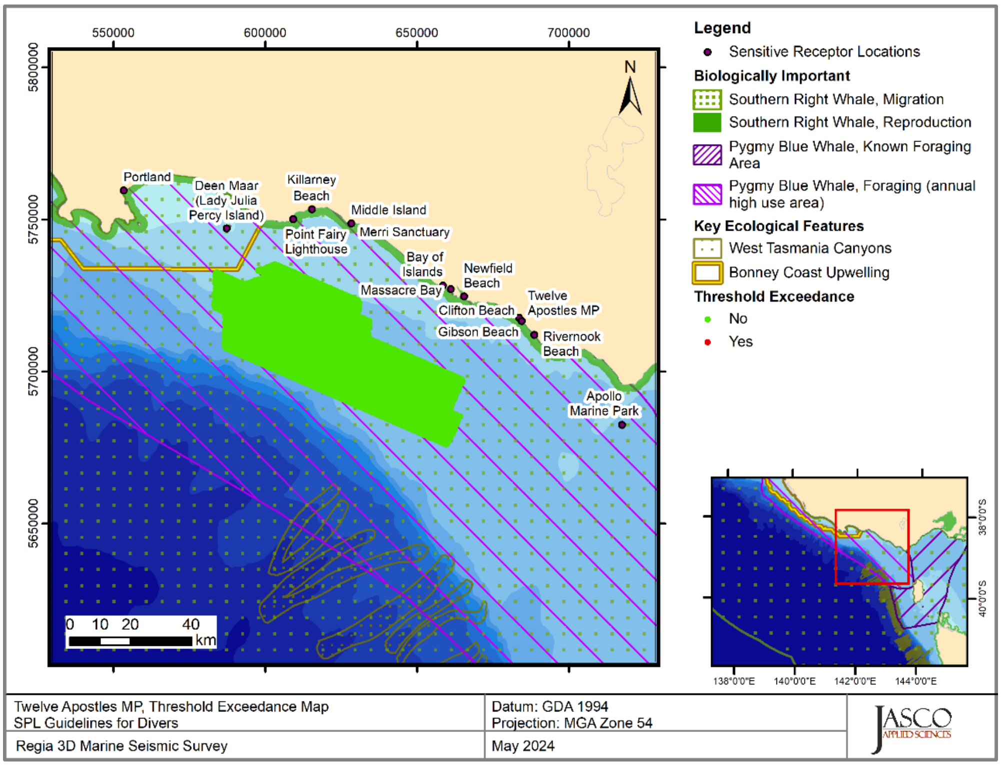


Figure G-14. *SPL, 2820 in³ source,* seismic impulse locations where the human health assessment threshold at Twelve Apostles MP is exceeded.

Appendix H. Supplemental Animal Movement Modelling Results

Histograms of CPA ranges to SEL_{24h} PTS, TTS, and the behavioural response threshold for Scenarios B, C and D are shown in Figures F-1 to F-30.

H.1. Scenario B

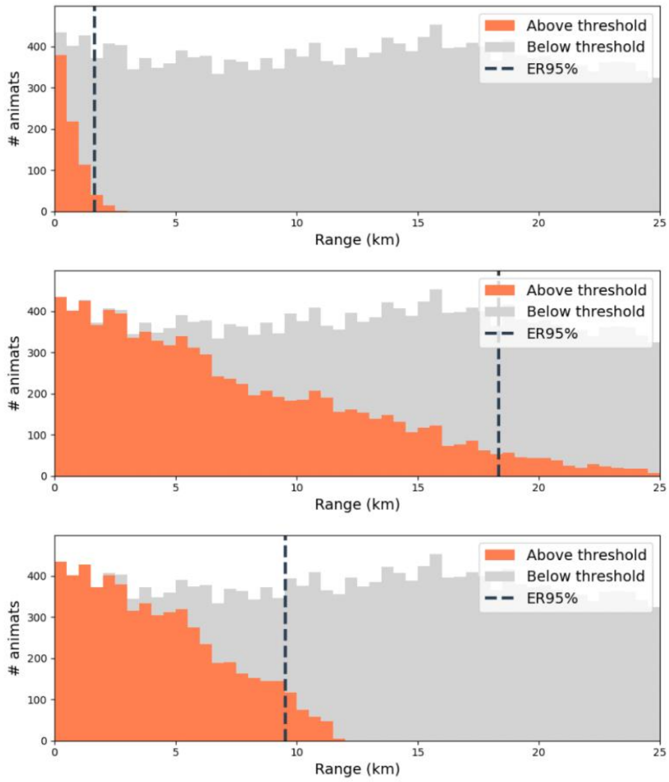


Figure H-1. *Scenario B, female pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

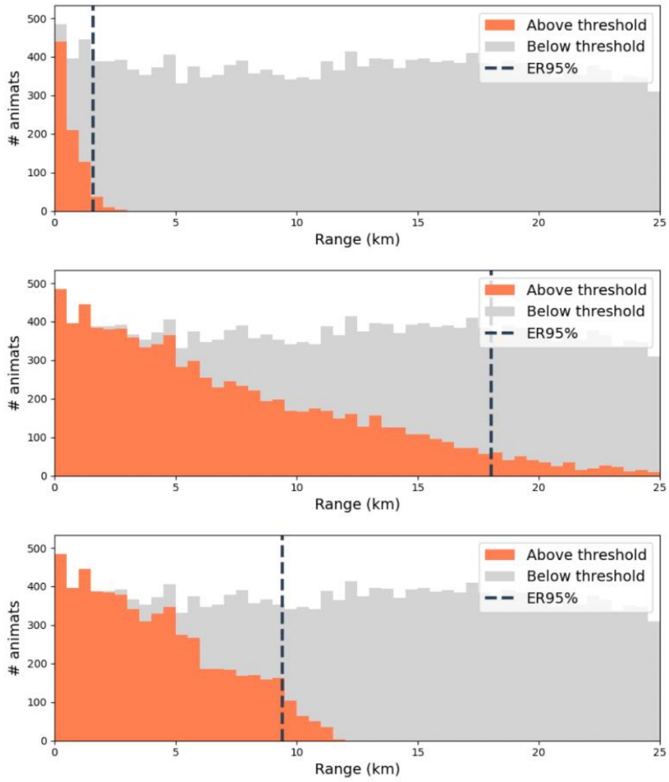


Figure H-2. *Scenario B, male pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

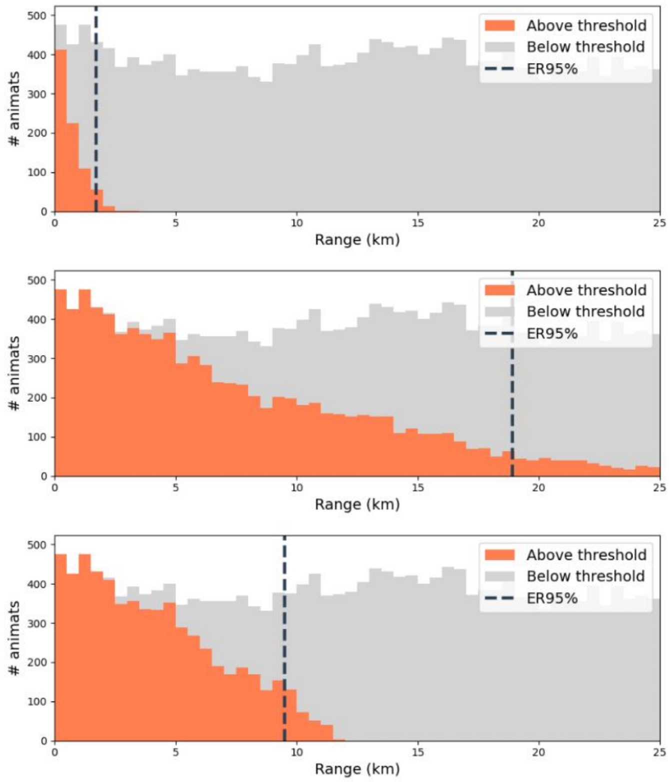


Figure H-3. *Scenario B, female pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

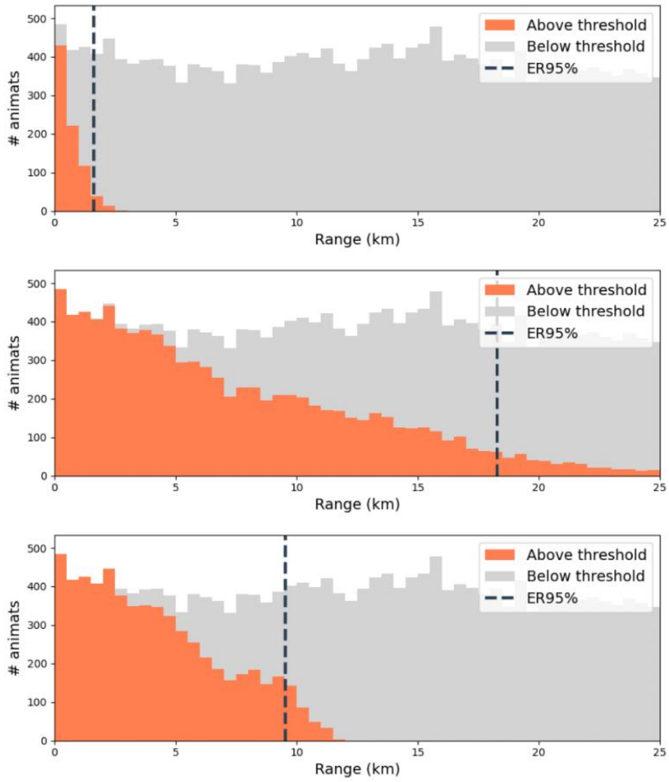


Figure H-4. *Scenario B, male pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

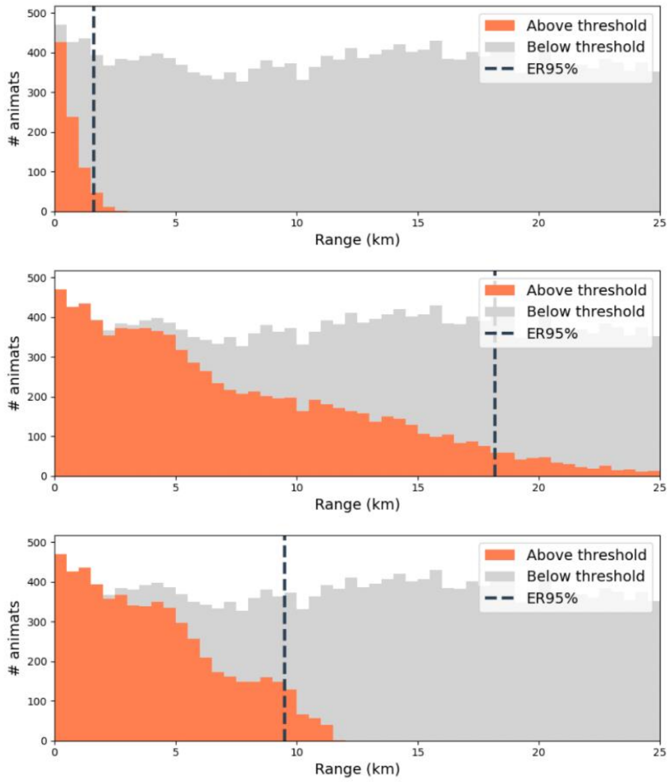


Figure H-5. *Scenario B, female pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

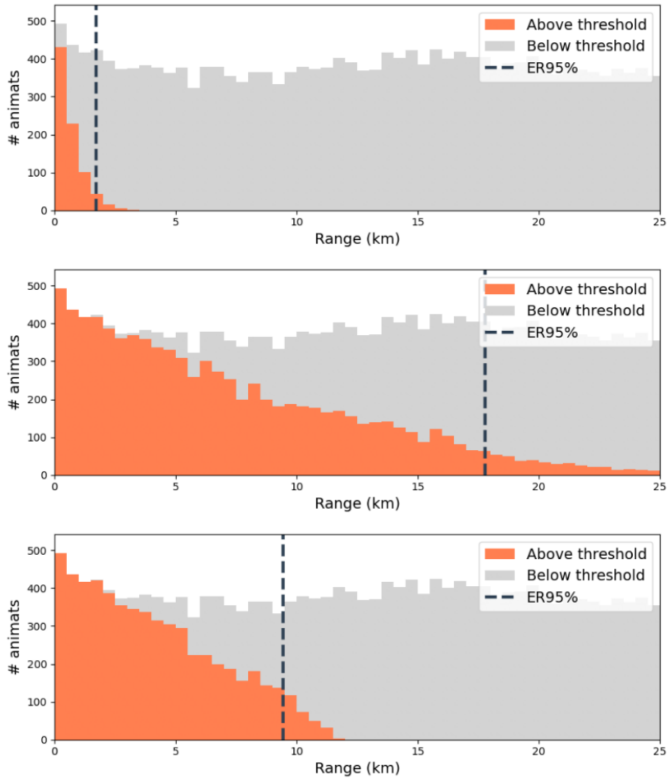


Figure H-6. *Scenario B, male pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

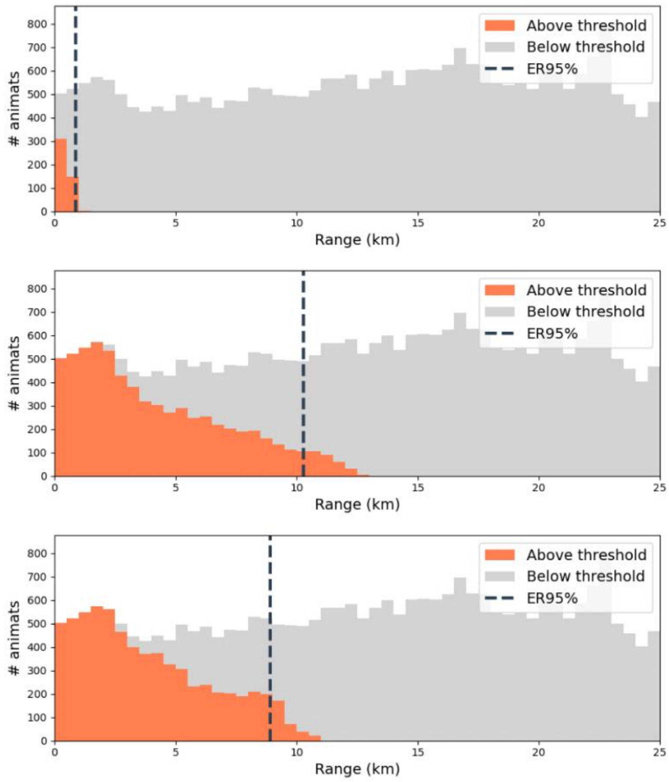


Figure H-7. *Scenario B, migrating southern right whale animats, no calf, unrestricted:* CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

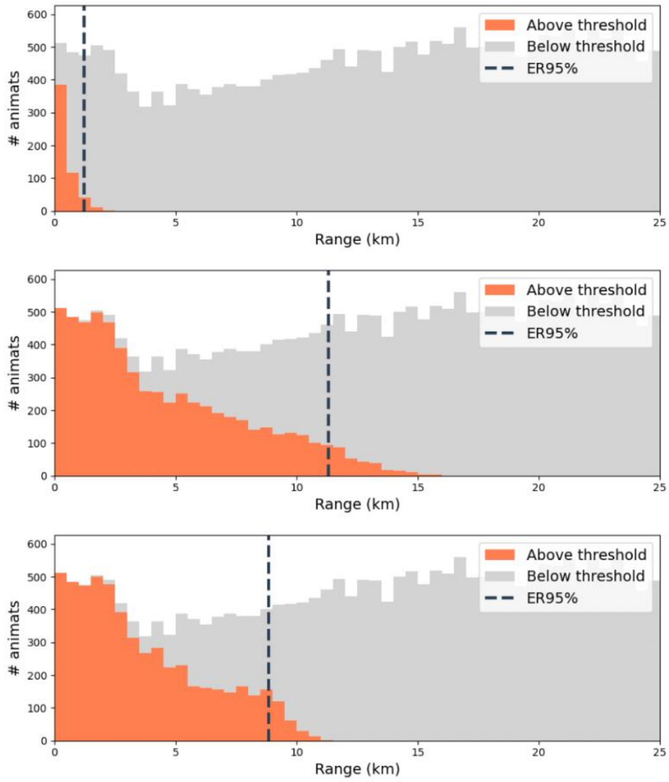


Figure H-8. *Scenario B, migrating southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

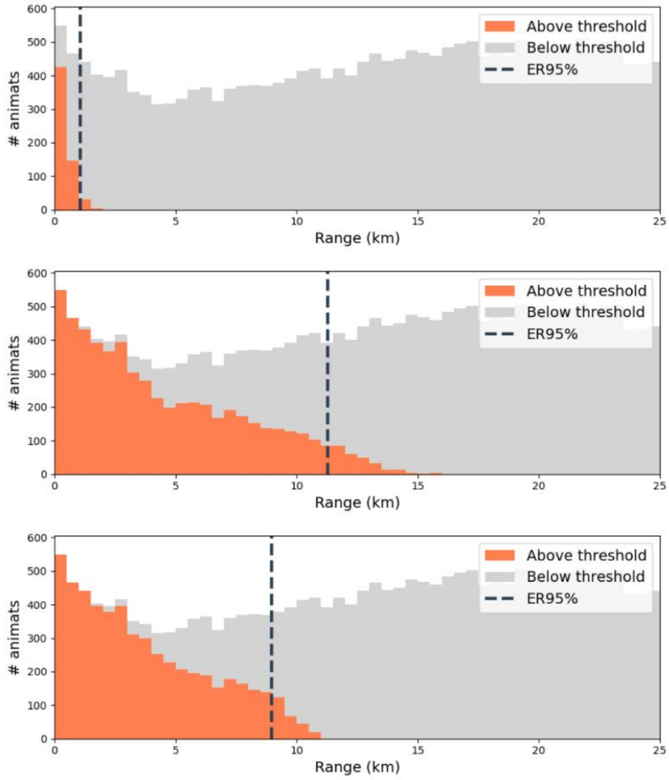


Figure H-9. *Scenario B, reproducing southern right whale animats, no calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

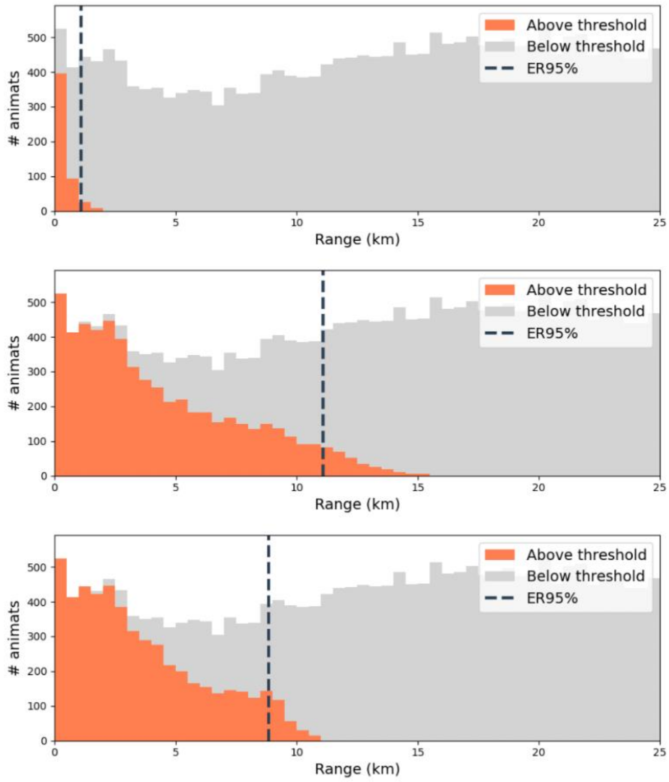


Figure H-10. *Scenario B, reproducing southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

H.2. Scenario C

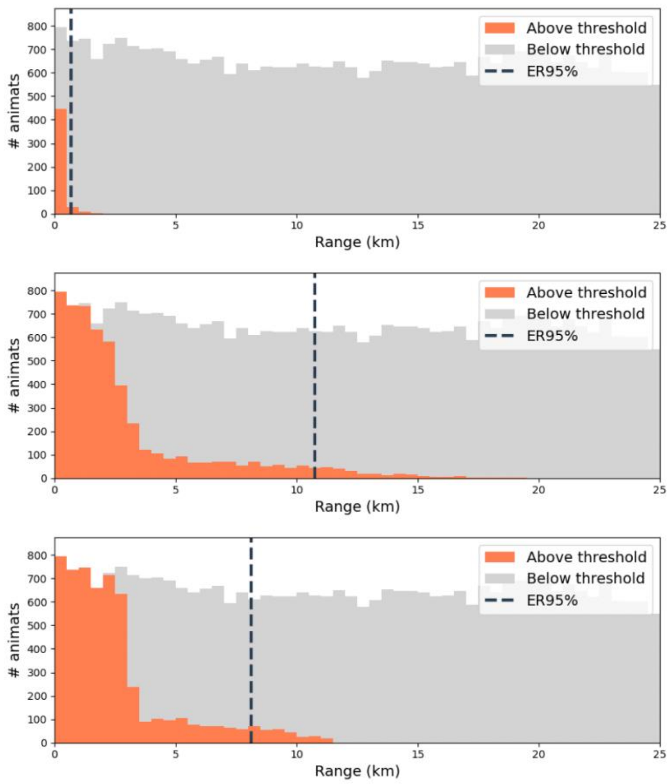


Figure H-11. *Scenario C, female pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

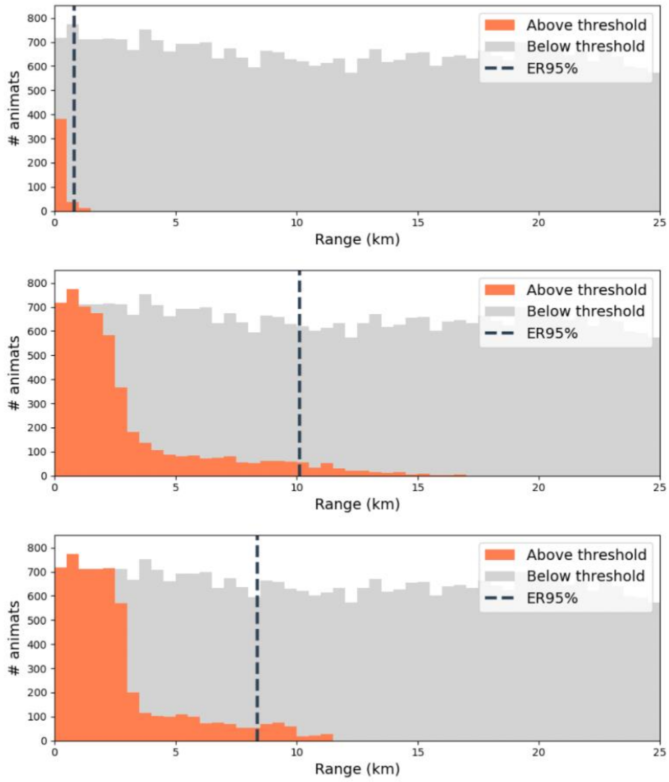


Figure H-12. *Scenario C, male pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

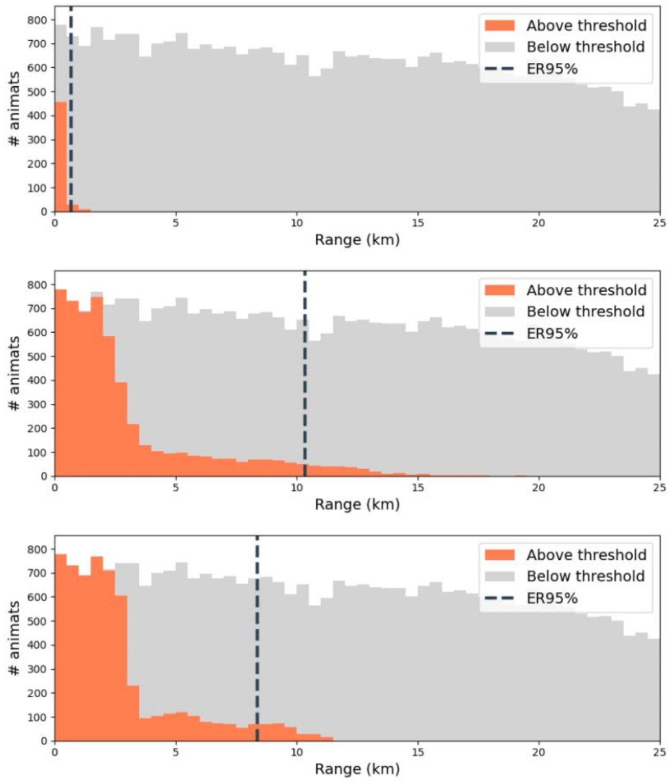


Figure H-13. *Scenario C, female pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

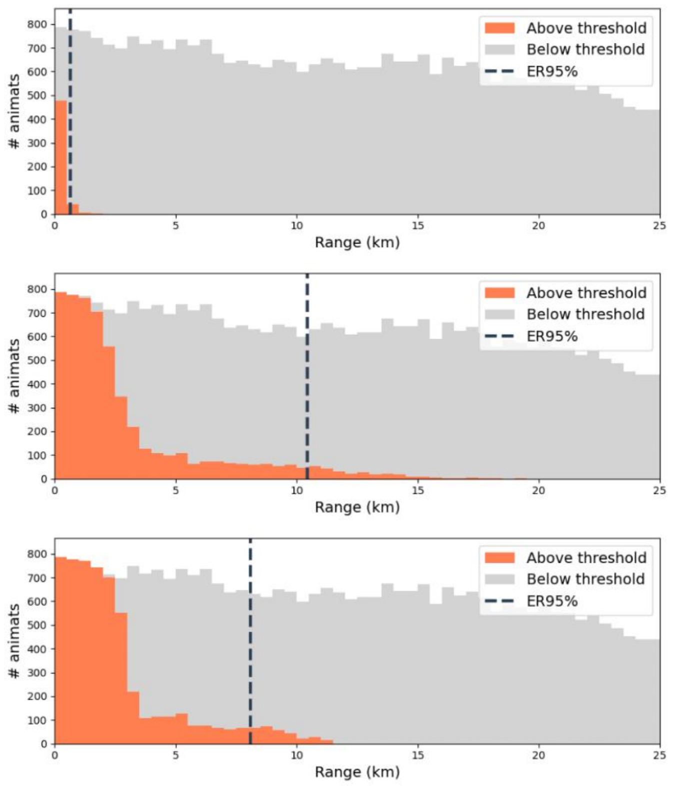


Figure H-14. *Scenario C, male pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

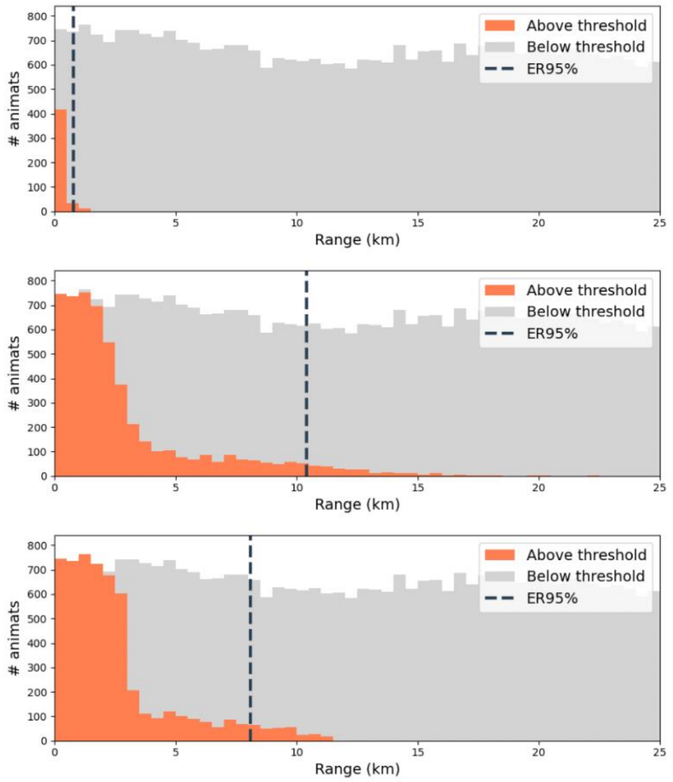


Figure H-15. *Scenario C, female pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

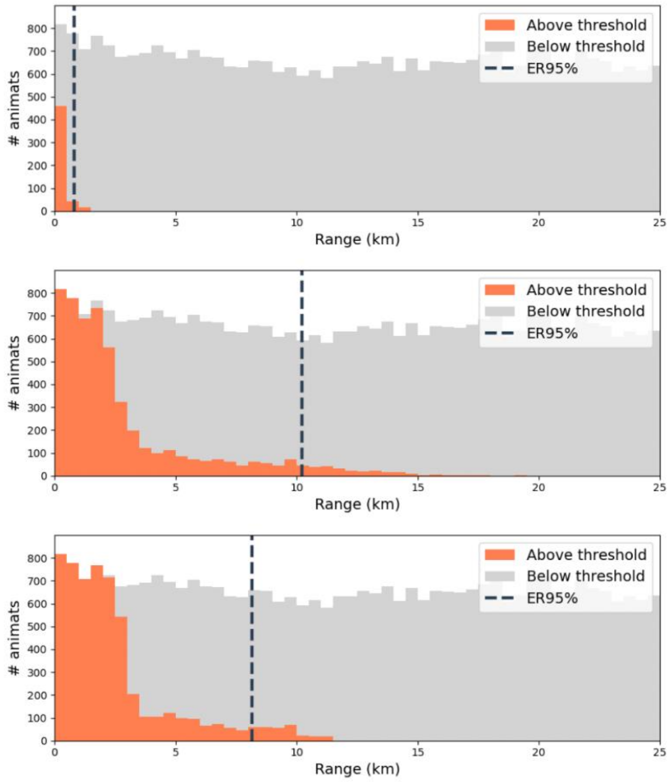


Figure H-16. *Scenario C, male pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

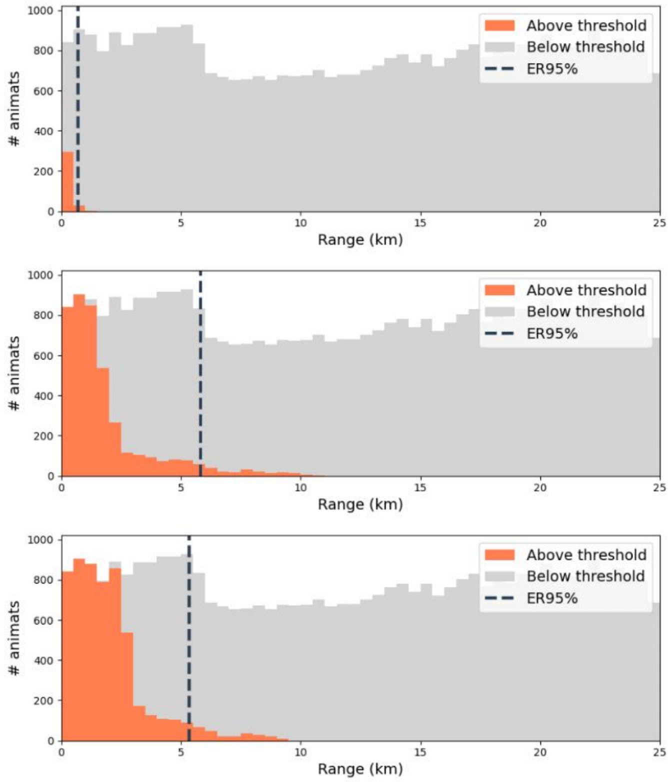


Figure H-17. *Scenario C, migrating southern right whale animats, no calf, unrestricted:* CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

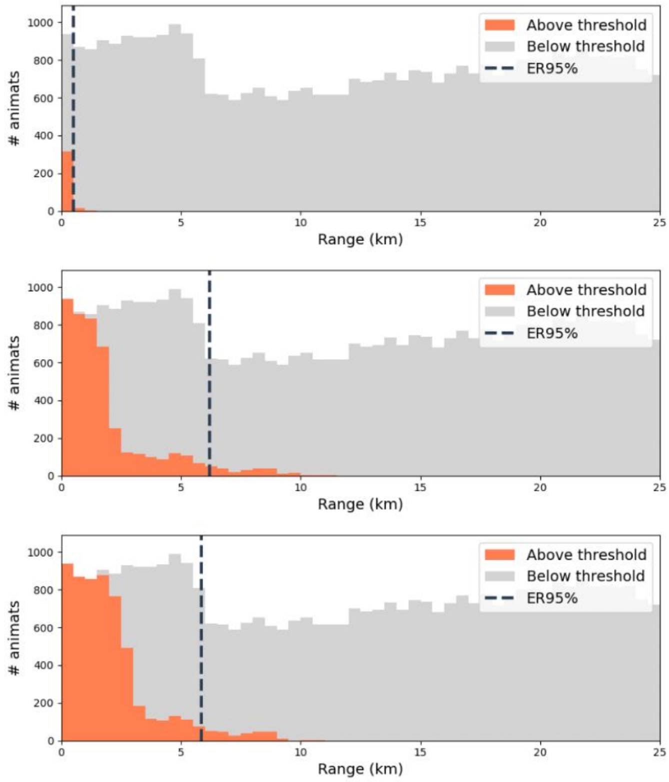


Figure H-18. *Scenario C, migrating southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

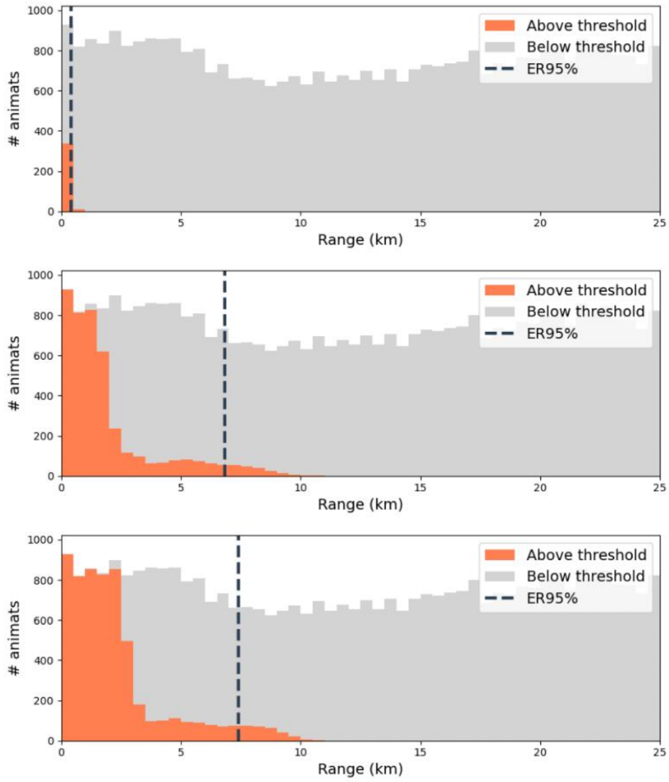


Figure H-19. *Scenario C, reproducing southern right whale animats, no calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

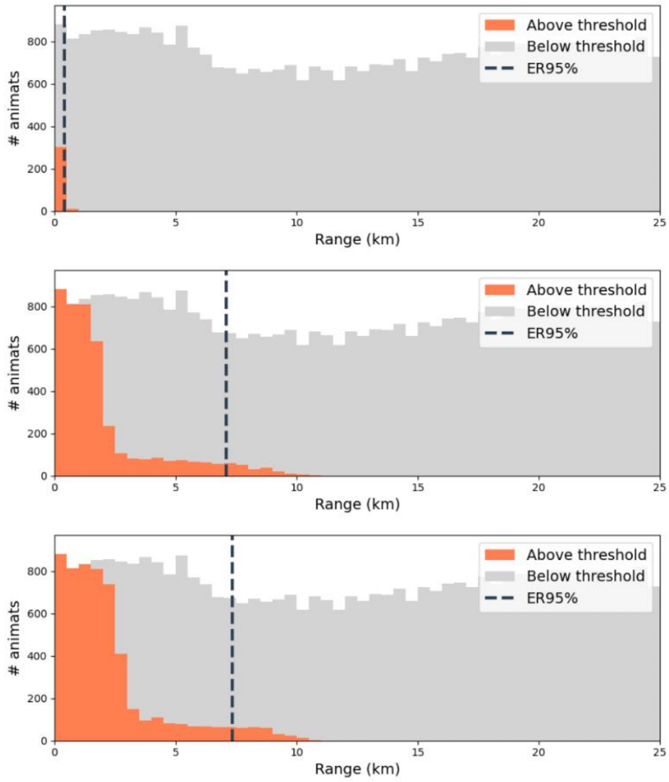


Figure H-20. *Scenario C, reproducing southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

H.3. Scenario D

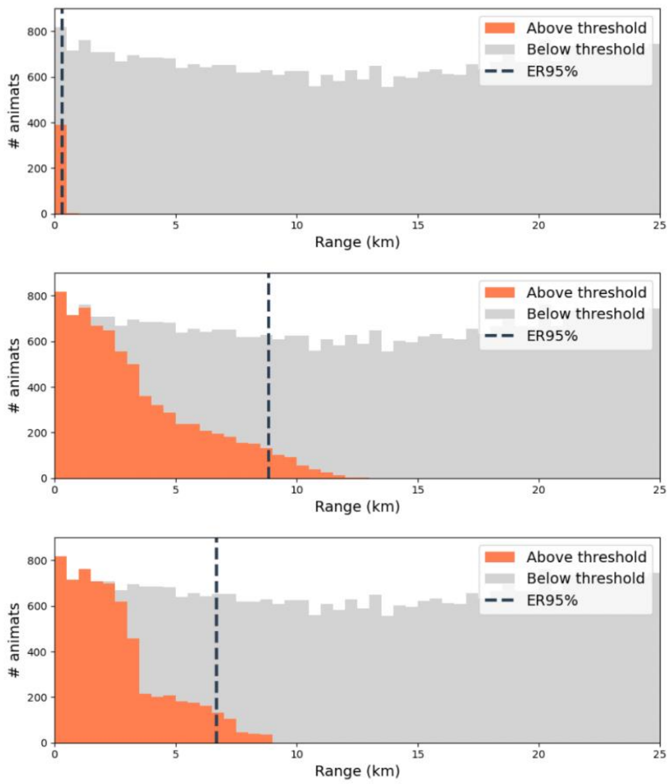


Figure H-21. *Scenario D, female pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

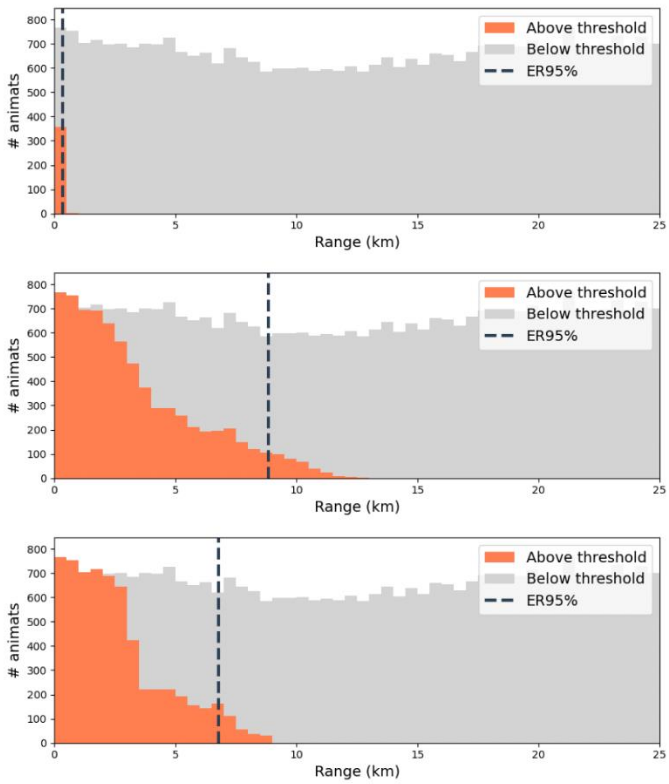


Figure H-22. *Scenario D, male pygmy blue whale animats, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

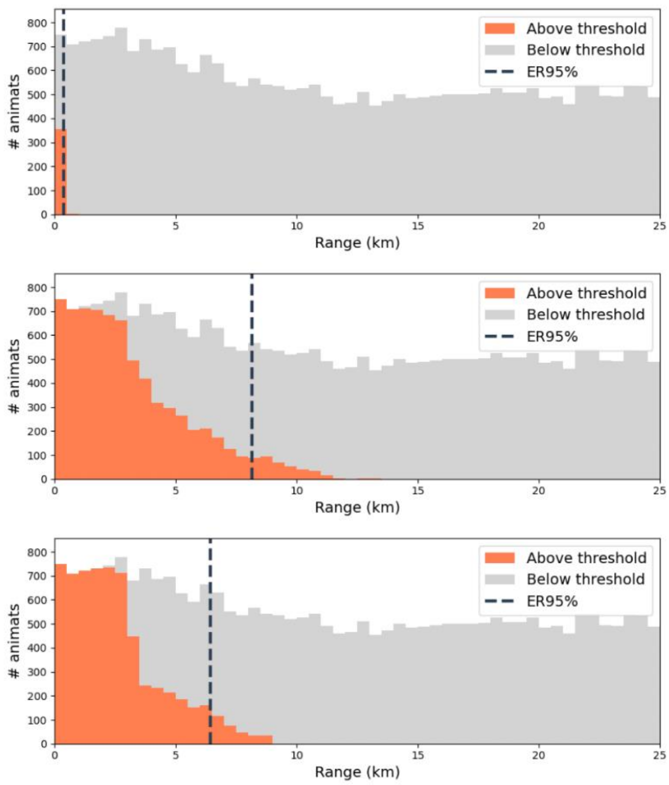


Figure H-23. *Scenario D, female pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

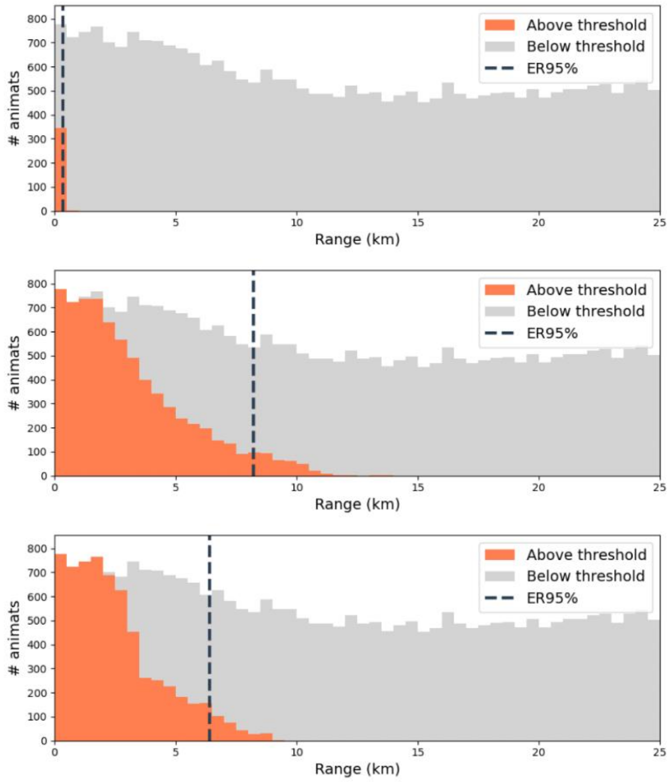


Figure H-24. *Scenario D, male pygmy blue whale animats, restricted to shelf*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

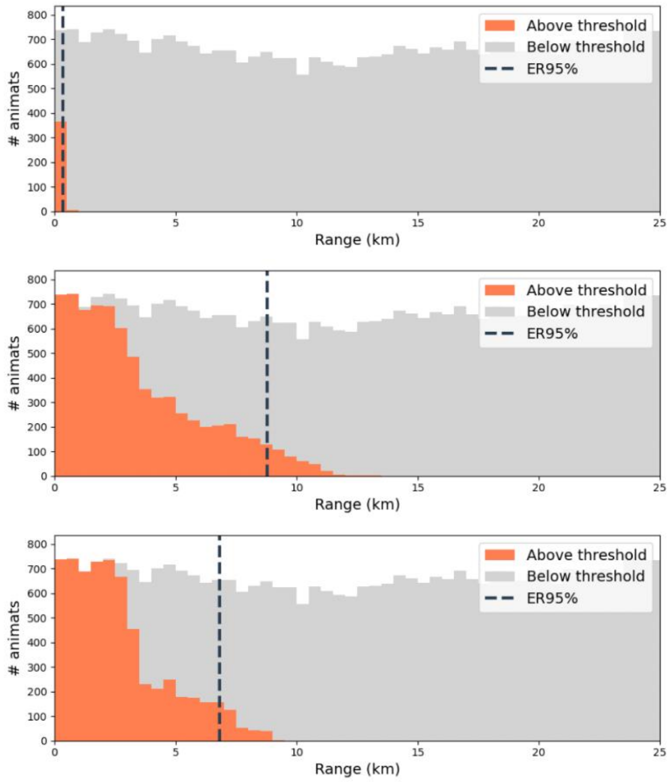


Figure H-25. *Scenario D, female pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

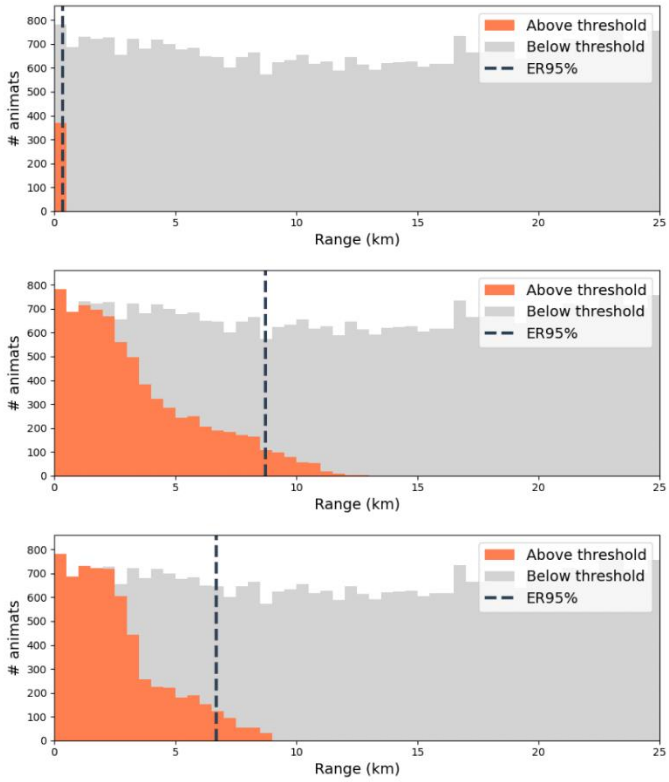


Figure H-26. *Scenario D, male pygmy blue whale animats, restricted to foraging BIA*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

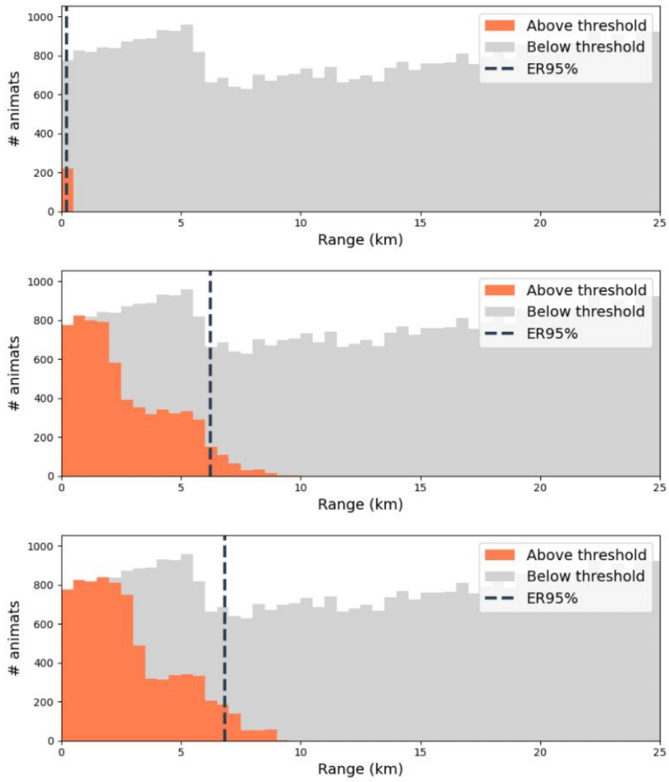


Figure H-27. *Scenario D, migrating southern right whale animats, no calf, unrestricted:* CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

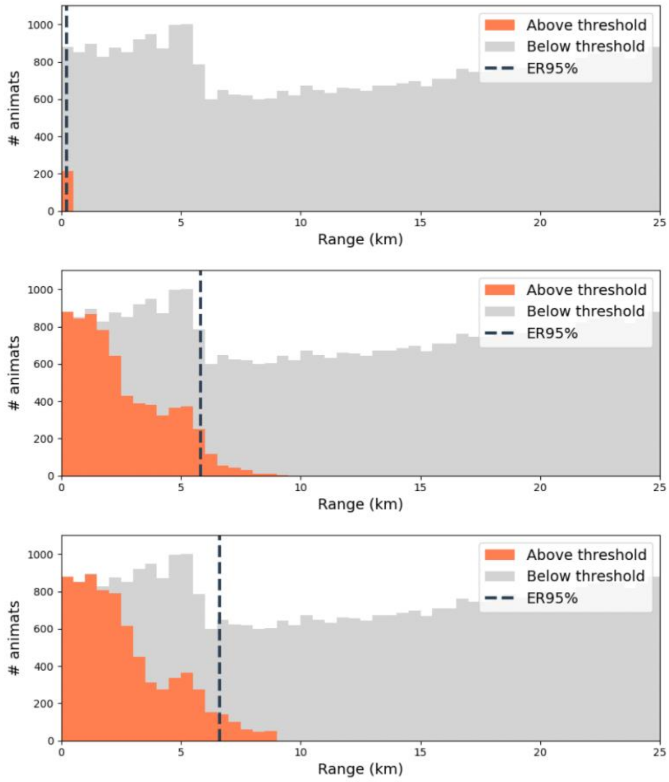


Figure H-28. *Scenario D, migrating southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

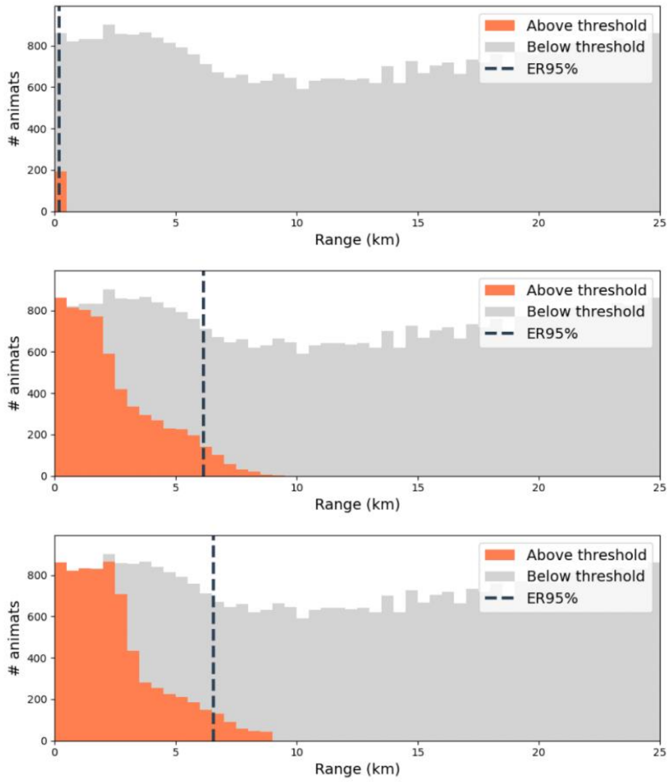


Figure H-29. *Scenario D, reproducing southern right whale animats, no calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

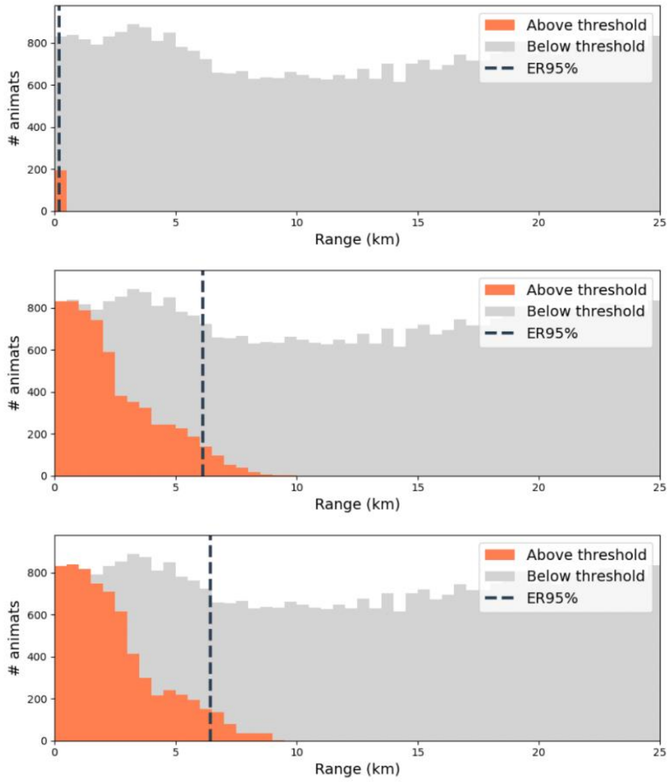


Figure H-30. *Scenario D, reproducing southern right whale animats, with calf, unrestricted*: CPA range histogram for animats, SEL_{24h} PTS threshold (top panel), SEL_{24h} TTS threshold (middle panel), SPL behavioural threshold (bottom panel). Bar colours indicate whether the animats exceeded the threshold.

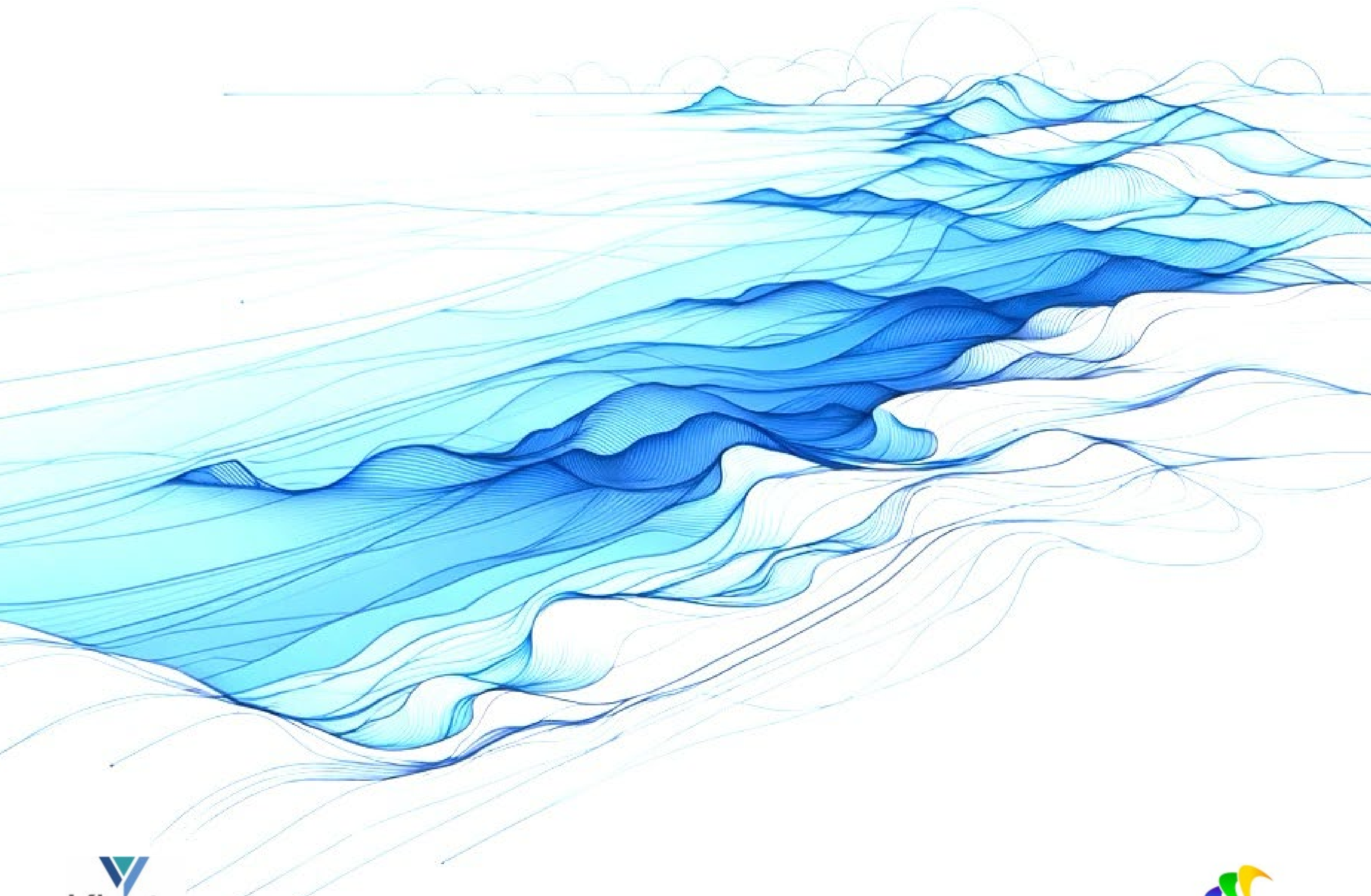
REGIA
Marine Seismic Survey

Seismic Studies Summary

Appendix B8: REG-EP-011-B8

Rev 2

May 2024



Klarite

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1 Introduction

Marine fauna use sound in a variety of functions, including social interactions, foraging, orientation, and responding to predators. The type and scale of effect of seismic sound emissions on receptors depends on several factors including the level of exposure, the physical environment, the location of the receptor in relation to the seismic source, how long the receptor is exposed to the sound, the exposure history, how often the sound repeats (repetition period) and the ambient sound level.

This document provides a summary of the available information that will be used to inform the acoustic impact assessment for the Regia Marine Seismic Survey (Regia MSS).

1.1 Overview of Seismic Acoustic Emissions

When underwater objects vibrate, they create sound-pressure waves that alternately compress and decompress the water molecules as the sound wave travels through the sea. Sound waves radiate in all directions away from the source like ripples on the surface of a pond. The compressions and decompressions associated with sound waves are detected as changes in pressure by the receiver.

Sound moves at a faster speed in water than in air because the mechanical properties of water differ from air. The reference level used in air (20µPa @ 1m) was selected to match human hearing sensitivity. A different reference level is used for underwater sound (1µPa @ 1m). Because of these differences in reference standards, noise levels cited in air do not equal underwater levels.

The energy, or intensity (loudness) of a sound is measured on the decibel (dB) scale. It takes about 61.5 times more energy to transmit a sound through air than through water. Because of this energy difference, there is a 61.5 dB difference between sounds transmitted through air and water, such that a sound intensity of 120 dB in water would be equivalent to an intensity of about 60 dB in air (Webb 2023).

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

Underwater acoustic emissions from a seismic source are characterised by high energy pulses of low frequency sound. The frequency of the sound produced from each seismic pulse is primarily less than 2 kHz, with the highest levels at frequencies in the range of 10-500 Hz (McCauley 1994).

The rate of sound attenuation from the seismic source is dependent on local sound propagation characteristics, including seawater temperature and salinity profiles, water depth, bathymetry and the geoacoustic properties of the seabed (McCauley 1994). While the seismic pulses are directed downwards, horizontal propagation may be detected over long distances due to the high intensity and low frequency properties of the sound.

Sound travels as a wave with the amplitude of the wave related to the amount of acoustic energy it carries. Figure B8-1-1igure B8-11 shows a representative sound wave and the sound metrics used in this studies summary. Table B8-1-1le B8-12 provides definitions of the sound metrics and other sound related terms used in this studies summary.

The particle motion component of sound is also relevant to the assessment of potential impacts to marine fauna. Acoustic particle motion refers to the physical motion caused by a sound wave within the water, seafloor or other medium. Unlike pressure, particle motion is directional in nature, although the actual to-and-fro particle displacements that constitute sound are extremely small, in the order of nanometres (Popper & Hawkins 2018). Particle motion can be described in terms of particle displacement (m), velocity (m/s), or acceleration (m/s-2) (Popper et al. 2014; Carroll et al. 2017). Alternatively, it is sometimes expressed in dB with respect to a reference value of displacement (dB re 1 pm), velocity (dB re 1 nm/s) or acceleration (dB re 1 µm/s^2) (Nedelec et al. 2016).

Particle motion is important because marine invertebrates and most fishes are primarily sensitive to particle motion rather than sound pressure and, therefore, particle motion is the most relevant metric for perceiving underwater sound by invertebrates and most fish species (Popper & Hawkins 2019). It is of less importance to marine mammals as evolution of the mammalian ear operating in air has led to a greater dependence on pressure for hearing sound (Finneran et al. 2002). There is currently limited information available to quantify the particle motion sensitivity of fishes and invertebrates. It is complex and challenging to directly measure particle motion compared to sound pressure, hence most research is presented in the context of sound pressure or exposure levels instead of particle motion (Carroll et al. 2017; Popper & Hawkins 2018).

It should be noted that particle motion is most relevant close to the source where it is the dominant component of a sound wave (i.e., in the near field), while pressure will dominate a sound wave propagating over distance (i.e., in the far field) (Radford et al. 2012; Morley et al. 2014; Nedelec et al. 2016; Popper & Hawkins 2018). Sound pressure levels received at increasing distance from a source do not, therefore, provide a reliable representation of particle motion. Organisms that are sensitive only to particle motion have typically been found to be sensitive only at close range where these particle motions are greatest (Popper et al. 2014; Edmonds et al. 2016; Popper & Hawkins 2018).

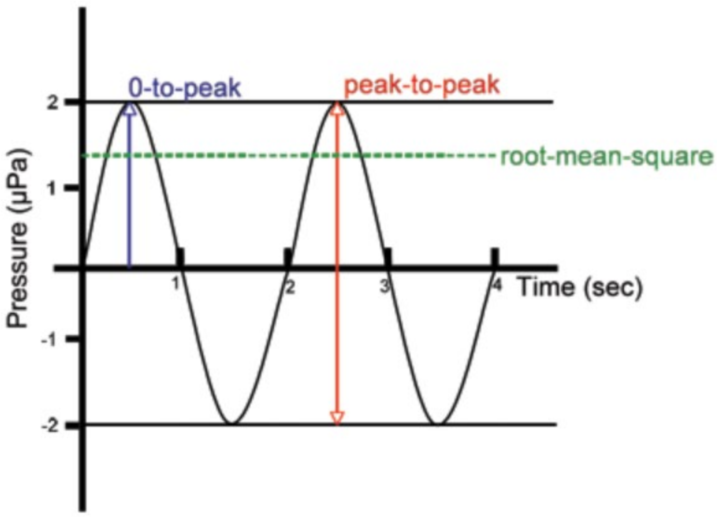

Figure B8-1-1: Simplified Sound Wave and Sound Pressure Metrics (DOSITS 2023)

Table B8-1-1: Underwater Sound Terminology

Term	Definition
0-to-peak or Peak sound pressure level (PK)	The peak pressure, also called the 0-to-peak pressure, is the range in pressure between zero and the greatest pressure of the signal. It is represented by PK and the unit dB re 1 µPa and summarised as dB PK.
Peak-to-peak sound pressure level (PK-PK)	The peak-to-peak pressure is the range in pressure between the most negative pressure and the most positive pressure of the signal. It is represented by PK-PK and the unit dB re 1 µPa or dB re 1 µPa2m2 and summarised as dB PK-PK.
Permanent threshold shift (PTS)	Permanent loss of hearing sensitivity at certain frequencies caused by excessive sound exposure.
Received sound level	The sound level measured at a receiver.

Term	Definition
Root mean square sound pressure level (RMS)	The root-mean-square pressure is the square root of the average of the square of the pressure of the sound signal over a given duration. It is represented by sound pressure level (SPL) and the unit dB re 1 µPa and summarised as dB SPL.
Sound exposure level (SEL)	A measure of the sound energy that considers both received level and duration of exposure. SEL is specified in terms of either single pulse (SEL) or a defined accumulation period (SEL_{cum}). For this assessment 24 hrs is used for the accumulation period and is shown as SEL24h. Units are dB re 1 µPa2 s or dB re 1 µPa2m2s.
Source sound level	The sound pressure level or sound exposure level measured 1 metre from a theoretical point source that radiates the same total sound power as the actual source.
Temporary threshold shift (TTS)	Temporary loss of hearing sensitivity at certain frequencies caused by excessive sound exposure.

2 Assessment Input

2.1 Public Comment

The completed EP was published for public comment on the NOPSEMA website on 25 Jan 2024 for a 30-day period, closing 26 February 2024. Table B8-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table B8-2-2 - Public comment input into the preparation of the EP

Matter	Matter ID	Changes made arising from public comment
Matter: Research on impacts of anthropogenic noise on marine mammals.	M11	CGG has considered these claims and has updated the EP Seismic Studies Report (Appendix B8) Section 8.

3 Zooplankton including Fish and Invertebrate Eggs and Larvae

This section summarises the published studies in relation to seismic acoustic emission studies on plankton and fish and invertebrate eggs and larvae. Plankton is a collective term for all marine organisms that are unable to swim against a current. This group is diverse and includes phytoplankton (plants) and zooplankton (animals), as well as fish and invertebrate eggs and larvae.

Some zooplankton can sense pressure changes to some degree. Swim bladders may also develop during the larval stages of some fish species, rendering larvae susceptible to pressure-related injuries such as barotrauma (Popper et al. 2014). Data on the effects of sound upon eggs and larvae containing gas bubbles is, therefore, largely focused on barotrauma rather than actual hearing. Very few publications have considered the effects of particle motion or vibration on plankton (Popper et al. 2014).

Few studies have found significant negative impacts on zooplankton, fish eggs, larvae, or fry, and most have reported that impacts occur within a few metres or tens of metres from the source (Kostyuchenko 1973; Dalen & Knutsen 1987; Holliday et al. 1987; Kosheleva 1992; as cited in Parry et al. 2002; Pearson et al. 1994; Turnpenny & Nedwell 1994; Booman et al. 1996; Payne et al. 2004; Payne et al. 2009). These studies included exposures to sound pressures up to approximately 242 dB SPL.

Larval stages of fish are often perceived to be more sensitive to stressors than adult stages, but exposure to seismic sound does not appear to result in any differences in larval mortality or abundance for fishes, crabs, or scallops (Carroll et al. 2017).

Kostyuchenko (1973) found up to a 17% increase in mortality of fish eggs of various species exposed to a seismic source, but no effect beyond 10 m. Kosheleva (1992; as cited in Turnpenny & Nedwell 1994) also reported that eggs and larvae died within 1 m of a seismic source producing sound pressures of 220-240 dB SPL, but no injuries were reported at greater distances. Dalen and Knutsen (1987) exposed eggs, larvae and post-larval stages of cod exposed to seismic source elements with source levels of 222 – 231 dB SPL at 1 m. At ranges of 1 – 10 m from the source, some specimens indicated temporarily impaired balance following exposure but with rapid recovery. Mortality was only observed in just one of the three exposure experiments, with 90% mortality when exposed at 2 m from the seismic source, but no significant impacts at 6 m from the seismic source. Overall, there was no significant change in the survival of eggs.

Holliday et al. (1987) obtained mixed results during studies undertaken over a two-year period, with eggs and larvae exposed to sound pressures of 221 – 235 dB SPL at 1.5 m from a seismic source. Either no significant impact was observed or a 9% reduction in the survival of eggs. Pearson et al. (1994) reported no effects to crab larvae exposed to sound pressures up to 231 dB SPL at 1 m from a seismic source. Booman et al. (1996) exposed fish eggs and larvae to sound pressures of 220 – 242 dB SPL. High rates of mortality were observed at distances of 1.4 m from the seismic source, but low or no mortality rates at distances of 5 m.

In a review of the above studies, Payne et al. (2004) noted that injury and mortality to eggs and larvae is likely to be limited to within 5 m of the seismic source. Payne et al. (2009) found no statistical differences between controls and exposed larvae following exposure to mean sound pressure levels of 205 dB PK-PK, positioned 0.5 m from the seismic source element.

Parry et al. (2002) undertook studies on the effects of a marine seismic survey on scallop fisheries in Bass Strait, including on larvae. This study was undertaken in December 2001 and February 2002 during a 3D marine seismic survey undertaken by Esso Australia in the Gippsland Basin, which used a 3,542 m^3 source towed 6 m below the sea surface. Plankton samples (impact and duplicate) were collected from five sites located 500 m apart in water depths of 55 m in a Before-After-Control-Impact (BACI) experimental study. The study results found few bivalve larvae in the live plankton samples and there was no significant difference in the number of bivalve larvae found in samples collected before and after passage of the seismic vessel (the same was true for all planktonic taxa). Parry et al. (2002) postulated that invertebrates that do not contain gas spaces (like swim bladders in fish) appear to be very resilient to seismic pulses. The research also notes that while the study does not exclude the possibility that some changes to planktonic communities resulted from the seismic survey, the failure to detect any impacts occurred because impacts were small. Parry et al. (2002) also indicated there is no evidence of mortality-associated population effects such as reduced abundance in plankton a few hours after exposure.

Pearson et al. (1994) exposed crab larvae to single pulses from a seismic source array (840 m^3) with a measured sound pressure level of 231 PK-PK at 1 m. For immediate and long-term survival and time to moult, this study did not reveal any statistically significant differences between the exposed and unexposed larvae, even those exposed within 1 m of the seismic source.

Impacts to scallop larvae have been identified following intense and lengthy periods of exposure to low-frequency sound. Tank experiments by Aguilar de Soto et al. (2013) showed evidence of morphological abnormalities in early-stage scallop larvae from simulated seismic signals for a 6,920 in^3 seismic source. However, the lengthy exposure period of 3 second pulse intervals for an exposure duration of 90 hours and at 1 m distance from sound source is not realistic of an actual survey. Christian et al. (2003) found major developmental differences between control and treatment groups of snow crab eggs exposed to a peak pressure level of 216 dB SPL every 10 seconds for 33 minutes. Again, the exposure to a constant peak pressure level for a prolonged period is not realistic of an actual survey where the source is moving and so does not remain in one place.

Hawkins (2014) used continuous sonar to record zooplankton layers, comprising copepods, cladocerans, decapod larvae, gastropod larvae, and bivalve larvae, exposed to playback of pile driving sound (pile driving sound typically has a more rapid rise time, more frequent strike rates and therefore a greater sound exposure regime than a seismic survey). Zooplankton layers responded to sound by showing a 'dent' in the top of the layer at the onset of the sound sequence, although the change in depth often did not persist for the whole duration of the sound exposure and zooplankton distribution quickly returned to normal.

Day et al. (2016a) found no effects on the mortality, abnormality, competency, or energy content of lobster larvae after exposure of early embryonic stages to seismic exposure. In this study, egg-bearing female southern rock lobsters (*Jasus edwardsii*) were exposed to signals from three air gun configurations, all of which exceeded sound exposure levels (SEL) of 185 dB re 1 $\mu Pa^2 \cdot s$ (209-212 dB PK-PK). Lobsters were maintained until their eggs hatched and the larvae were then counted for fecundity, assessed for abnormal morphology using measurements of larval length and width, tested for larval competency using an established activity test and measured for energy content. Overall, there were no differences in the quantity or quality of hatched larvae, indicating that the condition and development of spiny lobster embryos were not adversely affected by air gun exposure. Day et al. (2016a) detailed that the results suggest that embryonic spiny lobster are resilient to air gun signals and highlight the caution necessary in extrapolating results from the laboratory to real world scenarios or across life history stages.

Based on the studies discussed above, physical impacts to planktonic organisms have typically been found to be limited to within approximately 10 m of the seismic source. Using this 10 m impact range, a study by McCauley (1994) calculated the impact in a seismic survey area, assuming plankton mortality of 100% within 10 m of a seismic source. This suggested that the total mortality due to seismic testing would impact less than 1% of plankton in the survey area. DNV Energy (2007) and Hawkins & Popper (2012) conducted comprehensive reviews of a number of scientific studies, including those by Kostyuchenko (1973), Dalen & Knutsen (1987), Booman et al. (1996) and Saetre & Ona (1996); the effects of seismic activities on eggs and larvae were predicted to result in average and worst-case mortality rates of 0.0012% and 0.45% per day respectively, which were not deemed significant when compared to a natural mortality rate of 5-15% per day, as applicable to most species during early life stages. Natural mortality rates in larvae can be much higher than this—exceeding 50% per day in some species and commonly exceeding 10% per day (Tang et al. 2014). For example, in a review of mortality estimates (Houde & Zastrow 1993), the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day.

In 2014, noise effect criteria for fish eggs and larvae were established by the American National Standards Institute (ANSI) accredited report of sound exposure guidelines for fishes and sea turtles (Popper et al. 2014). The criteria from Popper et al. (2014) are from an offshore pile driving study by Bolle et al. (2012) that indicated no damage was caused by simulated repeated pile driving (100 strikes at 100 m) of 210 dB SEL_{cum}. Popper et al. (2014) also detailed that other studies suggest that eggs and larvae in proximity (<5 m) to a seismic source are likely to suffer mortality and tissue damage (Kostyuchenko 1973; Booman et al. 1996). Sætre and Ona (1996) concluded that mortality rates caused by exposure to seismic source sounds are so low compared to natural mortality that the impact from seismic surveys must be regarded as insignificant.

However, a study by McCauley et al. (2017) received notable attention for suggesting the potential for zooplankton mortality to increase two- to three-fold out to 1.2 km from a single seismic source element, with an estimated decline in zooplankton abundance of up to 64% and a "hole" in the zooplankton backscatter observed via acoustic detection methods. The 1.2 km range corresponded with pressure levels of 178 dB PK-PK (McCauley et al. 2017). However, the extent of such impacts is inconsistent with previously and subsequently documented effects to plankton.

The findings of this study have been questioned by several reviews (Richardson et al. 2017; IAGC 2017; Fields et al. 2019) particularly in relation to:

- There was no evidence of attenuation of impacts with distance from the source with no consistent decline in the proportion of zooplankton that were killed with increasing distance from the source.
- Sonar backscatter data indicated an immediate decline in zooplankton abundance (the "hole" in the data). However, if the zooplankton had been killed, they would not have sunk from the surface layers of the water column immediately, suggesting that some zooplankton may have moved, or they may have simply reorientated themselves to the sonar in response to the seismic pulses, which raises questions over the occurrence, magnitude, and extent of mortal impacts.
- The study was based on a relatively small number of tow samples on two separate days. On the second day, even before the use of the seismic source element, the zooplankton net tow abundance counts were significantly lower than the first day and, therefore, it is difficult to draw reliable conclusions from these data. On the second day almost all values at 80 m range presented greater plankton abundance from exposed samples and lower abundance of control samples, indicative of a potential flaw in the sampling scheme and analysis protocol.

The McCauley et al. (2017) study was undertaken in early March 2015, using two replicated experiments in Storm Bay in southeast Tasmania. It involved the deployment of acoustic noise loggers to measure air gun signals and used an acoustic source volume of 150 in^3 and operating pressure of 2,000 psi. The study measured zooplankton abundance and the proportion of the population that was dead at three distances from the acoustic source - 0, 200 and 800 m. The experiment estimated the proportion of the zooplankton that was dead, both before and after exposure to acoustic source sound, using net samples to measure zooplankton abundance, and bioacoustics to identify the distribution of zooplankton. In this study, copepods dominated the mesozooplankton (0.2-20 mm), and impacts were not assessed on microzooplankton (0.02-0.2 mm) or macrozooplankton (>20 mm). There was movement of water through the experimental area, which made interpreting their results more difficult (Richardson et al. 2017).

The results of the experiment found that zooplankton exposure to acoustic sources increased the mortality rate from a natural level of 19% per day to 45% per day (on the day of exposure), with this mortality rate observed out to 1.2 km. This is more than two orders of magnitude greater than the 10 m previously assumed (McCauley et al. 2017). These results escalated the concerns that some stakeholders had about the effects of marine seismic surveys on plankton, particularly fishers and conservation groups.

This study postulates that the external sensory hairs that zooplankton possess may be extremely sensitive and in response to seismic sound, may 'shake' to the point where damage could accrue to sensory hairs or tissue. Importantly, the study notes that for anthropogenic sources to have significant impacts to plankton at an ecological scale, the spatial or temporal scale of the impact (i.e., the seismic survey) must also be large when compared to the impacted ecosystem.

In response to this research, the Australian Petroleum Production and Exploration Association (APPEA) commissioned the Commonwealth Scientific and Industrial Research Organisation (CSIRO) to assess the potential local and regional impacts on zooplankton of a typical marine seismic survey. A large-scale marine seismic survey conducted on the North West Shelf of Australia was modelled in a hydrodynamic model using the McCauley et al. (2017) results, as reported in Richardson et al. (2017). The modelled survey parameters include a survey area of 2,900 km^2, 60 survey lines, waters 300 - 800 m deep, an acoustic source of 3,000-3,200 m^3 and operating pressure of 2,000 psi. This paper reports that impact is recorded within the survey area and within 15 km of it, but that these impacts are not discernible at the bioregional scale and barely discernible within 150 km of the survey area. Zooplankton populations recovered quickly after seismic exposure due to their fast growth rates and due to the dispersal and mixing of zooplankton from both inside and outside of the impacted region. The modelling undertaken by Richardson et al. (2017) found that while there was a maximum decline of 22% in zooplankton populations in the survey and a 14% decline within 15 km of the survey area, it took only three days following the completion of the survey for zooplankton biomass to recover to pre-seismic survey levels within the survey area and within an area of 15 km around the survey area. The study notes that because zooplankton growth rates are slower in colder regions (e.g., Bass Strait), the recovery rate of zooplankton populations following exposure to a seismic survey is likely to be slower in colder waters. It is important to note that Fields et al. (2019) and IAGC (2017) noted that the findings of McCauley et al. (2017) (which were used in Richardson et al. 2017) may provide an overly conservative estimate of the potential effects of seismic pulses to zooplankton.

Independently of the APPEA/CSIRO study, the International Association of Geophysical Contractors (IAGC) conducted its own review of the McCauley et al. (2017) study. This review came to the following conclusion: "*While we found the study interesting, we are also troubled by the small sample sizes, the large day-to-day variability in both the baseline and experimental data, and the large number of speculative conclusions that appear inconsistent with the data collected over a two-day period. Both statistically and methodologically, this project falls short of what would be needed to provide a convincing case for adverse effects from geophysical survey operations*." (IAGC 2017).

An assessment of zooplankton was undertaken to determine pre- and post-seismic survey abundance of zooplankton at sites within CarbonNet's Pelican Marine Seismic Survey area in the Gippsland Basin and at reference sites during January and February 2018. Pre-seismic survey plankton samples collected were dominated by copepods, cladocerans and salps while post-seismic survey plankton samples were dominated by the dinoflagellate *Noctiluca scintillans*. Other groups present included siphonophores, fish larvae, fish eggs, polychaetes, ghost shrimps and cnidarians. There was variance between and within assessments, with samples exhibiting levels of diversity and abundance typical of healthy temperate coastal waters. Neither lobster nor scallop larvae were present in any of the samples assessed (CarbonNet 2018).

A study by Fields et al. (2019) exposed the copepod (*Calanus finmarchicus*) to seismic pulses at various distances up to 25 m from a seismic source. The source levels produced were estimated to be 221 dB SEL comparable to the far-field source levels associated with some commercial scale seismic surveys. The study observed an increase in immediate mortality rates of up to 30% of copepods in samples compared to controls at distances of 5 m or less from the seismic source. Mortality one week after exposure was significantly higher by 9% relative to controls in the copepods placed 10 m from the seismic source. Fields et al. (2019) also reported that no sublethal effects occurred at any distance greater than 5 m from the seismic source. The findings of the study are consistent with numerous other field studies, as referenced previously, indicating that the potential effects of seismic pulses to zooplankton are limited to within approximately 10 m from the seismic source. Fields et al. (2019) detailed that it is difficult to reconcile the high mortality reported by McCauley et al. (2017) with the low mortalities reported in the body of earlier studies and in the experiment they undertook. Fields et al. (2019) details that it is possible that their results can be attributed to *C. finmarchicus* having a high tolerance to air gun impulses and that other species would be more sensitive. Other possible causes for the high mortality observed by McCauley et al. (2017) could be bubbles because of cavitation or small-scale shear produced by the sampling boat, unrelated to the air gun impulses.

Day et al. (2021, 2022) undertook a study to determine whether early development and recruitment of southern rock lobsters puerulus and juveniles might be affected by exposure to seismic sound by assessing mortality rates following exposure; impairment of the righting reflex, and development through assessment of progression through the moult cycle. This study also undertook to respond to the finding by McCauley et al. (2017) of increased mortality in zooplankton following exposure to air gun signals that suggests that planktonic, early life stages of marine invertebrates may be more vulnerable than adults or developing embryos. Outcomes of this study are detailed in the section below on crustaceans.

Vereide et al. (2023) conducted a field experiment to assess mortality and naupliar body length of the calanoid copepod (*Acartia tonsa*) when exposed to an air gun array discharge. The air gun array treatment consisted of two 40 in^3 air guns fired at a pressure of 110 bar every 10 seconds for three hours. The air gun array was towed at 2 knots at a depth of 3–4 m along an oval transect (3 nm in total) by the research vessel *H.U. Sverdrup II*. The vessel sailed between 50 m and 1,220 m from the line holding the bags. During the boat control treatment, *H.U. Sverdrup II* followed the same transect without discharging the air guns. The boat control treatment was included to control for the sound generated by the vessel itself.

The sound exposure level (SEL) was 152 dB re 1 μPa^2 s furthest away and 183 dB re 1 μPa^2 s at the closest distance. Nauplii were placed in plastic bags and attached to a line at a depth of 6 m. For each treatment, three bags of nauplii were exposed to one of three treatments for 2.5-hours: Air gun array discharge, a boat control, or a silent control. After exposure, nauplii were kept in filtered seawater in the laboratory without food. The immediate mortality was significantly higher in the air gun array treatment than in the silent and boat control treatments. On average, 13.5 ± 3.8% of the nauplii in the air gun array exposed treatment died immediately after exposure, compared to 3.4 ± 1.3% in the silent control and 2.6 ± 1.7% (mean ± SD) in the boat control. There was a significant difference in delayed mortality between the treatments. On days 1 and 2 after exposure, nearly all of the nauplii from the control groups were alive, while 27.0 ± 14.2% and 14.8 ± 14.2% of the air gun array exposed nauplii had died in the aliquots from day 1 and day 2, respectively. Mortality started occurring from day 3 (5.7 ± 10.1%, boat control) and 4 (9.4 ± 14.4%, silent control) in the control treatments but with lower mortality than in the air gun array exposed treatment (day 3, 47.5 ± 19.2% dead nauplii). In the aliquots from days 5 and 6 after the treatments, almost all of the air gun array exposed nauplii were dead, in contrast to the control groups, in which the proportion of dead nauplii was 49.2 ± 12.0% on day 5, and 72.6 ± 21.8% day 6 in the silent control and 4.0 ± 10.1% on day 5 and 48.4 ± 17.9% on day 6 in the boat control.

There was a significant interaction between treatment and time (days) on the body length (µm) of the nauplii, with lower growth from day 1–4 in the air gun array exposed treatment than in the control treatments. On day 1 after treatment, the average body length was 125 ± 10 µm. After four days, the average body length in the air gun array exposed nauplii was 128 ± 7 µm, which differed from the silent control (144 ± 8 µm) and the boat control (146 ± 7 µm). Over the first four days after exposure, the growth rates were 1.7 (4.1% in total), 5.4 (12.5%), and 6.1 per day (18.7%) in the air gun array exposed, silent control, and boat control, respectively. Naupliar development stages (NI–NIV) were positively correlated with body length (µm). In all treatments, >50% of the nauplii reached stage NII one day after exposure. By day 4, 43 ± 26.9% of the air gun array exposed nauplii were still in NI, compared with 11 ± 12.7% in the silent control and 1 ± 3.6% in the boat control. Only four individuals reached stage NIV: 3 in the silent control and 1 in the boat control.

Immediate mortality in the air gun array exposed nauplii was approximately 14% compared to less than 4% in the silent and boat control. Similarly, there was higher mortality in the air gun array exposed nauplii up to six days after exposure compared to the control treatments. Nearly all of the air gun exposed nauplii were dead after four days, while >50% of the nauplii in the control treatments were alive at six days post-exposure. There was an interaction between treatment and time on naupliar body length, indicating lower growth in the nauplii exposed to the air gun discharge. These experiments indicate that the output of two small air guns affected mortality and growth of the naupliar stages of *Acartia tonsa* in close vicinity to the array.

Vereide et al. (2023) concluded:

- The results of this study suggest that air gun array discharges affected the growth and mortality of *Acartia tonsa* in early naupliar stages. However, the degree of impact is likely to be stage- and species-specific and may be difficult to separate from background mortality.

- The results observed are consistent with many previous studies that show small effects of air gun discharges on zooplankton mortality. For example, no effects were detected in bivalve larvae sampled 2 km away from the source after exposure to air gun discharges (Parry et al. 2002) or in adult scallops sampled up to 1 km from the source shortly after exposure (Harrington et al. 2010). Similarly, Fields et al. (2019) reported that the mortality of the copepod *Calanus finmarchicus* adults to a two air gun array discharge increased (<5%) compared to that of the control groups, but only at <10 m from the air guns and no effects at distances from 10 to 50 m.

- There were notable differences in these results from previous studies. For example, in contrast to Fields et al. (2019), this study found significantly higher mortality in the exposed animals compared to the controls at distances of 50–~1,200 m. Although the sound exposure levels were higher in Fields et al. (2019) than those in this study, the animals in this study were exposed to multiple air gun discharges that resulted in a cumulative exposure that lasted much longer. The cumulative exposure of multiple blasts coupled with the younger stage used in this study may help to explain the higher mortality.

- Despite the higher mortality, the immediate mortality observed in this study is much lower than the 50% mortality in zooplankton at >1 km from the source (McCauley et al. 2017). Even though the absolute immediate mortality was lower than that reported by McCauley et al. (2017), the relative increase in mortality compared to the controls was somewhat greater in this study (greater than three-fold increase) than in McCauley et al. (2017) (two-to three-fold increase). However, in McCauley et al. (2017), the mortality in the controls was ~20% compared to less than 4% in this study.

- In this study, the mortality rate in nauplii directly after exposure was lower than the natural mortality rates observed in *Acartia* nauplii (up to 0.35 per day), although this is dependent on temperature, season, and region (Elliott & Tang 2011). This indicates that the population-level effect of air gun exposure might not be detectable from the background mortality.

- The air gun array exposed nauplii grew less and developed slower over four days than the boat and silent control groups. The slower development in the air gun array treatment nauplii was correlated with decreased growth. The progression through developmental stages and increase in body length observed in the control groups in our study is more similar to the development of naturally observed in *Acartia tonsa* nauplii cultured in 10–15° C water than is the development in the air gun array exposed nauplii. Slowed or arrested development at naupliar stages can reduce fitness or cause death. Thus, mortality could be affected long after seismic exposure. The population-level effects that this might have are uncertain.

4 Invertebrates

Research is ongoing into the relationship between sound and potential effects on benthic invertebrates, including the relevant metrics for both effect and impact. Marine invertebrates lack a gas-filled bladder and are unable to detect the pressure component of sound waves (Parry & Gason 2006; Carroll et al. 2017) or "hear" sound in the way that mammals and fish can. Instead, invertebrates detect sound by sensing the particle motion component of sound in water and seabed sediments through physiological structures such as sensory hairs, statocysts and muscles, and therefore detect sound at close range (McCauley 1994; Parry & Gason 2006; André et al. 2016: Roberts et al. 2016: Edmonds et al. 2016: Carroll et al. 2017: Popper & Hawkins 2018). Statocysts, found in a wide range of invertebrates, are utilised by animals to maintain their orientation, direct their movements through the water and may play a key role in controlling the behaviour responses of invertebrates to a wide range of stimuli. Although directly sensitive to particle motion and not to sound pressure, most available research on seismic impacts to invertebrates characterises received sound levels in terms of the sound pressure. Therefore, available literature suggests particle motion, rather than sound pressure, is a more important factor for benthic invertebrates such as crustacean and molluscs.

A range of physiological responses have been identified in some studies; however, the received sound levels are typically at levels that would be received within tens or a few hundred metres from the sound source or have been from repeated exposure at the same sound levels, which is not typical of an actual seismic survey (Carroll et al. 2017; Edmonds et al. 2016; Salgado Kent et al. 2016; Webster et al. 2018).

The most recent critical review of the potential impacts of marine seismic surveys on fish and invertebrates by Carroll et al. (2017) summarised the impacts of seismic sound emissions on marine invertebrates based on a literature review of 70 studies, which comprised a total of 68 species of fish and 35 species of invertebrates, including several studies that were not differentiated. Carroll et al. (2017) concluded that:

> *"Our review has identified scientific evidence for high-intensity and low-frequency sound-induced physical trauma and other negative effects on some fish and invertebrates; however, the sound exposure scenarios in some cases are not realistic to those encountered by marine organisms during routine seismic operations. Indeed, there has been no evidence of reduced catch or abundance following seismic activities for invertebrates, and there is conflicting evidence for fish with catch observed to increase, decrease or remain the same."*

4.1 Crustaceans

Specific studies examining the effect of seismic survey signals on crustaceans, including larval stages, are relatively rare, though recent Australian studies (e.g., Day et al. 2016b; Przeslawski et al. 2016b; Carroll et al. 2017; Day et al. 2019; Day et al. 2021, 2022), have aimed to narrow the knowledge gap. These are being supplemented by global research, including ongoing projects such as Canadian Healthy Oceans Network Project 2.1.4 (Anthropogenic Noise in The Ocean Soundscape: Effects on Fishes and Invertebrates).

To understand interactions between marine seismic surveys and marine invertebrates, the Commonwealth Government's Fisheries Research Development Corporation (FRDC), Origin Energy Ltd and the CarbonNet Project contributed funding to a research program assessing the impact of marine seismic surveys on southern rock lobsters and commercial scallops. This program study was undertaken by researchers from the Institute for Marine and Antarctic Studies (IMAS) at the University of Tasmania (Day et al. 2016b).

The research program involved exposure of cohorts of southern rock lobsters to multiple seismic acoustic source pulses at two sites (sandy substrate and limestone rock platform), both in 10–12 m water depths off the southern Tasmanian coast. The exposed lobsters were captive and control lobsters (no exposure) were also examined during subsequent analyses undertaken at 0-, 14-, and

120 -days post-exposure. Exposure experiments were undertaken in July 2013 (45 in^3 acoustic source, 2,000 psi), July 2014 (150 in^3 acoustic source, 1,300 psi and 2,000 psi) and February 2015 (150 in^3 acoustic source, 2,000 psi). The acoustic source was towed at approximately 5 m depth from 1 km away and at a speed of approximately 5.5–7.4 km/hr with a shot interval of 11.6 seconds. The seismic source circled near the lobster pots. The maximum calculated exposures were 212 dB re 1 μPa PK-PK, a per-pulse SEL of 190 dB re 1 $μPa^2$.s, an accumulated SEL of 199 dB re 1 $μPa^2$.s and maximum peak magnitude of ground acceleration of 68 ms^{-2}, though Day et al. (2016b) note this was an outlier.

Conclusions from the study are:

- Exposure to seismic sound did not result in any mortality from any of the experiments comprising this study.
- There was no difference in fecundity between control and exposed lobsters.
- The ability of exposed lobsters, and one cohort of control lobsters, to right themselves, a complex reflex, was compromised in the long-term (120 days post-exposure) in three of the four experiments. This response was linked to damage to sensory hairs of the statocyst, the primary mechano-sensory and balance organ in lobsters.
- Tail extension, a simple behavioural reflex response, showed reduction in exposed lobsters in one of the four experiments. The authors noted it is unclear how significant this finding is, as the warm summer water conditions during this experiment may have been a contributing factor.
- Haemolymph (blood) biochemistry showed little effects on metabolic and respiratory stress, or vitality following exposure.
- Haemocyte count (indicative of immune response function) in exposed lobsters showed a long-term decline to 120 days post-exposure. However, haemocyte counts subsequently recovered to double the number of haemocytes in control lobsters at 365 days post-exposure, which may indicate a possible immune response to pathogens.
- Seismic exposure did not cause any mass mortality. Not considering when both the control and exposed groups suffered mass mortality, the experimental mortality rates at 120 days' post-seismic acoustic source exposure were between 9.4% and 20%. These fall towards the low end of what might be expected from natural mortality rates. Even the highest levels of mortality recorded, 17.5% and 20% suffered by 4-pass treatments from the 2014 and 2015 experiments, were assessed by the authors to be modest compared to naturally occurring mortality rates.

Overall, no direct lethal effects to adult lobsters were observed and impacts were limited to statocyst condition, behavioural reflexes, and immune response functions in adult lobsters. Day et al. (2016b) note that these could have some effect on longer-term survivability.

Subsequent to the Day et al. (2016b) study, Day et al. (2020) undertook additional work to determine whether southern rock lobsters with pre-existing damage to their mechanosensory statocyst organs as a result of exposure to anthropogenic sound, incur further damage from exposure to marine seismic surveys. For this study, southern rock lobsters collected from a site subject to high levels of anthropogenic noise (a high shipping traffic lane used by cargo vessels and cruise ships, as well as pumping stations) were exposed to an equivalent seismic air gun signal regime as the Day et al. (2016b) study of lobsters, which was from an area of minimal anthropogenic sound ('noise-naïve' lobsters). Following exposure, both control and exposed treatments were found to have damage to the statocyst equivalent to that of noise-naïve lobsters following seismic exposure, leading to the conclusion that the damage was both pre-existing and not exacerbated by seismic exposure. Additional to the lack of further damage following marine seismic survey exposure, no disruption to the righting reflex was observed, demonstrating the lobster's ability to cope with or adapt to the mechanosensory damage (Day et al. 2020).

The lobsters from the high shipping site showed a pre-existing level of statocyst damage equivalent to that of lobsters exposed to the seismic signals. These lobsters also demonstrated a resilience to further damage, with exposure to seismic sound not increasing the level of cell loss in the statocyst hairs (Day et al. 2020). There were also no significant differences in the time taken to right themselves (from 'belly up' to 'belly down') between the control and exposed lobsters from the shipping site, though righting time was slower and more variable than the lobsters at the control site.

Day et al. (2021, 2022) undertook a study to determine whether early development and recruitment of southern rock lobsters puerulus and juveniles might be affected by exposure to seismic sound by assessing mortality rates following exposure; impairment of the righting reflex, and development through assessment of progression through the moult cycle. This study also undertook to respond to the finding by McCauley et al. (2017) of increased mortality in zooplankton following exposure to air gun signals that suggests that planktonic, early life stages of marine invertebrates may be more vulnerable than adults or developing embryos.

The Day et al. (2021, 2022) study involved exposing puerulus and juvenile southern rock lobsters within oyster baskets on the seabed to a full-scale array (three 2,820 in^3 seismic sources at 2,000 psi at a depth of 8 m) during a commercial seismic survey in 51-58 m of water. Day et al. (2021, 2022) identified that:

- Exposure did not result in any elevated mortality for puerulus or juveniles and thus, seismic surveys are unlikely to produce significantly increased mortality in puerulus and juvenile southern rock lobsters.
- An impact to righting reflex occurred in the immediate vicinity (directly below the sound source) for puerulus and out to at least 500 m for juvenile southern rock lobsters. However, juveniles exposed at 500 m recovered after the first moult, indicating that the impact range extended to at least 500 m from the source, the maximum range tested in the study. The results from the combined puerulus and juvenile treatments indicated that puerulus and juveniles below the sound source did not show the capacity for recovery whereas juvenile lobsters at 500 m from the source recovered from impairment after the first moult, providing evidence of a range threshold for recovery.
- The intermoult period was significantly increased in juvenile lobsters directly below the sound source and appeared to be increased in puerulus, though the latter could not be statistically analysed.
- Juveniles at 500 m showed a moderate, non-significant increase in moult duration.
- Increased intermoult duration suggested impacted development and potentially slowed growth, though the proximate cause was not identified.

In another study focusing on southern rock lobster, Fitzgibbon et al. (2017) examined the impact of seismic acoustic exposure on the haemolymph physiology and nutritional condition of this species and found no effect of seismic exposure on 24 haemolymph biochemical parameters, hepatopancreas index or survival. However, this study did report evidence of:

- A chronic negative impact on immune competency for up to 120 days post-exposure.
- A potential immune response to infection after 365 days post-exposure.
- Chronic impairment of nutritional condition 120 days post-exposure.

These authors concluded that the biochemical hematological homeostasis of rock lobster is reasonably resilient to seismic acoustic signals; however, exposure may negatively influence the rock lobster's nutritional condition and immunological capacity. The impact of these results at an ecological level is not known.

Payne et al. (2007) conducted a pilot study of the effects of exposure to seismic sound on various health endpoints of the American lobster *(Homarus americanus*). Adult lobsters were exposed either 20 to 200 times to 202 dB re 1µPa PK-PK or 50 times to 227 dB re 1µPa PK-PK, and then monitored for changes to survival, food consumption, turnover rate, serum protein, enzyme and calcium levels. Lobsters were exposed to seismic pulses at very close range to the source (~2 m). The SEL that the lobsters were exposed to was not described in the report but can be estimated to be up to 207 dB re 1 μPa^2.s. Observations were made over a period of a few days to several months and found that:

- Results indicated no effects on delayed mortality or damage to the mechanosensory systems associated with animal equilibrium and posture (as assessed by turnover rate).
- There was a decrease in the levels of serum protein, enzymes, and calcium in the haemolymph of animals exposed to seismic sound. Statistically significant differences were noted in serum protein at 12 days post-exposure, serum enzymes at five days post-exposure, and serum calcium at 12 days post-exposure. Serum enzymes are valuable in detecting major organ damage whereby enzymes leak into the blood upon cellular rupture. Within this study two enzymes, aspartate transaminase and creatine kinase, were not elevated in seismic-exposed animals, reflecting the absence of major cellular rupture or necrosis being affected by seismic sound, including high exposure conditions. Similar results were obtained in studies with snow crabs (Christian et al. 2003). However, there was evidence of decreased serum enzymes in some trials, indicating the possibility of haemodilution or uptake of excess water by the animals. A similar decrease in serum protein and calcium was noted in some trials indicating a potential for disturbance to osmoregulation (i.e., the process by which the body regulates the osmotic pressure of any organisms' fluids to keep the homeostasis of the organisms' water level constant). Altogether, the results suggest a potential for osmo-regulatory disturbance in lobsters exposed to seismic sound. This study did not provide evidence for delayed mortality in lobsters several months after exposure, with some observations extending to nine months.
- During the histological analysis conducted four months post-exposure, no structural differences in hepatopancreatic tissues were noted, which would denote cell or tissue rupture, necrosis, or inflammation. There was also no evidence of tissue necrosis or inflammation in the ovaries. However, histology identified elevated deposits of carbohydrates, thought to be glycogen, in the hepatopancreas of seismic-exposed animals. Such abnormal accumulations are believed to be due to disturbance in cellular processes connected with synthesis and secretion; however, the report concludes that further research is required to assess whether this observation is due to organ stress. These studies are noted as being exploratory in nature, with the authors cautioning against over-interpretation.

In 2018, the CarbonNet Project undertook the Pelican 3D marine seismic survey in waters 15 m to 35 m deep located between 1 km and 13 km from the Gippsland shoreline in Victoria. Underwater sound and its potential impact on the marine environment was a key issue raised by stakeholders, particularly the commercial fishing industry. In response, and among other actions, CarbonNet undertook southern rock lobster surveys before and after the marine seismic survey to ascertain whether any differences in abundance could be attributed to the marine seismic survey. The design of the survey was overseen by an independent advisory panel to provide advice on the survey methodology and interpretation of the survey results and its implications.

Ten sites (in areas of reef) were monitored, including six sites within the survey acquisition area and four reference sites located more than 15 km to the northeast. At all sites, more southern rock lobster were retrieved during the post-survey assessment (four months after the survey), with 81 individuals trapped during the pre-survey assessment compared to 122 trapped post-survey. This increase in numbers post-survey was most likely due to seasonal effects rather than any impact of the survey (CarbonNet 2018). These results indicate no effect of the marine seismic survey on lobster abundance.

Morris et al. (2018) and Cote et al. (2020) undertook field studies in from 2015 – 2017 into the effects of marine seismic surveys on the behaviour of the snow crab (*Chionoecetes opilio*) on the shelf and slope habitats of Atlantic Canada using a BACI study design to assess the behavioural responses of snow crab to seismic exposure. A 4,880 in^3 seismic source operated at 2,000 psi, 9 m depth and fired at a frequency of 10 seconds (approximately 25 m apart). Animal movements were tracked using an acoustic positioning array consisting of 50 acoustic receivers. The study concluded that while effects of seismic exposure on snow crab movement could not be ruled out completely, effects were at most quite small relative to natural variation. In contrast, snow crab exhibited much clearer responses to handling, temperature, and time of day. Overall, the results suggested that seismic effects, specific to the behaviour of adult male snow crab, were at most subtle and are not likely to be a prominent threat to the fishery.

A pilot study on snow crabs (*C. opilio*) (Christian et al. 2003, 2004) exposed captive adult males, egg-carrying females, and fertilised eggs to variable SPLs (191–221 dB re 1 µPa PK) and SELs (<130–187 dB re 1 $\mu Pa^2.s$) under controlled field experimental conditions. The crabs were exposed to 200 discharges over 33 minutes and found that:

- Neither acute nor chronic (12 weeks post-exposure) mortality was observed for the adult crabs.
- There was a significant difference in the development rate noted between the exposed and unexposed fertilised eggs/embryos in this study with the egg mass exposed to seismic energy demonstrating a higher proportion of less-developed eggs than the unexposed mass. However, this experiment was performed on eggs stripped from a single berried female and cultured in a laboratory for six weeks prior to exposure and 18 weeks following exposure.
- Stress indicators in the haemolymph of adult males were monitored immediately after exposure of the animals to seismic survey sound (Christian et al. 2003, 2004) and at various intervals after exposure. No significant acute or chronic differences between exposed and unexposed animals in terms of the stress indicators (e.g., proteins, enzymes, cell type count) were observed.

Christian et al. (2003) also investigated the behavioural effects of exposure to seismic survey sound on snow crabs. Caged animals on the ocean bottom at a depth of 50 m were monitored with a remote video camera during exposure to seismic sound and did not exhibit any overt startle response during the exposure period. Eight animals were equipped with ultrasonic tags, released, and monitored for multiple days prior to exposure and after exposure. None of the tagged animals left the immediate area after exposure to the seismic survey sound. Five animals were captured in the snow crab commercial fishery the following year, one at the release location, one 35 km from the release location, and three at intermediate distances from the release location.

In 2003, a collaborative study was conducted in the southern Gulf of St. Lawrence, Canada, to investigate the effects of exposure to sound from a commercial seismic survey on egg-bearing female snow crabs (DFO 2004). Caged animals were placed on the ocean bottom at a location within the survey area and at a location outside of the survey area. The maximum received SPL was ~195 dB re 1 µPa PK. The crabs were exposed for 132 hours of the survey, equivalent to thousands of seismic shots of varying received SPLs. The animals were retrieved and transferred to laboratories for analyses. Neither acute nor chronic lethal or sub-lethal injury to the female crabs or crab embryos was indicated. DFO (2004) reported that some exposed individuals had short-term soiling of gills, antennules and statocysts, bruising of the hepatopancreas and ovary, and detached outer membranes of oocytes. However, they were found to be completely cleaned of sediment when sampled five months later and any differences could not be conclusively linked to exposure to seismic survey sound.

In a field study, Pearson et al. (1994) exposed Stage II larvae of the Dungeness crab (*Cancer magister*) to single discharges from a seven-source air gun array and compared their mortality and development rates with those of unexposed larvae. For immediate and long-term survival and time to moult, this study did not reveal any statistically significant differences between the exposed and unexposed larvae, even those exposed within 1 m of the seismic source (with a mean peak pressure as high as 231 dB re 1 µPa).

4.2 Molluscs

Molluscs include benthic invertebrates such as marine bivalves (e.g., scallops, oysters, mussels and clams), gastropods (e.g. sea snails/trochus, sea slugs and nudibranchs) and cephalopods (e.g. octopi and squid). Like crustaceans, the mechanism of impacts for molluscs are unlikely to be from sound pressure, but rather from particle motion. The physiology and sensory structures of different marine bivalves and gastropods is similar and so results of studies on the effects of seismic sound are broadly representative for species other than those studied.

Wardle et al. (2001) monitored molluscs and echinoderms on a shallow water reef exposed to seismic sound with peak SPLs of 218, 210 and 195 dB re 1 µPa at distances of 5 m, 16 m and 109 m respectively. Video observations made over two weeks indicated that the sound did not result in invertebrates moving away from the reef and there was little effect on their day-to-day behaviour.

Kosheleva (1992; as cited in Parry & Gason 2006) identified no detectable effects to marine bivalves and gastropods (mussels and periwinkles) after exposure to a single seismic source element of source level 233 dB re 1µPa at 0.5 m or greater from the source. Conversely, Matishov (1992; as cited in Parry & Gason 2006) reported a single scallop shell splitting in a sample of three scallops, but this was located 2 m beneath a seismic source and therefore exposed to maximum sources levels.

Recent Australian studies (Harrington et al. 2010; Przeslawski et al. 2016a, 2016b, 2018; Day et al. 2016b, 2017) have focussed on commercial scallops (*Pecten fumatus*).

Harrington et al. (2010) conducted a BACI study of the short-term effects of seismic surveying on adult commercial scallops within the Bass Strait Central Zone Scallop Fishery between February and June 2010. The study aimed to determine the survival and health of adult scallops within impacted (directly below seismic survey transects), semi-impacted (within the seismic survey transect grid) and control (outside of the seismic survey transect grid) strata two months after seismic surveying. A before-seismic impact scallop dredge survey was conducted in February 2010 at both impact and control sites. In total, 45 sample dredge tows were conducted, with 15 sample tows being completed within each survey stratum. Between February 2010 and April 2010, the seismic survey vessel *M/V Aquila Explorer* completed 8,000 line kilometres of 2D seismic transects within eastern Bass Strait, including areas within the Bass Strait Central Zone Scallop Fishery with high densities of adult scallops. The seismic source, 4,130 in^3 with an operating pressure of 2,000 psi was towed at a depth of ~6 m, with seismic discharges occurring at intervals of approximately every five seconds. The after seismic impact scallop dredge survey was conducted on the 2nd and 3rd June 2010, approximately eight weeks after the seismic survey had been completed within the vicinity of the dredge survey location.
Data on the abundance of live and dead scallops within the impacted and control sites were examined to assess whether any changes were evident and whether they may be attributable to effects of the seismic survey. Animals collected in surveys were separated into one of four shell categories; live scallops, clappers (very new dead scallops with two shell halves still joined together),

new dead shell and old dead shell. Sub-lethal impacts were investigated by examining changes in roe and meat condition within each of the areas sampled.

No change in the abundance of live scallops (or related change in dead scallop categories) or macroscopic gonad and meat condition was detected after seismic surveying within either the control, impacted or semi-impacted strata. There was also no observable change in the size frequency distribution of scallops in the impacted and semi-impacted strata following seismic surveying. The conclusion was that no short-term (<2 months) impacts on the survival or health of adult commercial scallops (*Pecten fumatus*) were detected following the seismic survey.

Przeslawski et al. (2016a, 2016b, 2018) examined the short-term impacts on scallops and other marine invertebrates from a 2,530 in^3 seismic array and found no evidence of mortality or change in condition following exposure to a seismic survey. Analysis of images and samples revealed some site-specific differences in scallop abundance, size, condition, and assemblages, but these were not related to seismic operations.

From 2013-2015, a long-term study evaluated the acoustic impacts from seismic exposure on scallops in Australia (Day et al. 2016b, 2017). The experimental field research maintained the scallops in mesh enclosures while a vessel with the acoustic source passed close to the animals. Day et al. (2016b, 2017) exposed scallops to maximum received sound exposures of up to 213 dB re 1μPa PK-PK, 181 to 188 dB re 1 μPa^2.s per-pulse SEL, and SEL_{cum} of 188 to 198 dB re 1μPa^2.s. The study also predicted ground acceleration of up to 37.57 m/s^2.

Day et al. (2016b, 2017) concluded that exposures did not result in any immediate mass mortalities; however, repeated exposures, not representative of typical survey conditions, resulted in a chronic increase in mortality over timeframes of approximately four months post-exposure, though not beyond naturally occurring rates of mortality. Separate experiments undertaken in 2013 and 2014 yielded mortalities of 3.6-3.8% in control scallops (no seismic exposure), 9.4-11.3% mortality in scallops exposed to a single pass of the seismic source, 11.3-16.1% mortality in scallops exposed to two passes of the seismic source, and 14.8-17.5% mortality in scallops exposed to four passes of the seismic source. The mortality rates were at the low end of the range of naturally occurring mortality rates documented in the wild, which range from 11-51% with a six year mean of 38% (Day et al. 2017). A third experiment in 2015 resulted in 100% mortality to both control scallops and exposed scallops, and accordingly was attributed to other causes and not to seismic exposure (Day et al. 2016b, 2017).

Sub-lethal effects to exposed scallops were also observed by Day et al. (2016b, 2017) indicating a compromised capacity for homeostasis and potential immunodeficiency over acute (hours to days) and chronic (months) timescales post exposure. Exposures did not elicit energetically expensive behaviours (i.e., extensive swimming or long periods of valve closure), but scallops showed significant changes in behavioural patterns during exposure, through a reduction in classic behaviours and demonstration of a non-classic "flinch" response to seismic signals. Furthermore, following exposure scallops showed an increase in recessing into sediment following exposure (Day et al. 2017).

Though Day et al. (2016b) recorded increased mortality with repeated exposure to a seismic source, it has not been established as to whether this was due to exposure to the seismic source or other mechanism related to the study design (Przeslawski et al. 2016). Using a precautionary approach, if the increased mortality was due to exposure to the seismic source, then the increased mortality identified translates to an annual increase of between 9.4% and 20%. These fall towards the low end of what might be expected when compared with natural mortality rates in wild scallop populations, which range from 11-51% with a six year mean of 38% (Day et al. 2016b).

Scallops exposed to repeated seismic sound suffered physiological damage with no signs of recovery over the four month period, suggesting potentially reduced tolerance to subsequent stressors. In addition, changes in behaviour and reflexes during and following seismic exposure were observed. However, Day et al. (2016a, 2016b) cautioned that it was unclear from the study whether the observed physiological (and behavioural) impairments would result in mortality beyond the timeframes considered in their study.

Przeslawski et al. (2018) concluded that there was no evidence of increased scallop mortality, or effects on scallop shell size, adductor muscle diameter, gonad size, or gonad stage due to the seismic sound from an actual seismic survey. The authors concluded that the study provided no clear evidence of adverse effects on scallops, fish, or commercial catch rates due to the 2015 seismic survey undertaken in the Gippsland Basin. Przeslawski et al. (2018) further concluded that the study provided a robust and evidence-based assessment of the potential effects of a seismic survey on some fish and scallops.

Studies by Mooney et al. (2010) showed squid use their statocysts to detect low frequency, particle motion stimuli with a frequency response similar to the accelerometer ears of most elasmobranch and teleost fishes. Evoked potential response characteristics also parallel those found in many fish species that lack auditory specializations.

Laboratory studies that exposed two species of squid to seismic sound showed that *Alloteuthis sublata* was tolerant to a sound level up to 260 dB re 1 µPa (SPL) and *Loglio vulgaris* was fatally injured at levels of 246 – 252 dB re 1 µPa (SPL) within 3 – 11 minutes of exposure (Norris & Mohl 1983). However, received sound levels from a typical seismic survey do not reach these levels.

Fewtrell & McCauley (2012) assessed the effects of air gun noise on caged squid (*Sepioteuthis australis*). No sub-lethal injury or mortality as a result of exposures in this study was observed. Several squid showed alarm responses to the start-up of an air gun by firing their ink sacs and/or jetting away from the source, but this was not observed for similar or greater levels if the signal was ramped up. General habituation was observed with a decrease in alarm responses with subsequent exposures. During the trial the squid showed avoidance to the air gun by keeping close to the water surface at the end of the cage furthest from the air gun (within the sound shadow). Fewtrell & McCauley (2012) suggested a threshold of 166 dB re 1 µPa (SPL) would give an indication of the extent of disruption of a seismic survey by significant alteration in swimming patterns. They found that in one trial, where the received level of the first airgun impulse was 162 dB re 1 µPa^2·s, the squid inked. This response was not observed again within this trial; however, the authors stated that it was unknown if this was due to depleted ink reserves or habituation. In two other trials, the initial received levels were lower (132 and 146 dB re 1 µPa^2·s per–pulse SEL), and although the cumulative received levels did exceed 162 dB re 1 µPa2 s, no inking behaviour was observed. The authors hypothesised that the results also suggest that a gradual increase in received levels and prior exposure to air gun impulses decreases the severity of the alarm responses in this species. This aligns with findings of general habituation in response to predators in squid (Long et al. 1989). Recent work (Jones et al. 2020) supports these findings as well, indicating potential rapid, short–term habituation by squid to impulsive noise, however, similar response rates were seen 24-hours later, which indicated that squid might re–sensitise to the noise.

The results presented in by Fewtrell and McCauley (2012) were stated by the authors to be preliminary, and while they stated that while it is possible that noise levels greater than 147 dB re 1 µPa^2·s are required to induce avoidance behaviour, the level associated with inking, of 162 dB re 1 µPa^2·s per–pulse SEL, has been considered as a startle response level for squid. In the absence of additional studies and thresholds this level may be considered for other cephalopods; however, it may be limited when applied to other species.

André et al. (2011) exposed cephalopods (squid, cuttlefish, and octopus) to low-frequency sounds, 50–400 Hz sinusoidal wave sweeps with 100% duty cycle and one second sweep period for two hours in either a 2 L fiberglass reinforced plastic tank or a 200 L glass-walled tank, filled with natural seawater. The sweep was produced and amplified through an in-air loudspeaker, with measured received SPL of 157 ± 5 dB 1 µPa, with peak levels at 175 dB re 1 µPa. Following exposure, the individuals were decapitated at different intervals, ranging from immediately afterward to 12, 24, 48, 72, and 96 hours after exposure, respectively. All exposed individuals from presented the same lesions and the same incremental effects over time. The most pronounced lesions were visible in specimens observed 96 hours after sound exposure. In these individuals, the sensory epithelium was severely damaged, with very few hair cells remaining; most of the hair cells had been extruded. The epithelium only presented supporting cells, creating a holed mosaic, where residual hair cells showed either very few bent, flaccid, or fused kinocilia, or none at all. André et al. (2011) detailed that the lesions described in the study were new to cephalopod pathology and that their presence in all the noise-exposed individuals (versus their absence in controls) and their clear progression over time are consistent with the effects observed in other species that have been exposed to much higher intensities of sound.

Mooney et al. (2016) detailed that squid responded to sounds from 80 to 1,000 Hz, with response rates diminishing at the higher and lower ends of this frequency range. Animals responded to the lowest sound levels in the 200-400 Hz range. These results demonstrate that squid can exhibit a range of behavioural responses to sound include fleeing, startle, and protean behaviours, all of which are associated with predator evasion. Response types were frequency and sound level dependent, reflecting a relative loudness concept to sound perception in squid.

Solé et al. (2017) conducted offshore noise controlled exposure experiments on common cuttlefish (*Sepia officinalis*), at three different depths and distances from the source and particle motion and sound pressure measurements were performed at each location. Scanning electron microscopy revealed injuries in statocysts, which severity was quantified and found to be proportional to the distance to the transducer. These findings are the first evidence of cephalopods sensitivity to anthropogenic noise sources in their natural habitat. From the measured received power spectrum of the sweep, it was possible to determine that the animals were exposed at levels ranging from 139 to 142dB re 1μPa^2 and from 139 to 141 dB re 1μPa^2, at 1/3 octave bands centred at 315 Hz and 400 Hz, respectively. These results could therefore be considered a coherent threshold estimation of noise levels that can trigger acoustic trauma in cephalopods.

Dead beached squids have been documented in the vicinity of seismic surveys (Guerra et al. 2004) and from a seismic survey vessel (Leite et al. 2016).

Guerra et al. (2004) detailed that five giant squids were stranded between the end of September and the middle of October and four giant squid were found floating or stranded along the Asturian coast during a single week in September 2003. Guerra et al. (2004) examined seven of the nine animals, and did not find an obvious cause of death in any of these giant squid; however, internal examinations showed that two of the squids suffered extensive damage to internal muscle fibres, stomachs and digestive tracts were mangled. Some of the squids had also suffered severe damage to their statocysts that would have effectively disorientated them. Coincidentally, at the time of both mass strandings, vessels had been conducting seismic geophysical surveys in the vicinity, using ten compressed air guns that produced sound waves of low frequency (below 100 Hz) and high intensity (source level of 240 dB re 1 μPa at 1m per air gun) (Guerra et al. 2011).

Leite et al. (2016) reported that a squid, ~2 m long and identified as *Architeuthis dux,* was sighted as dead from a seismic survey vessel that had been operating in the area using a 5,085 in^3 seismic source with an operating pressure of 2,000 psi. Leite et al. (2016) detailed that while there is no definite proof to link the death of this specimen to the seismic activity, its occurrence in an area of active surveys is suggestive of a possible link.

Given the similarities in physiology between squid and octopus, octopus are not thought to be at risk of physical injury even if individuals are exposed to several passes as noted by Fewtrell and McCauley (2012). There is limited information on the hearing sensitivity of octopus to sound stimuli. Kaifu (2008) studied *Octopus ocellatus* and concluded that the statocyst was responsible for the observed responses kinetic sound energy (particle motion). It is unknown how octopuses will respond behaviourally, but since they are benthic and territorial it is thought more likely that they will retreat into their lair as they normally do to perceived threats. They may also freeze and camouflage themselves if out in the open. Octopus are not expected to move very far from their territory and therefore will not be exposed to repeat close passes in short period of time since subsequent survey lines are about 4 km apart. If they remain in the same area they may be exposed to sounds shown to elicit strong responses two to three times throughout the survey period and these events will be several days apart allowing the individual animals to recover.

4.3 Corals

A literature review by Dr Mardi Hastings stated that the primary mechanisms for injury of hermatypic corals from seismic sound emissions are: (1) breaking of the external coral skeleton which could also damage the polyp tissue, and (2) rupture or tearing of polyp tissues inside the corallites (Hastings 2008).

Although injury to corals is theoretically possible as described by Hastings (2008), studies on the actual impacts were limited prior to the Maxima 3D and Gigas 2D studies at Scott Reef (see below). A survey of coral reefs in Brunei that were subjected to seismic noise did not detect any damage to hard or soft corals, sponges, or other sessile benthic organisms (IEC 2003).

The most relevant data currently available are results from exposure studies that Woodside conducted during the Maxima 3D and Gigas 2D Pilot Ocean Bottom Cable (OBC) marine seismic surveys at Scott Reef offshore northern Western Australia.

In the Maxima 3D experiments corals in and around the lagoon were exposed to seismic signals (both experimental seismic lines and a full seismic survey) using a 2,055 in^3 source over a 59-day period. The experimental lines passed directly over the coral communities (source at 7 m depth, corals at ~60 m depth) whereas the full seismic survey passed within tens to hundreds of metres (horizontal offset). The maximum estimated received seismic signal levels at coral impact sites were 226–232 dB PK-PK, 214–220 dB SPL, 197–203 dB SEL, and a maximum cumulative SEL of 197–203 dB (Salgado Kent et al. 2016).

For plate corals, *Lobophytum* spp., and various soft corals including *Sarcophytum* spp., the proportion of dead and bare coral cover and the percent cover of red algae were documented, and no detectable effect was found from one or multiple passes of the seismic source (Battershill et al. 2008). Further, there was no evidence of coral breakage, no signs of physiological impairment in the corals (polyp withdrawal or reduction in soft coral rigidity) and no long-term change in coral community structure related to the experimental or full seismic survey activities (Battershill et al. 2008).

The Gigas 2D Pilot OBC coral monitoring study (SKM 2008) examined the potential for physical damage to a range of shallow water corals in North Scott Reef lagoon from seismic source emissions. This study used several sub-lethal indicators of stress and mortality (partial and whole colony mortality) to determine the effects of seismic source emissions on corals. The conclusion from this study was that emissions from the seismic source did not cause significant injury, tissue damage, sublethal stress or mortality to coral colonies, even when colonies were within a few metres of the seismic source (SKM 2008). This survey had a measured at source SEL of 206 dB (McCauley 2008).

Heyward et al. (2018) reviewed the research undertaken at Scott Reef and the analyses detected no effect of seismic activity measured as coral mortality, skeletal damage, or visible signs of stress immediately after and up to four months following the 3D marine seismic survey. Maximum received levels were 226 dB PK.

5 Fishes

Although hearing ranges and sensitivities vary substantially between species (e.g., Ladich & Fay 2013), all fish species tested to date can detect sound and vibration to some degree (Dale et al. 2015). Fish produce sounds in a wide range of context such as feeding, mating or fighting, and as a result anything that inhibits the detection of these sounds can have a negative effect on their fitness and survival (Popper & Hawkins 2019). The majority of fish species detect sounds from <50 Hz up to 500-1500 Hz (Popper & Hawkins 2019). A smaller number of species can detect sounds over 3 kHz, while very few species can detect ultrasound over 100 kHz (Ladich & Fay 2013). The critical issue for understanding whether an anthropogenic sound will affect the hearing of a fish is whether it is within the hearing frequency range of the fish and loud enough to be detectable above background ambient noise.

The hearing sensitivity of fish varies depending upon the auditory structures in the inner ear (otoliths surrounded by an epithelium of hair cells) and, if present, the swim bladder (Finneran & Hastings 2000; Nedwell et al. 2004). Otoliths are sensitive only to particle motion, while the swim bladder may provide an indirect route for sound pressure to reach the inner ear. The other main mechano-reception system in fish is the lateral line system, which runs along the side of the body and is more pronounced in some groups of fish than others. The lateral line system responds to particle motion produced in the near-field of a sound source, as well as to tiny water currents set up by the motions of the fish (Nedwell et al. 2004); therefore, all fish are sensitive to the particle motion component of sound at close range from a sound source. Particle motion is the most relevant metric for perceiving underwater sound for most species, but with the exception of a few species (Popper & Fay 2011; Popper et al. 2014), there is an almost complete lack of relevant data on particle motion sensitivity in fish (Popper & Hawkins 2018). Some more specialised fish with a swim bladder that they use for hearing are sensitive to sound pressure and are capable of detecting less intense noise and a wider range of frequencies, compared to less-specialised groups of fish (Popper et al. 2014; Carroll et al. 2017; Hawkins & Popper 2017). The susceptibility of fish to injury from noise exposure varies depending on the species and the presence and possible role of a swim bladder in hearing. Inter-specific variations in hearing range and sensitivity result from the different adaptations in these systems for perceiving sound pressure and particle motion information (Popper & Fay 2011).

Based on their morphology, Popper et al. (2014) classified fishes into three categories comprising:

- Fishes with swim bladders whose hearing does not directly involve the swim bladder or other gas volumes.
- Fishes whose hearing does directly involve a swim bladder or other gas volume.
- Fishes without a swim bladder that can sink and settle on the substrate when inactive.

The Popper et al. (2014) classifications can be assigned to the following families or species of commercial fish species, common in Australian waters:

- Fishes with swim bladders or other gas volumes, but whose hearing does not directly involve the swim bladder, e.g., snappers, emperors, groupers and rock cods (lutjanids and lethrinids such as *Pristipomoides* spp., *Lethrinus* spp., *Lutjanus* spp., and Family Serranidae), and some species of tuna (*Thunnus* sp.) (Tavolga & Wodinsky 1963; Higgs et al. 2006; Braun & Grande 2008; Engineering-Environmental Management, Inc. 2008; United States Department of the Navy 2008; Caiger et al. 2012; Bertrand & Josse 2000; Song et al. 2006).
- Fishes whose hearing does directly involve a swim bladder or other gas volume e.g., Family Clupeidae (herrings, sardines, pilchards, and shads) and some Haemulidae (grunters and sweetlips) (Nedwell et al. 2004; Braun & Grande 2008; Popper et al. 2014).

- Fishes without a swim bladder (e.g., mackerel, *Scomberomorus* spp., some species of tuna, *Thunnus* sp. and sharks) (Casper et al. 2012; Popper et al. 2014; Carroll et al. 2017).

Underwater noise levels significantly higher than ambient levels can have a negative impact on fishes, ranging from physical injury or mortality to temporary effects on hearing and behavioural disturbance effects.

The effects of underwater sound on fishes within the vicinity of a seismic sound source array will vary depending on the size, age, sex, and condition of the receptor among other physiological aspects, and the topography of the benthos, water depth, sound intensity and sound duration. The effect of noise on a receptor may be either physiological (e.g., injury or mortality) or behavioural, as described in the following sub-sections.

Mortality/Potential Mortal Injury

It is noted that while thresholds for fish mortality have been included for consideration in this assessment based on the Popper et al. (2014) guidelines, no studies to date have demonstrated direct mortality of free-swimming adult fish in response to seismic source emissions, even when at close proximity (within 1 7 m) (DFO 2004; Boeger et al. 2006; Popper et al. 2016; Carroll et al. 2017).

Although some fish deaths have been reported during cage experiments, these were more likely caused by experimental artefacts of handling fish or confinement stress (Hassel et al. 2004). For free swimming fishes that can move away from seismic sources as they approach, the potential for lethal physical damage from air gun emissions is even further nullified. However, reef or bottom-dwelling fishes that show greater site attachment may be less inclined to flee from a seismic sound source and experience greater effects.

Despite mortality being a theoretical possibility for fish exposed to seismic source emissions, Popper et al. (2014) did not reference an actual occurrence of this effect. At the time of developing the guidelines, no quantified data on injury and mortality from seismic sources on fishes had been reviewed by the Working Group. Therefore, the Popper et al. (2014) exposure guidelines for mortality/potential mortal injury and recoverable injury for fishes exposed to seismic source emissions are based solely on data from pile driving conducted on predominantly temperate, freshwater fish species. Although seismic surveys and pile driving both produce impulsive sound, their sound characteristics are markedly different; pile driving impulses result in a more rapid rise time in sound pressure than seismic pulses and it is this rapid rise time that has the greatest potential for trauma (Caltrans 2001, 2004; Hastings & Popper 2005; Popper et al. 2006). Also, pile driving sound effects are usually more significant due to the fact that they usually involves a static source and static receivers (e.g., site-attached fishes).

Environmental Resources Management Australia (ERM) undertook a detailed literature review of potential fish mortality and physical injury because of exposure to seismic sources (ERM 2017). Of the 28 studies reviewed, only three observed direct mortality and in each case, mortalities occurred to caged fish at very close proximity to the seismic source (<2 m), which is not representative of real-life exposures from seismic surveys because fish are free-swimming and are not likely to be exposed at such close range. The received sound levels that resulted in mortality ranged from 220 to 241 dB re 1 μPa PK; however, other studies reported no mortality or injury at levels as high as 246 dB re 1 μPa PK. Therefore, the sound exposure criteria proposed by Popper et al. (2014) for mortality and mortal injury are highly conservative.

Other than physiological stress responses or hearing loss, no other physical damage to adult fish or invertebrates have been directly attributed to exposure to seismic source emissions, even at close proximity (NSW DPI 2014). It should be noted that some reports of physical damage arise from studies undertaken using explosions and other high-pressure sound waves, and not from seismic source emissions that generate lower maximum pressures and pressure change (Popper & Hastings 2009).

There is some evidence that bony fishes can regenerate the sensory cells in their hearing system to a fully functional state within weeks after a detrimental exposure. The processes involved in the recovery are not fully understood, and there is conflicting evidence from sound exposure studies, such as McCauley et al. (2003). These findings could also suggest that the process of sensory hair cell death and regeneration is species-specific.

Recovery processes take a few days to a few weeks (Scholik & Yan 2001; Mackenzie & Raible 2012), and the time course for recovering from hearing loss likely depends on the species, its normal hearing sensitivity, the sound exposure intensity and duration, and the amount of sensory epithelial damage (Smith & Monroe 2016). Noise-induced PTS has not been reported for fishes yet, which may be explained by their apparent ability to regenerate hair cells.

Injurious effects caused by rapid pressure changes within the body are called 'barotrauma' (Stephenson et al. 2010; Halvorsen et al. 2011, 2012b). The range of barotrauma effects in fishes mostly depends on the temporal pattern of the pressure changes and the physiological state of the exposed fishes (Stephenson et al. 2010; Halvorsen et al. 2012a, 2012b); they range in severity from damage with full recovery to lethal injury (McKinstry et al. 2007).

Casper et al. (2012) showed that fishes can recover from less severe injuries under laboratory conditions, suggesting that minor injuries do not inevitably lead to mortality. Nevertheless, in open waters, they have the potential to reduce the animal's fitness to the extent that its ability to find food decreases and its risk of being predated increases (Halvorsen et al. 2011, 2012b).

Mortality is either a direct effect of barotrauma (in the case of severe injury) or indirect if an animal is moderately injured. Data on sound-induced mortality in fishes are scarce and mainly related to underwater explosions (see review by Popper & Hastings 2009). Caltrans (2001) documented fish mortality near underwater pile driving. There is no evidence for fish mortality caused by exposure to other sound sources such seismic source emissions, dredging, or vessel noise (Normandeau Associates, Inc. 2012).

Temporary Threshold Shift

The following is sourced from Popper et al. (2014):

> *"Temporary threshold shift (TTS) is a temporary reduction in hearing sensitivity caused by exposure to intense sound. TTS has been demonstrated in some fishes, and its extent is of variable duration and magnitude. TTS results from temporary changes in sensory hair cells of the inner ear and/or damage to auditory nerves innervating the ear (Smith et al. 2006; Liberman 2015). However, sensory hair cells are constantly added in fishes (e.g., Corwin 1981, 1983; Popper and Hoxter 1984; Lombarte and Popper 1994) and also replaced when damaged (Lombarte et al. 1993; Smith et al. 2006; Schuck and Smith 2009), unlike in the auditory receptors of mammals. When sound-induced hair cell death occurs in fishes, its effects may be mitigated over time by the addition of new hair cells (Smith et al. 2006, 2011; Smith 2012, 2015).*
>
> *After termination of a sound that causes TTS, normal hearing ability returns over a period that is variable, depending on many factors, including the intensity and duration of sound exposure (e.g., Popper and Clarke 1976; Scholik and Yan 2001, 2002a, b; Amoser and Ladich 2003; Smith et al. 2004a, b, 2006, 2011; Popper et al. 2005, 2007). While experiencing TTS, fishes may have a decrease in fitness in terms of communication, detecting predators or prey, and/or assessing their environment."*

McCauley et al. (2003) demonstrated that exposure to repeated emissions of a single air gun (source level of 222.6 dB re 1µPa PK-PK) from 5 to 15 m at the closest approach caused extensive damage to the sensory hair cells in the inner ear of caged pink snapper (*Pagrus auratus*). Although no mortality was observed, the damage was severe with no evidence of repair or replacement of damaged sensory cells up to 58 days post-exposure. However, the study did not investigate the effects on fish hearing. The study acknowledged that the fish were caged and therefore not able to swim away from sound source, and that the monitoring video suggested the fish would have fled the sound source if possible. The authors of the study also acknowledged that the impact of exposure on ultimate survival of the fish was not clear.

As part of Woodside's Maxima 3D marine seismic survey, an extensive field study was undertaken at Scott Reef. A component of this study investigated the potential physical, physiological, and behavioural noise-induced effects on fish assemblages. The results showed statistically more damage to the hearing in blue-stripe sea perch (*Lutjanus kasmira*) exposed to the seismic impulses than in control fishes. However, the damage found in these fishes was marginal, and—assuming a direct relationship between hair cell density and hearing capability—a negligible effect on the fishes' hearing capability. The damage was monitored through time out to 58 days post seismic exposure and did not increase significantly through time, with almost zero damage detected by 58 days (McCauley 2008).

A study of auditory sensitivity in four species of tropical reef fishes following exposure to emissions from the 2,055 in^3 array showed that none of the four species, including the pinecone soldierfish (a species with expected to have good hearing sensitivity) experienced any hearing sensitivity loss (i.e. TTS) following exposure to SEL_{cum} up to 190 dB re 1 µPa^2·s (Hastings et al. 2008; Hastings & Miksis-Olds 2012). No detectable gross physiological damage was found in individuals from any of the seven species (McCauley & Kent 2012). The results of the hearing tests are consistent with the sound exposure guidelines proposed in Popper et al. (2014), which indicated that TTS may occur at SEL_{cum} levels >186 dB re 1 µPa^2·s while other studies (Popper & Hastings 2009; Song et al. 2008) indicate that TTS may occur at levels as high as SPL 205-210 dB re 1µPa (PK).

Behavioural Effects

The sound-related factors influencing behavioural reactions in fishes can include its frequency content, intensity above background noise and temporal sound characteristics. If exposed to the same stimulus over a prolonged period, an initial behavioural reaction might fade as the fishes habituate to the sound. Behavioural reactions that are usually observed in fishes in response to sound are dispersion, directed movements away from the sound source (leaving the area of the noise source, aggregation and descending closer to the bottom), startle response (fast start escapes, C-start response) at sound onset (Wardle et al. 2001; Slotte et al. 2004). Effects can be acute (such as acoustic masking), or chronic (including altered distribution), lasting from the immediate duration of sound exposure to several days or weeks if fishes are displaced from their preferred areas during a survey (Engås et al. 1996; Slotte et al. 2004; Løkkeborg et al. 2012; Streever et al. 2016).

The onset level of behavioural responses in fishes varies greatly between and within species, including between fishes of different ages and sizes, the behavioural and social context, and the motivation of the fishes. Existing data on behavioural responses do not provide a clear dose-response relationship and, consequently, it is currently impossible to determine single value thresholds for the onset of behavioural reactions. Instead, broad response and effect categories such as those proposed by Popper et al. (2014) seem most reasonable and may guide regulatory decisions in this context.

Strong 'startle' responses have been observed in some fish species at received sound levels of 200-205 dB re 1 µPa, indicating that sounds at or above this level may cause more severe behavioural reaction such as avoidance. Sound levels of this intensity are likely to occur 100 to 300 m from an acoustic array. Based on this, an approximate range of 200 m was estimated as the minimum distance at which fishes may start avoiding the approaching seismic source (McCauley 1994). Wardle et al. (2001) documented that schooling reef fishes swam past a seismic source array at received levels that would be received at about 20 m below a survey array consisting of 30 air guns.

Pearson et al. (1992) showed that that exposure to air gun sound can cause changes in schooling patterns and distribution. Løkkeborg et al. (2012) found changes in catch rates of fish species in Norwegian waters, indicating that these species all responded to seismic sound emissions. However, they also showed that gillnet catches were doubled for some fish species during seismic surveying and only longline catch rates fell slightly. Except for one species, they did not find any changes in abundance or displacement from fishing grounds. Hawkins et al. (2014) used synthetic impulsive signals in a behavioural response study; they documented that sprat and mackerel reacted to the impulsive sound exposure generally by dispersal and depth changes (which would make it difficult to detect the true scope of effects in a study relying on fisheries technology).

Some other studies looking at the behavioural response of sound pressure-sensitive Gadidae and Clupeidae species, such as whiting, Atlantic cod and herring, have reported changes in vertical position in the water column, potential avoidance responses and short-term changes in distribution. Chapman & Hawkins (1969) observed that the depth distribution of free-ranging whiting changed in response to an intermittently discharging stationary seismic source, which resulted in fish being exposed to an estimated SPL of 178 dB re 1 μPa. The fish school responded to the sound by shifting downward, forming a more compact layer at greater depth although temporary habituation was observed after one hour of continual sound exposure (Chapman & Hawkins, 1969).

Hawkins et al. (2014) exposed free-swimming sprat (a sound pressure-sensitive Clupeidae species with a swim bladder connected to the inner ear) and Atlantic mackerel (a particle motion detecting species without a swim bladder) to playback of impulsive sound. Sprat schools were more likely to disperse laterally in response to received sound levels of approximately 135 dB re 1 $\mu Pa^2.s$ SEL. Mackerel schools were more likely to alter their depth in the water column in response to approximately 142 dB re 1 $\mu Pa^2.s$ SEL. Hawkins et al. (2014) note how the two different species seemed to respond to the sound playback at similar sound levels despite the differences in sound sensitivity of the two species, but suggested that mackerel were simply more "flighty" than sprat and therefore more likely to react. The tests were also undertaken using low sound level playback in very close proximity to the schools of fish and it is not clear how relevant the sound pressure and sound exposure levels are in relation to mackerel given that their response was likely driven by particle motion. The study location, a very small, enclosed, quiet, coastal sea lough, where fish were not accustomed to heavy disturbance from shipping and other intense sound sources is also very different from an open ocean location.

Slotte et al. (2004) monitored the effects of a 3,090 in^3 seismic array on migrating herring (Clupeidae) and whiting (Gadidae), mapping their distribution and abundance in relation to the seismic survey lines. There was no significant evidence of immediate, near-field scaring reactions on the horizontal scale in response to acquiring survey lines, but there was some evidence that fish changed position in the water column, moving closer to the seabed. Some short-term changes in distribution were observed but weren't statistically significant; fish consistently remained within the immediate vicinity of the survey area, but in a limited number of measurements there was an indication that fish abundance was lower near to the survey area and increased with distance out to a maximum range of 37 km. However, results were inconsistent and clear trends were not observed in all cases. Slotte et al. (2004) concluded that it was not possible to determine how much abundance and distribution were attributed to the seismic survey or to the natural migration patterns and food availability of the fish, or other natural factors. Herring and whiting were found to be abundant in the survey area again after a pause in seismic acquisition and monitoring of fishes for three to four days, indicating that if any displacement did occur as a result of seismic sound exposure, the displacement was temporary (i.e. less than 3-4 days) (Slotte et al. 2004).

In similar studies, Engås et al. (1996) and Engås & Løkkeborg (2002) reported on the effects of seismic surveys on Atlantic cod and haddock (Gadidae) and found that the abundance of fish were lower in the survey area compared with areas outside of the survey area, which the authors hypothesize may be the result of an avoidance response. Some differences in abundance were still detectable within the survey area five days after the survey was completed (Engås et al. 1996; Engås & Løkkeborg 2002).

Santulli et al. (1999) exposed caged European sea bass (a demersal species) to a 2,500 in^3 seismic source. Limited response was observed at 2.5 km distance, a startle response was observed when the array was at a distance of approximately 800 m, but after passing within 180 m, fish behaviour appeared to return to normal within one hour. Increased biochemical stress levels were measured in some fish following exposure, returning to normal levels within 72 hours of exposure. It is noted that exposures of fish in the wild would likely result in avoidance of high sound levels prior to the seismic source approaching to as close a range and to as high sound levels as the captive fish in the experiment were exposed to.

The behavioural observations of free-swimming fishes in Woodside's Maxima 3D survey at Scott Reef (Miller & Cripps 2013) show that seismic source emissions did not cause lethal or sub-lethal effects on fish near the operating array. At close range, the vessel approach caused fishes to cease their behaviours and move towards the seabed, but the effect was short-lived, and fishes began to feed and behave normally again within 20 minutes after the passage of the seismic survey vessel. Caged fishes displayed startle responses too infrequently to analyse. However, agitation levels increased with increasing received sound exposure level for the three holocentrid species (squirrelfishes and soldierfishes, suborder Holocentroidei) but were not detectable for the blue-stripe sea perch. Sonar observations of free-swimming fishes indicated that individual animals tended to move towards the seabed on approach of the operating seismic source, consistently out to 400 m either side of the survey test line. Schools of fishes moved towards the seabed within 200 m of the survey test line in response to the passage of the operating seismic source and stayed significantly closer to the seabed up to 63 minutes post-exposure. The vocal behaviour of fishes was unaffected from the seismic activity; fish choruses remained unchanged with regards to timing and chorus level (at daily, lunar and seasonal scales); these findings suggest that in the long-term the survey had little effect on the fish that produced the choruses. Underwater visual censuses (UVC) revealed that diversity and abundance of both Pomacentridae (damselfishes and clownfishes) and non-Pomacentridae fish species (inhabtiting shallow-slope regions) showed no significant changes after the seismic survey compared to the long-term temporal trend before the survey. Analysis of recordings from baited remote underwater video stations showed no detectable effects of the seismic survey on the diversity and abundance of deeper water fish communities at the spatial and temporal scales examined. Also, there were no signs of loss of individuals or of systematic re-distribution of individuals and species at any of the time scales examined.

The findings from the research at Scott Reef support those by Wardle et al. (2001), who exposed free ranging fishes inhabiting an inshore reef to sounds from a seismic source (maximum received levels of 195-218 dB re 1 µPa PK). The study found that fishes exhibited a startle response to all received levels, but no avoidance behaviours were observed, they showed no signs of moving away from the reef and exposure to the seismic noise did not interrupt a diurnal rhythm of fishes gathering at dusk. Slight changes were recorded to the long-term day-to-night movements of two tagged pollack (*Pollachius sp.*), particularly when positioned within 10 m of their normal living positions. However, the seismic sound had little effect on the day-to-day behaviour of the resident fishes and invertebrates.

Behavioural observations of two tropical snapper species and another coral reef fish species, spadefish, in field enclosures before, during and after exposure to seismic sound showed that repeated exposure resulted in increasingly less obvious startle responses (Boeger et al. 2006). This is consistent with the potential habituation suggested by McCauley et al. (2000) and by Fewtrell and McCauley (2012).

McCauley & Salgado Kent (2007) observed the behaviour of goldband snapper in fish traps in the Timor Sea using cameras placed inside the fish traps. A seismic vessel towed two 3,090 in^3 seismic sources. Maximum signals reached at the closest trap to each seismic pass-by were 200, 202 and 212 dB re 1 µPa PK-PK (equivalent to approximately 194, 196 and 206 dB re 1 µPa PK). No dramatic behavioural responses of fish to the passing seismic source were observed. Fish generally displayed increased activity immediately after entering a trap presumably as they searched for a way out, with this activity reducing with time. Fish that had been in a trap for some time showed increased activity levels as the operating seismic source approached but were 'quiet' when the array passed at the point of closest approach.

Fewtrell & McCauley (2012) showed that fishes tended to remain lower in the water column and/or swim faster and form tighter schools during periods of close air-gun emissions. Fish populations can be potentially impacted if behavioural responses result in deflection from migration paths, feeding grounds or disturbance of spawning, thereby affecting recruitment of fish stocks.

Paxton et al. (2017) observed temperate reef fishes, including snapper and grouper species, in 33 m water depths located 7.9 km from a seismic survey line using video recordings. The authors observed fish abundance and habitat use during the evening hours for three days prior to a seismic survey and then during the evening of the day when seismic activity occurred. The authors attempted to measure sound at two other reefs in closer proximity to the survey, but the hydrophones malfunctioned. No video recordings were made at the other reefs where hydrophone measurements were attempted. No hydrophone measurements were made at the reef where video recordings took place, but maximum sound levels were estimated to be more than 170 dB re 1 µPa SPL. Despite no clear visual evidence of behavioural responses in fishes during the seismic survey, the authors noted a 78% decline in abundance in the evening following the survey. No further recordings were made to assess when fish abundance returned to pre-exposure levels or how far they may have moved. Therefore, with limited data, it is not clear from this study if reduced abundance is attributed to the seismic sound or other natural factors such as tidal influence or food availability. However, the study may indicate a possible avoidance response and temporary change in local abundance and distribution.

Bruce et al. (2018) tagged tiger flathead, which were monitored during a seismic survey undertaken in Australian waters. Minor behavioural effects were observed in exposed tiger flathead, which increased their swimming speed during the seismic survey and changed daily movement patterns after the survey but showed no significant displacement. Overall, there was little evidence for consistent behavioural responses (Bruce et al. 2018).

Davidsen et al. (2019) investigated the effects of seismic sound exposure on the physiology and behaviour of captive Atlantic cod (*Gadus morhua*) and saithe (*Pollachius virens*), both species from the Family Gadidae with a swim bladder directly involved in sound detection. Experimental sound exposures were 18-60 dB above ambient. The cod exhibited reduced heart rate in response to the particle motion component of the sound from the air gun, indicative of an initial flight response. No behavioural startle response to the air gun was observed despite some observed changes in swimming depth and position, and the fish seemed to habituate both physiologically and behaviourally with repeated exposure. The authors concluded that sound exposures induced over the three day study period appear unlikely to be associated with long-term alterations in physiology or behaviour.

Hubert et al. (2020) also exposed captive Atlantic cod to one hour of playback of seismic air gun sound pulses with a 10 second shot point interval. Results indicated no strong overall pattern of change in swimming patterns or immediate, short-term behaviours during the exposure, compared to baseline periods without playback. However, several individuals changed their time spent in several behavioural states during the one-hour sound exposure, which may be indicative of changes in energy expenditure.

van der Knaap (2021) investigated the effect of a 3.5-day, full-scale, seismic survey exposure on the movement behaviour of free-swimming Atlantic cod, using acoustic telemetry. The closest point of approach to the tagging location was 2.25 km. The study found that during the experimental survey, cod did not leave the detection area more than expected from baseline data. However, cod left more quickly than expected, from two days to two weeks after the seismic survey. Furthermore, behavioural analyses indicated that during the exposure cod decreased their activity, with time spent being locally active (moving over small distances, showing high body acceleration) becoming shorter, and time spent being inactive (moving over small distances, having low body acceleration) becoming longer. Additionally, diurnal activity cycles were disrupted with lower locally active peaks at dusk and dawn–periods when cod is known to actively feed.

Meekan et al. (2021) undertook a large-scale experiment that quantified the impacts of exposure of an assemblage of tropical demersal emperors (Family Lutjanidae), snappers (Family Lethrinidae) and groupers (Family Epinephelidae) targeted by commercial fisheries to a commercial-scale seismic source on the North West Shelf off Western Australia. Dominant species included spangled emperor (*Lethrinus punctulatus*), red emperor (*Lutjanus sebae*), and brownstripe snapper (*L. vitta*). A combination of Baited Remote Underwater Video Systems (BRUVS) and acoustic tagging methods were used to measure the behaviours and movements of fishes at high, medium, and low exposure sites, as well as at control sites. The high, medium, and low exposure sites were located at horizontal distances from the path of the seismic source of approximately 0 300 m, 2 10 km and 11 km respectively. The maximum modelled SEL values received at the high, medium, and low exposure sites were in the order of 180 – 200 dB re 1 µPa^{2}·s, 130 – 160 dB re 1 µPa^{2}·s and 115 – 125 dB re 1 µPa^{2}·s respectively. There were no short-term (days) or long-term (months) effects of exposure on the composition, abundance, size structure, behaviour, or movement of fishes at any exposure sites. The authors suggest that it is a reasonable assumption that the behavioural responses of demersal fishes to the bait cue provided by the BRUVS are a realistic proxy of the likely response of the same species to baited hooks or traps used by the commercial fisheries that target them. The acoustic tags and telemetry found little evidence that fish were displaced by the exposure to the seismic source. Movements of tagged fish occurred over a limited area focused on two or three acoustic receivers, and there was no evidence for the departure of tagged fish after exposure. These multiple lines of evidence suggest that seismic surveys have little impact on the behaviours of demersal fishes in this environment.

A recent study examined behavioural responses in spawning Atlantic cod in Norway (McQueen et al. 2022, 2023). Atlantic cod (*Gadus morhua*) may be especially vulnerable to sound disturbance during spawning, as it is a soniferous fish species, with acoustic communication playing an important role in the cod mating system, and a low frequency hearing range (10 – 650 Hz). During the spawning period, male cod produce low frequency grunts (~50 Hz) that have been associated with aggressive and courtship behaviours. Low frequency noise associated with ship traffic has been found to reduce the effective communication range of spawning cod (Stanley et al. 2017; as cited in McQueen et al. 2023), and low frequency anthropogenic noise can elicit stress responses in cod resulting in reduced egg production and fertilization rates (Sierra-Flores et al. 2015). Additionally, cod tend to demonstrate high site fidelity to spawning areas. There have been reports that free-ranging cod move away from an area in immediate or delayed response to seismic surveys (Engås et al. 1996; van der Knaap et al. 2021).

To investigate whether airgun sound causes cod to leave their spawning grounds, McQueen et al. (2022, 2023) deployed acoustic telemetry arrays were on two cod spawning grounds: a test and a reference site. From 2019 to 2021, 136 mature cod from the test site and 45 from the reference site were tagged with acoustic transmitters. Intermittent seismic shooting of two 40 cui airguns for one week during the spawning periods of 2020–2021 resulted in fluctuating SELs at the test site, comparable to a full-scale industrial survey 5–>40 km away. Residency and survival of tagged cod were analysed with capture–mark–recapture models fitted to the detection and recapture data. Departure rate of the mature cod varied between spawning seasons but was similar between the test and reference sites. Cod demonstrated only weak responses to the disturbance from repeated three hour treatment periods over five days, swimming on average slightly deeper during seismic exposure compared to silent control periods. This response varied between individuals. Longer-term effects of seismic exposure on swimming depth were not detected. No changes in swimming acceleration, displacement, or area use occurred. Neither survival nor departure significantly differed between seismic exposure and baseline periods. The results indicated that exposure to airguns at received SEL of up to ~145 dB re 1 µPa^{2} s, comparable to a seismic survey occurring several kilometres away, did not displace tagged cod from spawning grounds. These results suggest that relatively distant seismic surveys do not substantially alter cod behaviour during the spawning period at received sound exposure levels varying between 115 and 145 dB re 1 µPa^{2} s over a five day period (McQueen et al., 2022, 2023).

The following conclusions are made regarding behavioural effects to fish from seismic airguns, based on the literature above:

- Different fish may exhibit different behavioural responses when exposed to seismic survey noise, depending on their activities, motivation and the context in which they receive sound.
- Fish may change position in the water column (i.e., move closer to the seabed) as a response to becoming aware of approaching seismic sound (e.g., Pearson et al. 1992; McCauley et al. 2000, 2003; Slotte et al. 2004; Fewtrell & McCauley 2012; Miller & Cripps 2013; Davidsen et al. 2019).
- Exposure to higher sound levels at close range to a seismic source may begin to result in more noticeable startle or alarm responses, such as changes in school structure, increased swimming speed and avoidance of the sound source (e.g., Simmonds & MacLennan 2005; McCauley et al. 2000, 2003; Fewtrell & McCauley 2012; Popper et al. 2014; Carroll et al. 2017).
- Many exposure experiments are undertaken using a single airgun and it is not clear how transferrable the behaviours and received SPL/SEL levels are to a full commercial-sized seismic array, particularly if observed behaviours are in response to particle motion close to the sound source rather than to sound pressure.
- There is some evidence that fish may also tolerate gradual increases in sound levels and habituate to repeated sound exposures (Chapman & Hawkins 1969; McCauley et al. 2000; Boeger et al. 2006; Fewtrell & McCauley 2012; Peña et al. 2013; Davidsen et al. 2019).
- Many studies indicate that fishes resume normal behaviour shortly after cessation of the acoustic disturbance (within minutes / less than an hour), with no evidence of long-term changes (e.g., Wardle et al. 2001; Pearson et al. 1992; Santulli et al. 1999; McCauley et al. 2000, 2003; Fewtrell & McCauley 2012; Miller & Cripps 2013; Davidsen et al. 2019).
- Meekan et al. (2021) found no short-term (days) or longer-term (months) effects of seismic sound exposure on the behaviour and movement of tropical demersal snapper, emperor and grouper species on the North West Shelf.
- There is some evidence that changes in distribution may persist for longer than the initial change in behaviour, i.e. position in the water column, schooling behaviours and swim speeds may return to normal relatively quickly (within minutes or hours), but their distribution may not return to normal for hours or days. Potential changes in distribution of fish has been observed in some studies for approximately five days following sound exposure, although such changes are limited to studies that focused primarily on migrating sound pressure-sensitive types of fish with a swim bladder-ear connection (e.g. Clupeidae, Gadidae). These studies also acknowledge that it is difficult to attribute these changes in distribution directly to the seismic survey or to natural migration patterns, food availability or other natural factors (Slotte et al. 2004; Engås et al. 1996; Engås & Løkkeborg 2002). However, it is possible that changes to the behaviour and distribution of some sound-sensitive prey species (e.g. herring, sardines) may have some indirect influence on the distribution of larger predatory fishes during the days following exposure and disturbance.
- Small changes in behaviour or disruption to diurnal activities of pressure-sensitive species of fish (Gadidae) with a swim bladder-ear connection may indicate that activities such as feeding and energy expenditure can be affected if exposed long-term (Davidsen et al. 2019; Hubert et al. 2020; van der Knaap 2021), although these species of fish may also habituate to the sound with repeated exposure (Davidsen et al. 2019).

Given the limited convergence in results from the available studies, the subjective nature of many assessments and the context under which fish received sound, the Popper et al. (2014) ANSI-Accredited Standards Committee Sound Exposure Guidelines for Fishes and Turtles determined that it is not possible to define exact sound level thresholds for changes in fish behaviours. Instead, Popper et al. (2014) applies relative risk criteria. The criteria reflect the potential for substantial changes in behaviour for a large proportion of the animals exposed to a sound, which may alter distribution, and moving from preferred sites for feeding and reproduction. The criteria do not include effects on single animals or small changes in behaviour such as a startle response or minor movements. As such, Popper et al. (2014) indicate that fish without a swim bladder or with no connection between the swim bladder and the inner ear may experience substantial changes in behaviour within tens or hundreds of metres of a seismic source. These peer-reviewed and accredited sound exposure criteria are reflected in this risk assessment. It is acknowledged that some fishes with swim bladders may show varying levels of awareness of sound pressure at greater distances from the seismic source, but it is important to recognise changes in behaviour that may be of ecological significance from those that aren't.

Acoustic Masking

Masking impairs an animal's hearing impairment with respect to the relevant biological sounds normally detected within the environment and can have long lasting effects on survival, reproduction, and population dynamics of fishes. The consequences of masking for fishes; however, have not been sufficiently examined to allow a thorough assessment of effects caused in the context of this survey. Popper et al. (2014) surmised that "*It is likely that increments in background sound within the hearing bandwidth of fishes and sea turtles may render the weakest sounds undetectable, render some sounds less detectable, and reduce the distance at which sound sources can be detected. Energetic and informational masking may increase as sound levels increase, so that the higher the sound level of the masker, the greater the masking*." If impulsive sounds are generated repeatedly by many sources over a wide geographic area there is a possibility that the separate sounds might merge and that the overall background noise be raised (Nieukirk et al. 2004). However, acoustic masking only occurs while the interfering sound is present, and therefore, masking resulting from a single pulse of sound (such as seismic source impulses) or widely separated pulses would be infrequent and not likely affect an individual's overall fitness and survival.

5.1 Sharks

Myrberg (2001) stated that sharks differ from bony fishes in that they have no accessory organs of hearing such as a swim bladder and therefore are unlikely to respond to acoustical pressure. The study also suggested that the lateral line system does not respond to normal acoustical stimuli and is unable to detect sound-induced water displacements beyond a few body lengths, even with large sound intensities (Myrberg 2001).

Chapuis et al. (2019) detailed that the auditory apparatus of sharks comprises the paired inner ears that, as in all fishes, detect the particle motion component of a sound. However, unlike most bony fishes, cartilaginous fishes do not possess a swim bladder, which responds to the pressure component of a sound, and therefore are thought to only be sensitive to particle motion. Though Lobel (2009) noted that at very loud levels, an elasmobranch is able to discriminate between sounds based upon the phased difference between particle motion and acoustic pressure (Lobel 2009).

Two sensory maculae, the sacculus and the macula neglecta, have been shown to be responsive to particle motion detection in the inner ear of cartilaginous fishes which are known to be sensitive to low frequency sounds up to 1.5 kHz, peaking between 200 and 600 Hz, depending on the species (Chapuis et al. 2019). This range overlaps with seismic pulses which are primarily less than 2 kHz, with the highest levels at frequencies in the range of 10-500 Hz (McCauley 1994).

There is some indication that a sudden onset of sound can also cause a startle response in sharks (Myrberg et al. 1978). Klimley and Myrberg (1979) established that an individual shark will suddenly turn and withdraw from a sound source of high intensity (more than 20 dB re 1 μPa above broadband ambient SPL) when approaching within 10 m of the sound source.

Research by Bruce et al. (2018), which tagged two shark species and monitored their movements in response to a seismic survey in Australian waters noted that both control sharks and exposed sharks moved freely in and out of the study area which did not indicate any changes in behaviour or distribution as a result of seismic sound exposure.

A study by Chapuis et al. (2019) used a baited underwater camera rig to record the behavioural responses of eight species of sharks (seven reef and coastal shark species and the white shark) to the playback of two distinct sound stimuli in the wild: an orca call sequence and an artificially generated sound. The aim of the study was to look at sound-induced behavioural changes in sharks to potentially identify acoustic repellent devices. When sounds were playing, reef and coastal sharks were less numerous in the area, were responsible for fewer interactions with the baited test rigs, and displayed less 'inquisitive' behaviour, compared to during silent control trials. White sharks spent less time around the baited camera rig when the artificial sound was presented but showed no significant difference in behaviour in response to orca calls.

It is noted that there has been reported cased of sharks biting the seismic streamers, such as during seismic surveys conducted by the survey vessel *Pacific Titan* in New Zealand waters.

6 Marine Turtles

Morphological studies of green turtles (*Chelonia mydas*) and loggerhead turtles (*Caretta caretta*) (Ridgway et al. 1969; Wever 1978; Lenhardt et al. 1985) found that the turtle ear is similar to other reptile ears but has adaptations for underwater listening. In-air electrophysiological and behavioural studies on green and loggerhead turtles found their hearing frequency range is approximately 50-2,000 Hz, with highest sensitivity to sounds between 200 and 400 Hz (Ridgway et al. 1969; Bartol et al. 1999; Ketten & Bartol 2005; Bartol & Ketten 2006; Yudhana et al. 2010; Piniak et al. 2011; Lavender et al. 2012, 2014).

Underwater audiograms are only available for three species, all of whom have poor hearing sensitivity. Two of these species, the red-eared slider (*Trachemys scripta elegans*, freshwater, semi-aquatic) (Christensen-Dalsgaard et al. 2012) and the loggerhead turtle (Martin et al. 2012), demonstrated highest sensitivity at around 500 Hz (Willis 2016). Piniak et al. (2016) found that green turtles have maximum underwater sensitivity between 200 and 400 Hz. Very little research has been performed on the hearing capabilities of hawksbill turtles (*Eretmochelys imbricata*). Yudhana et al. (2010) measured auditory brainstem responses from two hawksbill turtles in Malaysia and found that peak frequency sensitivity occurred at 457 Hz in one turtle and at 508 Hz in the other.

There is no robust information on the susceptibility of marine turtles to noise-induced effects. Most studies researching the effect of seismic noise on marine turtles focused on behavioural responses, as physiological impacts are more difficult to observe in living animals. Turtles avoid low-frequency sounds (Lenhardt 1994) and sounds from an air gun (O'Hara & Wilcox 1990), but these reports did not note received sound levels. Moein et al. (1995) found that penned loggerhead turtles initially reacted to an air gun but then showed little or no response to the sound (i.e., habituated to it). Caged green and loggerhead turtles increased their swimming activity in response to an approaching air gun when the received SPL was above 166 dB re 1 μPa, and they behaved erratically when the received SPL was approximately 175 dB re 1 μPa (McCauley et al. 2000).

The 166 dB re 1 μPa level has been used as the threshold level for a behavioural response to marine turtles by NMFS and applied in the Arctic Programmatic Environmental Impact Statement (PEIS) (NSF 2011) and the Recovery Plan for Marine Turtles in Australia (DoEE 2017). The 175 dB re 1 μPa level from McCauley et al. (2000) is recommended as the threshold for behavioural disturbance. Sound levels defined by Popper et al. (2014) show that animals are very likely to exhibit a behavioural response when they are near an air gun (tens of metres), a moderate response if they encounter the source at intermediate ranges (hundreds of metres), and a low response if they are far (thousands of metres) from the air gun.

Mortality and potential mortality injury (PMI) impacts have not been reported to have occurred in turtles as a result of noise emissions during seismic surveys. Popper et al. (2014) suggested injury to turtles could occur for sound exposures above 207 dB re 1 μPa (PK) or above 210 dB re 1 uPa^2·s (SEL_{24h}). However, Finneran et al. (2017) presented revised thresholds for turtle injury and hearing impairment from impulsive noise, considering both PK and frequency weighted SEL, suggesting that PTS may occur in response to received levels of 204 dB re 1 uPa^2·s (SEL_{24h}) or 232 dB re 1 μPa (PK) and TTS may occur in response to received levels of 189 dB re 1 uPa^2·s (SEL_{24h}) or 226 dB re 1 μPa (PK).

7 Birds

There is very little known about the effects of intense underwater sound (i.e. seismic surveys) on marine birds. However, impacts have not been observed during previous seismic surveys (Turnpenny and Nedwell, 1994), and it is generally thought that noise produced from activities associated with seismic surveys may impact only those species of birds that spend large quantities of time underwater, either swimming or plunge diving while foraging for food, for example penguins.

Pichegru et al. (2017) investigated the behavioural response of endangered African penguins (*Spheniscus demersus*) before, during and after a seismic survey conducted within 100 km of their breeding colony in South Africa, using a multi-year GPS tracking dataset.

Penguins foraging within 100 km of the active seismic operations showed a change of foraging direction during seismic periods, increasing their distance between their feeding area and the location of the seismic vessel. The avoidance behaviour by penguins observed in this study may be explained by either a direct disturbance from the noise generated by the operation or a change in fish distribution during that period (possibly as a result of seismic activities). Small-scale acoustic fish surveys assessing distribution and abundance of small pelagic fish in Algoa Bay around both penguin colonies did not show a significant change in distribution and/or abundance of small pelagic fish in the region in March 2013 compared to a few months prior to or after the seismic operations. Therefore, African penguins likely relocated away from their traditional feeding zone to avoid the disturbance generated by the noise of the seismic vessels, rather than to follow their prey.

The African penguins quickly reverted to normal foraging behaviour after cessation of seismic activities during this study, which suggest a relatively short-term influence of seismic activity on these birds' behaviour and/or that of their prey. Most bird and many fish species have the capacity to regenerate lost or damaged sensory cells of the ear, although the researchers could not rule out potential longer-terms impacts on the penguins hearing ability.

Stemp (1985; as cited in LGL 2012) conducted observations on the effects of seismic exploration on seabirds and did not observe any negative effects.

Lacroix et al. (2003) assessed the effect of near shore seismic surveys on the foraging behaviour of moulting long-tailed ducks in the Beaufort Sea, Alaska. Long-tailed ducks are not capable of flying during the moult and to compensate for the nutritionally costly moult process they increase their foraging. Lacroix et al. (2003) found that the abundance and distribution of ducks, in both the seismic and control areas, changed similarly following the start of the seismic operations suggesting other influencing factors such as wind were more important for duck distribution than seismic activities, and that seismic activities did not significantly change the diving intensity of ducks. Overall Lacroix et al. (2003) concluded that there was no evidence to suggest any displacement away from seismic operations.

In a controlled exposure experiment, Sørensen et al. (2020) exposed captive Gentoo Penguins (*Pygoscelis papua*) to impulsive signals, and most animals showed strong aversive reactions at received levels above 120 dB re 1μPa (SPL). While the experiment made efforts to reduce some of the limitations of captive experiments, the study is still difficult to reconcile exposures to sudden sound stimuli at close range (metres) in the absence of natural ocean background noise with a real-life exposure.

8 Marine Mammals

The potential impacts of anthropogenic noise on marine mammals have been the subject of considerable research (see reviews by Nowacek et al. 2007; Southall et al. 2007; Weilgart 2007; Wright et al. 2007; Southall et al. 2019; Southall et al. 2021).

Kavanagh et al. (2019) modelled over 8,000 hours of cetacean survey data across diverse offshore region of the Northeast Atlantic to investigate the effect of seismic surveys on baleen and toothed whales. They found a significant effect of seismic activity across multiple species and habitats, with an 88% (82–92%) decrease in sightings of baleen whales, and a 53% (41–63%) decrease in sightings of toothed whales during active seismic surveys when compared to control surveys. Significantly fewer sightings of toothed whales also occurred during active versus inactive air gun periods of seismic surveys, although some species-specific response to noise was observed.

Southall et al. (2007), Finneran & Jenkins (2012), Wood et al. (2012), Finneran (2015) and more recently NMFS (2018) and Southall et al. (2019, 2021), reviewed available literature to determine noise exposure criteria, based on the onset levels of non-recoverable PTS and TTS in cetaceans. The NMFS (2018) criteria incorporate the best available science to inform assessment of PTS and TTS. However, a lack of a quality low-frequency (LF) cetacean audiograms has made it difficult to precisely determine hearing sensitivity, and the criteria for LF cetaceans are likely precautionary.

Hearing Sensitivity

Current data and predictions show that marine mammal species differ in their hearing capabilities, absolute hearing sensitivity and frequency band of hearing (Richardson et al. 1995; Wartzok & Ketten 1999; Southall et al. 2007). While hearing measurements are available for a small number of species based on captive animal studies, direct measurements of many odontocetes and all mysticetes do not exist. As a result, hearing ranges for many odontocetes are grouped with similar species, and predictions for mysticetes are based on other methods, such as anatomical studies and modelling (Houser et al. 2001; Parks et al. 2007; Tubelli et al. 2012; Cranford & Krysl 2015), vocalizations (see reviews in Richardson et al. 1995; Wartzok & Ketten 1999; Au & Hastings 2008), taxonomy, and behavioural responses to sound (Dahlheim & Ljungblad 1990)

To better reflect the auditory similarities between phylogenetically closely related species, but also significant differences between species groups among the marine mammals, Southall et al. (2007) defined five groups of marine mammals, based on phylogenetic relationships and a combination of auditory, physiological, and behavioural characteristics, where known. A revised set of marine mammal hearing groups and associated frequency-weighting functions were proposed by Finneran (2016) and these groups were adopted in technical guidance (NMFS 2018) as a useful approach in developing auditory weighting functions and deriving noise exposure criteria for marine mammals. In 2019, Southall et al. reviewed these marine mammal hearing groups and modified them based on phylogenetic relationships and a comprehensive review of studies on hearing, auditory anatomy, and sound production (Southall et al. 2019). This review resulted in eight discrete hearing groups as detailed in Table B8-8-1.

Frequency weighting

Different animals are sensitive to different sound frequencies, which are measured in Hertz (Hz) and kiloHertz (kHz). Therefore, if an animal is sensitive to a particular frequency range, a sound in that frequency range will seem louder to that animal than to a different animal that is less sensitive to those frequencies. For example, some large baleen whales are sensitive to very low frequency sounds (7 Hz to 35 kHz), while toothed whales and dolphin species are considered more sensitive to mid-high frequency sounds (150 Hz to 160 kHz) with their peak hearing frequency somewhere between these frequency ranges (NMFS 2018). Therefore, how loud a sound will be perceived will differ between species.

As the hearing of different species of marine fauna is frequency dependent, rather than express received sound pressures in terms of their levels over a broad bandwidth, levels can be weighted by the frequency response of hearing for the animal. This approach has been widely used for examining exposure of humans to sound (Popper et al. 2014). Southall et al. (2007) developed M frequency weighting functions (M-weightings) for five functional hearing groups of marine mammals, with this method designed specifically to represent the broader bandwidth at which auditory effects (TTS and/or PTS) might occur for higher exposures. Southall et al. (2019) expanded on this approach to provide M-weighting functions for eight marine mammal hearing groups, including LF cetaceans, HF cetaceans, VHF cetaceans, sirenians, phocid carnivores and other marine carnivores (refer Table B8-8-1able B8-71).

Table B8-8-1: Marine Mammal Hearing Groups

Group	Genera or species included
Low-frequency (LF) cetaceans	The LF cetacean group contains all of the mysticetes: Balaenidae (*Balaena* spp. and *Eubalaena*, Neobalenidae (*Caperea*), Eschrichtiidae (*Eschrichtius*), and Balaenopteridae (*Balaenoptera* spp. and *Megaptera*).
High frequency (HF) cetaceans	The HF cetacean group contains most delphinid species (e.g., bottlenose dolphin, common dolphin, and pilot whale), beaked whales, sperm whales and killer whales.
Very high frequency (VHF) cetaceans	The VHF cetacean group comprises the true porpoises, most river dolphin species, pygmy/dwarf sperm whales, as well as number of oceanic dolphins (Commerson's, Chilean, Heaviside's, Hector's, Hourglass, and Peale's dolphins).
Sirenian (SI)	The SI group includes the manatees and dugongs.
Phocid Carnivores in Air (PCA) and Water (PCW)	This group contains all the true seals, including harbour, grey, and freshwater seals; elephant and monk seals; and both Antarctic and Arctic ice seals.
Other Marine Carnivores in Air (OCA) and Water (OCW)	This group contains all non-phocid marine carnivores, including the otariid seals (sea lions and fur seals), walruses, sea otters, and polar bears.

Behavioural Effects

Differences between species, individuals, exposure situational context, the temporal and spatial scales over which they occur, and the potential interacting effects of multiple stressors can lead to inherent variability in the behavioural response of marine mammals to sound exposure (Southall et al. 2021).

Southall et al. (2007) presented a severity-index ranking the intensity of behavioural responses that was later amended by Ellison et al. (2012), Miller et al. (2012), and Sivle et al. (2015) and has recently been updated by Southall et al. (2021) based primarily on studies of free-ranging mammals.

The NMFS currently uses a step function with a 50% probability of inducing behavioural responses at an SPL of 160 dB re 1 µPa to assess behavioural impact. This threshold value was derived from the HESS (1999) report, which, in turn, was based on the responses of migrating mysticete whales to seismic sounds (Malme et al. 1983, 1984). The HESS team recognized that behavioural responses to sound may occur at lower levels, but significant responses were only likely to occur above an SPL of

140 dB re 1 µPa. An extensive review of behavioural responses to sound was undertaken by Southall et al. (2007), which found varying responses for most marine mammals between an SPL of 140 and 180 dB re 1 µPa, consistent with the HESS (1999) report.

In 2012, Wood et al. (2012) proposed a graded probability of response for impulsive sounds using a frequency weighted SPL metric (Table B8-8-2able B8-72). They designated behavioural response categories for sensitive species (such as harbour porpoises, *Phocoena phocoena*, and beaked whales) and for migrating mysticetes.

Table B8-8-2: Graded Probability of Response for Impulsive Sounds

Marine Mammal Group	Probability of response to frequency -weighted SPL (dB re 1 µPa)			
	120	**140**	**160**	**180**
Sensitive species	50%	90%		
Other species		10%	50%	90%

McCauley et al. (2000) monitored the effects of seismic survey sounds on humpback whales in the Exmouth Gulf region of Western Australia. They documented rapid swimming on the surface, breaching and localised avoidance behaviour by migrating whales during the seismic operation, indicating that the 'risk factor' associated with the marine seismic survey was confined to a comparatively short period and small range displacement. During their migration and breeding season, humpback whales rarely display deep dives. This tendency to stay close to the surface has been interpreted as actively utilising the 'sound shadow' (Lloyd's Mirror effect) near the surface; irrespective of the motivation for this behaviour, it reduces the risk for noise-induced effects unless at very short range from a large seismic source array.

A comparison of behavioural observations of humpback whale behaviour during seismic surveys shows the variability and context dependence of these responses (Richardson et al. 1995). McCauley et al. 2000) estimated that humpback whales would avoid seismic surveys in key habitat (such as breeding, resting, or feeding areas) at distances between 7 and 12 km, whereas migrating individuals generally showed an avoidance range of around 3 km. Some males have even been recorded approaching seismic survey vessels to within 1 to 2 km (McCauley et al. 2000). It is considered that avoidance behaviour represents a temporary and minor effect, unless avoidance results in displacement of whales from breeding, resting, or feeding areas.

The BRAHSS (Behavioural Response of Australian Humpback whales to Seismic Surveys) project conducted studies at Peregian Beach in Queensland, and off Dongara in Western Australia, to better understand the behavioural responses of humpback whales to noise from the operation of seismic air gun arrays (20 in^3 and 140 in^3 arrays) (Cato et al. 2013). Results from the experiments are published in Dunlop et al. (2015, 2016, 2017a, b). The BRAHSS Project found:

- Humpback whale groups responded by decreasing both dive time and speed of southwards movement though the response magnitude was not found to be related to the proximity of the source vessel, the received level of the air gun, the tow path direction, or the exposure time within the during phase. There was no evidence of orientation of the groups towards, or away from, the source vessel in the during phase. Interestingly, this behavioural response was found in the control trials as well as the active trials suggesting a response to the source vessel.
- No abnormal behaviours were recorded during the trials. However, in response to the active seismic array and the controls, the whales displayed changes in behaviour. Changes in respiration rate were of a similar magnitude to changes in baseline groups being joined by other animals suggesting any change group energetics was within their behavioural repertoire. However, the reduced progression southwards in response to the active

treatments, for some cohorts, was below typical migratory speeds. This response was more likely to occur within 4 km from the array at received levels over 135 dB re 1 μPa^2.s

- Humpback whales were more likely to avoid the air gun arrays (but not the controls) within 3 km of the source at levels over 140 re. 1 μPa^2 s, meaning that both the proximity and the received level were important factors and the relationship between dose (received level) and response is not a simple one.

The results of the BRAHSS study are consistent with previous studies with humpback whales in different behavioural contexts. Feeding humpback whales, for example, responded at ranges up to 3 km from the source, at levels of 150-169 dB re 1 μPa (Malme et al. 1985). Resting female humpback whales with calves displayed avoidance reactions at 140 dB re 1 μPa, though other cohorts reacted at higher levels (157-164 dB re 1 μPa - McCauley et al. 2000).

Blackwell et al. (2015) found evidence for two behavioural thresholds in migrating bowhead whales responding to seismic operations in the Beaufort Sea. A moderate cessation or modification of vocal behaviour (interpreted as compensation behaviour) was found at received SEL over a 10 minute period of 94 dB re 1μPa^2·s (increase of calling rates) and 127 dB re 1μPa^2·s (decrease in calling rates). At received levels of >160 dB re 1μPa^2·s; however, whales were completely silent. Robertson et al. (2013) detected changes in surfacing, respiration, and diving behaviour of bowhead whales in response to seismic survey activity but did not provide any qualitative information on the received levels. Castellote et al. (2010) documented avoidance behaviour in fin whales in response to seismic survey activity in the Mediterranean Sea lasting over 10 days.

Observations of sperm whale behaviour during seismic surveys provided conflicting results: Stone (2003) identified that while sperm whales were frequently (visually) detected during seismic surveys, these animals did not show any observable behavioural reactions. Jochens et al. (2008) found sperm whales tolerant of seismic activity; however, a decrease in foraging activity was observed for a small number of animals but no horizontal avoidance was measured. In a tagging study, Jochens and Biggs (2003) found that sperm whales did not show any behavioural reaction (horizontal avoidance of the seismic vessel, change in feeding rates) at maximum received levels of 148 dB re 1μPa.

In the Gulf of Mexico, sperm whales were equipped with multisensory tags to investigate their behaviour in response to seismic surveys. The animals did not show any statistically significant changes in horizontal movement, diving and echolocation behaviour at received levels of approximately 118–131 dB re 1μPa^2·s ($SEL_{M\text{-weighted}}$) (Miller et al. 2009).

The hearing of dolphins (HF cetaceans) is less sensitive in the low frequency range of air gun impulses (<500 Hz) and seismic operators sometimes report dolphins and other small toothed whales near operating seismic source arrays. However, there is a component of seismic pulses in the higher spectrum and in general most toothed whales do show some limited avoidance of operating seismic vessels. Goold (1996) studied the effects of seismic surveys common dolphins (*Delphinus delphis*) in the Irish Sea. The results indicated that there was a local displacement of dolphins around the seismic operation. This observation is consistent with visual data compiled by Stone (2003) from marine mammal surveys in the North Sea that shows small toothed whale species tend to move away from operating compressed air seismic sources. In a review of behavioural effects of seismic surveys on marine mammals in UK waters, Stone and Tasker (2006) reported that small odontocetes (dolphins, HF cetaceans and porpoises, VHF cetaceans) showed the strongest avoidance response to the seismic survey activity, were seen less often during periods of seismic acquisition, remaining further from the air guns and showing altered behaviour (e.g., less bow-riding, orienting away from the survey vessel, faster swimming). The same study documented that killer whales also showed some localised avoidance to seismic surveys.

A reduction in feeding activity in response to seismic survey activity has been documented for harbour porpoises at estimated received SEL of 150 – 165 dB re 1μPa^2·s (Pirotta et al. 2014). Due to the permanently high energy demands of harbour porpoises (Wisniewska et al. 2016) a prolonged cessation of feeding can have significant effects on the fitness of affected animals.

Gotz et al. (2009) reported that controlled exposure experiments with small acoustic sources (215 - 224 dB re 1μPa) were carried out over one hour to individual harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*), and in seven out of eight trials with harbour seals, the animals exhibited strong avoidance reactions.

Two harbour seals equipped with heart rate tags showed immediate, but short-term, startle responses to the initial acoustic source pulses. The behaviour of all harbour seals seemed to return to normal soon after the end of each trial, even in areas where disturbance occurred on several consecutive days. Only one harbour seal showed no detectable response to the acoustic sources and approached the acoustic source to within 300 m, and seals remaining in the water returned to pre-trial behaviours within two hours of the end of the experiment (Gotz et al. 2009). General avoidance behaviour of other Northern Hemisphere seal species was exhibited at exposure levels above 170 dB re 1μPa.

Monitoring studies (Harris et al. 2001) undertaken on the behaviour of phocid seals (more sensitive to sound than otariid pinnipeds) during a nearshore seismic program in Alaska observed that:

- During daylight hours seals were seen at nearly identical rates during periods where there were no air guns firing, one air gun firing and the full array operational.
- Seals tended to be further away during full array seismic. Swimming away was more common during full array operation than no air gun periods, but relative behaviours (looked, approached, swam parallel to boat's track, dive or swam away when full array was firing) did not differ significantly among the distance categories.
- Approximately 79% of seal sightings were within 250 m of the seismic vessel. There was partial avoidance of the zone less than 150 m from the vessel during full array seismic, but seals did not move much beyond 250 m at any time.
- Received levels of noise pulses from the full array were ≥180 dB SPL out to a radius of 1 km. Despite this, many seals showed little or no obvious avoidance and no obvious tendency to avoid diving.

Physiological Effects

A study on the physiological response of Arctic Narwhals to anthropogenic noise found individuals had marked cardiovascular, respiratory and locomotor reactions in response to seismic pulses. Noise exposed Narwhals experienced a 2-2.2-fold increase in the energetic cost of diving, whilst paradoxically heart rate reduced (bradycardia). Williams et. al. 2022 compared these results to studies on trained harbour porpoises (Phocoena phocoena, Elmegaard et al., 2021) and a closely related species, the Beluga Whale (Delphinapterus leucas, Lyamin et al., 2011). In the harbour porpoise study, the cetaceans initially had intensified levels of bradycardia, however this response diminished as they habituated to the noise. In the Beluga Whale study, the continued noise exposure resulted in eventual bradycardia. These studies are impacted by variation in environmental conditions and type of fear stimuli (Williams et. al. 2022). [Paragraph has been added in response to Matter M11].

Acoustic Masking

Masking is the process by which the threshold of hearing for one sound is raised by the presence of another (masking) sound (Erbe & Farmer 1998; Erbe 2008; Erbe et al. 2016). This describes the reduction in audibility for one sound (termed 'signal') caused by the simultaneous presence of another sound (termed 'noise'). For this to occur, the sound must be loud enough, have similar frequency content to the signal, and must happen at the same time. Masking depends on the spectral and temporal characteristics of signal and noise and is reduced if the signal and noise are separated in time, frequency, or direction (space); it can occur if the noise happens shortly before or after the signal (forward and backward masking). The zone of masking can maximally be as large as the zone of audibility, as a faint noise might mask a faint signal. The masking effect can be reduced or remedied by various active or passive mechanisms for masking-release, such as spatial or temporal release from masking, the Lombard effect, or co-modulation masking release.

Auditory masking can lead to disruption of a behaviour, lack of appropriate behavioural reactions, increased vulnerability to predators, reduced access to prey, reduced communication, changes in vocal behaviour, disruption of spawning activities, and stress. The biological significance of acoustic masking is directly linked to the duration of the masking sound. While masking can be detrimental to the fitness, reproduction, and survival of individuals, it ends immediately after the masking sound ceases. Both anthropogenic and natural marine sound can affect hearing and partially or completely reduce an individual's ability to effectively communicate; detect important predator, prey, and/or conspecific signals; and detect important environmental features associated with spatial orientation (Clark et al. 2009). This is true for all marine fauna; however, masking is most frequently associated with marine mammals. Masking in fishes has not been studied in detail.

Masking reduces the communication space of marine mammals (Clark et al. 2009; Hatch et al. 2012). A calculation of reductions in communication range can be a useful proxy for impact. So far, a direct assessment and quantification of masking effects in wild animals has proven impossible (Tougaard et al. 2015). It depends on the positions of the signalling and the receiving animal relative to the sound source and to each other. In humpback whales (*Megaptera novaeangliae*), tonal and grunting sounds acting as contact calls between a mother and its calf were recorded at comparatively low levels (Videsen et al. 2017). While there is controversy about the validity of conclusions, such low levels would create a small communication space (<100 m) which, in turn, would be sensitive to increases in ambient noise.

Most studies related to masking effects in marine mammals have investigated the auditory parameters that are most relevant in this context, such as auditory sensitivity, frequency-tuning (critical bandwidth and critical ratio), auditory integration time, and critical interval. Erbe et al. (2016) reviewed the current knowledge on masking in marine mammals, summarising data on marine mammal hearing as they relate to masking and discussing masking release processes of receivers. The variability seen in auditory sensitivity (see Hearing sensitivity) indicates the variability seen with respect to auditory masking.

Temporary Threshold Shift and Permanent Threshold Shift

In marine mammals, the onset level and growth of TTS is frequency specific, depends on the temporal pattern, duty cycle, and the hearing test frequency of the fatiguing stimuli. Exposure to intense impulse noise might be more hazardous to hearing than non-impulsive noise, and there is a positive relationship between exposure duration and the amount of TTS induced. TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same total sound exposure level. Sounds generated by seismic sources, pile driving and mid-frequency sonars have directly been tested and proven to cause noise-induced threshold shifts in marine mammals at high received levels. Finneran (2015) reviewed the current state of knowledge on TTS and PTS. TTS typically decreases in marine mammals relative to the logarithm of the increasing recovery time. However, there is considerable individual difference in all TTS-related parameters between subjects and species tested so far.

PTS is considered injurious in marine mammals, but there are no published data on the sound levels that cause PTS in marine mammals. Hence, PTS effects in marine mammals should be viewed as theoretical, as they have never actually been demonstrated in either captive or wild animals. Regeneration of sensory cells, as known to occur in fishes, has not been documented for any marine or terrestrial mammal. Onset levels of PTS onset are typically extrapolated from TTS onset levels and assumed growth functions (Southall et al. 2007). The NMFS (2018) criteria incorporate the best available science to estimate PTS onset in marine mammals from sound energy (SEL_{24h}), or very loud, instantaneous peak sound pressure levels. Criteria are given separately for each cetacean functional hearing group and discriminate between impulsive and non-impulsive sounds. Southall et al. (2019) undertook a comprehensive review of all available data on direct measures of hearing auditory anatomy, and emitted sound characteristics for all marine mammal species. The quantitative process undertaken resulted in exposure criteria, in many respects identical to those derived by Finneran (2016) and adopted by the NMFS (2016, 2018); however, the Southall et al. (2019) exposure criteria (Table B8-8-3able B8-73) appear in a peer-reviewed publication and include marine mammal species for all noise exposures, both under water and in air for amphibious species.

Table B8-8-3: TTS- and PTS-onset Thresholds for Marine Mammals Exposed to Impulsive Noise

Marine mammal hearing group	TTS onset: SEL (weighted)	TTS onset: Peak SPL (unweighted)	PTS onset: SEL (weighted)	PTS onset: Peak SPL (unweighted)
LF	168	213	183	219
HF	170	224	185	230
VHF	140	196	155	202
SI	175	220	190	226
PCW	170	212	185	218
OCW	188	226	203	232
PCA	123	138	138	144
OCA	146	161	161	167

The role of the temporal pattern of sound on TTS in marine mammals has been studied in MF and HF cetaceans (Mooney et al. 2009; Finneran et al. 2010; Kastelein et al. 2014; Kastelein et al. 2015). The results of these studies show that TTS can accumulate across multiple exposures, but the resulting TTS will be less than the TTS from a single, continuous exposure with the same total SEL.

Only a few studies have investigated TTS in marine mammals in response to exposure to impulsive sounds such as seismic impulses. Lucke et al. (2009) tested the effect of a single seismic source on a male harbour porpoise. They documented onset of TTS at received (unweighted) SEL of 164 dB re 1 $\mu Pa^2 \cdot s$. This equates to a (HF) weighted SEL_{24h} of 140 dB re 1 $\mu Pa^2 \cdot s$ (NOAA 2016). The main energy of the fatiguing stimulus (seismic pulse) was centred below 500 Hz, but a substantial amount of energy was also present at higher frequencies. Kastelein et al. (1997) tested the auditory tolerance of a harbour porpoise to playbacks of broadband pile driving sounds. After one hour of exposure an unweighted SEL 146 dB re 1 $\mu Pa^2 \cdot s$ and a SEL_{24h} of 180 dB re 1 $\mu Pa^2 \cdot s$, a TTS of 2.3 dB and 3.6 dB occurred at 4 kHz and 8 kHz, respectively. The average weighted SEL_{24h} from these exposures was 144 dB re 1 μPa²·s.

In a study using playbacks of pile driving sounds, Kastelein et al. (2013) exposed harbour porpoises to a maximum single-strike unweighted broadband SEL of 145 dB re 1 μPa²s and a cumulative SEL_{24h} of up to 187 dB re 1 μPa²·s. TTS increased from 0 dB after 15 minutes exposure to 5 dB after 360 minutes exposure. Based on their results, they calculated an onset of TTS for this type of sound at a SEL_{24h} of approximately 175 dB re 1 μPa²·s. Kastelein et al. (2017) exposed a harbour porpoise to 10 and 20 consecutive seismic impulses at received SEL_{24h} of 188-191 dB re 1 μPa²·s with a mean shot intervals of around 17 seconds. TTS of ~4.4 dB was measured at 4 kHz.

Finneran et al. (2015) tested the exposed three bottlenose dolphins to 10 impulses produced by a seismic source. The highest exposures were conducted at peak sound pressure levels (PK) of 210 dB re 1 μPa, peak-peak sound pressure levels (PK-PK) of 212 dB re 1 μPa, and cumulative (unweighted) SEL_{24h} of 195 dB re 1 μPa²·s. This exposure induced 9 dB TTS in one animal at 8 kHz.

9 Commercial Fishing Catch and Abundance Effect Studies

Some effort to relate fishing catch data to marine seismic survey effects has been undertaken, but to date none of the Australian efforts to relate catch data with marine seismic surveys have yielded significant results. Elsewhere, the potential effects of seismic operations on fish distribution, local abundance or catch have been examined for some teleost species with varying results (Carroll et al. 2017).

A range of behavioural responses have been observed in wild fish in the presence of anthropogenic sound. Studies suggest that fish will generally move away from a loud sound source to minimise their exposure, but this response may depend upon the animal's motivational state. Anthropogenic sound (including marine seismic surveys) has been shown to cause changes in schooling patterns and distribution (Engås et al. 1996; Engås and Lokkeborg 2002; Slotte et al. 2004; Lokkeborg et al. 2012; Popper at al. 2014; Streever et al. 2016) potentially altering the catchability of commercially valuable species or recreationally targeted species.

The following studies have relevance to commercial fish and invertebrate species with respect to their catchability:

- The effects of a marine seismic survey on demersal long-line and trawl catch rates of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) in Norway after a marine seismic survey were shown to fall by 45% and 70% respectively five days after survey completion (Engås et al., 1996). Based upon this decline Engås et al. (1996) hypothesised a reduction in catch rates due to fish avoidance behaviour, but this was not quantified. Similar reductions in catch rates (52% decrease in catch per unit effort (CPUE)) relative to controls) has been observed in the hook-and-line fishery for rockfish during controlled discharges of a single air gun (Skalaski et al. 1992). The authors suggest that the CPUE decline may not be dispersal but a decreased responsiveness to baited hooks from alarm response behaviour. A companion behavioural study showed the alarm and startle responses were not sustained following the removal of the sound source (Pearson et al. 1992; Skalski et al. 1992) suggested fishing effects may be transitory, primarily occurring during the sound exposure.
- Lokkeborg et al. (2012) observed, following air gun exposure, gillnet catches increased substantially for redfish (*Sebates norvegicus*) and Greenland halibut (*Reinharditius hippoglossoides*) by 86% and 132% respectively compared with pre-shooting levels, while longline catches of Greenland halibut and haddock decreased by 16% and 25% respectively compared with pre-survey catch. These contradictory results were explained by greater swimming activity versus lowered food search behaviour in fish when exposed to air-gun emissions. Changes in catch rates of all species studied, including saithe and ling, found all species responded to air-gun sounds. Except for saithe (a pelagic hearing sensitive fish), acoustic mapping of fish abundance did not suggest displacement from fishing grounds.
- Sonar observations by Peña et al. (2013) observing real-time behaviours of Atlantic herring (*Clupea harengus* - a clupeid species with good hearing capability) schools exposed to an acoustic source approaching from 27 km to 2 km over a two hour period found no changes in school size, swimming speed or direction. The lack of response was interpreted as a combination of a strong motivation for feeding, a lack of suddenness of the air gun stimulus and an increased tolerance to seismic shooting.
- Catch studies undertaken as part of a marine seismic survey in the Gippsland Basin found no clear evidence of adverse effects on scallops, fish or commercial catch rates (Przeslawski et al. 2016a; Bruce et al. 2018) The study followed 15 species caught by Danish

seine and demersal gillnet and identified in the six months which followed the survey, six species showed increased catch. For Danish seine this included tiger flathead, goatfish and elephantfish. For demersal gillnet this included boarfish, broadnose shark and school shark. Three species showed decreased catch caught via Danish seine – gummy shark, red gurnard, sawshark. No change was observed in the remainder of species. No change to gummy shark catch was observed for demersal gillnet capture techniques. These results support previous studies in which the effects of seismic surveys on catch seem transitory and vary among species and gear types.

In October 2020, the FRDC released preliminary results of a Multiple BACI experiment that they funded to investigate the effects of a 3D marine seismic survey in eastern Bass Strait on Danish Seine catch rates (Fishwell Consulting 2020). The key targets for the Danish Seine fishery in the areas of the marine seismic survey are flathead (*Platycephalus* sp.) and whiting (*Sillago* sp.). The October 2020 report (Fishwell Consulting 2020) provided preliminary results of three phases of the four phase study and found that overall, the BACI analyses provide robust evidence for a negative impact of seismic acquisition on whiting catch rates in the Danish Seine Fishery up to ~100 days following the survey and on flathead rates up to ~200 days. Relative catch indices for both species in the years preceding the marine seismic survey were highly variable (temporally and spatially), and that relative catch index is a measure of catch per effort, not an absolute measure of abundance. As the relative catch indices for both species in the years preceding the marine seismic survey were highly variable it is difficult to determine the effect of the survey.

Specific studies examining the effect of seismic survey signals on invertebrate catch data are rare but include:

- Carroll et al. (2017) undertook a critical review of the potential impacts of marine seismic surveys on fishes and invertebrates. Carroll et al (2017) found no significant differences in any of the studies reviewed in catch rates from the potential effects of seismic signals (Christian et al. 2003; Parry & Gason 2006; Przeslawski et al. 2016a).

- Christian et al. (2003) investigated the behavioural effects of exposure to seismic survey sound on snow crabs. Caged animals on the ocean bottom at a depth of 50 m were monitored with a remote video camera during exposure to seismic sound and did not exhibit any overt startle response during the exposure period. Eight animals were equipped with ultrasonic tags, released, and monitored for multiple days prior to exposure and after exposure. None of the tagged animals left the immediate area after exposure to the seismic survey sound. Five animals were captured in the snow crab commercial fishery the following year, one at the release location, one 35 km from the release location, and three at intermediate distances from the release location.

- Parry & Gason (2006) undertook a statistical analysis of CPUE data collected over nearly 30 years in the Victorian southern rock lobster (SRL) fishery (in southwest Victoria) that showed no influence of historical 2D and 3D marine seismic survey activity. Analyses looked at short-term (weekly) and long-term variations (up to seven years) in CPUE to determine whether changes were correlated with the marine seismic survey. The surveys occurred in water depths ranging from 10 m to 150 m. The study included surveys occurring during the SRL spawning period as well as during the lobster fishing. This study found no evidence that catch rates were affected in the weeks or years following the surveys; however, Day et al. (2016a) suggest that catch rates would have had to decrease by around 50% for this study to detect a result.

- A study undertaken by the CSIRO and Geoscience Australia (Thomson et al. 2014) examined fisheries catches (10 species of interest) and catch rates for potential effects from 183 seismic surveys undertaken in the Gippsland Basin (Bass Strait). The authors found that there were no clear or consistent relationships between seismic surveys and subsequent fisheries catch rates in their study. However, they cautioned that the results did not imply that such impacts do not exist, but that data was lacking. In terms of duration since a seismic survey occurred, significant positive and negative effects were found but could not be distinguished from inter-annual changes in stock size or availability to fishing gear resulting from other dynamics (Thomson et al., 2014).

- Przeslawski et al. (2016a) monitored scallop populations and fish behaviour before, during, and/or after an April 2015 seismic survey in the Gippsland Basin, commercial scallops (*Pecten fumatus*) and doughboy scallops (*Mimachlamys asperrima*) were assessed using dredged samples and underwater imagery from an Autonomous Underwater Vehicle (AUV) before and two and ten months after completion of the seismic survey. The study provided no clear evidence of adverse effects on scallops or commercial catch rates due to the 2015 seismic survey undertaken in the Gippsland Basin. It was noted that there were limitations with some of the analyses (e.g., large variance in scallop catch).
- Haddon (2017) further investigated the effect of the 2015 seismic survey in the Gippsland Basin on deepwater flathead catches and concluded that the significant drop in CPUE was very likely negatively influenced by the seismic survey. However, Haddon (2017) went on to add that the seismic survey did not appear to have had a lasting impact on deepwater flathead CPUE, which returned to typical values in the first month following the seismic survey.
- Morris et al. (2018) investigated the effects of 2D seismic acquisition on the snow crab fishery along the continental slope in Canada in a BACI study over a period of two years. Crabs were exposed to received levels of 187 dB re 1μPa^2 s (single shot) and 200 dB re 1μPa^2 s (cumulative over 24-hours). There was no negative effects on the catch rates in the shorter term (days) or longer term (weeks), and the authors concluded that seismic effects on snow crab harvest (if they do exist) would be smaller than changes related to natural spatial and temporal variation.
- In a further study, Morris et al. (2020) conducted a field experiment applying a series of comparisons conducted within a BACI study design to investigate the effect of prolonged industrial 3D seismic exposure on the catch rates of snow crab over nine weeks in 2017 and five weeks in 2018. Changes in catch rates at 3D seismic surveying sites were inconsistent across years, with reduced catches in 2017 and increased catches in 2018. Catch rates were similar at experimental and control sites within two weeks after exposure, and the potential effect of seismic surveying was not measured at a distance of 30 km. The large variation in catch rates across small temporal and spatial scales coupled with the absence of notable mechanistic responses of snow crab in past studies to seismic in associated snow crab movement behaviour, gene expression and physiology, the authors concluded that the observed differences owing to seismic surveying in this study design are likely a result of stochastic processes external to their manipulation.

10 Scuba Divers and Snorkelers

Scuba divers and snorkelers exposed to high levels of underwater sound can suffer from dizziness, hearing damage or other injuries to other sensitive (mainly air-filled) organs, depending on the frequency and intensity of the sound. The human auditory system is significantly less sensitive underwater than in air and is further degraded if diving equipment obstructs the ears or face (e.g., diving with a hood or full facemask).

Underwater, the human ear is about 20 dB less sensitive than it is in air at low frequencies (20 Hz), increasing to 40 dB at mid-frequencies (less than 1 kHz), and increasing to 70–80 dB less sensitive at higher frequencies (Parvin 1998). Divers who wear neoprene hoods have even higher hearing thresholds (lower sensitivity) above 500 Hz because the hood material absorbs high-frequency sounds (Sims et al. 1999). Exposure studies related to divers have typically focused on military sonar exposure, with little information on seismic survey operations, and as such care is required when considering thresholds for non-military divers, particularly for impulsive sounds such as seismic source impulses (Ainslie 2008).

Underwater auditory threshold curves indicate that the human auditory system is most sensitive to waterborne sound at frequencies between 400 Hz to 1 kHz (Parvin et al. 1994) and these frequencies have the greatest potential for damage. The auditory threshold of hearing under-water was lowest at 1 kHz (70 dB re 1 μPa SPL) and increased for lower and higher frequencies to around 120 dB re 1 μPa at 20 Hz (Parvin 1998).

Within the literature there is some variation in acceptable SPLs for divers (Ainslie 2008).

Fothergill et al. (2000) and Fothergill et al. (2001) conducted controlled acoustic exposure experiments on military divers under fully controlled conditions at a US Ocean Simulation Facility and an US Open water test facility. In all tests, the divers were covered with soft or hard shell dive suits and their position and distance relative to sound source, signal characteristics and received levels were controlled and documented (Pestorius et al. 2009). A total of 89 male Navy divers were exposed to pure tone signals and sweeps between 160-320 Hz at SPLs up to 160 dB re 1 μPa. The divers were exposed to these sounds over 100 seconds at depths from 10 to 40 m. The divers rated the sounds on a severity scale. For frequencies between 100 and 500 Hz, at a received SPL of 130 dB re 1 μPa, divers and swimmers detected body vibration. None of the divers tested rated levels of 140 dB re 1 μPa as “very severe”; however, at 157 dB re 1 μPa, sound was rated as “very severe” 19% of the time. No physiological damage was observed at the highest levels tested: 160 dB re 1 μPa (Fothergill et al. 2001).

In a subsequent study, recreational divers were exposed to tonal signals or 30 Hz sweeps at frequencies between 100 and 500 Hz at received levels of 130-157 dB re 1 μPa (Pestorius et al. 2009). Each exposure lasted for seven seconds. Nine female and 17 male scuba divers were tested, all wearing full body neoprene wetsuits. Diver aversion and perception of body vibration were used as test parameters. The results showed no sex-specific differences. The results differed as a function of frequency – while test results showed a strong overall variation between subjects, signals at 100 Hz elicited the strongest aversion in all tests and even at 148 dB a few diver ratings indicated extreme aversion. Due to this and the strong variation between test subjects, the following exposure limit for both military and recreational divers was suggested as a conservative measure: For frequencies between 100 and 500 Hz, the maximum SPL should be 145 dB re 1 μPa over a maximum continuous exposure of 100 seconds or with a maximum duty cycle of 20% and a maximum daily cumulative total of three hours. The trading relation between the maximum SPL and duration was 4 dB per doubling of duration (e.g., 141 dB SPL for a 200 second exposure) (Pestorius et al. 2009).

In alignment with these studies, and considering only frequencies between 100 and 500 Hz, Parvin (2005) suggested 145 dB re 1 μPa as a safety criterion for recreational divers and swimmers. This does not imply that this level is associated with the onset of injury not been established due to ethical research protocols. Parvin (2005) reported vibration in forearms and thighs at 180 dB re 1 μPa but no physical injury.

Guidance issued by the Diving Medical Advisory Committee (DMAC 2020) suggests that adverse effects to divers may be experienced at distances of up to 27 km from the seismic source, which is a considerably greater distance than has previously been recognised. However, the basis for this conclusion is not provided.

11 Acronyms and Abbreviations

BRUVS	Baited remote underwater video stations
dB	Decibels
FRDC	Fisheries Research Development Corporation
HF cetaceans	High-frequency cetaceans
hr	Hour
Hz	Hertz
IMAS	Institute for Marine and Antarctic Studies
In3	Cubic inch
kHz	KiloHertz
km	Kilometre
LF cetaceans	Low-frequency cetaceans
m	Metre
m3	Cubic metre
MSS	Marine Seismic Survey
nm	Nautical mile
OCA	Other Marine Carnivores in Air
OCW	Other Marine Carnivores in Water
PCA	Phocid Carnivores in Air
PCW	Phocid Carnivores in Water
PK	Peak sound pressure level
PK-PK	Peak-to-peak sound pressure level
PSI	Pound per square in
PTS	Permanent threshold shift
RMS	Root mean square
sec	Second
SEL	Sound exposure level
SPL	Sound pressure level
μPa	Micropascal
TTS	Temporary threshold shift
VHF cetaceans	Very-high-frequency cetaceans

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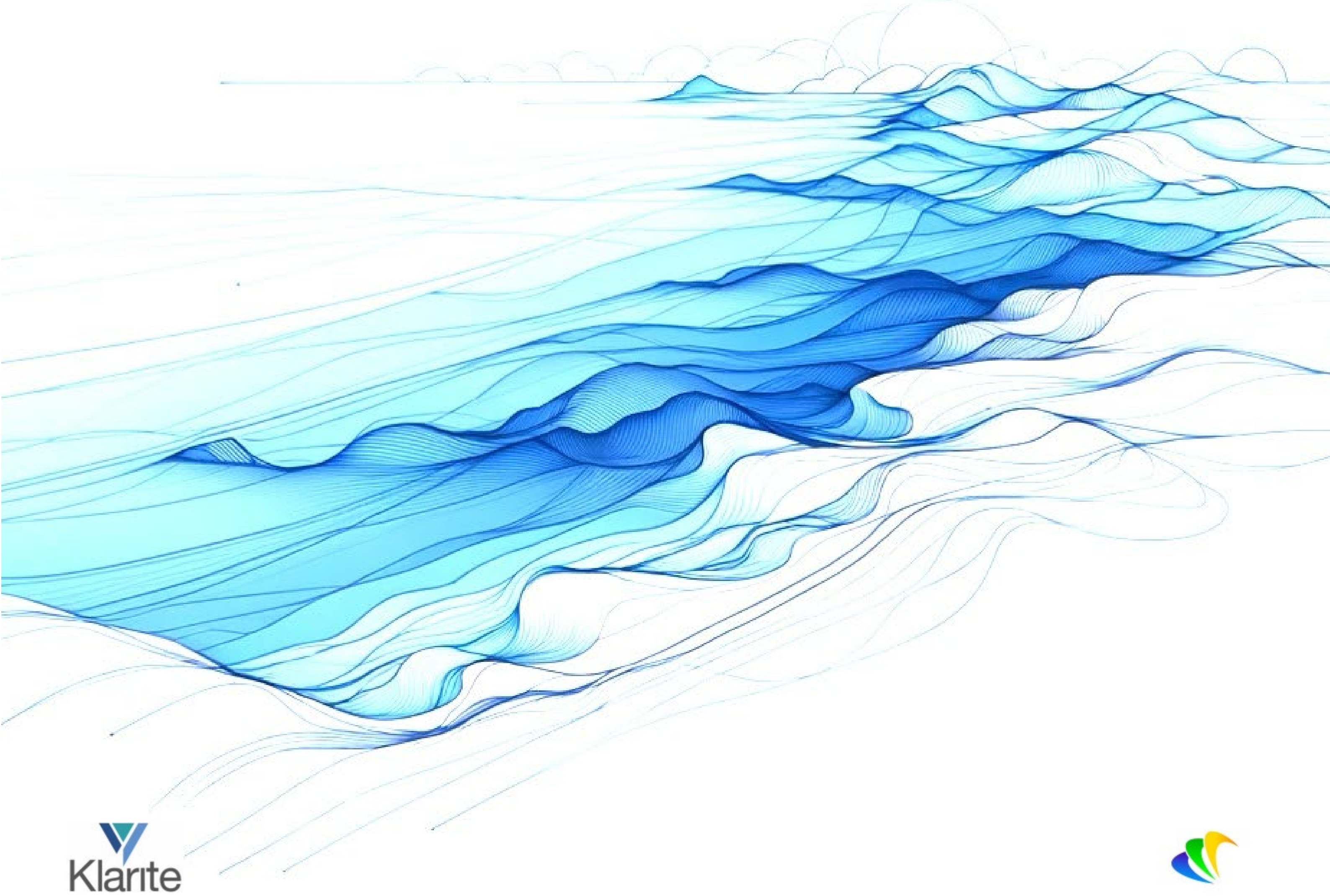
REGIA
Marine Seismic Survey

Environmental Assessment Methodology

Appendix B9: REG-EP-041-B9

Rev 1

January 2024



Klarite

Table of Contents

1 Introduction

This document has been prepared by CGG Services (Australia) Pty Ltd (**CGG**) as part of its environmental management of the Regia 3D Marine Seismic Survey (**Regia MSS**). The methodology provides a transparent and consultative approach and incorporates best practices in environmental management. The method is designed to facilitate the identification and management of potential impacts and risks associated with an offshore petroleum activity, ensuring compliance with relevant legislation and other requirements, while minimising the potential for adverse environmental, social, economic, and cultural impacts.

1.1 Purpose

This document provides the methodology for the assessment of environmental impacts and risks for offshore petroleum activities under the *Offshore Petroleum and Greenhouse Gas Storage (*Environment*) Regulations 2023* (**the Regulations**) administered by the National Offshore Petroleum Safety and Environmental Management Authority (**NOPSEMA**). The environmental impact and risk assessment method is a comprehensive process that evaluates the potential environmental impacts and risks associated with offshore petroleum activities, including seismic exploration.

The purpose of this document is to communicate how environmental impacts and risks will be assessed before the environmental assessments are started. This is intended to allow relevant persons an opportunity to influence the environmental assessment process and to support consultation with relevant persons.

1.2 Overview

CGG's impact and risk management method is based on the principles, framework and processes defined by the International Standards Organization (**ISO**) 31000:2009 Risk Management – Principles and Guidelines (Figure B9-1 & Figure B9-2). The following sections describe the steps in the risk management method, including the legislative framework, approach taken to identify and evaluate potential impacts and risks associated with the activity and how mitigation and management measures (treatments) will be assessed to ensure those adopted will reduce the impacts and risks to as low as reasonably practical (**ALARP**) and to an acceptable level.

The environmental impact and risk assessment method is a systematic, evidence-based approach to evaluate and interpret the impacts and risks associated with the Regia MSS activity. Each environmental aspect arising from the activity will be assessed to identify the environmental impacts and risks associated with the Regia MSS. Each assessment will use the following steps:

- Establish the context of the assessments.
- Identify and screen of affected receptors using the cause effect pathways for receptors within an area defined as relevant for each aspect.
- Describe the environmental values and sensitivities that may be affected by that environmental aspect.
- Predict the level of impact for each environmental aspect planned to occur or predict the level of risk for each environmental aspect actively prevented from occurring.
- Evaluate the predicted level of environmental impact or risk arising from the environmental aspect.
- Compare the predicted level of impact or risk to the acceptable level.
- Identify mitigation and management measures to lower levels of impact and risk.

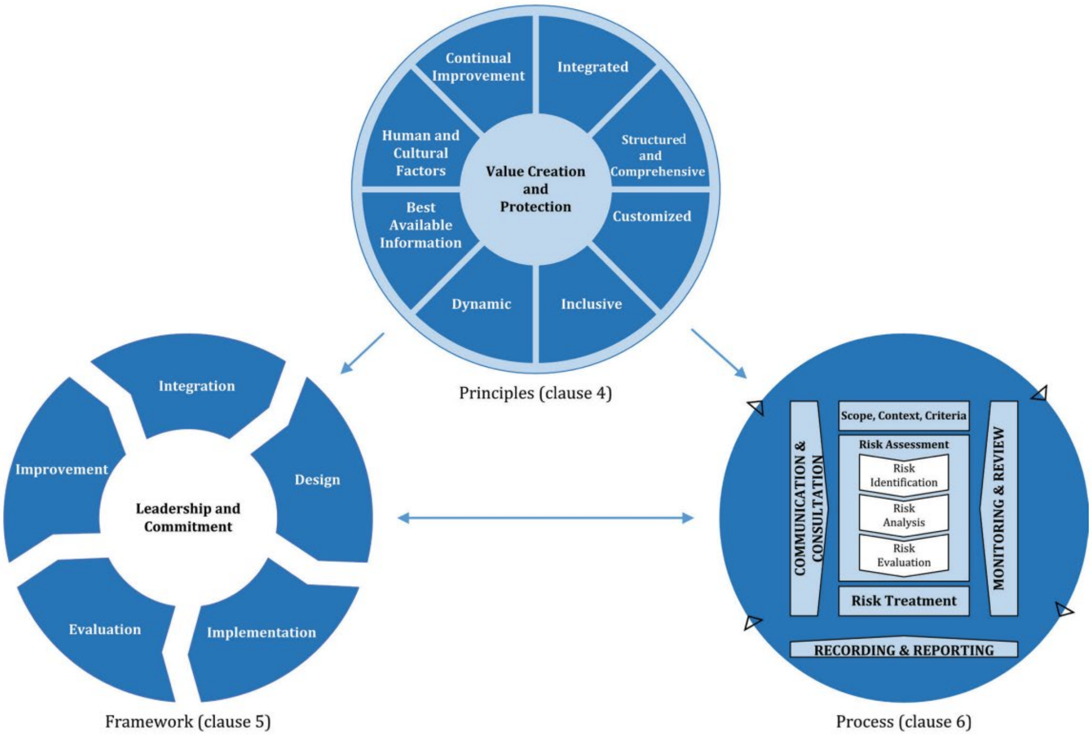


Figure B9-1 - ISO 31000 Risk Management Framework

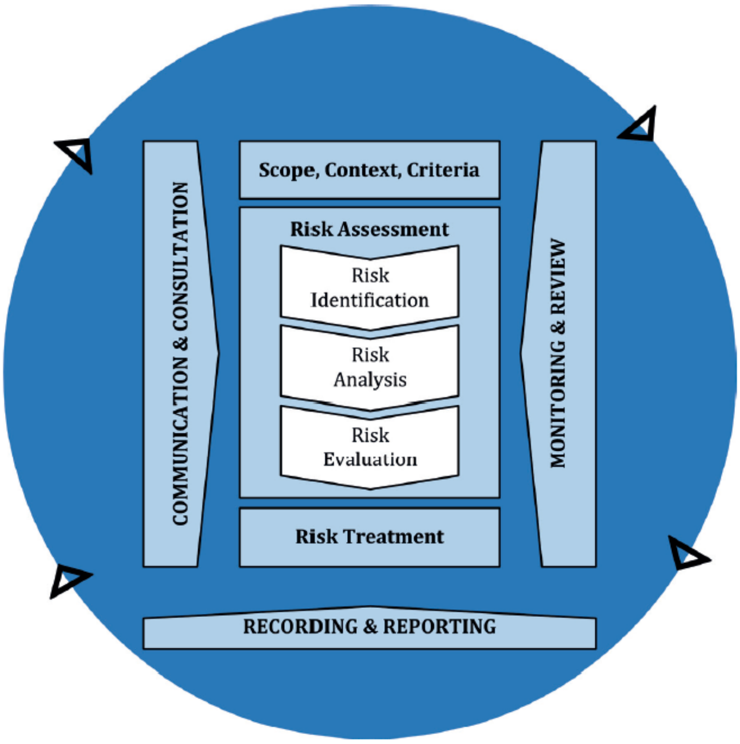


Figure B9-2 - ISO 31000 Risk Management Process

2 Communication and Consultation

Communication and consultation with internal and external stakeholders take place during all stages of the impact and risk assessment. The ISO 31000:2009 standard requires effective stakeholder communication and consultation to ensure that those accountable for implementing the impact and risk assessment process (namely, CGG and any appointed contractors), and stakeholders understand the basis on which decisions are made, and the reasons why particular actions are required. This is also consistent with NOPSEMA's guidance.

The OPGGS Act and the Regulations are guiding principles that underpin the process of external stakeholder communication and consultation in the development of an Environment Plan (EP). NOPSEMA's Consultation In The Course of Preparing an Environment Plan Guideline (N-04750-GL2086) outlines how the regulations relate to EPs and its recommendations have been followed herein.

CGG has commenced consulting with relevant persons who may be affected by the activity as per our Community Engagement and Consultation Plan available on the Regia MSS Consultation Hub (www.regiamss.com.au). This document explains how we will find relevant persons and consult with them to understand and mitigate any concerns and issues they may have. Input from relevant persons and the community will help to inform the preparation of the EP and the design and execution of the Regia MSS. Measures adopted because of the consultations will be captured in each assessment.

3 Context, Scope & Criteria

3.1 Context

The purpose of establishing the context in the assessment process is to define the external and internal parameters to be considered when assessing and treating environmental impacts and risks. The context is also used to define the acceptable levels of environmental impact and risk. This requires assessment of the external and internal environments in which CGG seeks to achieve its objectives.

The primary context of the assessment is the Description of Activity (Appendix A2). In addition, CGG commissioned an independent Preliminary Environmental Impact and Risk Assessment (**PEIRA**) to provide preliminary information on the potential impacts and risks to support consultations with relevant persons. The PEIRA also provides context to the subsequent impact and risk assessments.

The internal context relates to CGG's culture, processes, structure, and strategy, and includes anything within the organisation that can influence the way in which environmental impacts and risks are managed. CGG's commitment to minimising environmental harm and to operating and maintaining a safe and healthy work environment for its employees, contractors and project partners is reflected in its corporate HSE Policy (Appendix A1) and the Implementation Strategy (Appendix B3).

3.2 Scope

Each environmental assessment will start with identification of how the environmental aspect under assessment arises from the activity. Then, the extent and duration of the environmental aspect will be justified. Next there is a demonstration of how the legislative and other requirements that are relevant to that environmental aspect are to be met. There will follow an analysis of the relevant environmental aspect to make a prediction of the levels of each impact, or each risk, arising from that aspect. Then, once consultation has sufficiently progressed, an evaluation of the relevant impacts or risks will be performed. The subsequent collective treatment of environmental impacts and risks and setting of environmental performance is performed collectively to ensure any trade-offs or unintended consequences are understood.

3.3 Criteria

CGG has published its Decision-Making Criteria for the Regia MSS environmental impact and risk assessments in a separate document on the Regia MSS Consultation Hub. This is so that identified relevant persons, and unidentified relevant persons in the community, can understand and comment on the quality of the criteria. This document will be adapted over time to reflect relevant person feedback and information discovered through the impact and risk assessment process.

4 Impact Assessment

Each impact assessment is framed by the environmental aspect that causes it. This method is preferred as community concerns are usually aligned with the thing that causes harm rather than the specific effect it may have.

4.1 Identification of Impacts

Information used in identifying the environmental impacts associated with the activity has been obtained from the following sources:

- CGG's description of the activity.
- Professional experience of vessel activities/operations during seismic surveys.
- Previous EPs for seismic surveys.
- Literature review of the environmental values and sensitivity of the receiving environment with respect to species' presence, "biological calendars", habitat distribution and location of environmentally sensitive areas (breeding, migration, resting areas).
- Identification of environmental features within and adjacent to the Environment Planning Area.
- Feedback from stakeholders (onshore and marine) to understand socio-economic activities that may be affected by the proposed activity.

The PEIRA identified and screened impacts. Table B9-1able B9-1 shows the aspects that are planned to occur and the environmental impacts that require full assessment. Aspects that through the PIERA were identified as having a negligible impact are described and evaluated in the PIERA.

Table B9-1 - Environmental aspects identified for full assessment (Klarite, 2023)

Environmental Aspect	Environmental Impact	Preliminary Outcome
Artificial Light	Change in ambient light	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
Underwater Sound	Change in ambient sound	Qualitative assessment
	Change in fauna behaviour	Qualitative assessment
	Change in hearing capacity	Quantitative assessment
	Change in physical condition	Quantitative assessment
Physical Presence	Change in functions, interests, or activities	Quantitative assessment

4.2 Analysis of Impacts

Impact analysis and impact evaluation are two terms that are often used interchangeably, but they have different meanings and purposes in the context of environmental management. Impact analysis refers to the process of identifying, assessing, and predicting the environmental, social, and economic impacts of a proposed activity.

Impact evaluation refers to the process of comparing the predicted levels of environmental, social, and economic impacts of an activity to the defined acceptable levels of impact. Impact evaluation involves collecting and analysing data on the acceptable outcomes and effects of the activity, comparing those outcomes to the predicted impacts, and identifying the factors that contributed to any differences or discrepancies.

Each impact arises from a planned aspect of the activity. Each impact will be analysed by predicting the level of effect as per Table B9-2able B9-2, which includes consideration of the impact's extent, duration, and timing, and the receptors vulnerability, sensitivity, and recoverability from the effect. The predicted levels of impact are made with legislative and other requirements applied.

Then, each impact will be assigned a level of uncertainty associated with those effects as per Table B9-3able B9-3. It is important to note that uncertainty is not the same as risk or likelihood. Uncertainty refers to the degree of knowledge or confidence in the data or models used, while risk or likelihood refers to the probability of an event occurring and the potential consequences of that event.

Table B9-2 – Environmental impact assessment effect levels

Effect Level	**Definition**
Negligible	The impact is expected to have little or no effect on the environment or the affected species, populations, or ecosystems. The impact may be within the natural variation or background levels, or the system may have the capacity to absorb or recover from the impact without significant harm.
Minor	The impact is expected to have some effect on the environment or the affected species, populations, or ecosystems, but the effect is not considered significant or long-lasting. The impact may be localized or temporary, and the system may have the capacity to recover from the impact over time.
Moderate	The impact is expected to have a noticeable and potentially significant effect on the environment or the affected species, populations, or ecosystems. The impact may be more widespread or persistent than a minor effect, and the system may require longer periods of time or additional management measures to recover from the impact.
Major	The impact is expected to have a significant and potentially irreversible effect on the environment or the affected species, populations, or ecosystems. The impact may result in the loss or degradation of critical habitats, the decline or loss of species or populations, or the disruption of ecosystem functions or services. The system may require extensive management measures to recover from the impact, and the recovery may be incomplete or may take many years.
Catastrophic	The impact is expected to have a severe and potentially irreversible effect on the environment or the affected species, populations, or ecosystems. The impact may result in the loss of entire ecosystems or the collapse of ecological processes, with significant consequences for human health, safety, or well-being. The system may require extensive and long-term management measures to recover from the impact, and the recovery may be uncertain or impossible to achieve.

Table B9-3 - Environmental impact assessment uncertainty levels

Uncertainty Level	Definition
Very low	This level of uncertainty indicates that there is an extremely high degree of knowledge, understanding, or confidence in the data, models, or assumptions used in the analysis. This level of uncertainty is typically associated with very well-established scientific principles or data that have been extensively tested, validated, and replicated.
Low	There is a high degree of knowledge, understanding, or confidence in the data, models, or assumptions used in the analysis. This level of uncertainty is typically associated with well-established scientific principles or data that have been extensively tested and validated.
Medium	Some knowledge, understanding, or confidence in the data, models, or assumptions used in the analysis, but there are still gaps or uncertainties that need to be addressed. This level of uncertainty may require further research or data collection to reduce uncertainty.
High	Limited knowledge, understanding, or confidence in the data, models, or assumptions used in the analysis. This level of uncertainty may indicate a lack of data, or a poor understanding of the system being studied. At this level there is scientific uncertainty, and the precautionary principle must be applied.
Unknown	Insufficient knowledge, understanding, or data available to decide the level of uncertainty. This level of uncertainty may be associated with new or emerging scientific principles, or areas where data are scarce or difficult to obtain. The unknown uncertainty level may also be used when there are conflicting scientific opinions or when the scientific community is divided on a particular issue. At this level there is scientific uncertainty, and the precautionary principle must be applied.

4.3 Evaluation of Impacts

Impact evaluation is the process of comparing the results of the analysis against predefined criteria or standards to determine the significance of the impact and the need for treatment. After each impact has been assigned a level of effect and uncertainty, and a prediction of residual impact made, each impact will be compared to the pre-defined acceptable levels of impact. ISO 31000 recommends using a matrix to evaluate and communicate the results of analysis. The impact evaluation matrix in Table B9-4able B9-4 will be used to understand impact trade-offs, develop treatment strategies, and communicate the results of impact assessments to stakeholders.

The outcome of the impact evaluation is that either the environmental impacts are of an acceptable level, or they are not. If they are not, further mitigation and management measures must be applied to manage the impact to a lower level either by lowering the effect of the aspect or by lowering the levels of uncertainty in the prediction of impact.

Each impact assessment will end with a summary demonstrating that the environmental impacts that arise from the environmental aspect under consideration are of an acceptable level. The criteria for the acceptable level demonstration are in the Decision-Making Criteria.

Table B9-4 - Environmental impact evaluation matrix

	Effect				
Uncertainty	Negligible	Minor	Moderate	Major	Catastrophic
Very low					
Low					
Medium					
High					
Unknown					

Term	**Definition**
Low	Acceptable. The predicted levels of impact are beneath levels of perception and/or within normal bounds of variation. Good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.
Medium	Acceptable. The predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels.
High	Objectionable. The predicted levels of impact are close or like the pre-defined acceptable levels and/or there is enough uncertainty to apply the precautionary principle.
Very High	Unacceptable. The activity requires re-design and/or postponement or cancellation. Further studies may be required to lessen the uncertainty or reclassify the effect level. There are no additional mitigation and management measures that lower the effect.

5 Risk Assessment

Each risk assessment is framed by the environmental aspect that causes it. This method is preferred as community concerns are usually aligned with the thing that causes harm rather than the specific effect it may have.

5.1 Risk Identification

Information used in identifying the environmental risks associated with the activity has been obtained from the following sources:

- CGG's description of the activity.
- Professional experience of vessel activities/operations during seismic surveys.
- Previous EPs for seismic surveys.
- Literature review of the environmental values and sensitivity of the receiving environment with respect to species' presence, "biological calendars", habitat distribution and location of environmentally sensitive areas (breeding, migration, resting areas).
- Identification of environmental features within and adjacent to the Environment Planning Area.
- Feedback from stakeholders (onshore and marine) to understand socio-economic activities that may be affected by the proposed activity.

The PEIRA identified and screened impacts. Table B9-5able B9-5 shows the unplanned aspects and the environmental risks arising from them that require full assessment. Aspects that through the PIERA were identified as having a negligible risk are described and evaluated in the PIERA.

Table B9-5 - Environmental risk identified for full assessment (Klarite, 2023)

Environmental Aspect	Environmental Risk	Preliminary Outcome
Accidental Release of Fuel	Change in water quality	Low
	Change in sediment quality	Low
	Change in ecosystem dynamics	Low
	Change in physical condition	Low
	Change in fauna behaviour	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Introduction Of Marine Pest Species	Change in ecosystem dynamics	Moderate
	Change to functions, interests, or activities	Moderate
Accidental Release of Materials or Waste Overboard	Change in physical condition	Low
	Change to functions, interests, or activities	Low
	Change in aesthetic value	Low
Collisions With Marine Fauna	Change in physical condition	Moderate

5.2 Analysis of Risks

The environmental risks were identified by the PEIRA. Each risk arises from an unplanned aspect of the activity. Each risk will be analysed by first predicting the level of consequence should the event occur, as per Table B9-6, which includes consideration of the consequence's extent, duration, and timing, and the receptor's vulnerability, sensitivity, and recoverability from the consequence. The predicted levels of risk are made with legislative and other requirements applied.

Then, each risk will be assigned a level of likelihood associated with those consequences, as per Table B9-7able B9-7. Likelihood refers to the probability or frequency of an event or hazard occurring that could result in harm or damage. Likelihood will be analysed based on the available data, experience, and expert judgment. Depending on the significance of the consequence, further qualitative or quantitative assessments will be undertaken. Likelihood is a measure of the frequency or probability of an event occurring. The likelihood of an event or hazard occurring can be influenced by a range of factors, including the nature of the hazard, the conditions under which the activity takes place, and the effectiveness of mitigation and management measures.

Table B9-6 - Environmental risk assessment levels of consequence

Consequence	Definition
Negligible	Potential harm is minor, and it may be limited to minor injuries or damage to property that can be easily repaired or replaced. The impact may be temporary or localized, and the consequences may be reversible or easily mitigated.
Minor	Potential harm is moderate, and it may result in injuries or damage to property that require some level of repair or replacement. The consequences may be more widespread or longer lasting than a negligible consequence, and the consequences may require some level of mitigation or remediation.
Moderate	This level of consequence indicates that the potential harm is significant, and it may result in injuries or damage to property that require extensive repairs or replacement. The consequence may be more widespread or longer lasting than a minor consequence, and the consequences may require significant mitigation or remediation efforts.
Major	Potential harm is severe, and it may result in injuries or damage to property that are catastrophic or irreparable. The consequences may result in significant environmental, social, or economic harm, and the consequences may require extensive and long-term mitigation or remediation efforts.
Catastrophic	Potential harm is extremely severe, and it may result in loss of life, extensive environmental damage, or long-term social or economic harm. The consequence may be irreversible or impossible to mitigate, and the consequences may have significant consequences on human health, safety, and well-being.

Table B9-7 - Environmental risk assessment likelihood levels

Likelihood	Definition
Rare	The event is expected to occur only in exceptional circumstances, or it may have never occurred before in similar circumstances. This level of likelihood implies that the event is highly unlikely to occur, with a probability of less than 1%.
Unlikely	The event is possible but not expected to occur under normal circumstances. This level of likelihood implies that the event is not likely to occur, with a probability of between 1% and 10%.
Possible	The event could occur under certain conditions, or it may have occurred before in similar circumstances. This level of likelihood implies that the event is moderately likely to occur, with a probability of between 10% and 50%.
Likely	The event is expected to occur under normal circumstances, or it may have a high likelihood of occurring based on experience or data. This level of likelihood implies that the event is highly likely to occur, with a probability of between 50% and 90%.
Almost Certain	The event is expected to occur in most circumstances, or it may be virtually certain to occur based on experience or data. This level of likelihood implies that the event is almost certain to occur, with a probability of greater than 90%.

5.3 Evaluation of Risks

Risk evaluation is the process of comparing the results of the analysis against predefined criteria or standards to determine the significance of the risk and the need for treatment. After each risk has been assigned a level of consequence and likelihood, and a prediction of residual risk made, all risks will be compared to the pre-defined acceptable levels of risk. ISO 31000 recommends using a matrix to evaluate and communicate the results of the assessments. The risk matrix in Table B9-8able B9-8 will be used to prioritize risks, develop risk treatment strategies, and communicate the results of risk analysis to stakeholders.

The outcome of the risk evaluation is that either the environmental risks are of an acceptable level, or they are not. If they are not, further mitigation and management measures must be applied to manage the risk to a lower level either by lowering the likelihood of the event occurring or by improving levels of preparedness and lowering the level of consequence.

Each risk assessment will end with a summary demonstrating that each of the environmental risks that arise from the environmental aspect under consideration are of an acceptable level. The criteria for the acceptable level demonstration are in the Decision-Making Criteria.

Table B9-8 - Environmental risk evaluation matrix

	Consequence				
Likelihood	Negligible	Minor	Moderate	Major	Catastrophic
Rare					
Unlikely					
Possible					
Likely					
Almost Certain					

Term	**Definition**
Low	Acceptable. The predicted levels of risk are beneath levels of perception. Good industry practice (including legislation and standards) has been applied and therefore these risks are of an acceptable level without further reduction measures being required.
Medium	Acceptable. The predicted levels of risk are clearly below the pre-defined acceptable levels of risk and the mitigation and management measures in place provide reliable prevention to have confidence in the predicted likelihood levels.
High	Objectionable. The predicted levels of risk are close to or like the pre-defined acceptable levels of risk and/or the mitigation and management measures in place to prevent and respond to the event have lower levels of effectiveness such that others may disagree to the acceptability of the risk.
Very High	Unacceptable. The activity requires re-design and/or postponement or cancellation. Further studies may be required to lessen the uncertainty or reclassify the effect level. There are no additional mitigation and management measures that lower the effect.

6 Treatment of Environmental Impacts and Risks

The treatment of the environmental impacts and risks is through the adoption of mitigation and management measures that reduce the levels of impact or risk to ALARP and will be of an acceptable level. To demonstrate that the levels of each environmental impact and risk are ALARP the following steps are taken:

1. Determination of residual impact and risk with legislative and other requirements applied.
2. Identification of feasible (additional, alternative, and improved) mitigation and management measures.
3. Identification of the cost (in terms of money, time, and trouble) required to implement any feasible mitigation and management measure. Costs are qualitatively assessed by multi-disciplinary teams as either:
4. High – Very significant cost associated with the implementation of this measure and the cost may be prohibitive or not warranted based on the potential benefit gained. The level of cost is likely to compromise the objectives and viability of the project.
5. Medium – Significant cost associated with implementation of this measure, however it is not considered prohibitive, when compared to the potential risk reduction benefit.
6. Low – No significant cost associated with implementation of this measure.
7. Prediction of the environmental benefit gained by adopting the mitigation and management measure usually expressed in terms of the effectiveness of the measure (See Hierarchy of Measures below) or expressed as a change to the evaluation ranking in the impact/risk matrices.
8. Undertake a Cost Benefit Analysis of the proportionality between the cost and environmental benefit of each mitigation and management.
9. Justifying the adoption or rejection of each mitigation and management measure.
10. Setting the environmental performance required of any adopted mitigation and management measure.

6.1 Mitigation and management measures

Throughout the assessment there will be mitigation and management measures that will be implemented preparing for, and during, the activity. There are five types of mitigation and management measures as shown in Figure B9-3igure B9-3. Where a mitigation or management measure is identified in an assessment it will be shown within the text to emphasise their importance for environmental management.

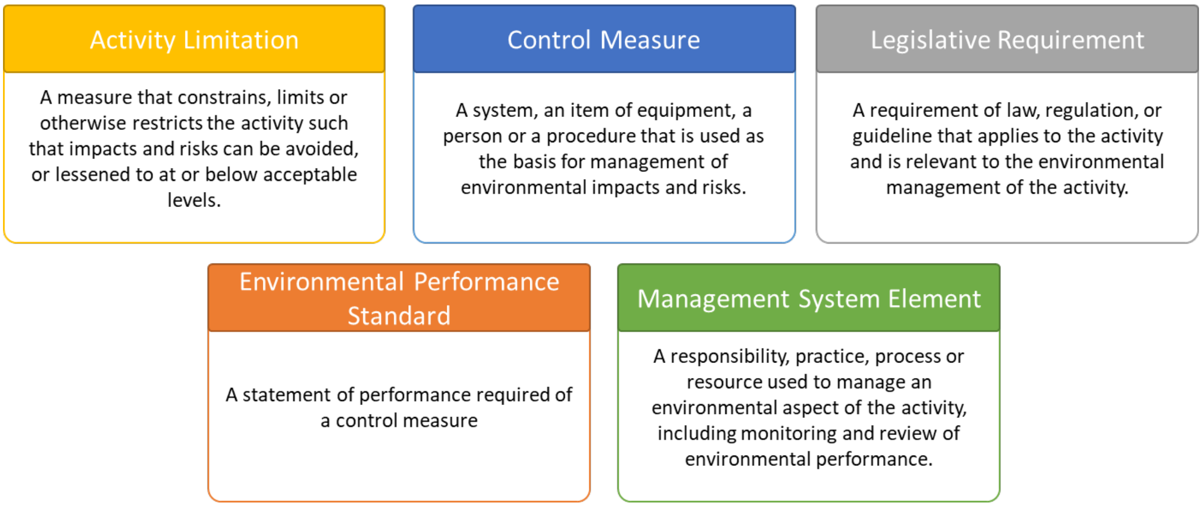


Figure B9-3 - Types of mitigation and management measures

6.2 Hierarchy of Controls

The hierarchy of controls (mitigation and management measures) is a philosophy used in occupational health and safety management to minimize or eliminate workplace hazards. It can be easily adapted to environmental management. Applying the hierarchy of controls involves a systematic approach to controlling hazards by implementing a series of control measures, with each measure building on the previous one in terms of effectiveness. The five levels of the hierarchy of controls, in order of effectiveness, are:

1. Avoidance: The most effective control measure is to avoid or eliminate the aspect completely. This involves removing the aspect from the activity, so that receptors are no longer exposed.
2. Substitution: If elimination is not feasible, the next best control measure is substitution. This involves replacing the cause of one aspect with another, less hazardous one.
3. Engineering control measures: If substitution is not feasible, the next best control measure is an engineering control measure. This involves modifying the activity or process or equipment to reduce exposure.
4. Administrative measures: If engineering control measures are not feasible, the next best measure is an administrative measure. This involves changing practices, policies, or procedures to reduce exposure.
5. Protective measures: The least effective control measure is protective measures. This involves implementing management plans to monitor and adapt to circumstances with protective measures, monitoring equipment, or devices to reduce exposure levels. Protective measures are the last line of defence and should only be used when other control measures are not feasible.

In summary, the hierarchy of controls philosophy emphasizes the importance of using the most effective measures first, with less effective measures used only when more effective measures are not feasible.

6.3 Environmental Performance

Environmental performance outcomes, standards, and measurement criteria for each aspect of the activity that has the potential to cause environmental impacts or risks are developed as part of the assessment process. Environmental performance will be measured and reported against these environmental performance outcomes standards and measurement criteria, as part of CGG's Implementation Strategy to ensure that impacts and risks are managed to the acceptable and are ALARP throughout the activity.

6.3.1 Environmental Performance Outcomes

An environmental performance outcome is a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.

6.3.2 Environmental Performance Standards

An environmental performance standard is a statement of the performance required of a control measure. The effectiveness of control measures will be assessed as part of the treatment of environmental impacts and risks. The effectiveness of control measures can be evaluated based on several key attributes, including functionality, availability, reliability, survivability, and independence, which are explained further in Table B9-9able B9-9.

Determination of effectiveness is made by qualified experts based on professional judgement, considering the attributes in Table B9-9able B9-9. In summary, evaluating the effectiveness of control measures based on these attributes can help ensure that control measures are effective in addressing environmental aspects, and minimizing or eliminating associated impacts and risks.

Table B9-9 - Effectiveness attributes of control measures

Control Measure Attribute	Description
Functionality	The functionality of a control measure refers to its ability to perform its intended function effectively. This includes the ability of the control measure to address the aspect, the ease of use, and any limitations or drawbacks associated with the control measure.
Availability	The availability of a control measure refers to its accessibility and readiness when needed. This includes the availability of the control measure at the appropriate time and place, as well as any limitations or challenges associated with accessing the control measure.
Reliability	The reliability of a control measure refers to its ability to perform its intended function consistently and accurately over time. This includes the control measure's ability to operate without failure, the consistency of performance, and the predictability of outcomes.
Survivability	The survivability of a control measure refers to its ability to withstand adverse conditions or events and continue to function effectively. This includes the control measure's ability to operate under extreme conditions, to withstand physical or environmental damage, and to continue to perform its intended function despite disruptions or failures.
Independence	The independence of a control measure refers to its ability to operate independently of other control measures and to avoid any potential conflicts of interest or biases. This includes the control measure's ability to operate without being influenced by external factors, and its ability to remain objective and impartial in evaluating and addressing the hazard.
Compatibility	Evaluates the integration of control measures with each other and the overall operations, ensuring harmonious functionality without compromising the effectiveness of other measures.

7 Monitoring and Review

Ongoing monitoring and review are essential to ensuring the environmental impact and risk assessments remain relevant over time. The Implementation Strategy describes the specific measures and arrangements that will be implemented for the duration of the activity to ensure that:

- Environmental impacts and risks of the activity will be continually identified and reduced to ALARP.
- Mitigation and management measures detailed in the EP are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels.
- Environmental performance outcomes and standards set out in the EP are met.
- Arrangements are in place to respond to, and monitor impacts of, oil pollution emergencies.
- Consultation is maintained throughout the activity as appropriate.

The Implementation Strategy outlines a systematic approach that describes:

- The management systems by which the mitigation and management measures identified in the impact and risk assessment will be implemented.
- The implementation of mitigation and management measures will be monitored to ensure environmental impacts and risks continue to be managed to ALARP.
- The ongoing consultation process prior to and during the activity.
- Monitoring, auditing, and reporting of environmental performance for activities carried out under the EP.
- Arrangements in place to respond to, and monitor consequences of, oil pollution emergencies.

The Implementation Strategy considered lessons learnt from the implementation of previous campaigns and inspection recommendations.

8 Recording and Reporting

In accordance with Section 27 of the OPGGS(E) Regulations, CGG will store and maintain documents or records relevant to the EP implementation for a period of five years in a way that makes retrieval reasonably practicable.

In accordance with Sections 26, 26A, 26B and 26C of OPGGS(E) Regulations, CGG will report all recordable and reportable incidents as defined in the Implementation Strategy.

9 Terms and Definitions

Table B9-10 - Terms and Definitions Relevant to Impact and Risk Assessment

Term	Definition
Acceptable level	The specified amount of environmental impact and risk that an activity may have, which is tolerable, is consistent with all relevant principles, and does not compromise the management/conservation/protection objectives of the environment.
Activity	Refers to a 'petroleum activity' as defined under the OPGGS(E) Regulations as: petroleum activity means operations or works in an offshore area undertaken for the purpose of exercising a right conferred on a petroleum titleholder under the Act by a petroleum title or discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act.
As low as reasonably practicable (ALARP)	The ALARP principle refers to reducing impacts and risks to a level that is `as low as reasonably practicable'. In practice, this means that the titleholder has to show through reasoned and supported arguments that there are no other practicable options that could reasonably be adopted to reduce impacts and risks further, i.e. to demonstrate that the cost involved in reducing the impact or risk further would be grossly disproportionate to the benefit gained.
Consequence	The consequence of an impact or risk is the potential outcome of the event on affected receptors (values and sensitivities) and can be positive, neutral or negative.
Control measure	A system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks.
Emergency condition	An unplanned event that has the potential to cause significant environmental damage or harm to matters of national environmental significance (MNES). An environmental emergency condition may, or may not, correspond with a safety incident considered to be a Major Accident Event (MAE).
Environment **(Values and Sensitivities)**	Defined under the OPGGS(E) Regulations as: • ecosystems and their constituent parts, including people and communities. • natural and physical resources; • the qualities and characteristics of locations, places and areas; and • the heritage value of places; and includes the social, economic and cultural features of the matters mentioned above.
Environmental aspect	Element of an activity that interacts or can interact with the environment. Environmental aspects can have a direct impact on the environment, contribute only partially or indirectly to a larger environmental change, or create a risk to one or more environmental receptors. Aspects can be planned (inherent part of the activity i.e., light) or unplanned (not part of the activity i.e., spill).
Environmental impact	A change to the environment, whether adverse or beneficial, that wholly or partly results from an activity.
Environmental Performance	The performance of a titleholder in relation to the Environmental Performance Outcomes (EPO) and Environmental Performance Standards (EPS) in an Environment Plan.
Environmental performance outcome (EPO)	A measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
Environmental performance standard (EPS)	A statement of the performance required of a control measure.
Environmental risk	A change, which could occur to one or more environmental receptors, that is caused either wholly or partly by one or more environmental aspects associated with an activity. Environmental risks have a degree of likelihood and are not certain to occur.
Inherent impact and risk	The level of impact or risk with 'legislative and other requirement' controls in place, before the application of additional control measures.

Term	Definition
Likelihood	The likelihood is the chance (or probability) of the consequence occurring, and only applies to risks.
Measurement criteria	A clear and objective way to evaluate environmental performance. Environmental performance outcomes and environmental performance standards must have appropriate measurement criteria, which define how environmental performance will be measured and determine whether the outcomes and standards have been met during the activity.
Residual impact and risk	The impact or risk remaining after additional control measures have been applied (i.e., after treatment of inherent impacts and risks)
Receptors	Features of the environment that may be affected by impacts and risks.

10 Revision History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	4 March 2023	MS	Initial version
0.1	3 April 2023	SJ	Peer review
0.2	3 April 2023	LT/PR	Review by CGG
0.3	4 April 2023	MS	Updated following CGG review
1.0	4 April 2023	MS	Published on Regia MSS Consultation Hub website
2.0	4 January 2023	MS	Formatting changes only for public comment.

Otway Exploration

Cultural heritage desktop assessment

Prepared for ConocoPhillips Australia Pty Ltd

1 September 2023

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Document information

Report to:	ConocoPhillips Australia Pty Ltd
Prepared by:	Erica Walther Emily Ward Dr Samuel Dix
Biosis project no.:	38331
File name:	38331.Otway.Exploration.CHDA.D01.ESW.20230131
Citation:	Biosis 2023. Cultural Heritage Desktop Assessment for Conoco Phillips, Walther et.al. Biosis Pty Ltd. Port Melbourne, VIC. Project no 38331

Document control

Version	Internal reviewer	Date issued
Draft version 01	SD/KJF	31/01/2023

Executive summary

Biosis Pty Ltd was commissioned by Conoco Phillips to undertake a cultural heritage desktop assessment for the proposed resource exploration in Bass Strait.

The purpose of this report is to explore cultural heritage and cultural heritage landscapes to understand Country, and Sea Country within and surrounding the project area in order to provide the project a grounding in Aboriginal cultural heritage. This short report will describe the known cultural environment, include a brief ethnohistory and history, and detail results of register searches.
The study area includes the proposed permit areas (the location of the exploration zone(s)), where seabed surveys and drilling exploration may occur. In general, the permit areas are located south of Port Fairy and the Great Otway National Park, and west of King Island.

The study area consists of a large geographical area noted as the 'Investigation Area for the Identification of Values and Sensitivities' which is based on stochastic modelling of oil spills, generating a statistical area where impacts may occur under many eventualities. This modelling predicts potential oil spill outcomes over many different variables to generate an investigation area for potential impacts.

Due to the significant size of the study area, it is broken into three areas for discussion in parts of this report and for the Communication Plan (CP), this includes:

1. Primary Stakeholder area (Victoria) – the area directly surrounding the proposed permit areas and adjacent coastlines
2. Secondary Stakeholder area – the wider area affected by the modelling of oil spills
3. Primary Stakeholder area (Tasmania) – North and Northwest Tasmania and the Bass Strait islands

Within the study area, along the Victorian coast, there are 5636 registered Aboriginal places with the most common site types being shell middens, artefact scatters and LDADs. Shell middens are typically found along the coastline, whereas artefact scatters, while also being found along the coast, are varied and move inland following freshwater sources, likely to be indicative of past inland-coastal travel routes. LDADs are also typically found further inland than shell middens and artefact scatters, indicative of widespread use of the landscape in the past, rather than concentrations and repeated patterning.

In light of a review of Aboriginal places within the study area, there is a high likelihood for Aboriginal cultural heritage material to be present within the areas subject to potential impact.

Within Tasmania and the Bass Strait Islands, there are no recent published figures of sites located on the coastal margins. Access to this data is restricted, and permission will need to be sought by the Aboriginal Heritage Council to access the Aboriginal Heritage Register via Aboriginal Heritage Tasmania. However, from the assessment of available regional data, Aboriginal heritage should be expected in any area of low-lying coastal areas, shelter sites, and sources of food, water and raw materials. These coastal margins contain all Tasmanian Aboriginal site types. It is also known on the West Coast of Tasmania, that a number of rock art sites are located on the coast, many either close or in tidal margins (Dix pers. obs.). Large midden sites are also located very close to the waters edge, as well as some stone quarry sites within tidal margins (Dix pers .obs.).

Contents

Tables

Figures

1 Introduction

1.1 Acknowledgement

Biosis acknowledges that the authors of this assessment identify as non-Aboriginal Australians living on Bunurong and Wurundjeri Countries. We acknowledge that they interpret, present and understand the past through their own cultural lens. In writing this report about Aboriginal living culture including their cultural heritage and the events following the commencement of colonisation, we pay our respects to Elders past, present and emerging and recognise that Country is unceded.

The authors acknowledge the inherent racism, cultural ignorance and political agendas imbedded within ethnographic sources at the time of, and following, colonisation.

Traditional Owners are the owners of all Traditional knowledge. Traditional knowledge and cultural values remain the intellectual property of the Traditional Owners and the interpretation and understanding of cultural values must be undertaken in genuine consultation with Aboriginal people.

1.2 Scope of works

Biosis Pty Ltd was commissioned by Conoco Phillips to undertake a cultural heritage desktop assessment for the proposed resource exploration in Bass Strait.

It must be emphasised, that this report is not intended to meet the requirements of a formal assessment under First Peoples – State Relations, Heritage Victoria, Aboriginal Heritage Tasmania or Heritage Tasmania guidelines.

The purpose of this report is to explore cultural heritage and cultural heritage landscapes to understand Country, and Sea Country within and surrounding the project area in order to provide the project a grounding in Aboriginal cultural heritage. This short report will describe the known cultural environment, include a brief ethnohistory and history, and detail results of register searches.

1.3 Study area

The extent of the study area is shown in Figure 1.

The study area includes the proposed permit areas (the location of the exploration zone(s)), where seabed surveys and drilling exploration may occur. In general, the permit areas are located south of Port Fairy and the Great Otway National Park, and west of King Island.

The study area consists of a large geographical area noted as the 'Investigation Area for the Identification of Values and Sensitivities' which is based on stochastic modelling of oil spills, generating a statistical area where impacts may occur under many eventualities. This modelling predicts potential oil spill outcomes over many different variables to generate an investigation area for potential impacts.

Due to the significant size of the study area, it is broken into three areas for discussion in parts of this report and for the Communication Plan (CP), this includes:

4. Primary Stakeholder area (Victoria) – the area directly surrounding the proposed permit areas and adjacent coastlines
5. Secondary Stakeholder area – the wider area affected by the modelling of oil spills

6. Primary Stakeholder area (Tasmania) – North and Northwest Tasmania and the Bass Strait islands

1.4 Heritage Advisor/Authorship

Emily Ward BArch

Emily has recently started her career in the Heritage Industry by initially interning at Biosis from August 2022 to September 2022, to her current role as a Graduate Heritage Consultant. Within her internship, Emily learnt and completed many techniques and processes such as aiding in background research to Cultural Heritage Management Plans, illustrating stratigraphic contexts and subsurface field testing. Emily also gained experience in field photography, rock art and heritage building surveys. Emily has been a part of several projects since she was an intern, gaining knowledge of several systems, such as HERMES and ACHRIS.

Emily completed her Bachelor of Archaeology at LaTrobe University at the end of 2022 and will start further study in 2024.

Erica Walther BArch(Hons)

Erica (B Arch Hons (2007)) is an Archaeologist and Heritage Advisor, with over 15 years' experience as a heritage consultant. Erica is the Technical Director for heritage in Victoria and specialises in project management, community liaison and the resolution of complex cultural heritage issues in varying situations. Erica provides specialist cultural heritage legislative advice and completes technical reports to meet the requirements of heritage legislation. Erica has broad experience completing various heritage assessments, including over 60 Cultural Heritage Management Plans (CHMPs). Erica carries out cultural heritage inductions, salvages, and other compliance requirements for completed CHMPs. Erica has also completed Due Diligence Assessments, Heritage Impact Assessments, "Consents to Disturb" and other permit applications, conservation management plans, and heritage reports. Erica has also assisted on a wide variety of other heritage projects, including as an expert witness and with planning and overlay applications, strategic advice, and continues to work towards completing projects to best practice standards.

Erica is a full member of the Australian Association of Consulting Archaeologists and is a listed heritage advisor under the *Aboriginal Heritage Act 2006*.

Dr Samuel Dix BA(Hons), PhD, MCIfA

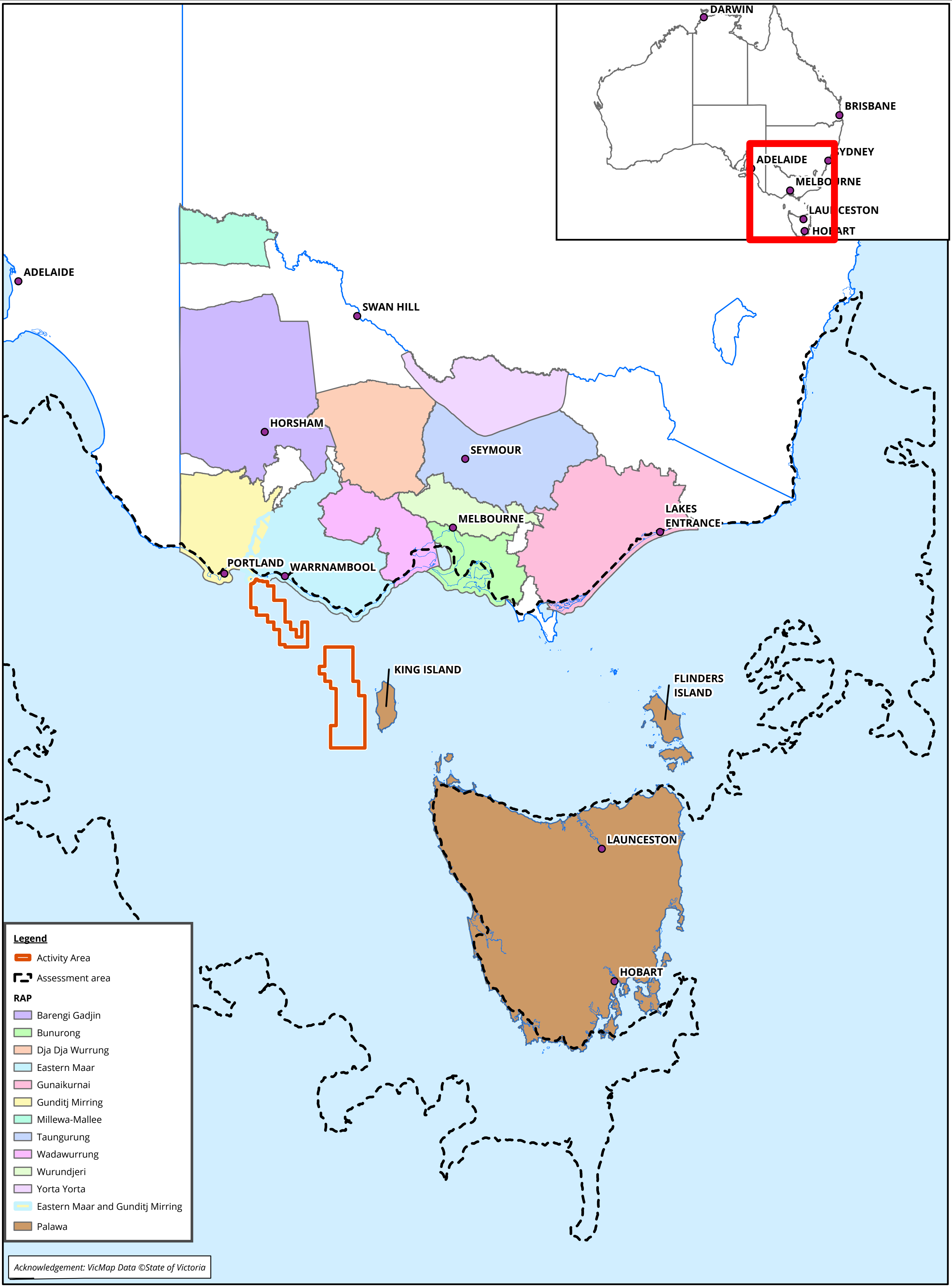
Samuel has worked in archaeology and heritage management since 2007. Samuel has undertaken numerous archaeological projects around Australia and has worked in consulting, government, teaching and museums in Victoria, Tasmania, Northern Territory, Western Australia, the United Kindom, Middle East, and South Africa. Samuel completed his Bacheor of Arts with First Class Honours where his thesis focussed on hand stencil rock art. After a break from university to undertake consulting, government and teaching based archaeological work, Samuel returned to complete his PhD at Griffith University where he was the recipient of the Australian Research Council Laureate Scholarship in 2016. His thesis explored contact archaeology in Arnhem Land, and how people reacted to change through what was depicted in rock art.

Samuel is a registered heritage advisor under the Victorian *Aboriginal Heritage Act 2006.*

1.5 Stakeholders

It is not within the remit of this report to undertake consultation with Traditional Owner groups, industry bodies or other stakeholders. No consultation was undertaken. Stakeholder engagement is considered in the Communication Plan (CP). In Victoria, Traditional Owner groups are represented by the relevant Registered Aboriginal Party (RAP). There are five RAPs registered in the study area, including the Gunditjmara, Eastern Maar, Wadawurrung, Bunurong, and Gunaikurnai.

In Tasmania, the Traditional Owner group is referred to collectively as the Palawa, and are not represented by a representative or governing body.



Biosis Pty Ltd
Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Figure 1 Location of the Activity Area

Matter: 38331,
Date: 07 February 2023,
Prepared for: GA, Prepared by: GO, Last edited by: mknudsen
Location:P:\38300s\38331\Mapping\38331_OtwayExploratoryDrilling

Scale 1:8,000,000 @ A4, WGS 1984 Web Mercator Auxiliary Sphere

2 Background review

2.1 Geology and geomorphology

The Bass Strait is the stretch between the south of the Australian mainland and north of the Tasmanian state. The Bass Strait formed during the last glacial period, also known as the Last Ice Age, which occurred between 110,000 and 12,000 years ago (Williams et al. 2018, p. 149). During this time, the Earth's climate was much cooler and global sea levels were much lower due to the large amount of water that was locked up in glaciers and ice sheets.

As the climate began to warm and the glaciers began to melt, sea levels began to rise. This process caused the land bridge that connected Tasmania to mainland Australia to be gradually flooded eventually forming the Bass Strait as we know it today.

This gradual flooding is therefore known to have occurred within the period of human occupation in southeastern Australia – the diaspora of people from Victoria to Tasmania occurred prior to the total flooding of the strait, across a land bridge for which archaeological evidence may be buried deep below the ocean (Lourandos 1997, p. 244). Evidence for this indicates people crossed the land bridge from Victoria to Tasmania at 35,000 years ago (Lourandos 1997, p. 254). In addition, dreaming stories of both Victorian and Tasmanian Aboriginal communities further reinforce the memories and songlines relating to the flooding and connection to Sea Country of coastal communities (Nunn & Reid 2016).

2.1.1 Bass Strait, Islands and the land bridge

The Bass Strait is bordered on the west by King Island and the King Island Rise and on the east by Flinders Island and the Bassian Rise, with an approximated depth of between 60 and 80 metres (Harris & Heap 2009, Robinson 1974). The predominant deposits within the Bass Strait consist of Tertiary sediments overlaid on early Cretaceous deposits. The sediments in the early Cretaceous period contained combinations of shale, siltstone, sandstone, while a variety of marl, mudstone, limestone and shale can be seen in the later deposits (Robinson 1974).

Phillip Island's geomorphology is centred around Quaternary limestone dunes with higher-level shore platforms that were formed by Quaternary sea levels (Birch 2003). French Island is boarded by sandy sheets, similar to Western Port Sunkland. Port Phillip Bay is the lowest part of the Sunklands and is currently flooded due to Quaternary sea-level fluctuations in the Last Glacial Maximum (Birch 2003, p. 556). Also during this period the Yarra River water levels had risen and spilled over the coastal plain, forming what is now known as the Bass Strait (Birch 2003, p. 556).

2.1.2 The Victorian Coast

The coastal plains of southwest Victoria are made up of both Tertiary and Quaternary marine and nonmarine sediments, formed on calcareous sands and sandy limestones, overlaid with dune ridges and beaches that were formed during the last 800 000 years. The dune ridges closer to the coast are younger than those further inland and are comprised of calcareous sands. Caves are common in ridges of the limestone sands (Birch 2003, p. 545).

The coastline of western Victoria is seen to have several layers of sedimentary deposits, as evident in the cliffs often found, containing stratigraphic sections of basalt, limestone and clay (Birch 2003, p. 555).

The geomorphic evolution of southeast coastal plains of Victoria is varied, with Tertiary overlaying early Cretaceous sediments on the Otway coast as well as Quaternary sand and limestone dunes in Mornington

Peninsula and Phillip Island (Birch 2003, pp. 547,556). The coast of East Gippsland is covered extensively in coastal dunes, with intermittent pockets of Pleistocene deposits. Parabolic dunes formed from Pleistocene and Holocene age deposits are also located in this area (Birch 2003, p. 557).

2.1.3 The Tasmanian Coast

The Tasmanian coast consists of varying deposits making up its rugged nature. Geological formations include Dolerite, Sandstone, Mudstone, Granite, Limestone, and other Volcanic rocks. These varying geologies are reflected in high cliffs and outcrops, dune-backed beaches, sea stacks and arches. The Tasmanian geological makeup is complex and varies. Along the coastal regions detailed in the study area, these consist of Devonian granites, Tertiary Basalt, Neoproterozoic dolomite, Cambrian bonitite, Cambrian Sediment, and Mesoproterozoic quartzite (MRT: 2022).

Tasmania is known to have been one of the few areas in the southern hemisphere that was glaciated during the Pleistocene (MRT 2002). This generally occurred in higher regions of the state and influenced many of the earlier Pleistocene sites recorded in Tasmania (MRT 2022).

2.1.4 Archaeology of the Sea Floor

Archaeology of the sea floor is an emerging aspect of archaeological science. Throughout the world, archaeological investigations have shown that there is evidence for human occupation to be recovered below current sea levels. Investigations in the Sunda Shelf, Southeast Asia demonstrates the impact of sea level rise at approximately 12,000 years ago, with the investigation of settlements, fish traps, and other structures. Other investigations have occurred in India (Kumar et al. 2021), and the Black Sea (Ryan et al. 1996), investigating more recent sea level change, around 7,500 years ago. In the UK and US, the offshore wind industry is required to complete offshore archaeological investigations including desk-based studies and field survey.

In comparison, Bass Strait is comparable to the vanished landscape of Doggerland that was submerged similarly in rising sea levels during the Mesolithic Period. Like the Bassian Plain, Doggerland formed a land bridge between the United Kingdom and Europe. Works by marine archaeologists have found that many artefacts and environmental sediments still remain form this now vanished ancient landscape (Gaffney et al. 2007). It is even suggested by Weninger et al (2008) that this was caused by a catastrophic flood. However, such ideas are not believed in the example of Bass Strait, and that this was a more gradual separation (see Davidson and Roberts 2008:20)

In Victoria, limited investigations have been completed, however the use of LiDAR and shoreline mapping has occurred. In particular, Gunditjmara have worked with Extent Heritage in partnership with Wessex University in determining the location of prior shorelines with the use of remote sensing. Should archaeological evidence survive, it is likely that the previous shorelines would provide the most likely locations for this. Physical investigations are likely to be difficult, complex, and costly.

Following deposition, archaeological evidence of human occupation along the Bass Strait has flooded. Since flooding, sedimentation has also occurred, capping any archaeological evidence deep below the current sea floor. The depth of sedimentation varies throughout the strait, however combined with deep waters (400 to 5,500 metres) and harsh conditions, exploration of sea floor archaeology utilising physical methods in this area is currently unlikely.

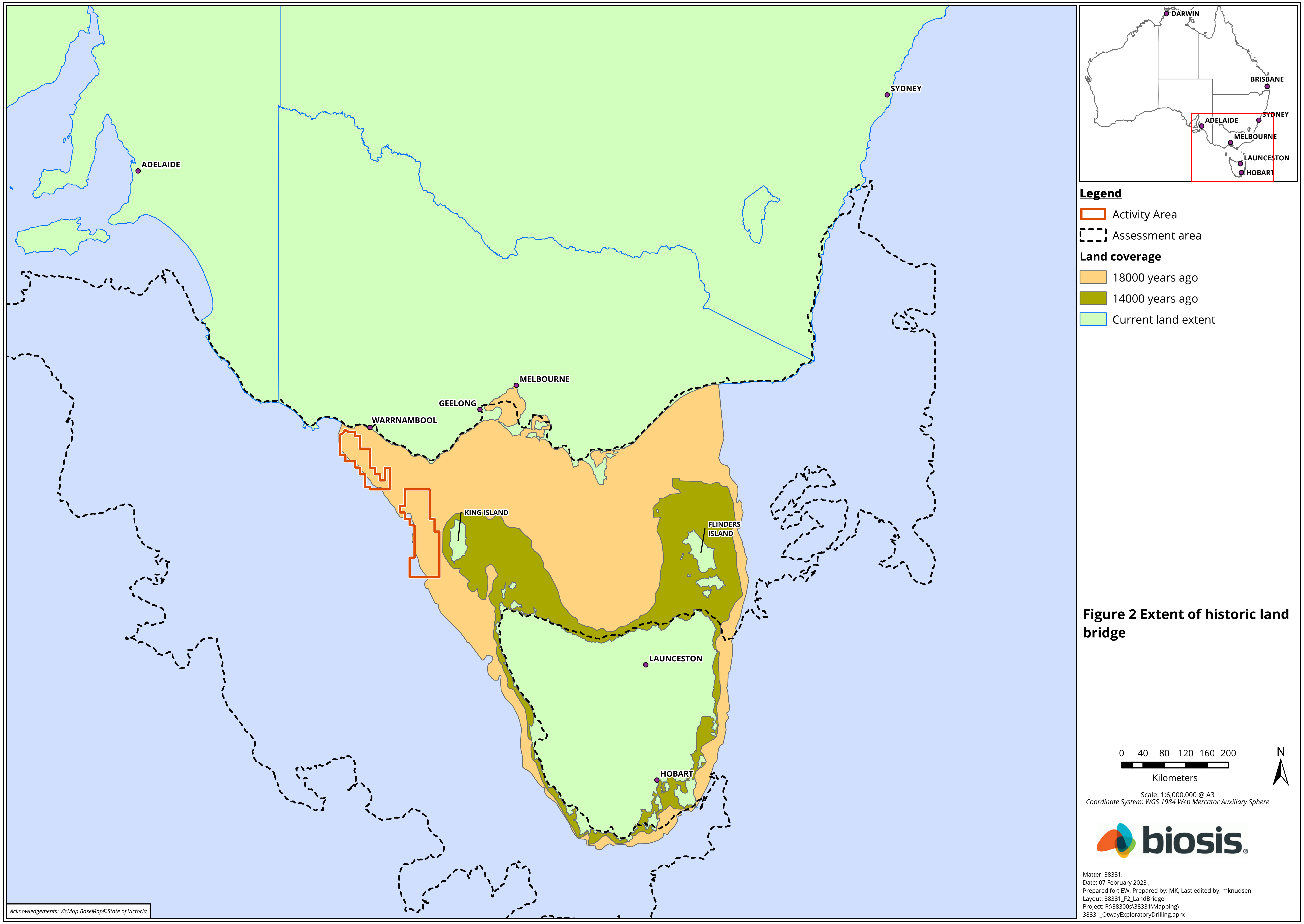


Figure 2 Extent of historic land bridge

2.2 Land use history

Permanent European colonisation of Victoria and Tasmania occurred first in Tasmania, in 1803, and Victoria in 1835. Earlier exploration and transitory, temporary or failed settlements occurred in the two states. Early settlements in Tasmania were penal, with free settlement commencing following. The Gold Rush in Victoria in the 1850s resulted in the rapid expansion of population and the establishment of towns throughout the state. Agriculture and Industry heavily influenced the growth of the population of Tasmania.

Settlement, population growth and utilisation of land for agricultural purposes has resulted in the spread of disease, displacement, and violence to Indigenous communities, leading to a significant decline in population and disruption to traditional cultural practice. Aboriginal people were subject to forced displacement and assimilation, including the forced removal of Aboriginal children, from the 1800s up until the 1970s. Overall the impact of colonisation on Aboriginal people has been devastating.

In regard to the remains of physical cultural heritage (such as sites and places), the practice of archaeology has increased the knowledge of Aboriginal occupation of the land in the past. The potential for archaeology to shed light on Aboriginal connections to Country has been realised with increasing frequency due to relatively recent legislative requirements.. Archaeology is, however, a finite resource which has also been impacted by the effects of population growth, construction, land clearance, resource extraction, and climate change. Self-determination for Aboriginal people in regard to ownership of cultural heritage and knowledge has resulted in increased investigations led by Aboriginal people supported by technical experts, following research pathways set by the communities themselves.

Archaeological sites are located throughout the land and adjacent seascape and consist of the physical remains of the way people used the land in the past. Places may reflect resource extraction (such as scarred trees, stone quarries); be evidence of settlement (such as stone huts), manufacture (stone artefact scatters) and cultural practices (such as painting, etchings, and stone arrangements); food consumption (shell middens, earth mounds and hearths); and ritual practice (such as burials). Other cultural values can take the form of intangible places or be recorded in historic (ethnographic) references.

Whilst long-lasting, archaeological sites are heavily affected, and frequently destroyed, by the effects of modern, and past, impacts. Land clearance and increasingly intense bushfires result in the removal of old growth trees, including those showing cultural scarring, and also increases the effects of erosion. Ploughing for agricultural practices displace artefact scatters and deflate earth mounds. Coastal erosion, coastal change and increased storm surges destroys shell middens and artefact scatters located in coastal and offshore landforms. The practice of archaeology itself is destructive and results in the loss of archaeological places. Alteration of the natural environment also affects intangible values, affecting connections between the Dreamtime and the landscape, for example, by interrupting songlines. As Aboriginal people have strong connections to Country, effects on the natural environment, the land, sea, and animals, also have strong effects on Aboriginal people.

2.3 Aboriginal heritage – registered archaeological places in the study area

A search of the Victorian Aboriginal Heritage Register (VAHR) was undertaken by Emily Ward, Biosis Pty Ltd on the 21 of December 2022 utilising access number 11456. The search area was set by the study area and consists of the entire Victorian coastline.

The search identified 5636 recorded Aboriginal places within the study area (Table 1).

The dominant Aboriginal place types in the study area are shell middens (n=2639, 46.82%), artefact scatters (n=2210, 39.21%) and low density artefact distribution also known as LDADs (n=321, 5.70%). Other place types include earth features (n=181, 3.21%), object collections (n=160, 2.84%), Aboriginal Ancestral Remains (Burial) (n=51, 0.90%), scarred trees (n=42, 0.75%), stone features (n-12, 0.21%), quarries (n=9, 0.16%), Aboriginal historical places (n=8, 0.14%), Aboriginal Ancestral Remains Reinterments (n=2, 0.04%) and rock art (n=1, 0.012%).

Object Collections represent places that have been removed from the context in which they were originally recorded. More specifically, they represent the location of stored artefacts (i.e. heritage consultancies, museums, private collections) or places where artefacts have been repatriated; therefore, Object Collections are not necessarily representative of the archaeological character of the region

Due to most of the search area being coastal, the dominance of shell middens in the study area is not surprising. Middens represent the repeated consumption of coastal resources (predominantly shells of rocky or sandy shore types, such as mussel, pipi, oyster, turban) and consist of the discarded shell. Other objects may be discarded within the midden, such as bones (seal and bird are common), and artefacts. The shells and other items were discarded in discrete areas over time, some middens are small consisting of a smaller number of meals or individuals, others are larger, indicating multiple meals, some revisited over many hundreds, or thousands, of years (Frankel 2017, p.38).

> *'Archaeological evidence from Victoria indicates that occupation of coastal areas is as old as the present coastline – about 6000 years. Most coastal occupation sites in Victoria, however, are 4000 years old or younger' (National Oceans Office, 2002:80)*

Within the study area the Traditional Owner group with the most registered Aboriginal places is Bunurong with 1486 place registrations, with 26.37% of the total registered sites in the study area. This is then followed by Gunditjmara with 853 registered sites (15.77%), then Eastern Maar with 853 registered sites (15.13%), Wadawurrung with 798 registered sites (14.16%), Gunaikurnai with 700 registered sites (12.42%) and the area of overlap of Gunditjmara and Eastern Maar has 88 registered sites (1.56). The area within the study area that has no registered RAP group has a total of 822 registered sites (14.16%). The specifics of each group are discussed below.

The areas of Bellarine Peninsula, Mornington Peninsula and French Island and Wilson's Promontory have been searched specifically on the Victorian Aboriginal Heritage Register (VAHR) as they are distinctive landforms on the coastline of Victoria and hold distinct cultural patterning, regarding both tangible and intangible cultural heritage values. These three areas contribute 1775 of the registered sites (31.5%), out of the 5636 total registered sites in the study area; The Bellarine Peninsula has 578 registered sites, Mornington Peninsula and French Island have 813 registered sites and Wilson's Promontory has 384 registered sites.

Table 1 – Aboriginal places within the study area (Victoria)

Aboriginal Place Type	Total number of sites	Percentage of sites
Aboriginal Ancestral Remains (Burial)	51	0.90%
Aboriginal Ancestral Remains (Reinternment)	2	0.04%
Aboriginal Historical Place	8	0.14%
Artefact Scatter	2210	39.21%
Earth Feature	181	3.21%
LDAD	321	5.70%
Object Collection	160	2.84%
Quarry	9	0.16%
Rock Art	1	0.012%
Scarred Tree	42	0.75%
Shell Midden	2639	46.82%
Stone Feature	12	0.21%
Total	5636	100%

2.3.1 Primary Stakeholder Area - Gunditjmara Aboriginal places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 889 recorded Aboriginal places within the Gunditjmara RAP area. The dominant Aboriginal place types in the study area are artefact scatters (47.36%), shell middens (38.81%) and LDADs (6.3%).

Artefact scatters have been registered throughout the search area, with notable clusters of artefact scatters south of Portland, around Point Danger. Low Density Artefact Distributions (LDADs) consisting of fewer artefacts less densely present than artefact scatters, are most often found further inland, compared to artefact scatters and shell middens which are located close to the shoreline. This suggests concentration of activity close to the coast, and increased transitory movement to and from the coast, as material is being discarded when people are moving across the landscape.

Other registered place types include earth features (6.3%), object collection (0.56%), Aboriginal historic places (0.34%), Aboriginal Ancestral Remains Burial (0.11%), quarry (0.11%) and scarred trees (0.11%) There are no registered sites in the western most area of the Gunditj Mara RAP group, within the study area. This area is along the southern most point of the Fitzroy River and west of Narrawong.

2.3.2 Primary Stakeholder Area - Eastern Maar Aboriginal places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 853 recorded Aboriginal places within the Eastern Maar RAP area. The dominant Aboriginal place types in the study area are shell middens (53.81%), artefact scatters (34.11%) and earth features (5.39%)

Shell midden sites on in coastal landforms have been frequently registered. The artefact scatters with the study area tend to follow natural paths inland. This suggests movement to and from the coast, with people utilising land resources. This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016).

Other registered place types include LDADs (3.99%), object collection (1.52%), Aboriginal Ancestral Remains Burial (0.94%), quarry (0.12%) and stone features (0.12%)

2.3.3 Primary Stakeholder Area – Shared Gunditjmara and Eastern Maar Aboriginal places

In this area, the two RAP groups overlap. The search of the Victorian Aboriginal Heritage Register (VAHR) identified 88 recorded Aboriginal places within the shared Gunditjmara and Eastern Maar RAP area. The dominant Aboriginal place types in the study area are shell middens (52.27%) artefact scatters (34.09%) and stone features (7.95%).

Majority of the artefact scatters and shell midden sites with the study area are located between the coast and Eumerella River. This suggests the use of both fresh and sea water sources for material and resources. Shell midden sites can be found along the coastline while the artefact scatters tend to be closer to fresh water sources. This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016).

Other registered place types include earth features (4.55%) and Aboriginal historic places (1.14%).

2.3.4 Secondary Stakeholder Area - Wadawurrung Aboriginal places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 798 recorded Aboriginal places within the Wadawurrung RAP area. The predominate Aboriginal place types in the study area are artefact scatters (46.12%), shell middens (33.83%) and LDADs (9.27%).

Within the study area, artefact scatters tend to follow freshwater sources inland and cluster around headlands (such as the Queenscliff and the Indented Heads area). This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016), with groups using freshwater sources as occupation sites and opportunities for resource gathering, as well as using the headlands as vantage points across the bay or out to sea. LDADs are most often found further inland, compared to shell middens which are located closer to the shoreline. This suggests movement to and from the coast, as material is being discarded when people are moving across the landscape

Other registered place types include object collection (5.64%), earth features (2.88%), scarred trees (0.88%), Aboriginal Ancestral Remains Burial (0.75%) Aboriginal historic places (0.25%), stone features (0.25%) and quarry (0.13%)

Bellarine Aboriginal Places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 578 recorded Aboriginal places within the Bellarine Peninsula. The predominate Aboriginal place types found on the Bellarine Peninsula are artefacts scatters (48.44%), shell middens (29.41%) and LDADs (10.03%).

Within the study area, artefact scatters tend to follow freshwater sources inland and cluster around headlands (such as Queenscliff and Barwon Heads). This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016), with groups using freshwater sources as occupation sites and opportunities for resource gathering, as well as using the headlands as vantage points across the bay or out to sea. LDADs are most often found further inland, compared to shell middens which are located closer to the shoreline. This suggests movement to and from the coast, as material is being discarded when people are moving across the landscape

Other site types include object collection (6.75%), earth features (3.29%), Aboriginal Ancestral Remains Burial (0.87%), scarred trees (0.69%), Aboriginal historical places (0.35%) and stone features (0.17%).

2.3.5 Secondary Stakeholder Area - Bunurong Aboriginal places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 1486 recorded Aboriginal places within the Bunurong RAP area. The predominate Aboriginal place types in the study area are shell middens (45.56%), artefact scatters (38.36%) and LDADs (8.28%).

Within the study area, artefact scatters on French Island and Phillip Island are found further inland, compared to shell middens. Some of the shell middens within the study area can be found in clusters around headlands (such as the Portsea and Sorrento area). This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016), with groups using freshwater sources as occupation sites and opportunities for resource gathering, as well as using the headlands as vantage points across the bay or out to sea.

Other registered place types include object collection (5.79%), earth features (1.28%), scarred trees (0.20%), Aboriginal Ancestral Remains Burial (0.20%), quarry (0.13%). Aboriginal historic place (0.07%), rock art (0.07%) and stone features (0.07%)

Mornington Peninsula and French Island Aboriginal Places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 813 recorded Aboriginal places within the Mornington Peninsula and French Island area. The dominant Aboriginal place types in the study area are shell middens (50.43%), artefact scatters (31.12%) and LDADs (11.69%).

Along the coast of the Mornington Peninsula there is a significant increase in shell midden sites from Sorrento to Cape Schanck. This could indicate targeted gathering of resources specific to this area and purposeful occupation of the coastline. From Cape Schanck, moving east, there is a noticeable decrease in the number of registered sites along the coast. Shell middens can be found along the coast, either along the shore or along creeks close to the coast (such as Merricks Creek). Artefact scatters can be found intermittently along the coast but can also be seen following water sources inland. This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016), with groups using freshwater sources and coastal sites as occupation sites and opportunities for variety in resource gathering. LDADs are an inland site type within the locality. This suggests movement to and from the coast, as material is being discarded when people are moving across the landscape.

There are 50 registered sites on French Island. Only 9 of these sites are located along its coast, the other 41 are inland sites, with the majority of the sites being artefact scatters. The inland artefact scatters are located along paths of water, suggesting targeted use of the landscape (land use patterning).

Other registered place types include object collection (4.31%), earth features (1.72%), scarred trees (0.37%), Aboriginal historic places (0.12%), quarry (0.12%) and rock art (0.12%).

2.3.6 Secondary Stakeholder Area - Gunaikurnai Aboriginal places

The search of the Victorian Aboriginal Heritage Register (VAHR) identified 700 recorded Aboriginal places within the Gunaikurnai RAP area. The predominate Aboriginal place types in the study area are shell middens (46.29%), artefact scatters (43.14%) and scarred trees (4.29%).

Clusters of artefact scatter sites can be found on the eastern coast of the Corner Inlet Marine and Coastal Park. These artefact scatters ten to follow sources of freshwater inland. This may indicate some form of land use patterning (Lawler, Oataway, & Berelov 2016), with groups using freshwater sources as occupation sites and opportunities for resource gathering, as well as using the headlands as vantage points across the bay or out to sea.

Other registered place types include LDADs (2.14%), Aboriginal Ancestral Remains Burial (2.14%), earth features (1%), object collection (0.57%), Aboriginal Ancestral Remains Reinternment (0.14%), Aboriginal historic places (0.14%) and stone features (0.14%).

Wilson's Promontory Aboriginal Places

The Traditional Owners of Wilson's Promontory come from two recognised RAP groups: Bunurong and Gunaikurnai.

The search of the Victorian Aboriginal Heritage Register (VAHR) identified recorded 384 Aboriginal places within the Wilson's Promontory area. The predominate Aboriginal place types in the study area are shell middens (72.40%), artefact scatters (21.61%) and earth features (2.08%)

Clusters of shell midden sites can be found both inland and around the coast of Wilson's Promontory. A large shell midden cluster can be found along the western coast of the Promontory with a total of 163 shell midden registered sites. Another two clusters have been recorded around the opening of Wilson's Promontory, with a total of 18 registered sites between them. All 18 shell midden sites are in close proximity to either the coast or moving water. Majority of the artefact scatter register sites recorded at Wilson's Promontory follow water sources inland. The strategic locations of both shell midden and artefact scatter sites demonstrate land use patterning.

Other registered place types include LDADs (1.56%), Aboriginal Ancestral Remains Burial (1.3%), object collection (0.52%), Aboriginal Ancestral Remains Reinternment (0.26%) and scarred trees (0.26%)

2.4 Aboriginal heritage – archaeological places in Tasmania

2.4.1 Primary Stakeholder Area – Bass Strait Island Aboriginal places

Mackay (1946) was the first to identify archaeological evidence of past Aboriginal use of the Bass Strait Islands in the 1930s (see also Sim 1991:6). Earlier thoughts were that these were stone artefacts left behind when the Tasmanians were moved to Flinders Island by George Augustus Robinson in the 1830s. It was not until Rhys Jones' work in the 1960s that attention to the Bass Strait islands was made. Sandra Bowdler (1979) excavated at Cave Bay Cave on Hunter Island that provided the first evidence of Pleistocene occupation, dating from 23,000 years. At this time, this was the oldest recorded date of Aboriginal occupation in Tasmania. This was also archaeological proof of the Bassian Land Bridge that once connected Tasmania to Mainland Australia (Sim 1991).

Further work was carried out on Flinders Island and several other smaller islands in Bass Strait showed signs of earlier occupation, including stone artefacts, middens and burials. It was believed at the time that the absence of middens on some islands, but the presence of stone artefacts meant that the midden sites were once closer to the original pre-Ice Age coast, which is now under water (Orchiston and Glenie 1978). The first middens excavated in Bass Strait was by Orchistone (Orchiston and Glenie 1978, Orchiston 1979a, 1979b, 1984), however, the full details of the report have not been published. Sim (1991:12) recorded a number of middens on Flinders Island in 1989 and noted that many of the remaining midden sites were found where the sea floor drops away abruptly, further suggesting that many of the midden sites were possibly found on ground level now under water due to rising waters after the Ice Age. Sim (1991) argued that the Bass Strait islands were abandoned before the last remnants of the Bassian Plain land bridge between Mainland Australia and Tasmania disappeared. Davidson and Roberts (2008:20) state:

> *For a while, perhaps, it was possible to use watercraft to maintain contact with families and friends on the other side but eventually this became more difficult. Boats sank sometimes, or storms and rough seas would have made the crossing perilous. When the sea barrier became too wide, those left on the Tasmanian side turned their backs and never saw their friends and families again. It proved to be a monumental turning point, leading to an independent evolution in their technology, economy, society and culture. They were alone for five hundred generations, knowing no other people in the world, living with the knowledge and beliefs derived from those they had known before the sea surrounded them. They remained isolated from the rest of*

humanity until that same sea brought the first Europeans in the late seventeenth and early eighteenth centuries

Brown (1990) conducted excavations on Flinders Island that again proved the antiquity of the Bass Strait Islands, where sporadic occupation from 20,000 years to 8,500 years was found at Mannalargenna Cave on Prime Seal Island. Again, it was hypothesised that the islands were abandoned after 8,500 years due to the rising sea levels (see Sim 1991:11). Early thoughts at the time state that water craft between the islands would have been possible, and the sea level rise was gradual and would have been shallower. However, with the rise of waters, also meant that the distance between land masses increased, therefore making travel much harder and dangerous. It is thus why many believe that the islands were abandoned around 6,000 years ago when the seas reached their current levels (Sim 1991:12).

The flooding of the Bassian Plain meant that the people who chose to remain in Tasmania would soon be Isolated for generations. Jones (1977) states '… no other human society, which survived until modern times, had been isolated so completely and for so long'.

2.4.2 Secondary Area – Tasmanian coastal Aboriginal places

Archaeological evidence of occupation in Tasmania range between 34,000 – 40,000 BP. The most accurate date for occupation is from the Parmerpar Rockshelter close to Cradle Mountain that was excavated by archaeologist Richard Cosgrove (Mulvaney and Kamminga 1999:189). This was a time when Tasmania was still a part of the landmass of Australia before it was disconnected with the flooding of the Bassian Plain after the last Ice Age. Further excavations of Kutukina Cave (formally Frasier Cave) in southwest Tasmania established Pleistocene settlement of Tasmania with radio carbon dates ranging from 15,000 to 20,000 years BP (Kiernan 1983; Mulvaney and Kamminga 1999:182).

By the end of the last Ice Age (12,000 BP) the rising temperatures and subsequent rising sea levels flooded the Bassian Plain and separated Tasmania from the mainland of Australia (Kee 1987:12; Taylor 2003). The formation of what is now known at the Bass Strait ultimately led to the isolation of the Tasmanians from their groups on the mainland of Australia. The resulting 10,000 years of isolation crafted a unique culture and economy that was independent from any mainland Australia influence (Mulvaney and Kamminga 1999:339). A series of environmental and climatic changes started to occur in Tasmania as a result of this separation with a reduction in rainfall, lower than normal temperatures, some reduction in the seeding of vegetation, as well as the formation of sand dune systems that were to become a prime area for the discovery of Aboriginal remains. Kee (1987:14) stated that these dunes formulated a new abundance of resources available to the Tasmanian's, which is reflected in much of the early archaeology of this period. These climatic changes started to stabilise around 6,000 years ago. This has been noted by radiocarbon dating at Carlton Bluff, where dates ranged from 8,000 to 6,000 BP (Dix 2015:147-148; Key 1987:12 Neil 1981; Reber1965), and therefore the range of sites found on the coast are more than likely representative of this 6,000 year figure.

Regionally, sites vary in Tasmania. As such, the state has been divided into three geographic regions. Various studies were conducted in the 1980s and 1990s to understand these regional differences in sites, and to understand more broadly Tasmanian Aboriginal archaeology (Brown 1991; Cane 1980; Cosgrove 1985; 1990; Gaughwin 1985: 52; Jones 1965; 1966; 1967; Key 1991; Lourandos 1968; 1970; 1977; MacFarlane 1993; Stockton 1977a, 1977b; 1982). Many of these were published as part of the Parks and Wildlife section of the Tasmanian government. More recent and accurate data is available at Aboriginal Heritage Tasmania, however prior approval from the Aboriginal Heritage Council will be required to access this data.

- East/South East Tasmania
  - Middens formulate 90% of all site types on the east coat with a range of shell from turbo, oyster, limpet, abalone and mussel. Brown (1991:46) determined that turbo middens dominated areas behind rock platforms where oysters were mostly predominant behind sandy beaches, where shell fish consumption generally took place within the immediate proximity of where it was procured from;
  - 50m within the coastline appears to be the limit of the majority of the larger sites in the area;
  - Sites are generally situated on well drained more inland areas;
  - That 81% of sites recorded contained some level of stone artefacts, and generally consist of hornfels, cert, quartzite and chalcedony flakes.
  - Stone artefact scatters were generally located on flat or gently inclined landscapes where they were close to a water source;
  - The underlying geology of the inland area suggests that areas where the underlying rock was sandstone was more favourable over those areas that contain dolerite;
  - Sandstone rock shelters located close to water often contain signs of occupation.
  - Rock art can occasionally be found on sandstone rock shelters, and is generally executed in ochre.
- Archaeological Sites – North/ North East Tasmania
  - Sites generally occur on high energy coastlines;
  - Approximately 78% of sites occur within 50m from a water source;
  - Sand dune areas most commonly have sites located on them;
  - The main stone typology noted in these assemblages include hornfels, chert, and quartz.
  - Rock art can be found pecked in stone on coastal margins
- Archaeological sites North West/ West/ South West
  - Majority of sites can be found on sand dunes close to rock platforms;
  - Middens are generally smaller and lower on sandy shores.
  - Middens are generally absent along rocky granite shorelines.
  - Site types include artefact scatters, isolated artefacts, stone and ochre quarry sites and rock shelters.

- The main stone types used in the area include spongolite, quartzite, quartz, silcrete and hornfels.
- Artefact scatters and isolated artefacts are generally located on the forest plain.
- Stone artefacts will be varies in material type, which reflects the opportunistic nature of collecting material.
- Areas within 500m of major water courses and creeks will generally contain Aboriginal sites.
- Sites that contain stone artefacts made from spongolite artefacts will no predate 2,500BP.
- Generally, sites are 70 to 100 artefacts per km^2. Densities are approximately 1.7 artefacts per site in places away from major rivers and quarry sites, whereas there will be approximately 6.5 artefacts per site in areas close to these resources.
- Sites will generally be located near the transition of inland heath plains and forest margins.
- Large artefact scatters will be located close to major creeks or rivers especially where flat grounds are associated with the area;
- Hut depression occur on coastal margins, generally close to food sources
- Rock art is found on coastal margins, and is generally pecked or engraved on large sandstone faces, or where creeks exit to the sea.

2.5 Archaeological summary

Within the study area, along the Victorian coast, there are 5636 registered Aboriginal places with the most common site types being shell middens, artefact scatters and LDADs. Shell middens are typically found along the coastline, whereas artefact scatters, while also being found along the coast, are varied and move inland following freshwater sources, likely to be indicative of past inland-coastal travel routes. LDADs are also typically found further inland than shell middens and artefact scatters, indicative of widespread use of the landscape in the past, rather than concentrations and repeated patterning.

In light of a review of Aboriginal places within the study area, there is a high likelihood for Aboriginal cultural heritage material to be present within the areas subject to potential impact.

Within Tasmania and the Bass Strait Islands, there are no recent published figures of sites located on the coastal margins. Access to this data is restricted, and permission will need to be sought by the Aboriginal Heritage Council to access the Aboriginal Heritage Register via Aboriginal Heritage Tasmania. However, from the assessment of available regional data, Aboriginal heritage should be expected in any area of low-lying coastal areas, shelter sites, and sources of food, water and raw materials. These coastal margins contain all Tasmanian Aboriginal site types. It is also known on the West Coast of Tasmania, that a number of rock art sites are located on the coast, many either close or in tidal margins (Dix pers. obs.). Large midden sites are also located very close to the waters edge, as well as some stone quarry sites within tidal margins (Dix pers .obs.).

2.6 Traditional Owner groups and ethnohistory

For the purposes of this assessment, information about Aboriginal Victorian pre and post contact history has been sourced from nineteenth and twentieth century primary and secondary ethnographic/historical records.

2.6.1 Primary Stakeholder Area - Gunditjmara

The Gunditjmara RAP group covers the area boarding the South Australia border with Victoria and the Southern Grampians. This area includes Harrow and Horsham, south to Dunkeld and MacArthur, and southwest to Portland and Cape Nelson. The Gunditjmara RAP area also includes many state and national parks such as Discovery Coastal Park, Mount Richmond National Park, Cape Nelson State Park and the Grampians National Park.

The area between the Shaw and Eumerella Rivers in the south-west to Lake Linlithgow in the north and Yambuk in the south, are shared by both the Gunditjmara RAP and the Eastern Maar RAP groups.

There are many landscapes within Gunditjmara Country – Nyamat Mirring (Sea Country), Tungatt Mirring (Stone Country), Bocara Mirring (River Country) and Woorrowarook Mirring (Forest Country) (Glenelg-Hopkins Regional Catchment Strategy 2023).

It can be noted that the Gunditj Mara view water as part of their traditional lands and should be recognised and protected as such (Clark 1990, RNTBC 2023)

Evidence of Gunditj Mara knowledge of water is found in the eel trapping and the redirecting of waterways at Lake Condah and in the larger Budj Bim National Heritage Landscape. The Budj Bim National Heritage Landscape had been managed by Traditional Owners to form waterways and channels to bring eels down from Darlots Creek into Lake Condah for fishing and resource gathering (Department of Climate Change, Energy, the Environment and Water 2021). This practice can be dated to approximately 6600 years old, with one of five of the eel trap systems around the lake's edge being carbon dated. The relocating and breeding of eels became a sustainable husbandry practice that sustained the Gunditj Mara through every season, providing food stuffs and sources of trade. There are plans currently being made with VicWater and Wannon Water to reestablish traditional eel farming in the Budj Bim area (VicWater 2022)Another plan devised to aid in the management of Indigenous water landscapes is the Sea Country IPA Program. The Sea Country IPA (Indigenous Protected Areas) Program was developed at the beginning of 2021 to aid in the conservation and protection of Indigenous marine and coastal environments. The IPA program covers the Gunditj Mara area from the Convincing Ground to the Yambuk Lakes and provides further protection of the Budj Bim landscape as well as opportunities for Indigenous employment, documentation of traditional knowledge and sea management (DCCEEW n.d.)

The Lake Condah mission was opened in 1867 in response to the displaced Gunditj Mara after the Eumerella wars (Budj Bim Cultural Landscape 2023). The Eumerella wars lasted over 20 years, beginning in the mid 1830's to the 1860's, starting over disagreements in ownership of land in southwest Victoria. The Dhauwurd wurrung people (apart of Eastern Maar country) refused to settle at the mission in Framlingham, so the Lake Condah mission was established, where they farmed and learnt to read and write English. The mission was strategically position to both house eel trapping facilities and have a view of the Budj Bim Reserve. In 1918, the mission was formally closed, and some of the Gunditj Mara were moved to other missions, such as the Lake Tyers Mission, while others refused to leave country. In 1987, the land on which the mission was situated on was given back to the Gunditj Mara (Budj Bim Cultural Landscape 2023).

Gunditj Mara hold strong cultural connections to sea country (Nyamat Mirring), and Nyamat Mirring features heavily in the Dreaming and creation stories of the Gunditj Mara. The Gunditj Mara believe that after the initial eruption of the creator spirit, Budj Bim, out of a volcano, the spirits movement throughout the landscape created the surrounding landscapes and their features. The lava flow from this eruption caused the creation of the wetlands found within the Gunditj Mara landscape. In the traditional funeral rites of the Gunditj Mara people, bodies are bundled in grass and laid into the ground with their heads pointing towards Deen Maar (Lady Julia Percy Island). This is due to Deen Maar having a cave called Tarn Wirrung, which is thought to be the beginning of the passage towards the afterlife. Once the bodies were buried, if grass grew at the mouth of the cave, it was thought that the spirit had made it to the island, and into the realm of the clouds

Deen Maar (Lady Julia Percy Island) is the point where two creator deities, Punjil and Pallian left this earth. Pallian was the creator deity of the sea and fish and the governor of the oceans (after William Thomas, Letters from Victorian Pioneers, in National Oceans Office 2003:12). This island holds and creation story holds significance for both the Gunditj Mara and Eastern Maar.

Significant locations of conflict are also located on the coast, including the massacre of Gunditj Mara at Convincing Ground, east of Portland. The Convincing Ground Massacre occurred at Allestree, approximately 10km from Portland, where Kilcarer Gundidj, Gundtij Mara people were killed by whalers over a disagreement about the ownership of a beached whale(VHR n.d.). The suggested dates for this massacre are between 1833 and 1834, with an unknown number of Indigenous peoples being killed(VHR n.d.).

2.6.2 Primary Stakeholder Area - Eastern Maar

The Eastern Maar RAP group covers the area including Port Fairy and Warrnambool, down to Apollo Bay, east to Lorne and northwest towards Ararat. The RAP area of Eastern Maar also extends 100 meters off the coast and therefore encompasses the Twelve Apostles.

Eastern Maar is an umbrella term, used to describe a large area of land containing many, smaller traditional owner groups, such as Maar, Eastern Gunditgimara, Tjap Wurrung, Peek Whurrong, Kirraw Whurrung, Kuurn Kopan Noot. Yarro waetch and many others.(Eastern Maar Aboriginal Corporation 2020)

In 1865 the first Aboriginal mission was formed in the Western District at Framlingham in Girai wurrung country, north-east of Warrnambool. Aside from the Dhauwurd wurrung clans who moved to the Lake Condah mission in the 1860s, other Indigenous people were removed to the Framlingham Aboriginal Mission, which was gazetted as a “temporary reservation for the use of Aborigines” (Barwick 1979: 4).In this mission the Eastern Maar people continued both cultural and spiritual traditional practices. In 1867 and 1899 the mission was meant to close down, and the Eastern Maar people were expected to move into the Lake Condah mission. Again, in 1916, the Eastern Maar people were expected to move into missions within Gippsland Victoria. All three times, the people refused to move and were successful in staying on country. During the 1970’s, Eastern Maar were granted ownership of the land, including 586 acres of the original mission(Lawler, Oataway, & Berelov 2016).

Eastern Maar’s connection to water relies heavily in the marine resources, abundant around the area. Fishing practices are still used today with the fishing and collection of eels, perch, blackfish, yabbies, abalone, cockles and crayfish (Eastern Maar Aboriginal Corporation 2015, pp. 9). The techniques used in eeling have been passed down for generations, meaning the practices used today are techniques and skills traditional owners were using to eat and to trade (Eastern Maar Aboriginal Corporation 2015, pp. 9). Shell middens are an important archaeological site to the Eastern Maar, where they take time to teach others about the importance of culture and preservation and management of sea resources (Eastern Maar Aboriginal Corporation 2015, pp. 9).

> *When Maar citizens visit places with archaeological sites, we take time to teach our young ones about what they mean in terms of our history and culture. For example, our ancestors left many ancient middens along the coast which continue to tell a story about our Country - how the coastline and estuaries fluctuated, how and when our ancestors used the resources along the coast, what was harvested from out in the open ocean, how climatic conditions changed over time, where the meeting places were and ceremonies took place. This type of cultural*

learning helps develop empathy for Country; a deeper understanding on a societal scale of what Country means to us as a nation. We always pay our respects…(Eastern Maar Aboriginal Corporation 2015, pp. 9)

Through Country, Eastern Maar People connect with their ancestors who are associated with different water systems within the landscape (Eastern Maar Aboriginal Corporation 2015, pp. 9):

> *We believe that the spirits of our dead reside in our waterways and water bodies, and that they use animate and inanimate objects to move through Country. The signs they reveal to us are an important part of the interaction with our Ancestors – engaging, guiding, informing and warning us. When our citizens die, they are often buried with their bodies facing towards Deen Maar (Island). A story associated with Deen Maar Island is that the spirits go first to Deen Maar and then up to the stars, as Bunjil had done. A star falling or lights flying through the sky is a sign that the spirit is going over.*
>
> *Sea Country Maar citizens have always had a close connection with the sea and its resources, which were central to our culture, economy and survival. The ocean nourished our Ancestors and we still rely on it for our survival. Abundant middens along the coastline tell a rich story of our past. The coastline is home to sites that are important for our Dreaming - Three Sisters Rocks and Deen Maar (Lady Julia Percy Island) where our Ancestors leave the earth. Our connection with our Sea Country extends well beyond the current shoreline to the edge of the continental shelf. While this area is under the sea today, we occupied it for thousands of years and rising sea levels have not washed away the history, physical evidence or our connection.*(Eastern Maar Aboriginal Corporation 2015, pp. 13)

2.6.3 Secondary Stakeholder Area - Wadawurrung

Aboriginal groups mapped natural features as boundaries for their ranges, estates and economic territories. The Wadawurrung held land along the coast from Painkalac Creek at Aireys Inlet, east into Port Phillip Bay and to the Werribee River and to the north as far as Mt Emu and Fiery Creeks (Clark 1990).

Little is known about the Wadawurrung and their social organisation as they were one of the first Aboriginal groups within the region to be affected by European settlement in the area (Clark 1990). However, the Wadawurrung RAP organisation has traced its people's lineage to that of the seven families of John Robinson who was born in 1846 and passed in 1919 (WTOAC 2019).

During the summertime months, Wadawurrung along with Djab wurrung, Dhauwurd wurrung and girai wurrung language groups gathered at Mirraewuae swamp for ceremony and hunting. In early autumn the *Wada wurrung* would meet with Girai wurrung at Lake Bolac with local Djab wurrung named groups to take advantage of the migratory eels. The Wadawurrung participated in trade meetings at Terang, trading axe's and adhesive gum.

The coastal Wadawurrung first came into contact with settlers around the early 1800s when John Murray and William Flinders surveyed part of Indented Head. By the end of 1836 sheep runs were endemic around Geelong for an approximate 40.2 kilometre radius. The following year, settlers began to spread westward towards the Colac district.

An important figure in the history of Wadawurrung country was an escaped convict named William Buckley. The Wadawurrung balug first encountered Europeans in 1832 when William Buckley, escaped from the failed Sorrento settlement in 1803. Buckley was adopted by the Wadawurrung balug and spent the next 32 years with them; taking part in their customs, learning the language as well as hunting gathering techniques (Clark 1990). Buckley's story was recorded by John Morgan in 1852. From Buckley's accounts it was recorded that the Wadawurrung balug would catch eels at Lake Modewarre and would spend time on the hunting ground of the neighbouring Bengalat bulluck. According to Buckley the clan was at odds with the Bun wurrung, Woi wurrung and Daung wurrung clans (Clark 1990).

2.6.4 Secondary Stakeholder Area - Bunurong

The land encompassing the eastern side of the study area, as mapped by Clark (Clark 1990), is held by the Boon Wurrung language group, commonly associated with the Bunurong people. Boon Wurrung land occupied the coastal area from the Werribee River to Anderson Inlet, Phillip Island and probably beyond to Wilsons Promontory(Horton & Morris 1983, pp. 44). The Bunurong RAP group covers the Mornington Peninsula (such as Rosebud and Frankston), Western Port (French Island, Phillip Island and San Remo) and the eastern most part of South Gippsland (Warragul down to Leongatha)(BLCAC 2023).

The Bunurong group is loosely divided into smaller clan or family groups, named for the area they associated with (Gaughwin & Sullivan 1984, pp. 85). Barwick (1984, pp. 117–118) identified six clans: the *Burinyung-balluk* from Point Nepean and Cape Schanck, the *Mayone-bulluk* associated with the Carrum swamp, Cranbourne and the northern part of the Mornington Peninsula, the *Ngaruk-willam* associated with the Brighton area and Mordialloc, the *Yallock-bulluk* (most relevant to the study area) associated with the eastern side of Bass River and Tooradin, the *Yallukit-willam* associated with the area now called St Kilda and a broader region from the Werribee River to Mordialloc, the *Yowengherra* occupying the Tarwin River area. Thomas distinguished between the Bunurong people from Port Phillip and those of Western Port, though he rarely had contact with the Bunurong people on the eastern side of Western Port Bay (Sullivan 1981, pp. 16–19, Clark 1990). The Yallock-Bulluk Bunurong group are the most likely to have lived and associated with San Remo and Phillip Island area. The moiety of the Yallock-Bulluk named group is Bunjil, commonly associated with the Phillip Island area.

People were likely to have moved between the interior in winter and the coast in the summer. Movement was made up of many small distances (c. 10 km per day) punctuated by camps of one to three nights and occasionally longer stays of eight to ten days (Sullivan 1981). Social activity involving neighbouring named or socio-dialectical groups was usually held in warmer periods, held at the intersection of group boundary's and arranged by a person assigned of the responsibility of travelling between groups to organise the time, place, and events of the meeting.

An important figure in the history of Bunuroung country was an Indigenous man named Derrimut. Derrimut was the *arweet* the *Yalukit Willam* group at the time of European settlement of the region (Clark 1990, pp. 368–369). His name, Derrimut (derrimart/derremot), is believed to mean 'to hunt' or 'to pursue' in the language of the *Yalukit Willam* (Clark 2005, p. 1), Derrimut was a prominent figure in both the Indigenous and European histories of early Melbourne, and historical and contemporary views of his status vary. William Buckley, an escaped convict who lived with the Wadawurrung people of the Geelong region, considered him a 'traitor' who should be speared for divulging impending attacks to European colonists (Clark 2005, pp. 109). Clark (2005) considers Derrimut a "culture-broker" who sought to navigate the newly imposed political context of colonial Victoria by forging relationships with prominent early European Melbournians including John Pascoe Fawkner and William Thomas, who held Derrimut in high regard (Clark 2005, pp. 111). In 1849, Derrimut and other members of the *Yalukit-Willam* agitated for the establishment of the Mordialloc Reserve, and when it was later divided for sale in 1863, Derrimut used his European connections to angrily protest its sale (Clark 2005, pp. 116).

Bunurongs use of water-based resources is evident in the quantity of shell midden sites found along the coastline. Within the study area and the bounds of the Bunurong RAP group, there are a total of 677 registered shell midden sites, within two hundred meters of the shoreline. This suggests knowledgeable exploitation of marine resources as practiced techniques and an understanding of the ocean would be needed to accumulate the amount of shell middens listed on Bunurong country.

2.6.5 Secondary Stakeholder Area - Gunaikurnai

The Gunaikurnai RAP group covers most of the Gippsland Area, spanning from Warragul and Noojee, down to Port Albert and Port Welshpool, eastward towards Bairnsdale, Lakes Entrance and Marlo, and north towards Omeo and Hotham Heights

The Gunaikurnai believe in strong connections between land (Wurruk), water (Yarnda) and air (Watpootjan) and how these connections support living things. The Gunaikurnai see no separation of land and water, combining the two to represent whole country and therefore, demonstrate the same levels of importance to both land and sea. Due to this definition of country, both land and ocean receive the same amount of protection and management(GLWAC 2023a).

Throughout Gunaikurnai country, there are multiple sites that detail indigenous relation to country and resource exploitation. One site that displays local resource exploitation is the recently excavated cave near Mitchell River, Raymond Creek 2 Rock Shelter, that provides evidence of using mussel shell tools and localised resource gathered through fishing(Monash University & GLWAC 2019).

The Buchan Caves Reserve is an example of the spiritual and physical relation to country that the Gunaikurnai people share. At this site in Eastern Victoria there are registered indigenous burials located in and around the cave system, creating a spiritual space within the landscape. In conjunction to the sacred burials, the site was already known to be a great place of connection as it played an integral role in the migrating patterns of the Gunaikurnai travelling through the mountains(GLWAC 2023b).

The area surrounding Buchan Caves Reserve is also considered special to country, with several other caves being recognized as having cultural meaning One such cave is Cloggs Cave, located southeast of Buchan Caves Reserve, having an undisturbed cultural sequence, that could prove indigenous settlement in the Late Holocene and holds evidence of megafauna that challenge the idea of megafaunal extinction being caused by the LGM(GLWAC 2023a, David et al. 2021, GLWAC 2023b)

2.6.6 Primary Stakeholder Area – Palawa (Tasmania)

According to Jones (1974), Tasmanian Aboriginal society consisted of three social units: hearth group, the band and the Tribe. The hearth group was described as being the family unit, and consisted of a man, woman, their children, aged relatives, and ranged from 2-8 people (Jones 1974: Plomley 1983).

> *There were nine individuals in this family, and clearly they represented a hearth group, because Peron visited their campsite with its single hut. The group comprised an older man and wife, a younger man and wife, and five children, one a daughter (Oure-Oure) of the older man and wife, and the other four the children of the younger man and wife. (Plomley 1983:168).*

The band was more similar to a social unit, comprising of a number of hearth groups, and this was defined by land owned and the boundaries within this territory being lined with defined geographic boundaries (Jones 1974:324-325). Brown (1986:21) further notes that the band was generally led by an older man who had a reputation as a successful hunter and fighter. Brown (1986:21) also believes that the band was exogamous, with the wife generally moving to her husband's band and hearth group. Each of these bands were then further associated with a 'political' unit, as termed by Jones (1974:328-329) as a tribe. Jones (1974:328-329) describes:

> *…that agglomeration of bands which lived in contiguous regions, spoke the same language or dialect, shared the same cultural traits, usually intermarried, had a similar pattern of seasonal movement, habitually met together for economic and other reasons, the pattern of whose peaceful relations were within the agglomeration and of whose enmities and military adventures were directed outside it. Such a tribe had a territory, consisting of the sum of the land owned by its constituent bands … The borders of a territory ranged from a sharp well defined line associated with a prominent geographic feature to a broad transition zone.*

Ryan (2012:14) hypothesises that the population of Tasmania was associated with a broad network of nine Tribes, each consisting of six to 15 bands. Ryan (2012:14) estimates that at by the time of European colonisation, the population of each tribe was around 350 and 800 people, where the overall population of Tasmania is estimated at being 3000-8000 people.

Coastal sites generally consist of midden sites, however, significant stone quarries, rock art, and former hut depressions and camp site can still be located. These sites show a seasonal exploitation of the coastal areas (Brown 1991; Jones 1977). The recording of bark canoes by early explorers shows that the Tasmanians did have a rich maritime tradition, however, many of these were used to access smaller off shore islands, not the larger islands of Bass Strait, or to the main land of Australia (Jones 1977).

With the removal of the Tasmanians to Flinders Island, population decreases, and associations with different geographical areas of Tasmania were lost. When the Tasmanian's returned to the mainland to Oyster Cove, many of these survivors were not allowed back into their traditional areas where they were born, or where their family had resided for generations.

2.7 Conclusion

Aboriginal communities in Victoria and Tasmania continue to be present and vibrant, and maintain strong connections to their traditional lands, waters, and their cultures. Each group is distinct and hold different systems of belief, connection, ceremony, language and lore and cultural practice. Each group hold traditional ecological knowledge of plants, animals and land management passed down through generations.

Aboriginal communities continue to practice traditional hunting, fishing, and gathering, and have a deep understanding of the environment around them. They also have a spiritual connection to the land and sea. Aboriginal people and representative bodies in Victoria and Tasmania have become more active in conservation, land and heritage management, working to protect and restore their traditional lands and waters, and to ensure that their cultural heritage is respected and protected.

> *Coastal environments in south-eastern Australia are rich in cultural sites. These include archaeological sites, such as shell middens and stone quarries, as well as "natural" sites, such as headlands, river mouths, reefs and islands. These sites have continuing cultural meaning because of their connection with Creation Stories, Dreaming Tracks, ceremonial places, camping places and massacre sites. Many of these places are listed on the Register of the National Estate, others are recorded in State-based heritage registers, while many others are known only to Indigenous people themselves and are not formally recorded…*
>
> *Protecting this cultural heritage is a major concern for Indigenous people. (National Oceans Office 2002:4).*

This Cultural Heritage Desktop Assessment explores the cultural heritage background for the region, provides a summary of available information in order to provide the project with a grounding in the cultural heritage of Aboriginal people in the study area.

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4 Glossary of Terms

The glossary provides definitions of various archaeological and heritage related terms.

Heritage place: A place that has aesthetic, historic, scientific or social values for past, present or future generations – ' ...this definition encompasses all cultural places with any potential present or future value as defined above' (Pearson & Sullivan, 1995, p. 7).

Aboriginal place: Aboriginal place is defined under Section 5 of the *Aboriginal Heritage Act* 2006 as follows:

5 What is an Aboriginal place?

(1) For the purposes of this Act, an Aboriginal place is an area in Victoria or the coastal waters of Victoria that is of cultural heritage significance to the Aboriginal people of Victoria.

(2) For the purposes of subsection (1), *area* includes any one or more of the following—

(a) an area of land;

(b) an expanse of water;

(c) a natural feature, formation or landscape;

(d) an archaeological place, feature or deposit;

(e) the area immediately surrounding anything referred to in paragraphs (c) and (d), to the extent that it cannot be separated from the thing without diminishing or destroying the cultural heritage significance attached to the thing by Aboriginal people;

(f) land set aside for the purpose of enabling Aboriginal human remains to be re-interred or otherwise deposited on a permanent basis;

(g) a building or structure.

Alluvial terrace: a platform created from deposits of alluvial material along river banks.

Angular fragment: a piece of stone that is blocky or angular, not flake-like.

Archaeology: the study of the remains of past human activity.

Artefact scatter: a surface scatter of cultural material. Aboriginal artefact scatters are defined as being the occurrence of five or more items of cultural material within an area of about 100 square metres. Artefact scatters are often the only physical remains of places where people have lived camped, prepared and eaten meals and worked.

Backed piece: a flake or blade that has been abruptly retouched along one or more margins opposite an acute (sharp) edge. Backed pieces include backed blades and geometric microliths. They are thought to have been hafted onto wooden handles to produce composite cutting tools. Backed pieces are a feature of the 'Australian small tool tradition', dating from between 5,000 and 1,000 BP in southern Australia (Holdaway & Stern, 2004).

Blade: a flake at least twice as long as it is wide.

Burial place: usually a sub-surface pit containing human remains and sometimes associated artefacts.

Contact place: see 'Aboriginal historical archaeological place'.

Core: an artefact from which flakes have been detached using a hammerstone. Core types include single platform, multi-platform and bipolar forms.

Cortex: original or natural (unflaked) surface of a stone.

Cortical: refers to the cortex.

Flake: a stone piece removed from a core by percussion (striking it) or pressure. It is identified by the presence of a striking platform and bulb of percussion, not usually found on a naturally shattered stone.

Flaked piece: a piece of stone with definite flake surfaces, which cannot be classified as a flake or core.

Formal tool: an artefact that has been shaped by flaking, including retouch, or grinding to a predetermined form for use as a tool. Formal tools include scrapers, backed pieces and axes.

Geocentric Datum of Australia 1994 (GDA94): a system of latitudes and longitudes, or east and north coordinates, centred at the centre of the earth's mass. GDA94 is compatible with modern positioning techniques such as the Global Positioning System (GPS). It supersedes older coordinate systems (AGD66, AGD84). GDA94 is based on a global framework, the IERS Terrestrial Reference Frame (ITRF), but is fixed to a number of reference points in Australia. GDA94 is the Victorian Government Standard and spatial coordinates for excavations, transects and places in CHMP documents.

Geometric microlith: a small tool that has been fashioned from breaking apart a microblade. The piece is then retouched or backed and a small tool formed.

Grindstones: upper (handstone) and lower (basal) stones used to grind plants for food and medicine and/or ochre for painting. A handstone sometimes doubles as a hammerstone and/or anvil.

Hearth: usually a sub-surface feature found eroding from a river or creek bank or a sand dune - it indicates a place where Aboriginal people cooked food. The remains of a hearth are usually identifiable by the presence of charcoal and sometimes clay balls (like brick fragments) and hearth stones. Remains of burnt bone or shell are sometimes preserved within a hearth.

Isolated artefact: the occurrence of less than five items of cultural material within an area of about 100 square metres. It/they can be evidence of a short-lived (or one-off) activity location, the result of an artefact being lost or discarded during travel, or evidence of an artefact scatter that is otherwise obscured by poor ground visibility.

Manuport: foreign fragment**,** chunk or lump of stone that shows no clear signs of flaking but is out of geological context and must have been transported to the place by people.

Map Grid of Australia (MGA): The official coordinate projection for use with the Geocentric Datum of Australia 1994 (GDA94).

Mound: these places, often appearing as raised areas of darker soil, are found most commonly in the volcanic plains of western Victoria or on higher ground near bodies of water. The majority were probably formed by a slow build-up of debris resulting from earth-oven cooking; although some may have been formed by the collapse of sod or turf structures.

Percussion: the act of hitting a core with a hammerstone to strike off flakes.

Platform preparation: removal of small flake scars on the dorsal edge of a flake, opposite the bulb of percussion. These overhang removal scars are produced to prevent a platform from shattering.

Pre-contact: before contact with non-Aboriginal people.

Post-contact: after contact with non-Aboriginal people.

Quarry (stone/ochre source): a place where stone or ochre is exposed and has been extracted by Aboriginal people. The rock types most commonly quarried for artefact manufacture in Victoria include silcrete, quartz, quartzite, chert and fine-grained volcanics such as greenstone.

Rejuvenation flake: a flake that has been knapped from a core solely for the purpose of preparing a new platform and making it easier to get flakes off a core, as it reduces the angle between platform and core surface.

Retouch: a flake, flaked piece or core with intentional secondary flaking along one or more edges.

Rock art: 'paintings, engravings and shallow relief work on natural rock surfaces' (Rosenfeld, 1988, p. 1). Paintings were often produced by mineral pigments, such as ochre, combined with clay and usually mixed with water to form a paste or liquid that was applied to an unprepared rock surface. Rock engravings were made by incising, pounding, pecking or chiselling a design into a rock surface. Rare examples of carved trees occasionally survive.

Rock shelter: may contain the physical remains of camping places where people prepared meals, flaked stone, etc. They are often classed as a different type of place due to their fixed boundaries and greater likelihood of containing sub-surface deposits. Rock shelters may also contain rock art.

Scarred tree: scars on trees may be the result of removal of strips of bark by Aboriginal people e.g. for the manufacture of utensils, canoes or for shelter; or resulting from small notches chopped into the bark to provide hand and toe holds for hunting possums and koalas. Some scars may be the result of non-Aboriginal activity, such as surveyors' marks.

Scraper: a flake, flaked piece or core with systematic retouch on one or more margins.

Shell midden: a surface scatter and/or deposit comprised mainly of shell, sometimes containing stone artefacts, charcoal, bone and manuports. These place types are normally found in association with coastlines, rivers, creeks and swamps – wherever coastal, riverine or estuarine shellfish resources were accessed and exploited.

Significance: the importance of a heritage place or place for aesthetic, historic, scientific or social values for past, present or future generations.

Striking platform: the surface of a core, which is struck by a hammerstone to remove flakes.

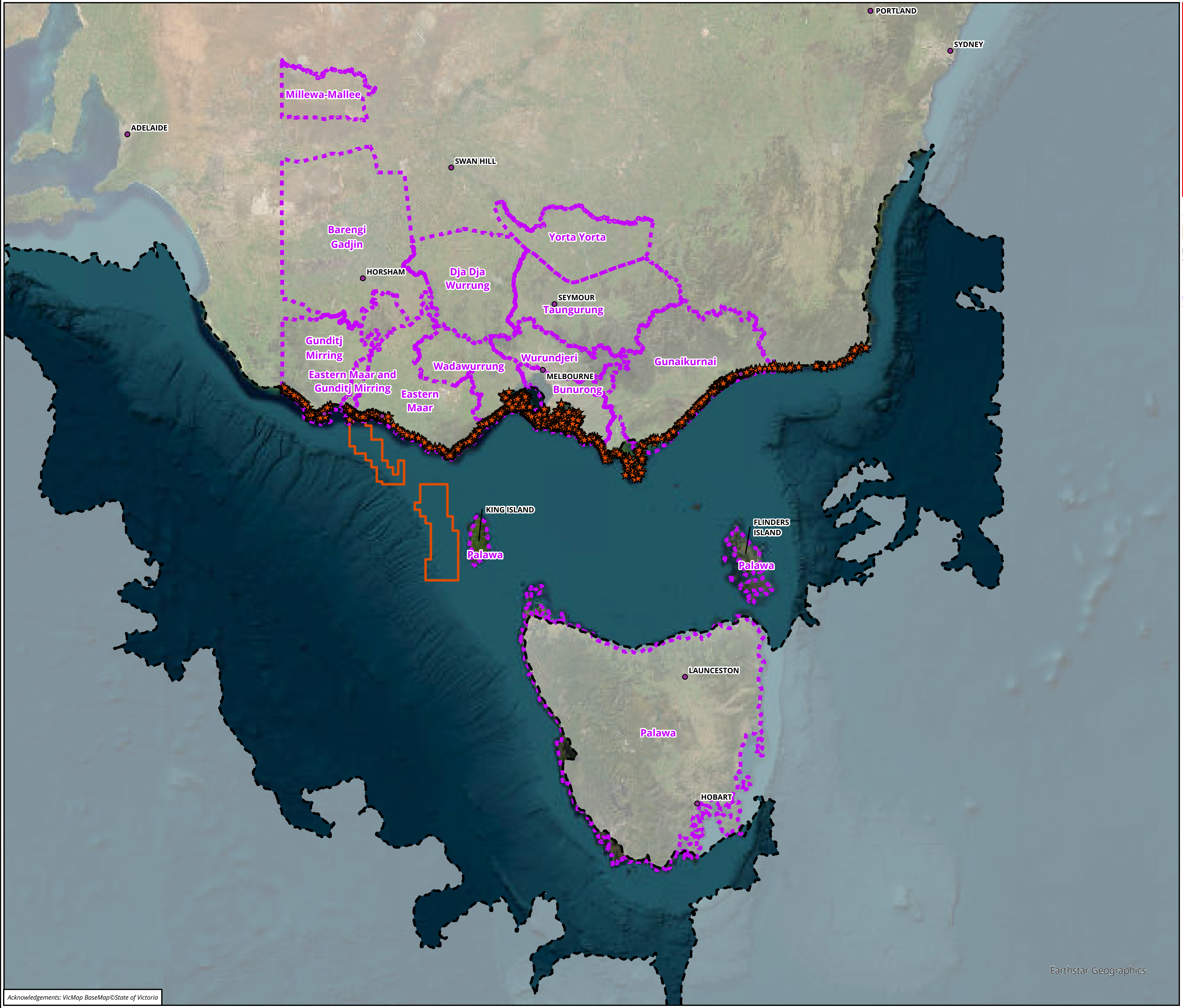
Structures (Aboriginal): can refer to a number of different place types, grouped here only because of their relative rarity and their status as built structures. Most structures tend to be made of locally available rock, such as rock arrangements (ceremonial and domestic), fishtraps, dams and cairns, or of earth, such as mounds or some fishtraps.

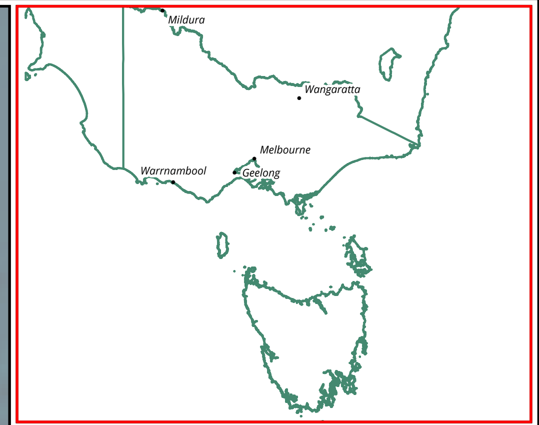
Stratified deposit: material that has been laid down, over time, in distinguishable layers.

Transect: A fixed path along which one records archaeological remains.

Utilised artefact: a flake, flaked piece or core that has irregular small flake scarring along one or more margins that does not represent platform preparation.

5 Appendix A – Aboriginal Cultural Heritage Search Results





Legend

Activity Area

Assessment area

Aboriginal Cultural Heritage

RAP groups

VAHR Place

Figure x Location of Victorian Aboriginal Heritage Register places in the Assessment area

0 60 120 180 240 300

Kilometers

N

Scale: 1:6,000,000 @ A3

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

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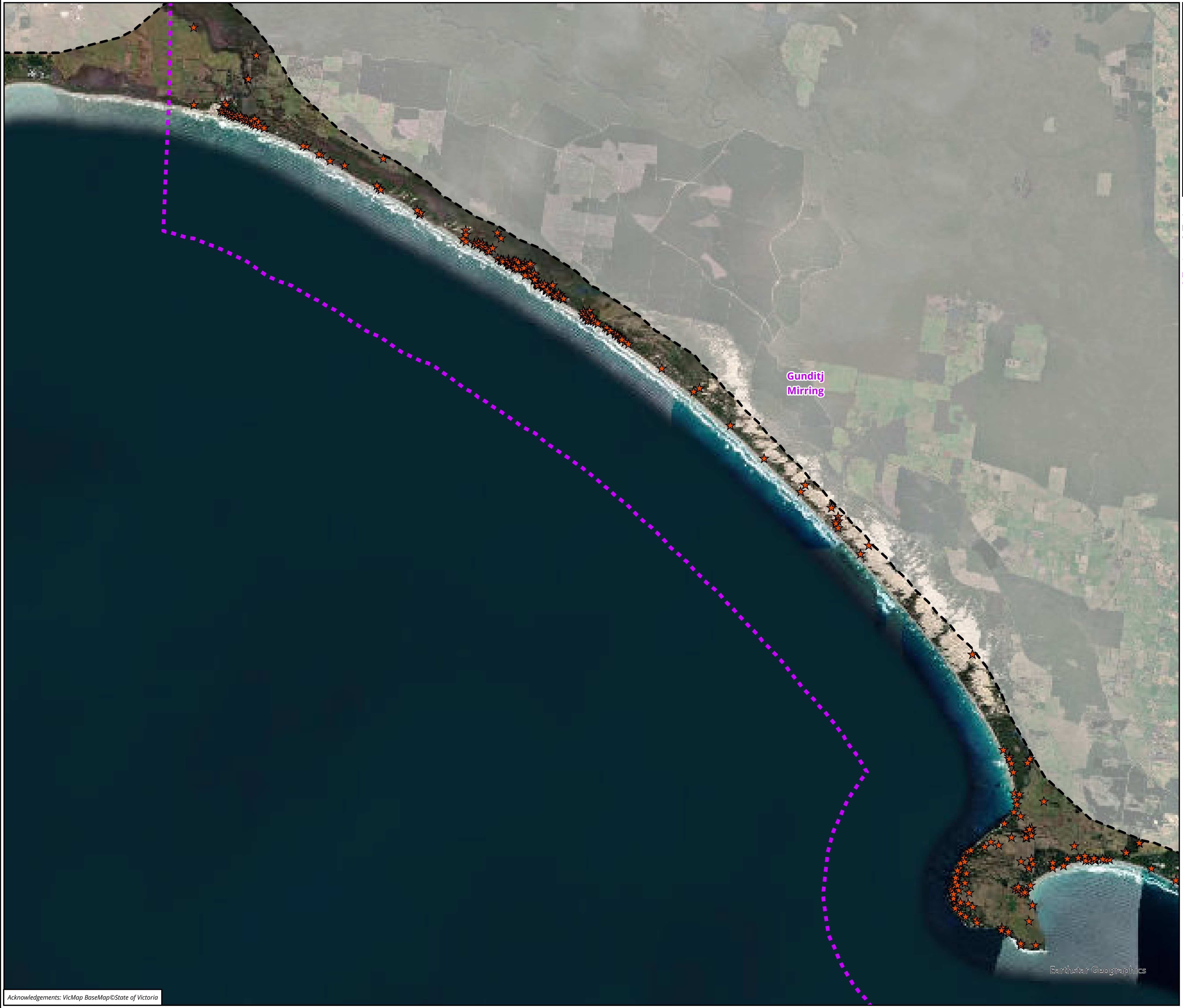

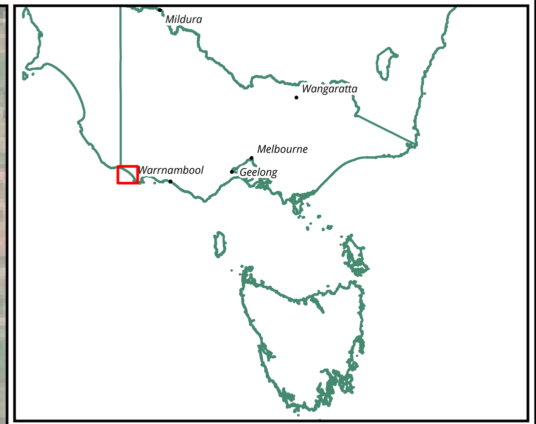

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Assessment area

Aborignal Cultural Heritage

RAP groups

VAHR Place

Figure x Location of Victorian Aboriginal Heritage Register places in the Assessment area

0 2 4 6 8 10

Kilometers

N

Scale: 1:200,000 @ A3

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

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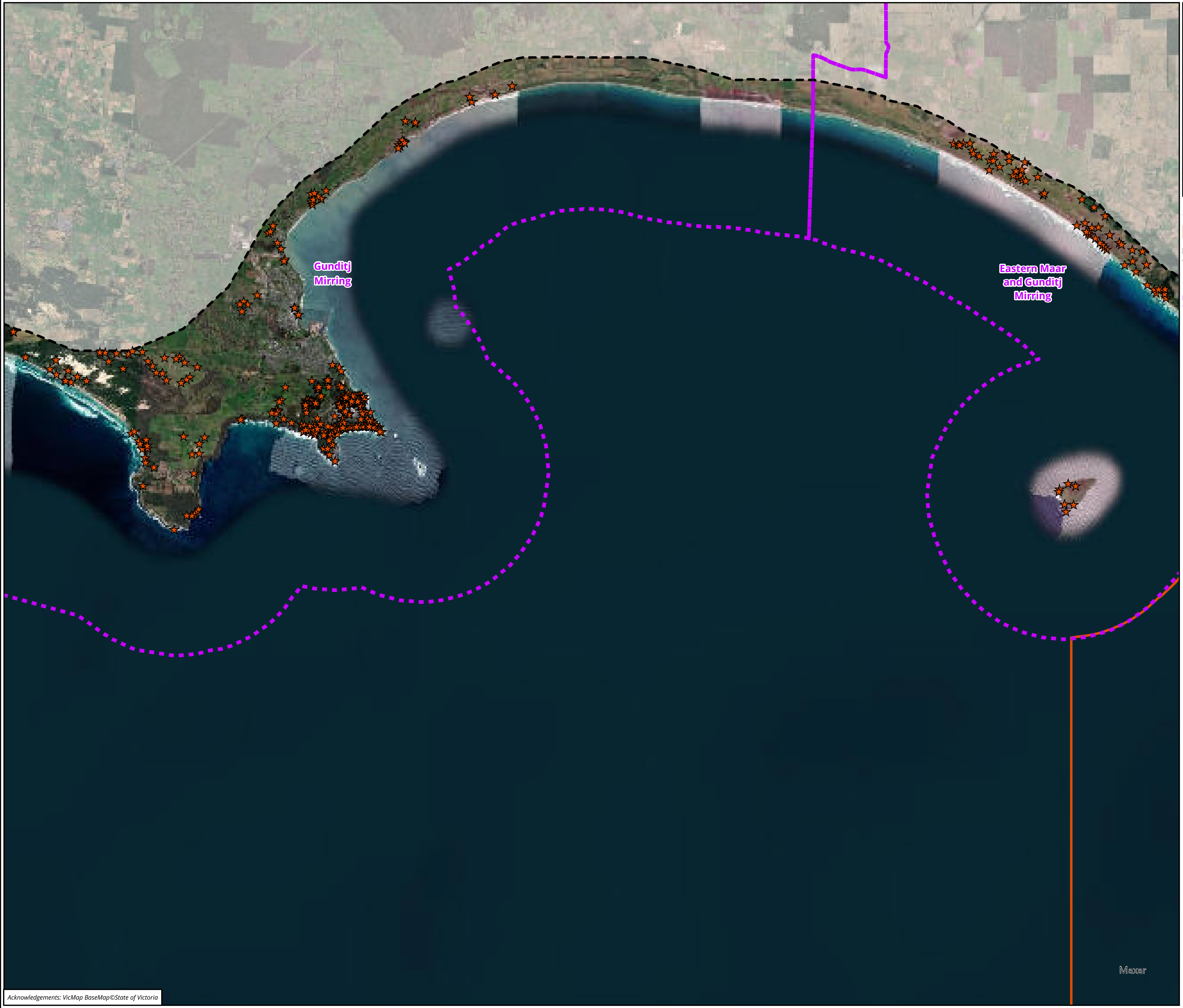

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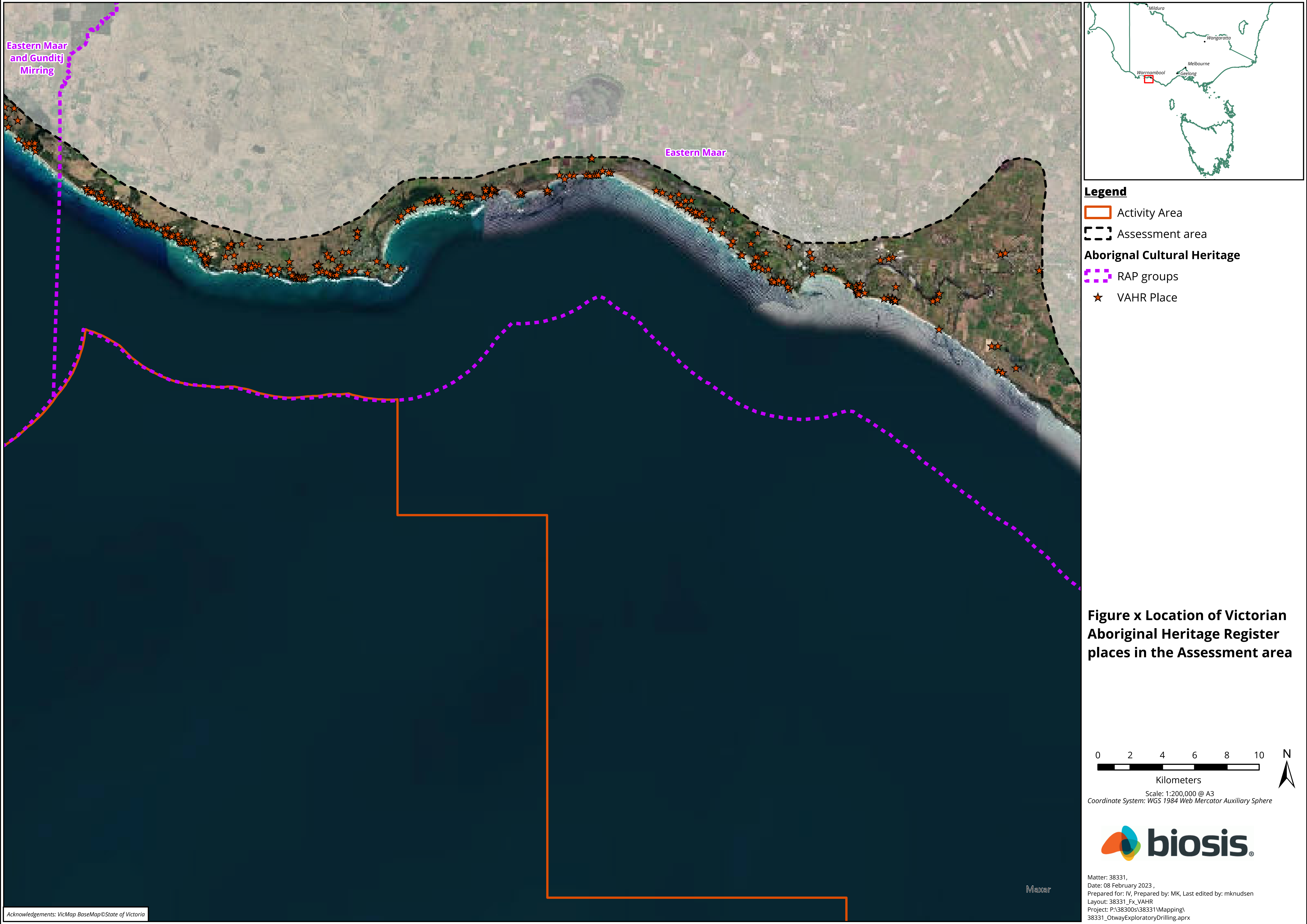

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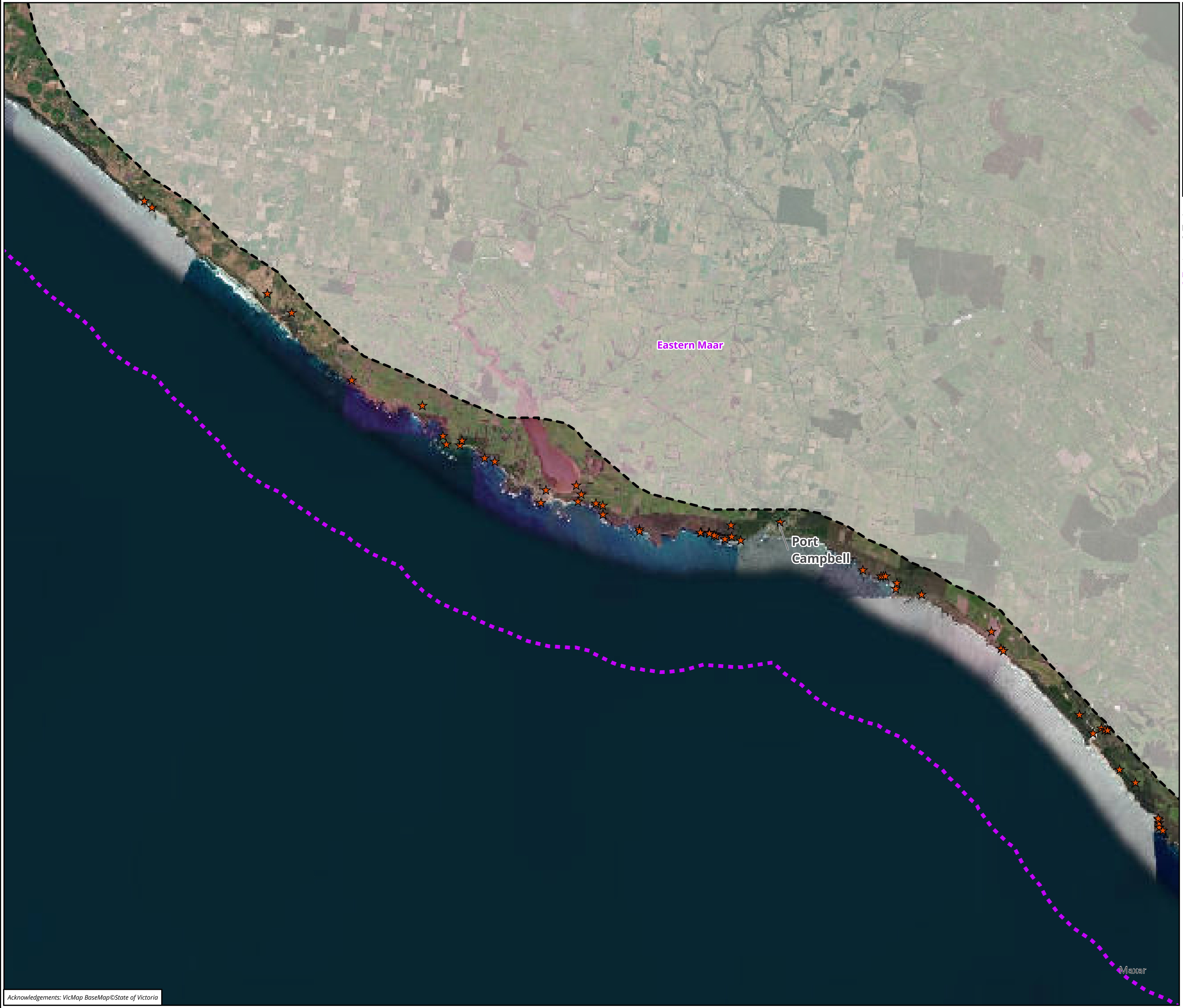

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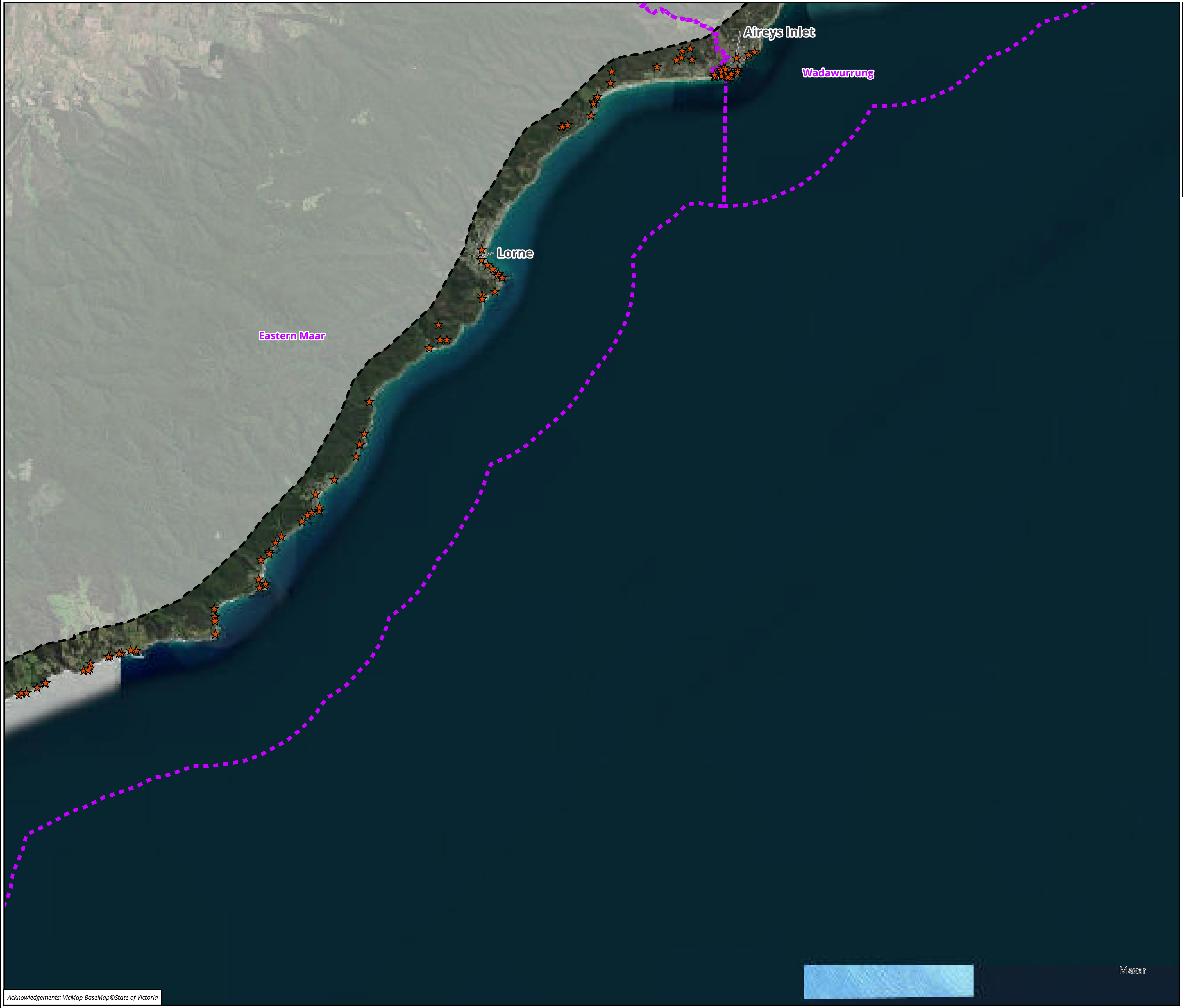

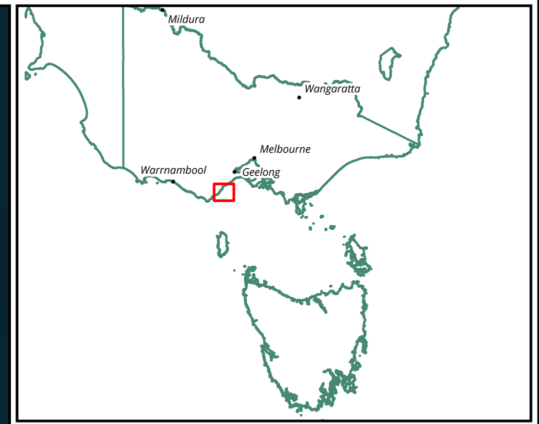

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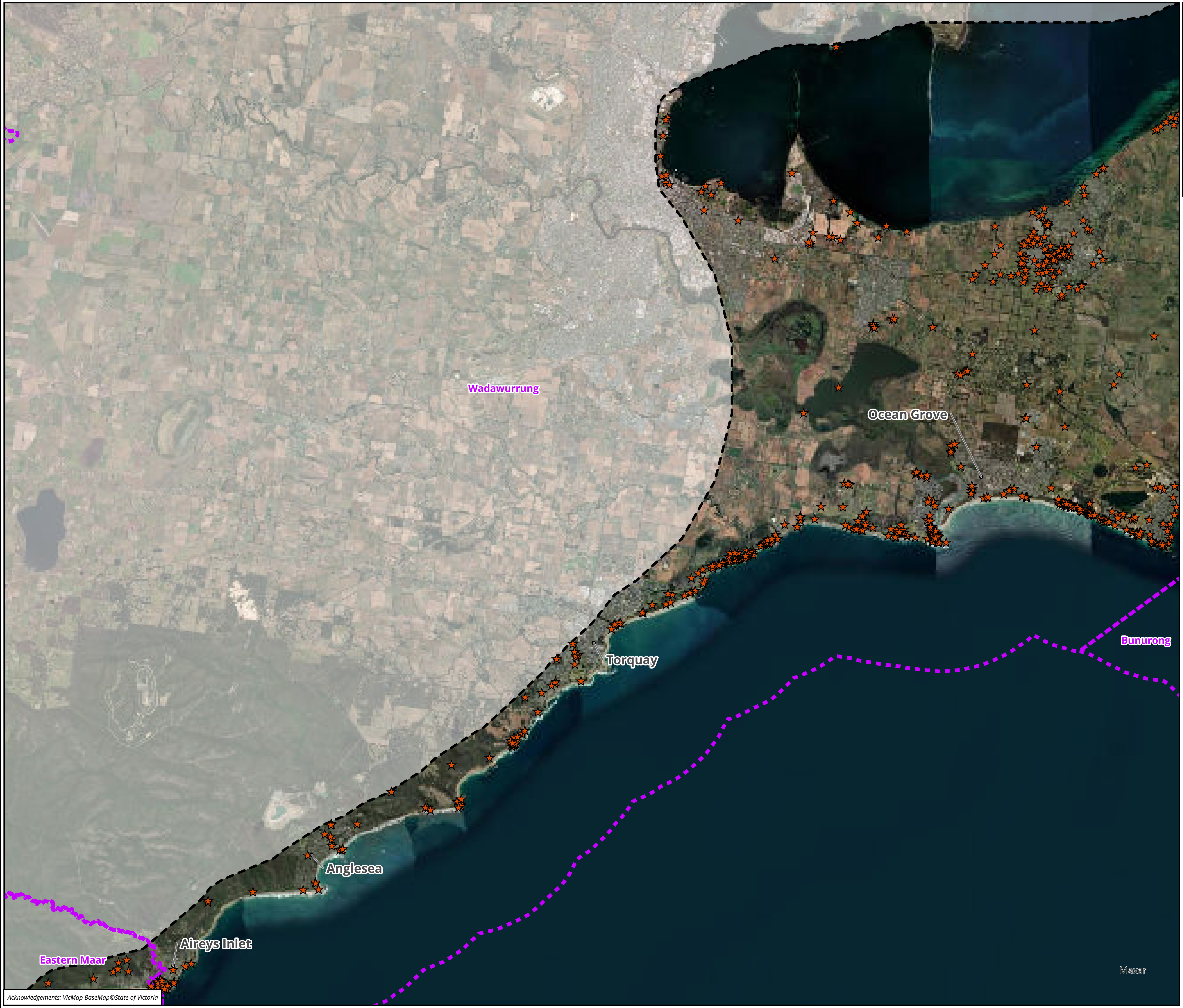

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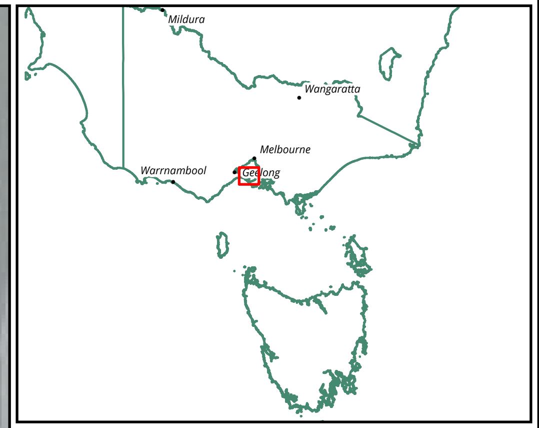

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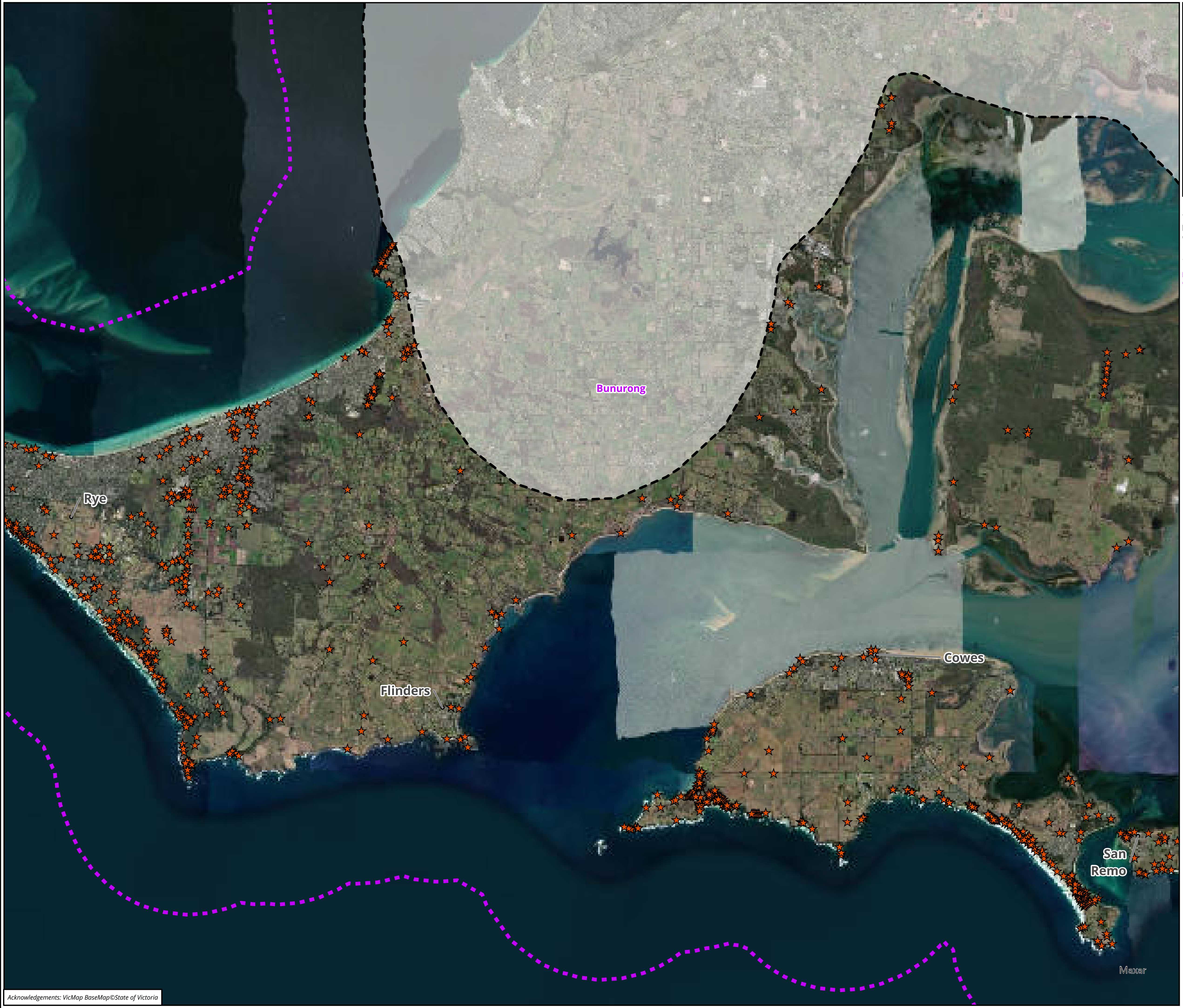

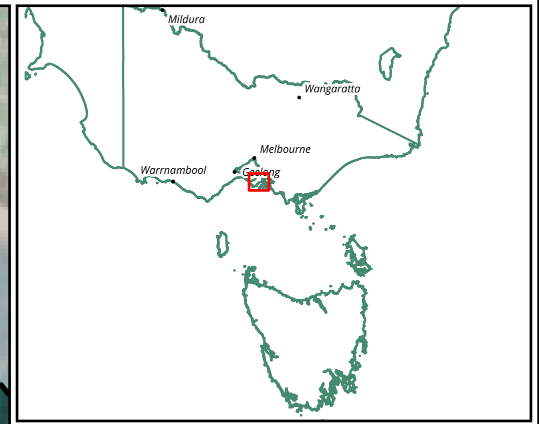

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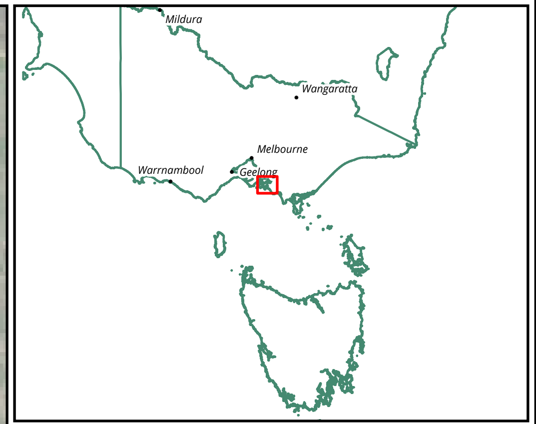

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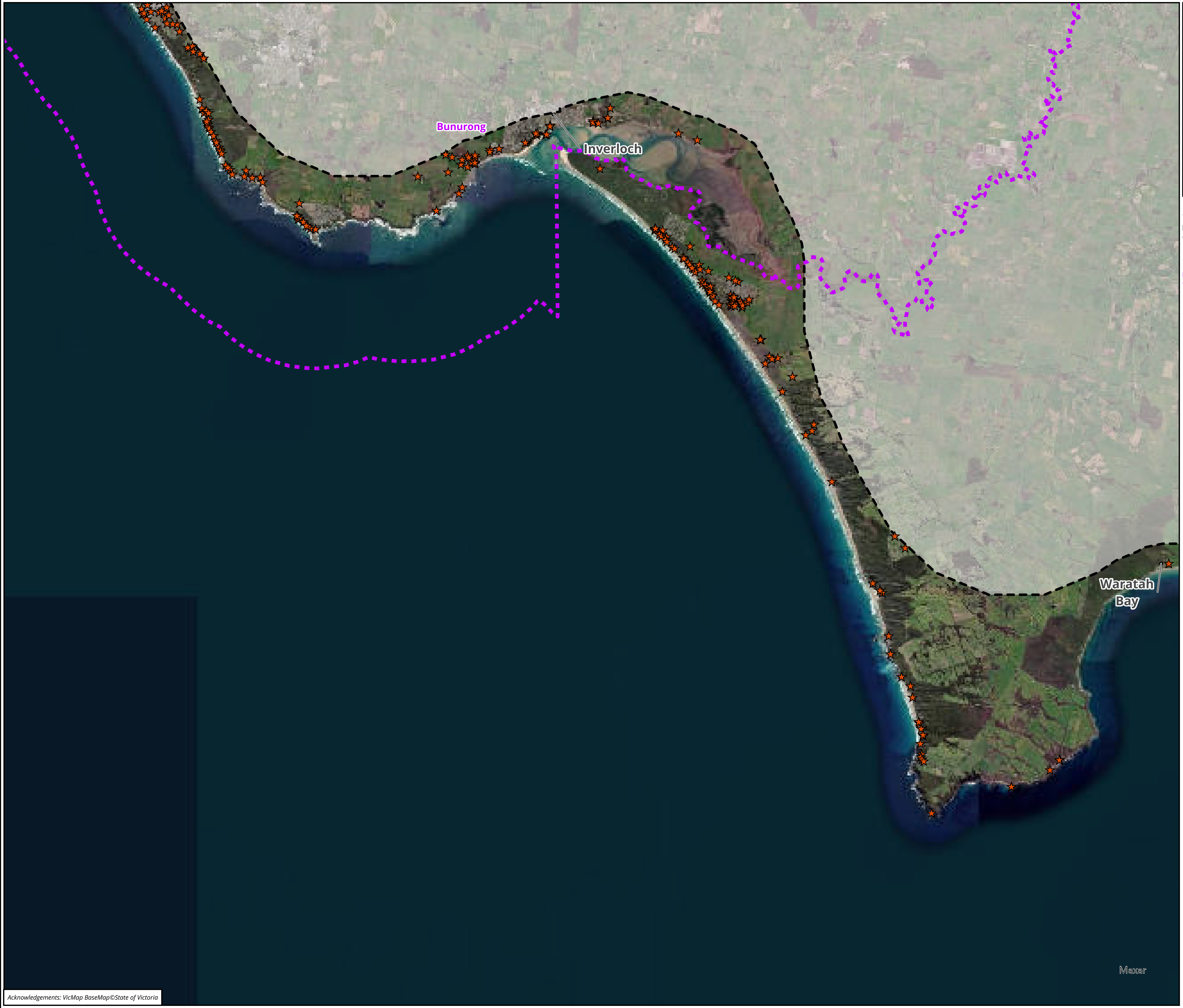

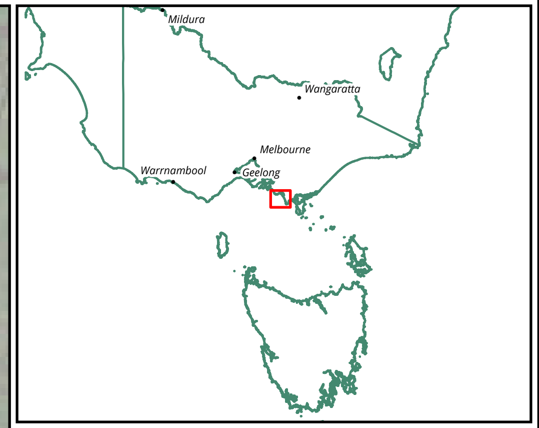

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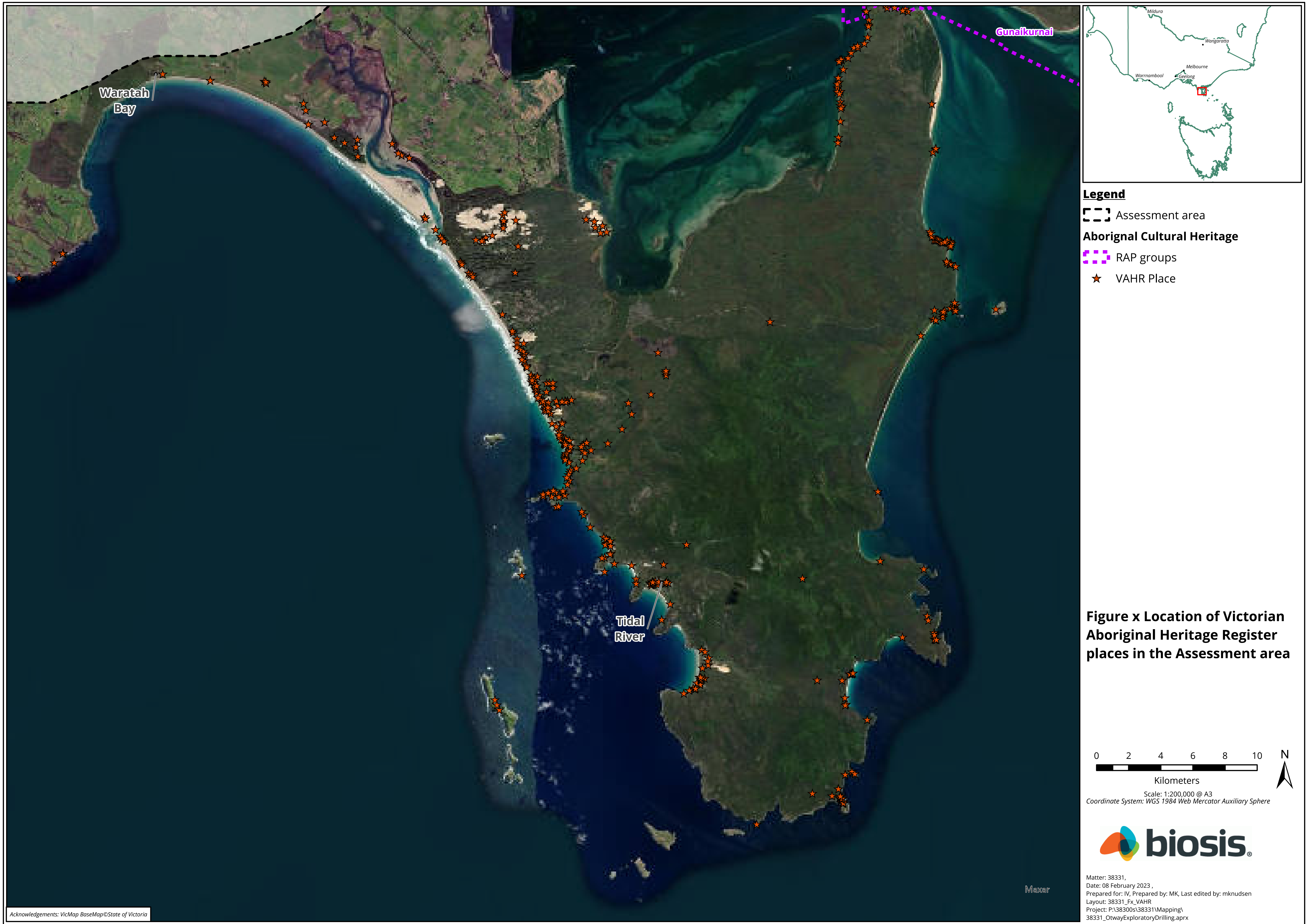

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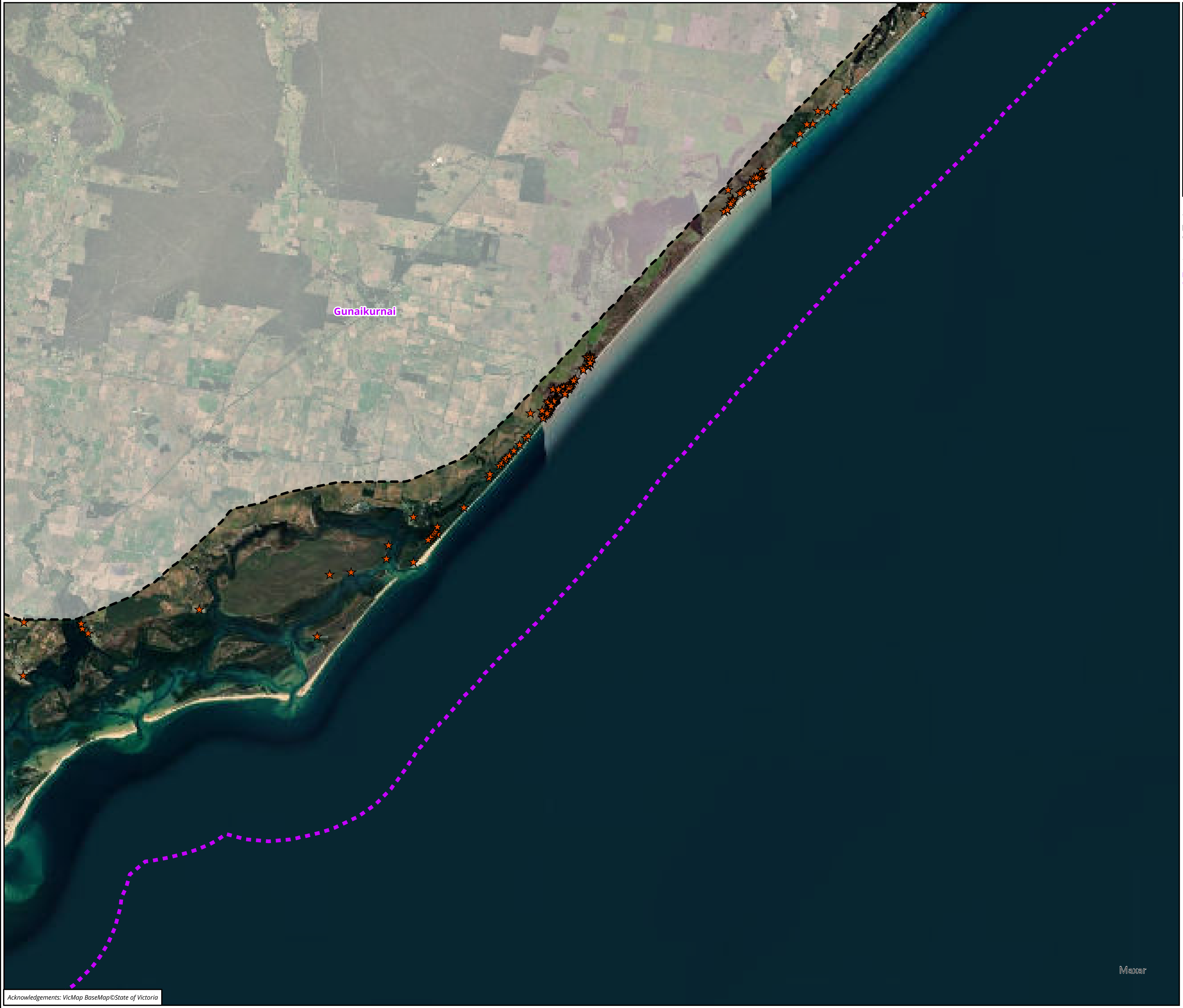

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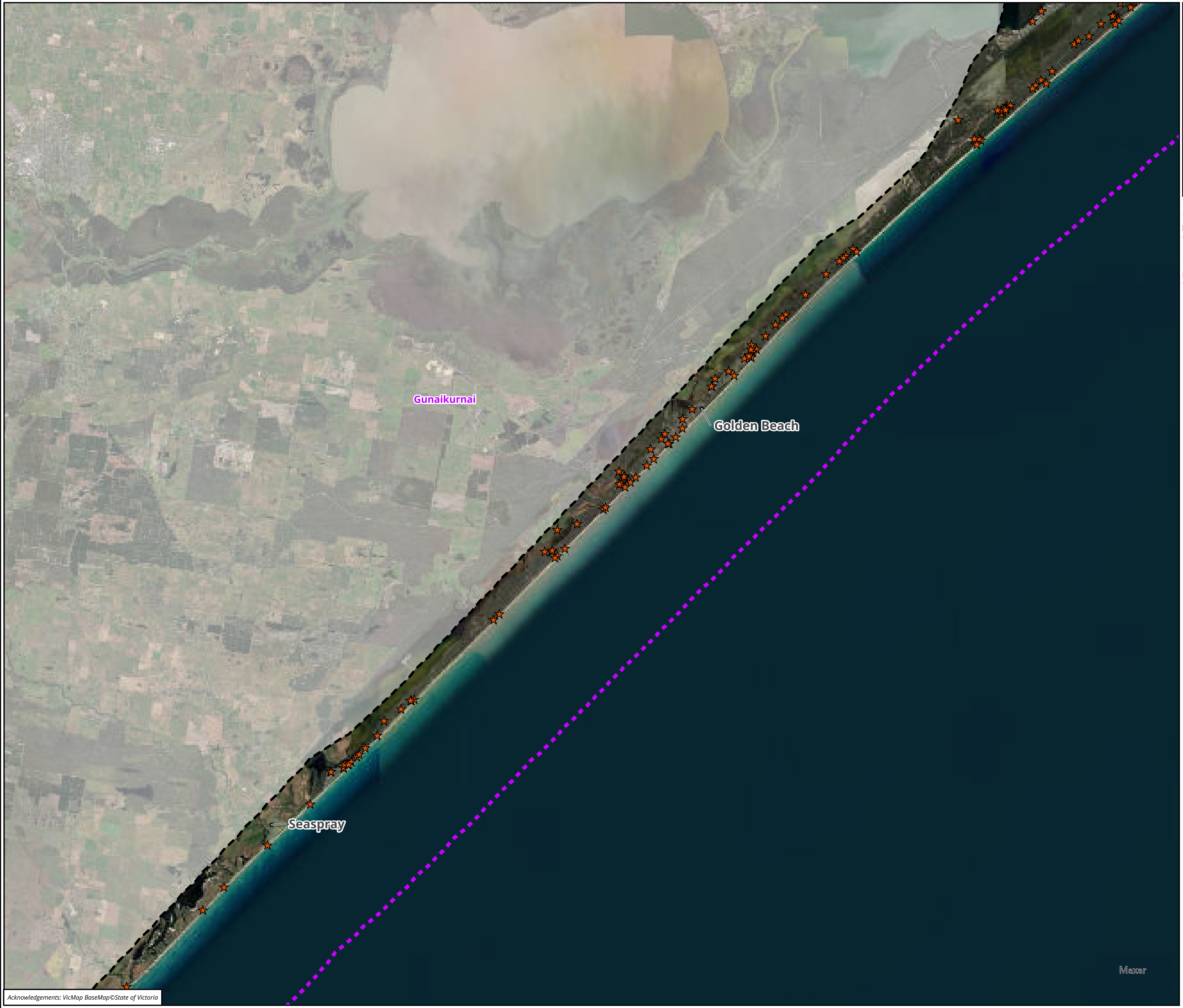

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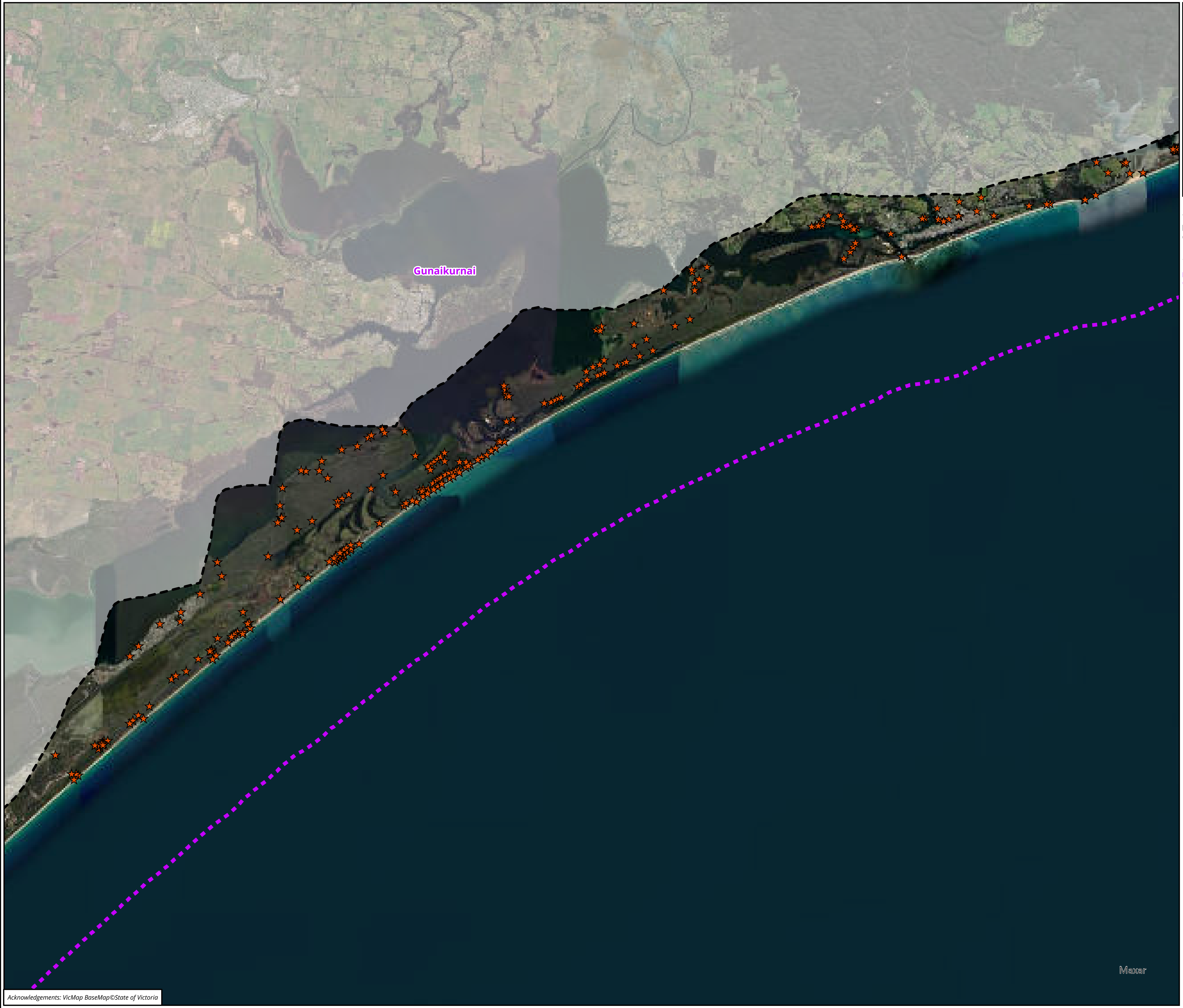

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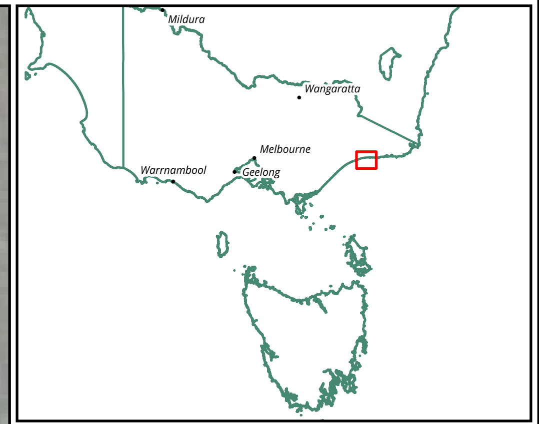

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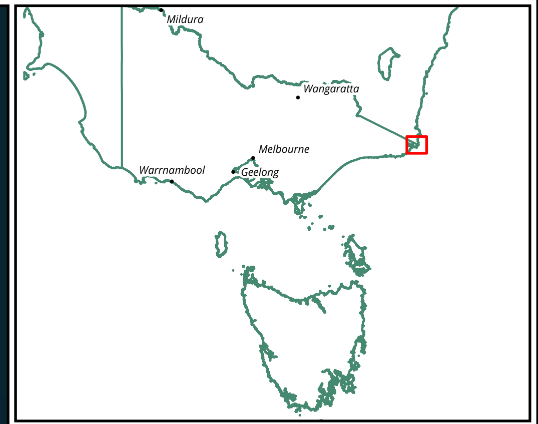

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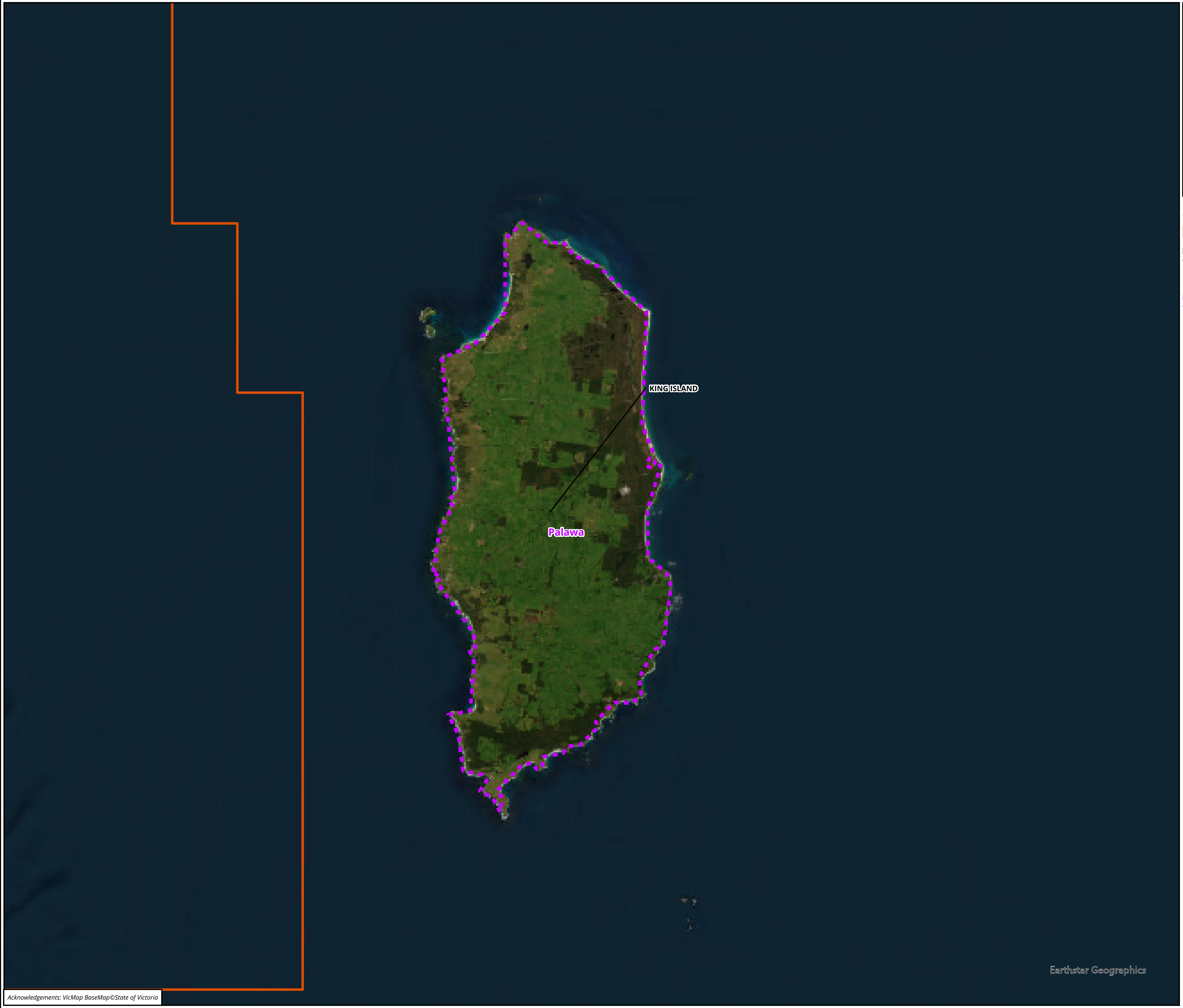

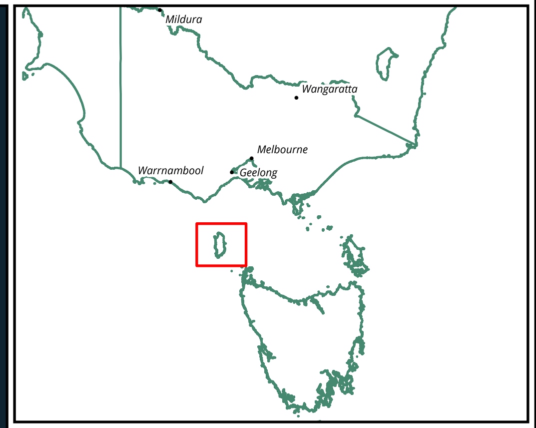

Legend

Activity Area

Assessment area

Aborignal Cultural Heritage

RAP groups

VAHR Place

Figure x Location of Victorian Aboriginal Heritage Register places in the Assessment area

0 5 10 15 20 25

Kilometers

N

Scale: 1:500,000 @ A3

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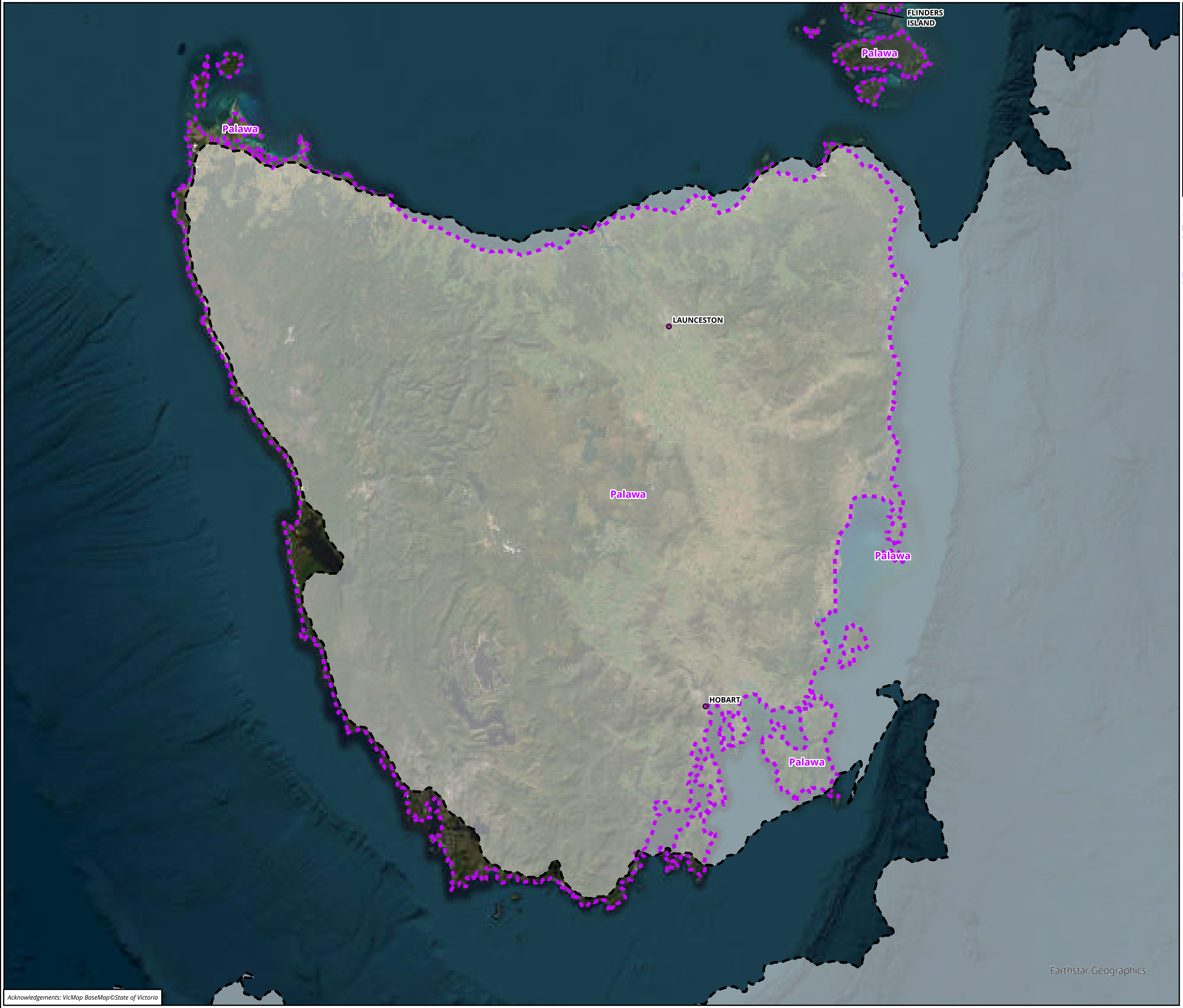

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Assessment area

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VAHR Place

Figure x Location of Victorian Aboriginal Heritage Register places in the Assessment area

0 20 40 60 80 100

Kilometers

N

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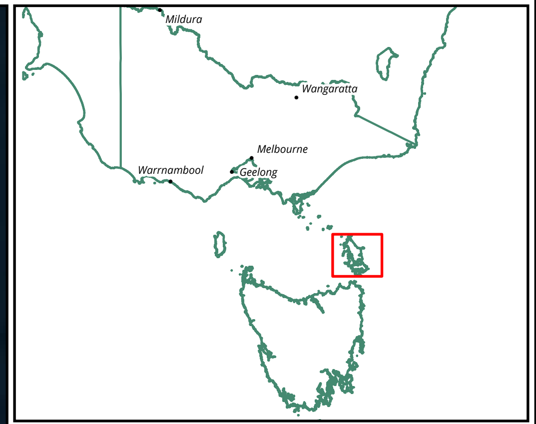

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Review of Oil Spill Modelling for the Regia 3D MSS

December 2023

S2 Services ENVIRONMENTAL CONSULTING

Table of Contents

1. Introduction

This technical review of oil spill modelling has been prepared to support CGG Services (Australia) Pty Ltd (CGG) in its impact and risk assessment process for the for the Regia Marine Seismic Survey (Regia MSS).

The Regia MSS Preliminary Environmental Impact and Risk Assessment (PIERA) used an Environmental Planning Area set at 155 km around the Activity Planning Area. This distance was selected using professional judgement and a review of previous impact and risk assessments for similar activities in the region. Further justifying the distance, the NERA Reference Case: Consequences analysis of an accidental release of diesel (NERA 2018) found that diesel spills under 700m^3 were reliably predicted to disperse within 150 km.

The PIERA recommended that following be undertaken: Review the NERA Reference Case 2018:1003 Consequence analysis of an accidental release of diesel and regionally relevant spill models from similar worst-case events to determine the applicability of the NERA Reference Case and, subsequently, the need for activity specific spill modelling. This report actions this recommendation to determine if the Environmental Planning Area is appropriate to approximate the spatial extent and variability of the receiving environment's contact with oil and subsequently inform risk evaluation and planning for oil spill response and monitoring, for the oil spill risk associated with the Regia MSS.

The initial spill modelling review was undertaken in April 2023 and updated in December 2023 prior to submission of the Regia MSS EP to NOPSEMA to consider any new oil spill modelling undertaken within the Otway Basin relevant to the review.

2. Review Recommendations

The following recommendations are made to CGG from this review:

- Basing the spill volume on the vessel's largest fuel tank is appropriate for the risk assessment.
- The NERA Reference Case distance of 150 km is appropriate for defining the furthest an oil spill could reach for spills up to 250 m^3 diesel spill that may occur within the Regia MSS Activity Planning Area.
- The Environmental Planning Area is appropriate for:
    - Estimating the spatial extent of oil exposure at the low thresholds (NOPSEMA 2019) for a 250 m^3 diesel spill within the Regia MSS Activity Planning Area.
    - Predicting oil exposure at King Island from a 250 m^3 diesel spill within the Regia MSS Activity Planning Area.
    - Predicting no oil exposure at the Tasmanian coast from a 250 m^3 diesel spill within the Regia MSS Activity Planning Area.
- CGG should keep the largest tank volume for vessels below 250 m^3.
- Once the seismic survey vessel and type of support vessels are contracted, undertake a review of the largest fuel tank volume. If the largest fuel tank volume is greater than 250 m^3 this oil spill modelling review should be redone to determine if the Environmental Planning Area is still appropriate. If it is not a management of change should be undertaken as per CGG's Implementation Strategy for the Regia MSS.

- If the Regia MSS Activity Planning Area changes, this oil spill modelling review should be redone to determine if the Environmental Planning Area is still appropriate. If it is not a management of change should be undertaken as per CGG's Implementation Strategy for the Regia MSS.

3. Regia MSS Spill Risk

The Regia MSS PIERA identified that whilst undertaking the activity, unplanned events may occur which result in a discharge of marine diesel. The Regia MSS Description of the Activity details that the worse-case credible oil spill risk of a vessel collision could result in the loss of diesel fuel from the vessels largest fuel tank. This assumption aligns with AMSA's National Plan Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities (AMSA 2015) that recommend that the indicative maximum credible spill volume for a vessel collision is the volume of the largest fuel tank.

The Regia MSS Description of the Activity details that the survey will be conducted using a purpose-built seismic survey vessel supported by up to three support vessels. CGG provided information on the proposed seismic survey vessel and type of support vessels that are likely to be used for the Regia MSS and it was identified that the largest fuel tank was 257.4 m^3.

4. Review Process

The review process focussed on oil spill modelling that is publicly available that met the following requirements:

- Surface release of marine diesel oil.
- Modelling thresholds align with those in the NOPSEMA Oil Spill Modelling Environment Bulletin April 2019.
- Modelling was used in an environment plan available on the NOSPEMA website.
- Modelled location is within the Regia MSS Activity Planning Area or > 20 km of the Regia MSS Activity Planning Area where the metocean conditions would be similar.

5. Review

The oil spill modelling that met the criteria in Section B11-4 are detailed in Table B11-51-. Marine diesel oil spill volumes ranged from 200 m^3 to 375 m^3 with all models using a release rate over 6 hours.

Distances to the modelling thresholds ranged considerable with the furthest distances typically to the east of the spill release location. This aligns with the major ocean currents in South-eastern Australia where the Leeuwin current from Western Australia flows south-east across the Great Australian Bight and reaches the west coast of Tasmania as the Zeehan Current (CoA 2015a).

Larger volumes modelled typically resulted in greater distances with entrained hydrocarbons travelling the furthest.

The NERA Reference Case (NERA 2018) detailed that, except for one outlier, there was no surface impact above thresholds beyond 150 km from the source of the spill for spills up to 700 m^3. This does not align with the modelling reviewed for which surface oil travelled between 10 to 300 km for spill volumes up to 373 m^3. Though it is noted that the moderate threshold for surface oil (NOPSEMA 2019) was used in the NERA Reference Case which would result in a smaller distance.

The NERA Reference Case (NERA 2018) also used 500 ppb for water column consequences of hydrocarbon release which does not align with NOPSEMA (2019) for which the low thresholds of 10 ppb for dissolved and entrained hydrocarbons are recommended for determining the spatial extent that may be exposed to a measurable level of hydrocarbons.

Only one spill volume of 250 m^3 was modelled (RPS 2019a) at the Annie-1 well location in 70 m water depth and 15 km from the Victorian coastline. The outputs from this modelling are relevant to the Regia MSS Activity Planning Area nearshore component and would be valid to estimate the distance to surface, dissolved and entrained low thresholds and oil contact to the mainland coast. The distances to these thresholds are within the Environmental Planning Area except for:

- The surface oil distance to the east of the oil spill modelling location was 193 km which is greater than the 150 km used for the Environmental Planning Area. However, the modelling used a threshold value of 0.1 g/m^2 which is lower than the current modelling threshold of 1 g/m^2 (NOSPEMA 2019) Based on a lower threshold was used and that the modelling at Minerva for Woodside (~ 10 km east of the Annie location) in a similar water depth (60 m) and distance to the Victorian coast (9 km) had a furthest distance of 75 km to the east for the low threshold surface oil, the 150 km used for the Environmental Planning Area in the nearshore Regia MSS Activity Planning Area would be appropriate.
- The moderate threshold for entrained oil was used for the modelling. This threshold is appropriate for informing the risk evaluation, but NOPSEMA (2019) recommend that the low threshold be used to define the area that may be exposed to oil above background levels. The moderate threshold was reached at a maximum distance of 60 km so even if this distance was double it would still be within the 150 km used for the Environmental Planning Area.

However, as the Regia MSS Activity Planning Area extends out ~ 120 km from the Victorian mainland and ~100 km from King Island the Annie-1 location may not accurately predict oil exposure to King Island or Tasmania.

Based on the following modelling that was undertaken closer to King Island and the Tasmanian mainland than the Regia MSS Activity Planning Area, the Regia MSS Activity Planning Area is appropriate for predicting low shoreline exposure to King Island and no shoreline exposure to the Tasmanian mainland from a 250 m^3 diesel spill over 6 hours:

- The ConocoPhillips Australia SH1 Pty Ltd modelling at Permit T/49P, 70 km west of King Island and 50 km south of Cape Otway, for a 350 m^3 diesel spill over 6 hours predicted no shoreline oil exposure for the Tasmanian mainland and a maximum probability of shoreline accumulation at the low threshold of 3%.
- The Beach Energy (Operations) Limited modelling at the Thylacine field located 70 km south of Port Campbell and 90 km northwest of King Island, for a 200 m^3 diesel spill over 6 hours predicted no shoreline oil exposure for the Tasmanian mainland and a maximum probability of shoreline accumulation at the low threshold of 2%.

- The Beach Energy (Operations) Limited modelling at the Thylacine field located 70 km south of Port Campbell and 90 km northwest of King Island, for a 300 m^3 diesel spill over 6 hours predicted no shoreline oil exposure for the Tasmanian mainland and a maximum probability of shoreline accumulation at the low threshold of 4%.

Table B11-t5-1: Oil Spill Modelling Outcomes

Company	EP	EP Status	Modelling Site	Approximate Modelling Location	Diesel Spill Volume	Water depth	Approximate Distance to Low Threshold			
							Surface Low - 1 g/m2	Shoreline Low - 10 g/m2	Dissolved Low- 10 ppb	Entrained Low - 10 ppb
ConocoPhillips Australia SH1 Pty Ltd	Otway Exploration Drilling Program Oil Spill Report – RPS 2023a	Public comment period recently closed	VIC/P79	50 km south of Port Campbell	350 m³ over 6 hours	93 m	52.8 km east 27.9 km west	390 km east 170 km west	125 km east 50 km northwest	700 km east 260 km west
ConocoPhillips Australia SH1 Pty Ltd	Otway Exploration Drilling Program Oil Spill Report – RPS 2023a	Public comment period recently closed	VIC/P79	30 km south of Warrnambool	350 m³ over 6 hours	74 m	59.9 km east 60 km west	430 km east 100 km west	159 km east 120 km west	446 km east 310 km east
ConocoPhillips Australia SH1 Pty Ltd	Otway Exploration Drilling Program Oil Spill Report – RPS 2023a	Public comment period recently closed	VIC/P79	25 km south of Yambuk	350 m³ over 6 hours	66 m	51.8 km east 30 km west	500 km east 160 km west	121 km east 120 km west	489 km east 430 km west
ConocoPhillips Australia SH1 Pty Ltd	Otway Exploration Drilling Program Oil Spill Report – RPS 2023a	Public comment period recently closed	VIC/P79	10 km south of Yambuk	350 m³ over 6 hours	45 m	62.3 km east 50 km west	470 km east 100 km west	119 km east 80 km west	598 km east 540 km west
ConocoPhillips Australia SH1 Pty Ltd	Otway Exploration Drilling Program Oil Spill Report – RPS 2023	Public comment period recently closed	Permit T/49P	70 km west of King Island 50 km south of Cape Otway	350 m³ over 6 hours	93 m	49.8 km east 10 km west	160 km west 250 km east	92 km east 50 km west	648 km east 250 km west
Woodside Energy (Victoria) Pty Ltd	Minerva P&A Oil spill report not provided with EP	Under Assessment	Minerva	9 km southwest of Port Campbell	330 m³ over 6 hours	60 m	75 km east 40 km west	200 km west 500 km east	150 km east 90 km west	450 km east 225 km west
Cooper Energy (CH) Pty. Ltd	Otway Offshore Operations - Casino, Netherby & Henry Revision Oil Spill Report – RPS 2019a	Under Assessment	Annie	15 km southeast of Port Campbell	250 m³ over 6 hours	70 m	145 km west 193 km east	75 km west 75 km east	42 km west Low - 62 km east	Used 100 ppb 51 km northwest 60 km southeast
Beach Energy (Operations) Limited	Thylacine Installation and Commissioning Oil Spill Report – RPS 2022	Accepted	Thylacine	70 km south of Port Campbell 65 km southwest of Cape Otway 90 km northwest of King Island	300 m³ over 6 hours	100 m	20 km west 39.3 km east	Discrete locations King Island Cape Otway	40 km west 90 km east	50 km west 230 km east
Beach Energy (Operations) Limited	Offshore Gas Victoria Geophysical and Geotechnical Seabed Survey Thylacine Installation and Commissioning Oil Spill Report – RPS 2022	Accepted	Thylacine	70 km south of Port Campbell 65 km southwest of Cape Otway 90 km northwest of King Island	200 m³ over 6 hours	100 m	15 km west 36.5 km east	Discrete locations King Island	20 km west 60 km east	50 km west 180 km east
Beach Energy (Operations) Limited	Otway Offshore Operations Oil Spill Report – RPS 2019b	Accepted	Artisan	32 km south of Port Campbell	300 m³ over 6 hours	60 m	93 km east 40 km west	No shoreline contact	Used 6 ppb 80 km west 160 km east	400 km east 400 km west
Beach Energy (Operations) Limited	Otway Phase 5 Early Dive Installation Campaign Oil Spill Report – RPS 2019a	Accepted	Thylacine	70 km south of Port Campbell 65 km southwest of Cape Otway 90 km northwest of King Island	300 m³ over 6 hours	100 m	Applied the Artisan modelling from the Otway Offshore Operations EP			
ConocoPhillips Australia SH1 Pty Ltd	Sequoia 3D Marine Seismic Survey Oil Spill Report – RPS 2020	Accepted	Seismic Survey Operational Area	23.5 km west of King Island 26 km south of Victorian coast	373 m³ over 6 hours	70 to 1,000 m	300 km east 20 km west	300 km east	251 km ENE	742 km ENE

6. References

AMSA. 2015. Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities. Australian Maritime Safety Authority

CoA. 2015a. South-East Marine Region Profile. As description of the ecosystems, conservation values and use of the South-east Marine Region. Commonwealth of Australia.

RPS. 2019a. Annie-1 Oil Spill Modelling. Report MAQ0748J.

RPS. 2019b Beach Energy Artisan-1 Exploration Well Oil Spill Modelling. Report MAQ0828J.

RPS. 2020. Sequoia 3D Marine Seismic Survey Oil Spill Modelling. Report MAQ0953J.

RPS. 2022. Thylacine Installation and Commissioning – Phase 5 Oil Spill Modelling. Report MAQ1217J.

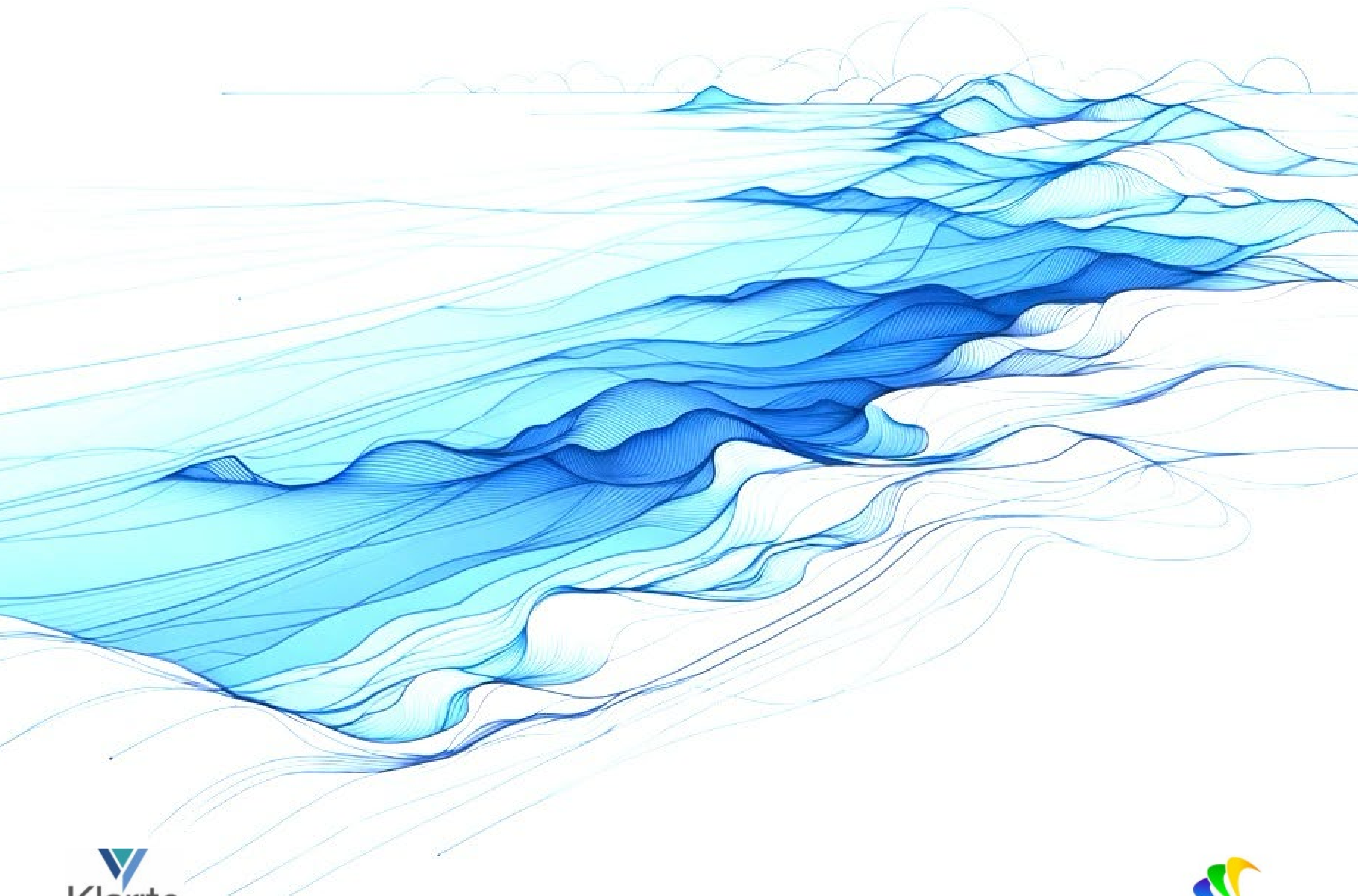
RPS. 2023. ConocoPhillips Exploration Permit T/49P Marine Diesel Spill Modelling. Report MAQ1155J.

Regia MSS Maps

Appendix B12: REG-EP-040-B12

Rev 2

May 2024



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1 Regia MSS Map Register

Revisions highlighted in red to show updated drawings or new drawings added for current submission

Map Number	Map Title	Current Rev	PC Rev
MAP-REG-EPM-001	Regia MSS - Southern Right Whale Reproductive BIA	C	C
MAP-REG-EPM-002	Regia MSS - Southern Right Whale Reproductive BIA with 15km Buffer with previous Activity Planning Area	D	C
MAP-REG-EPM-003	Regia MSS - Bonney Coast Upwelling Key Ecological Feature	C	B
MAP-REG-EPM-004	Regia MSS - West Tasmanian Canyons Key Ecological Feature	B	B
MAP-REG-EPM-024	Regia MSS - Australian Sea Lion Foraging	A	A
MAP-REG-EPM-030	Regia MSS - Fisher One Impact Management Zone	B	B
MAP-REG-EPM-031	Regia MSS - 50m Bathymetry	A	A
MAP-REG-EPM-032	Regia MSS - Giant Crab 2011 2021 Days Fished	A	A
MAP-REG-EPM-033	Regia MSS - Giant Crab 2011 2021 - Blocks	A	A
MAP-REG-EPM-034	Regia MSS - Giant Crab 2018-2022 - Days Fished	A	A
MAP-REG-EPM-035	Regia MSS - Giant Crab 2018-2022 - Blocks	A	A
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MAP-REG-EPM-057	Regia MSS - White Shark Biologically Important Areas	A	A
MAP-REG-EPM-058	Regia MSS - Orange Bellied Parrot Migration Route	B	A
MAP-REG-EPM-059	Regia MSS - Antipodean Albatross Biologically Important Areas	A	A
MAP-REG-EPM-060	Regia MSS - Black Browed Albatross Biologically Important Areas	A	A
MAP-REG-EPM-061	Regia MSS - Campbell Albatross Biologically Important Areas	A	A
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MAP-REG-EPM-065	Regia MSS - Short Tailed Shearwater Biologically Important Areas	A	A
MAP-REG-EPM-066	Regia MSS - Shy Albatross Foraging Biologically Important Areas	A	A
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Map Number	Map Title	Current Rev	PC Rev
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MAP-REG-EPM-086	Regia MSS - Australian Marine Parks - Distances from Operational area	**A**	
MAP-REG-EPM-087	Regia MSS - 12 Apostles Marine Park 5km Buffer - distance from operational area	**A**	

2 Public Comment

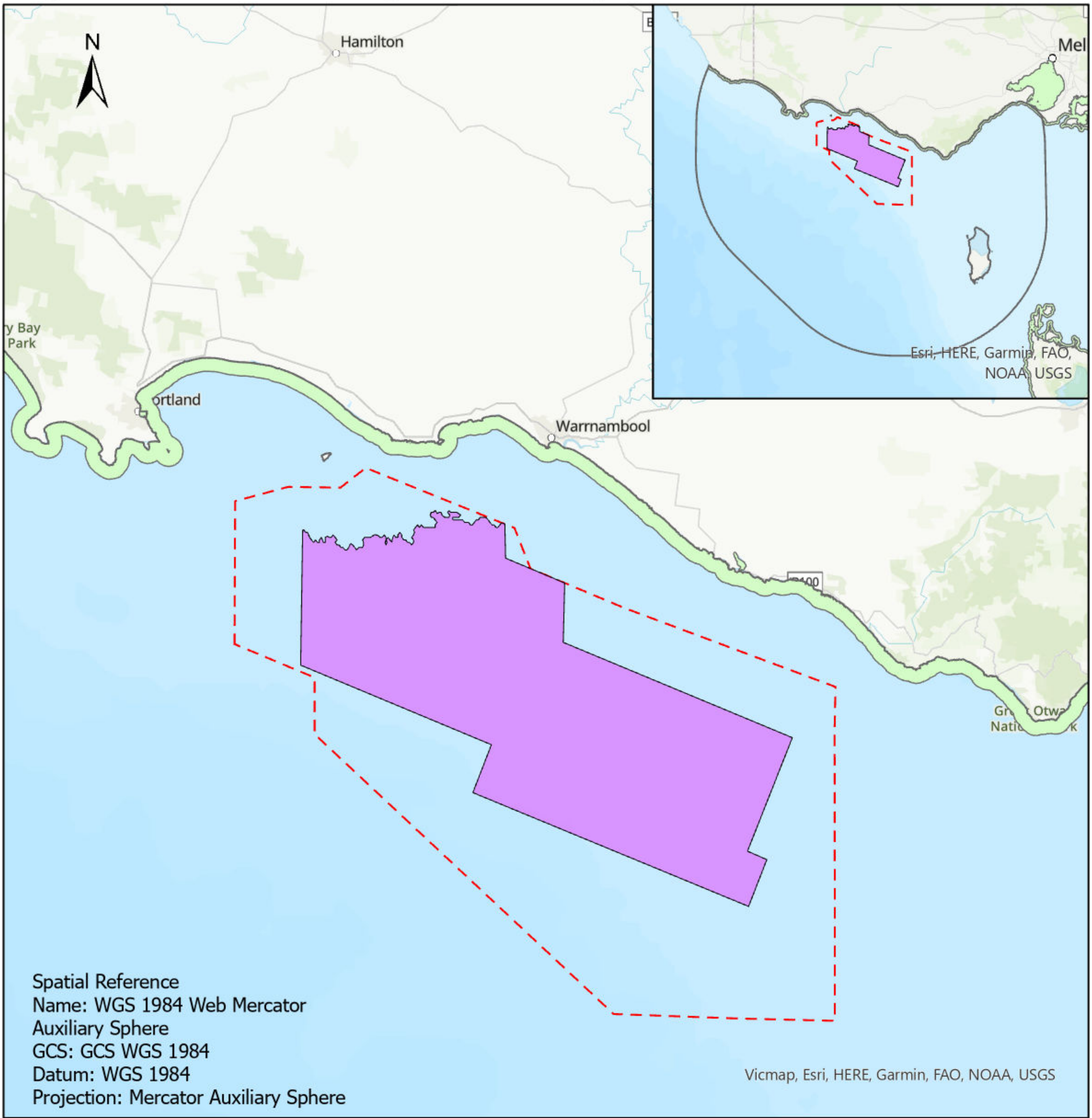
The following feedback was received during the public comment period starting 25 January 2024 which ran for 30-days. Table B12-2 21 shows how this feedback has been incorporated into the environmental assessments.

Table B12-2-1: Public comment input into the preparation of the EP

Matter	Matter ID	Changes made arising from public comment
Matter: Unacceptable impacts and risks to Marine Parks and protected areas	E01	CGG has considered these claims and has updated figures in Appendix B12 to include distances from operational and activity action zone areas to marine parks, reserves, and KEFs thereby providing further context of separation distances; and has calculated the percentage overlap of the Regia Operational Area with Bonney Coast Upwelling KEF.
Matter: Acknowledgement of breeding colonies	B02	The noise EMBA has been added to Figure MAP-REG-EPM-064 to show that the declared Little penguin BIAs occur outside of the noise EMBA.
Matter: Surveying previously surveyed areas is unnecessary	I24	CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above but has undertaken to update EP Appendix B12 (Regia MSS Maps), namely Figures MAP-REG-EPM-052 (2D NOPIMS) and MAP-REG-EPM-053 (3D Surveys) to show the overlap of the operational and activity action zone and previous survey data in response to these claims.

3 Maps

Regia MSS - Southern Right Whale Reproduction BIA



Legend

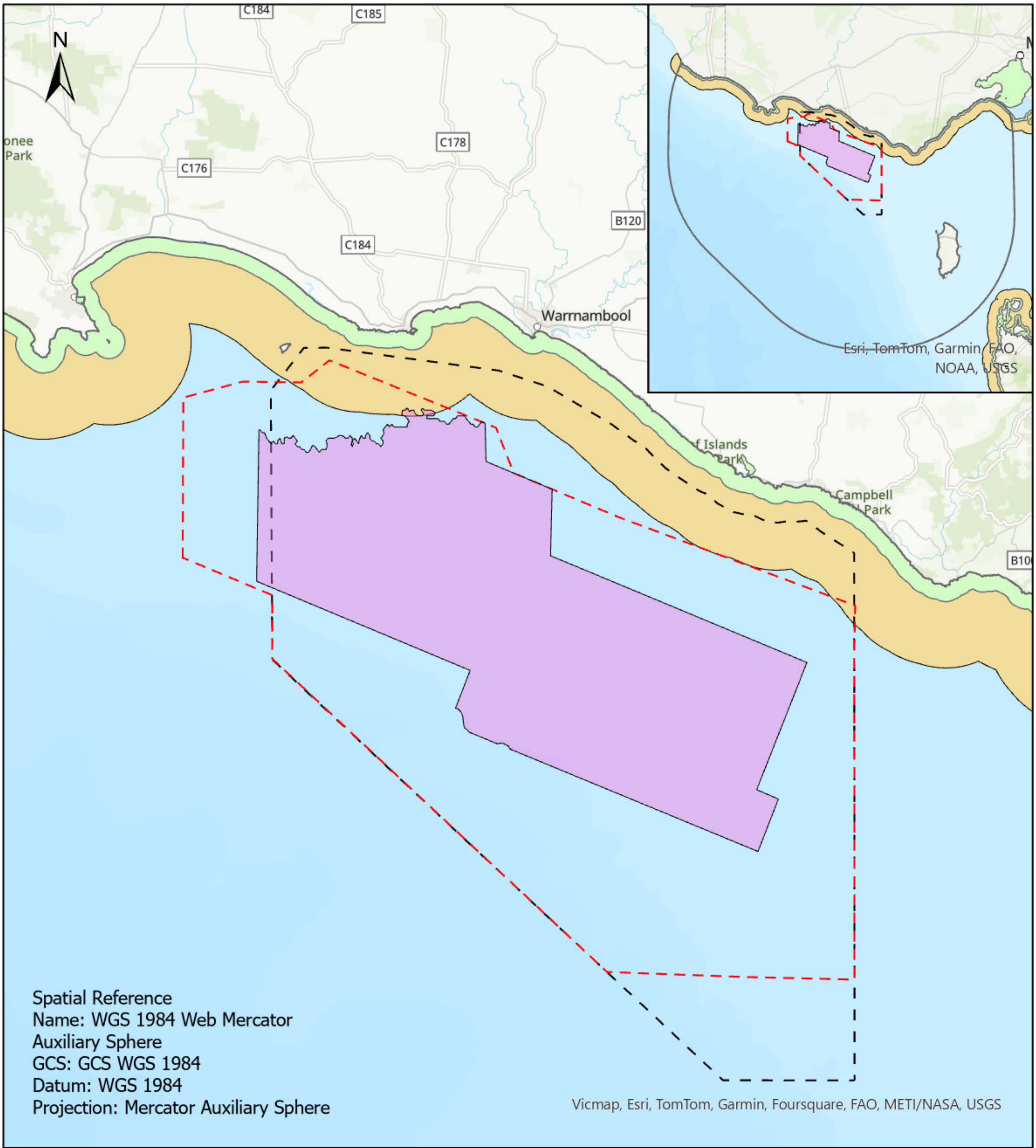
- Active Source Area
- Operational Area
- Environmental Planning Area
- Southern Right Whale Reproduction BIA

0 10 20 40 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-001_C

Regia MSS - Southern Right Whale Reproduction BIA with 15km Buffer with previous Activity Planning Area



Legend

- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Environmental Planning Area final
- Southern Right Whale Reproduction BIA
- 15km Buffer

0 5 10 20 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-002_D

Regia MSS - Bonney Coast Upwelling Key Ecological Feature

Legend

- Bonney Coast Upwelling Key Ecological Feature
- Active Source Area
- Operational Area
- Environmental Planning Area

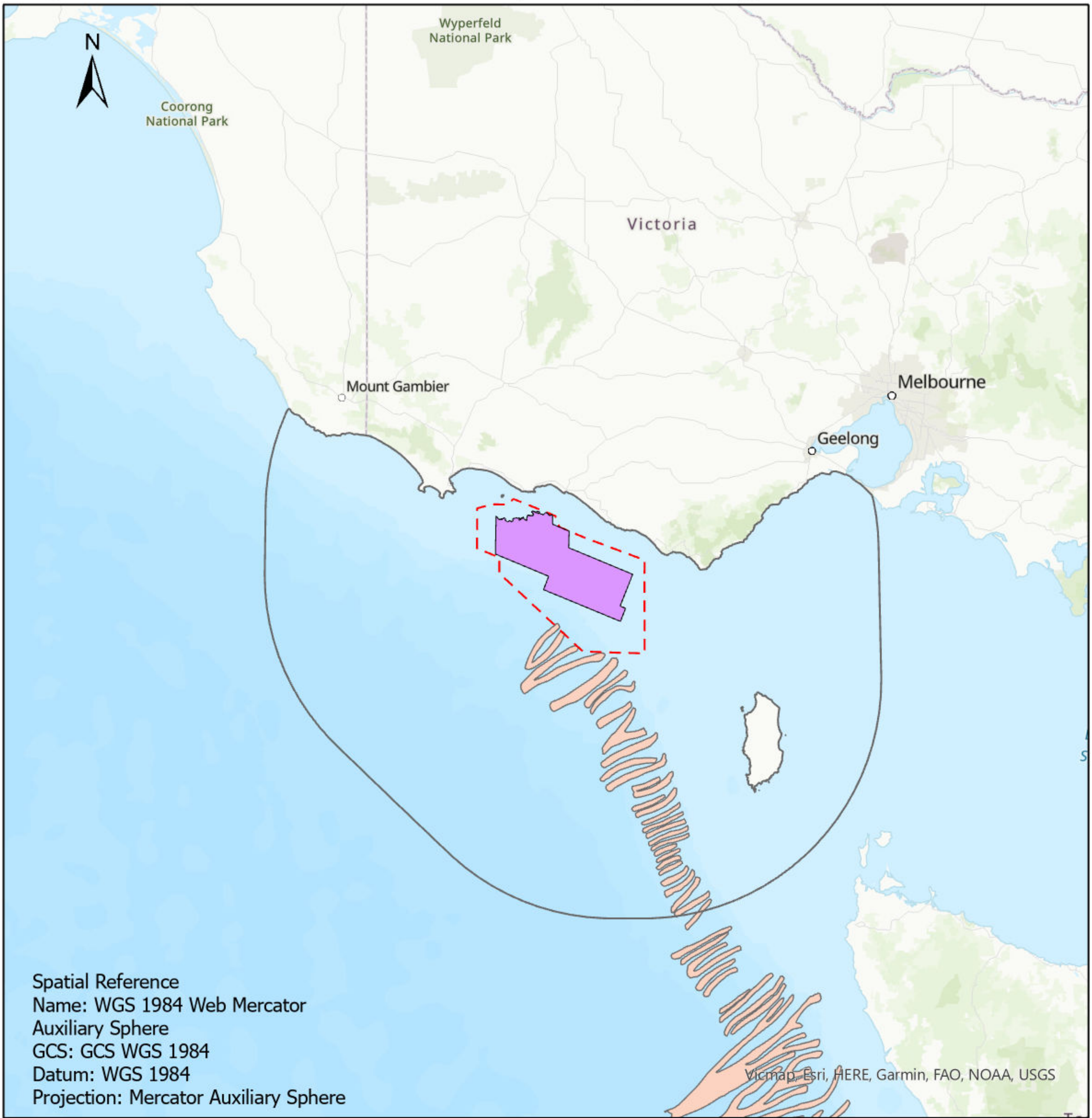
0 35 70 140 Kilometers

The Regia MSS operational area overlaps 1.21% of the Bonney Coast Upwelling Key Ecological Feature

REGIA Marine Seismic Survey

MAP-REG-EPM-002_C

Regia MSS - West Tasmanian Canyons Key Ecological Feature



Legend

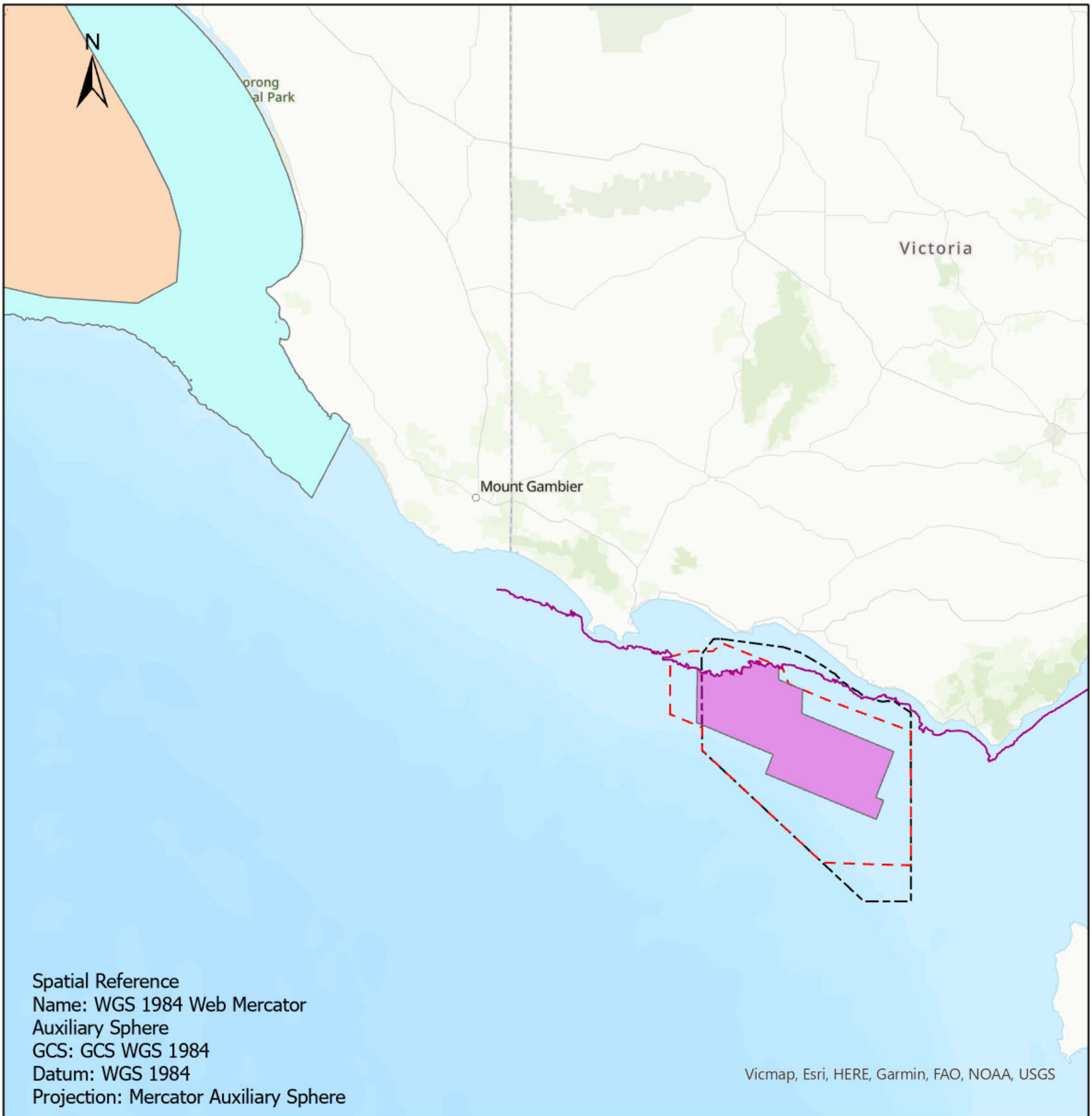
- West Tasmanian Canyons Key Ecological Feature
- Active Source Area
- Operational Area
- Environmental Planning Area

0 35 70 140 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-004_B

Regia MSS - Australian Sea Lion Foraging



Legend

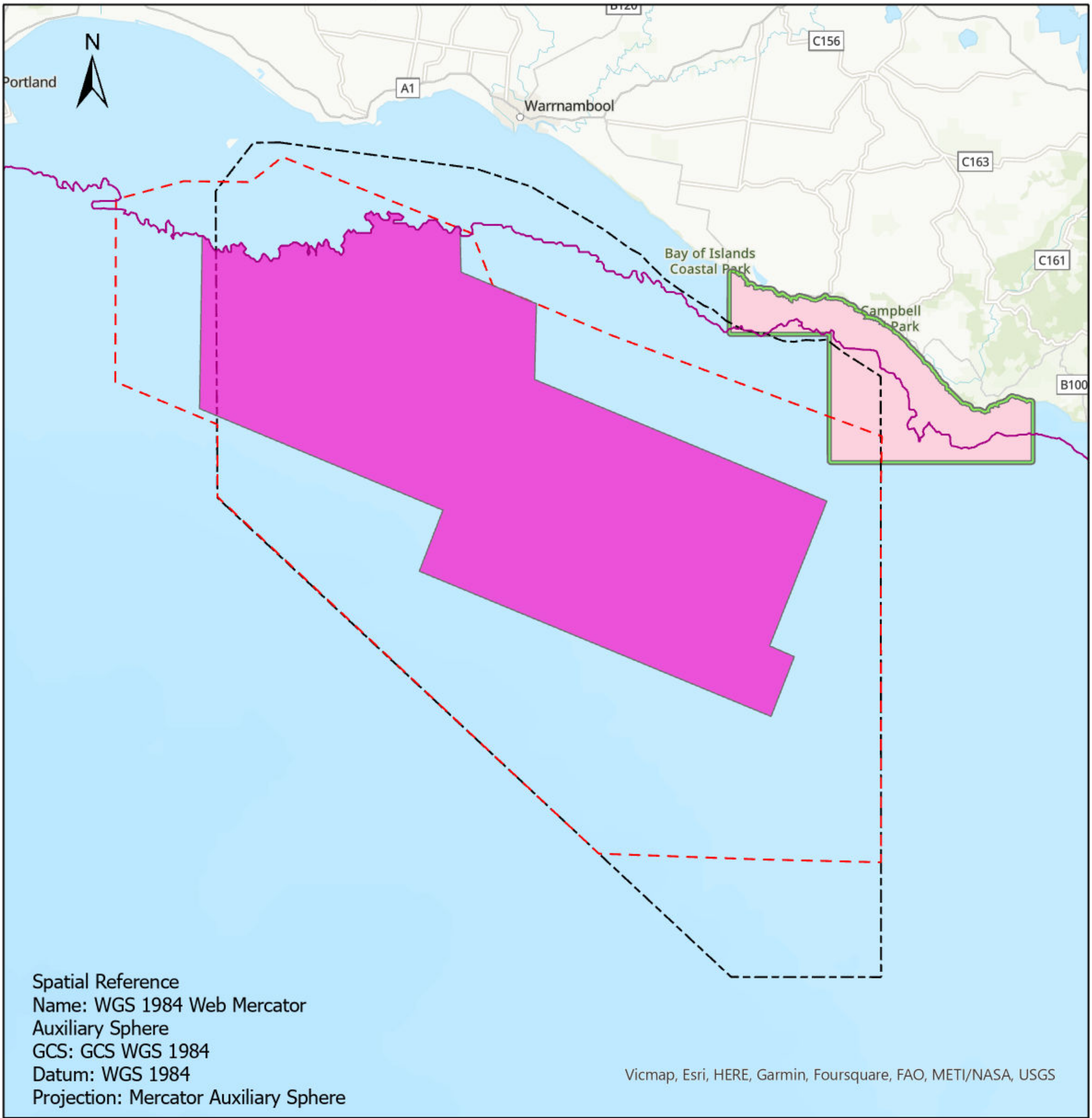
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Australian Sea Lion Foraging male/female
- Australian Sea Lion Male Foraging
- 50m Contour

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-024_A

Regia MSS - Fisher One Impact Management Zone



Legend

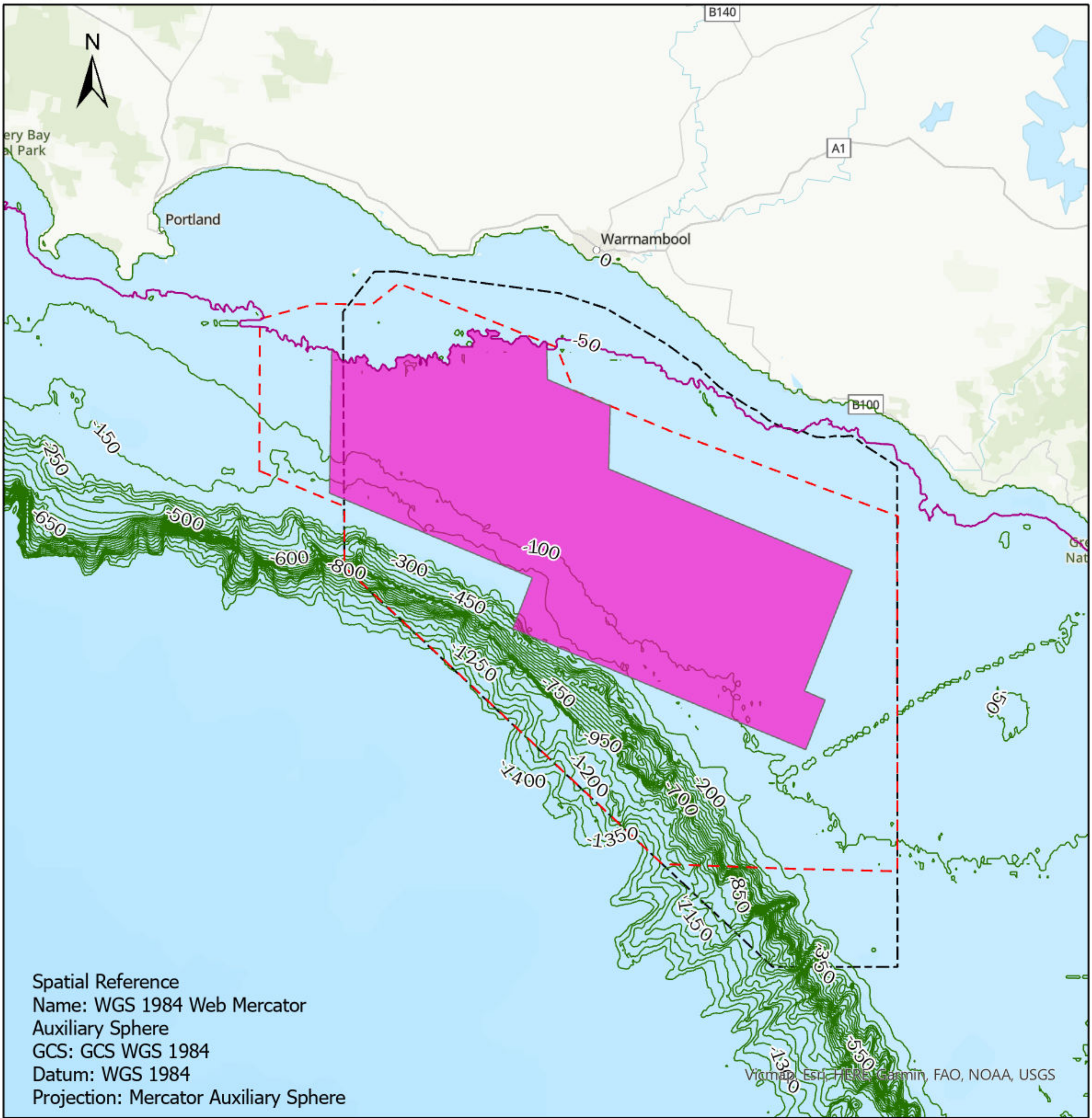
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour
- Fisher One Impact Management Zone
- Fisher One Impact Zone 500m Buffer

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-030_B

Regia MSS - 50 Meter Bathymetry



Legend

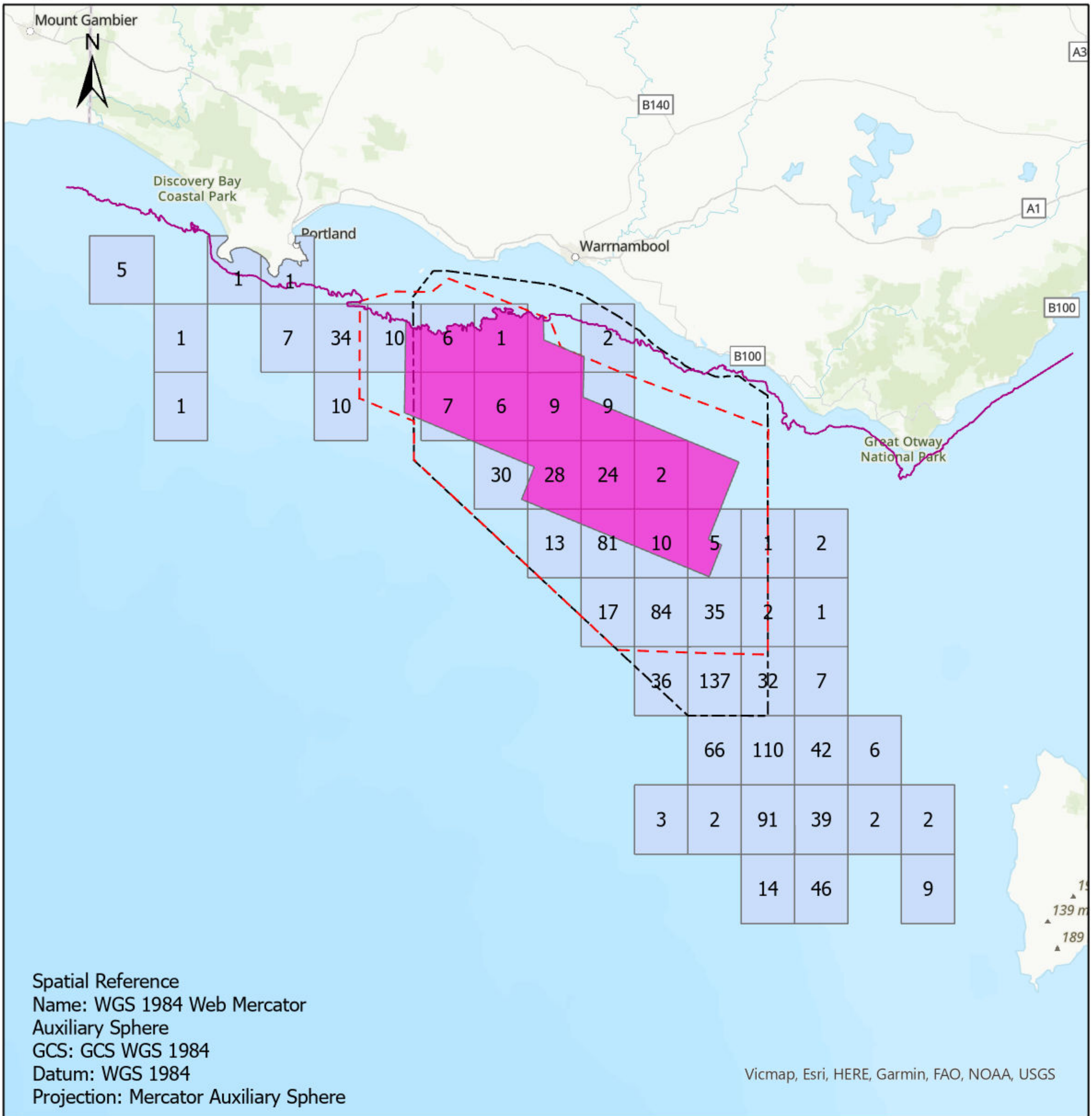
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour
- 50m Bathymetry

0 5 10 20 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-031_A

Regia MSS - Giant Crab 2011 2021 Days Fished



Legend

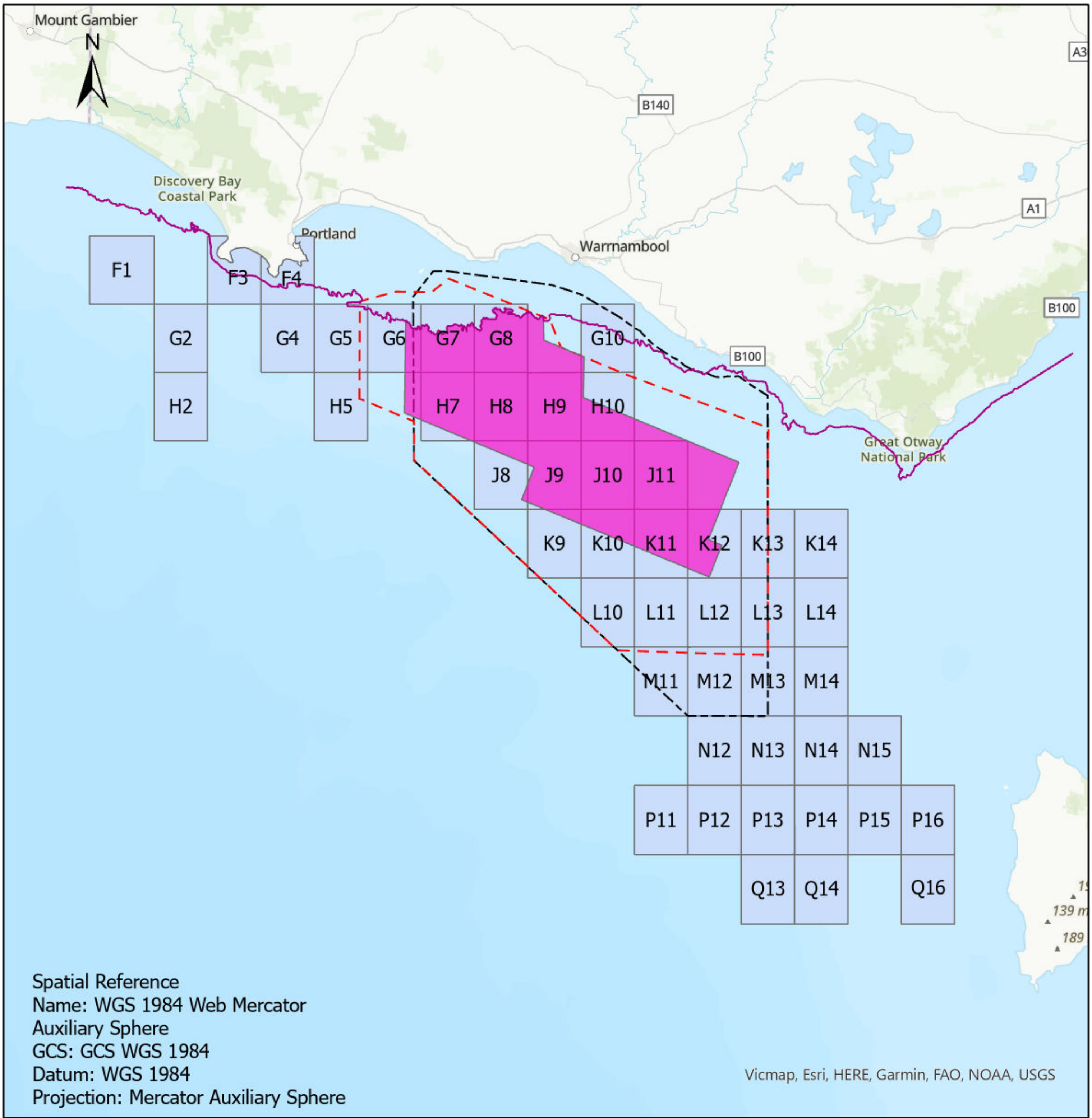
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Giant Crab 2011 2021 FD
- 50m Contour

0 15 30 60 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-032_A

Regia MSS - Giant Crab 2011 2021 - Blocks



Legend

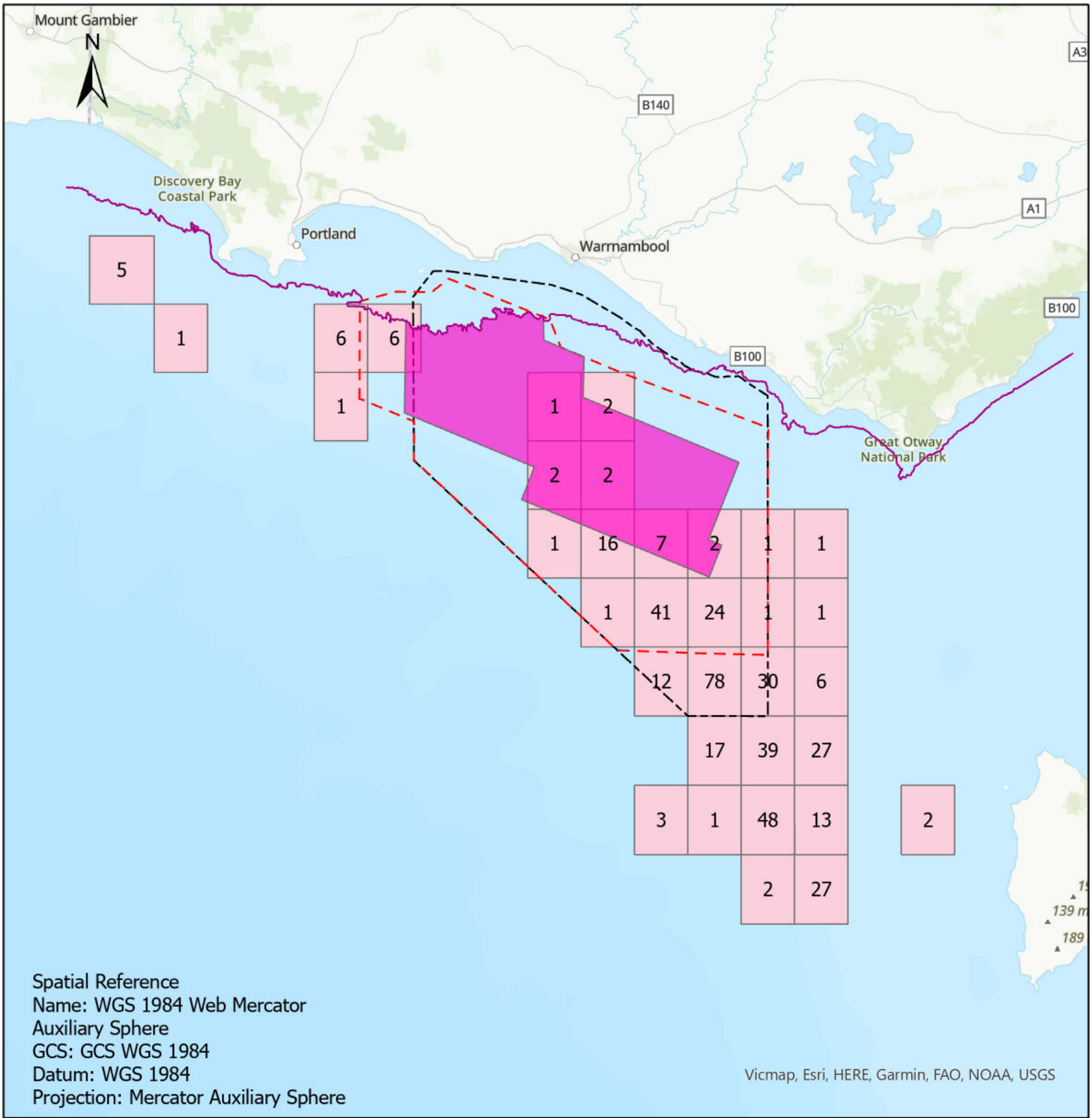
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Giant Crab 2011 2021 FD
- 50m Contour

0 15 30 60 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-033_A

Regia MSS - Giant Crab 2018-2022 - Days Fished



Legend

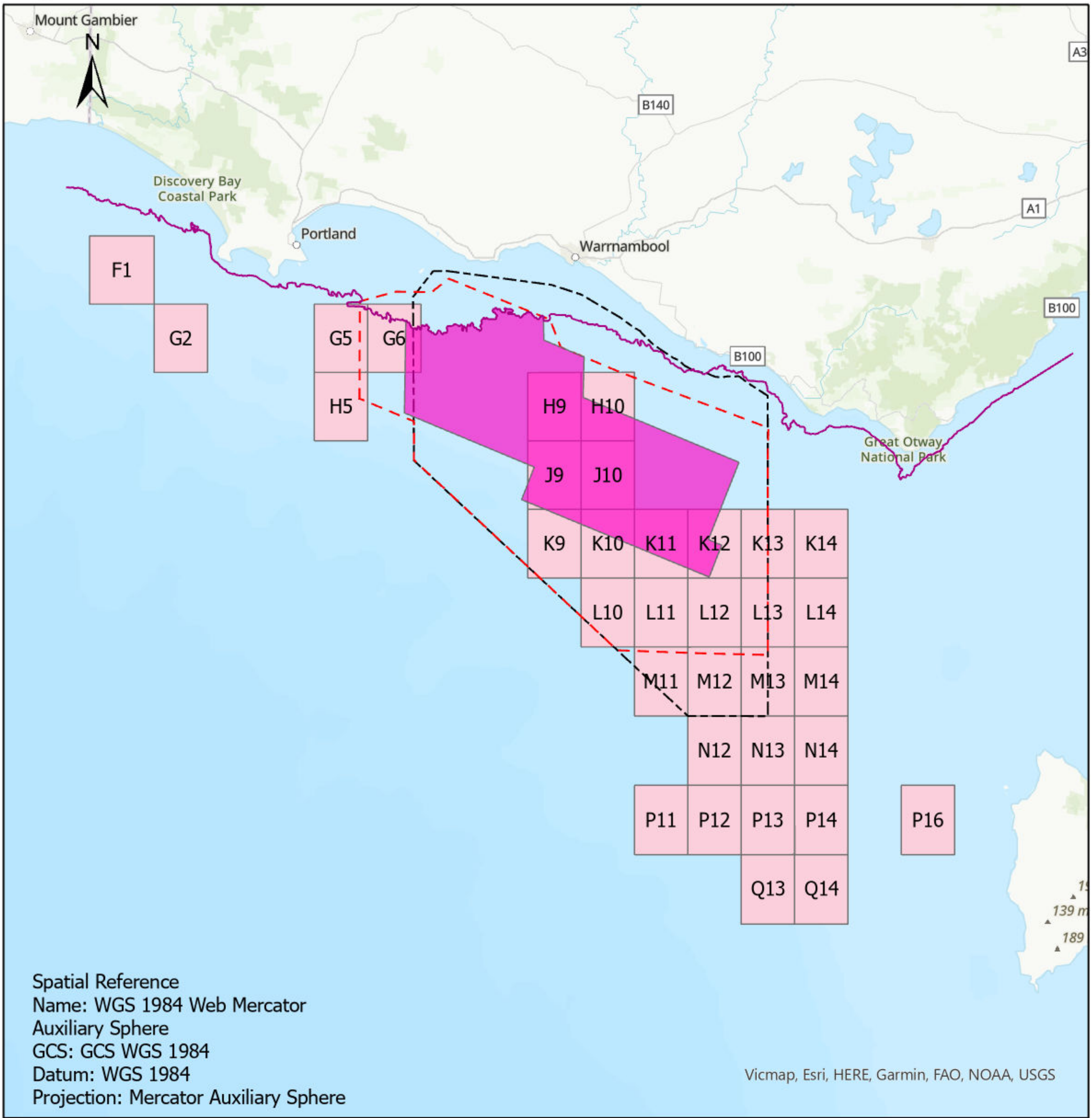
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Giant Crab 2018-2022-FD
- 50m Contour

0 15 30 60 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-034_A

Regia MSS - Giant Crab 2018-2022 - Blocks



Legend

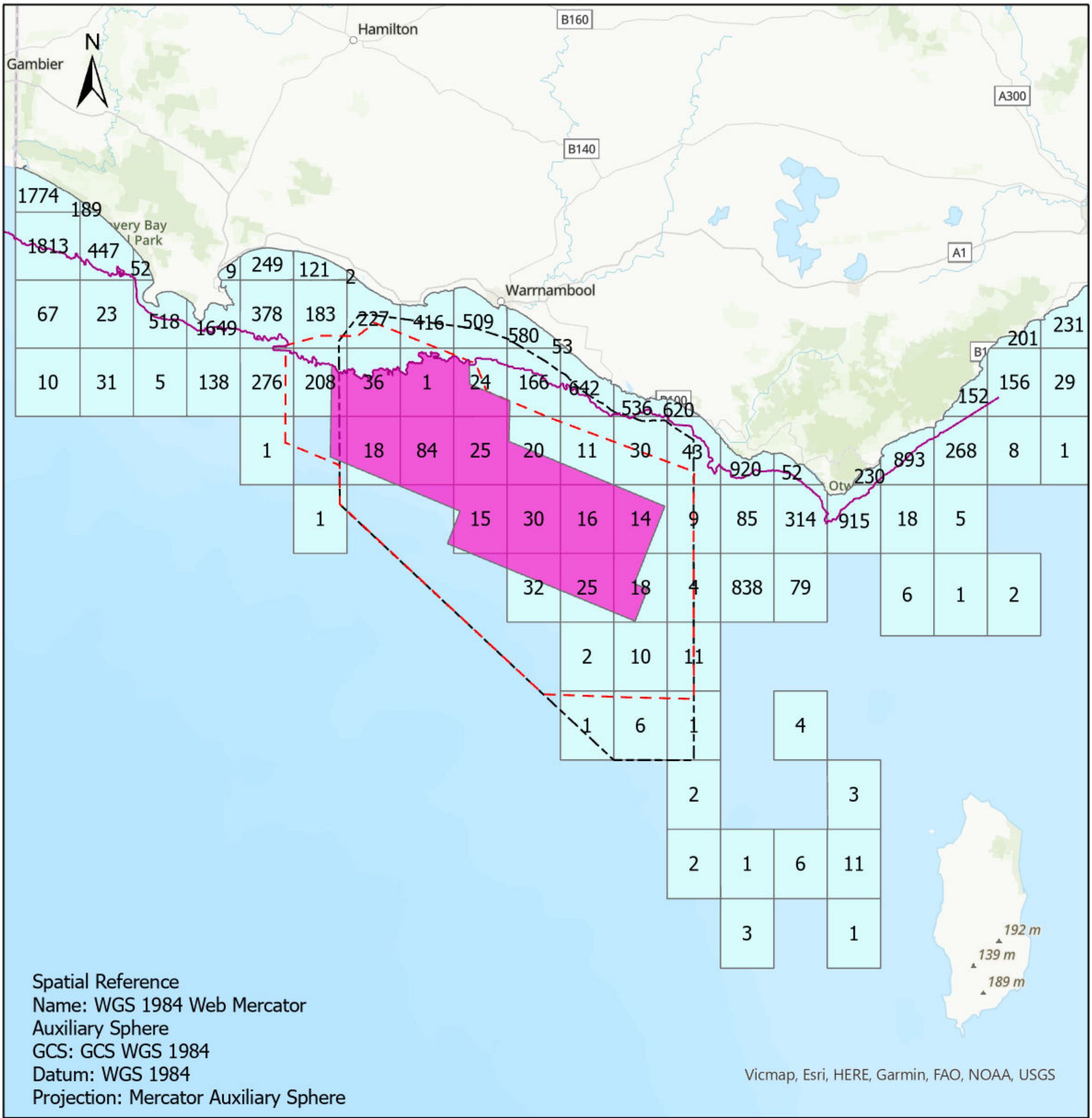
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Giant Crab 2018-2022-FD
- 50m Contour

0 15 30 60 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-035_A

Regia MSS - Rock Lobster 2018-2022 - Days Fished



Legend

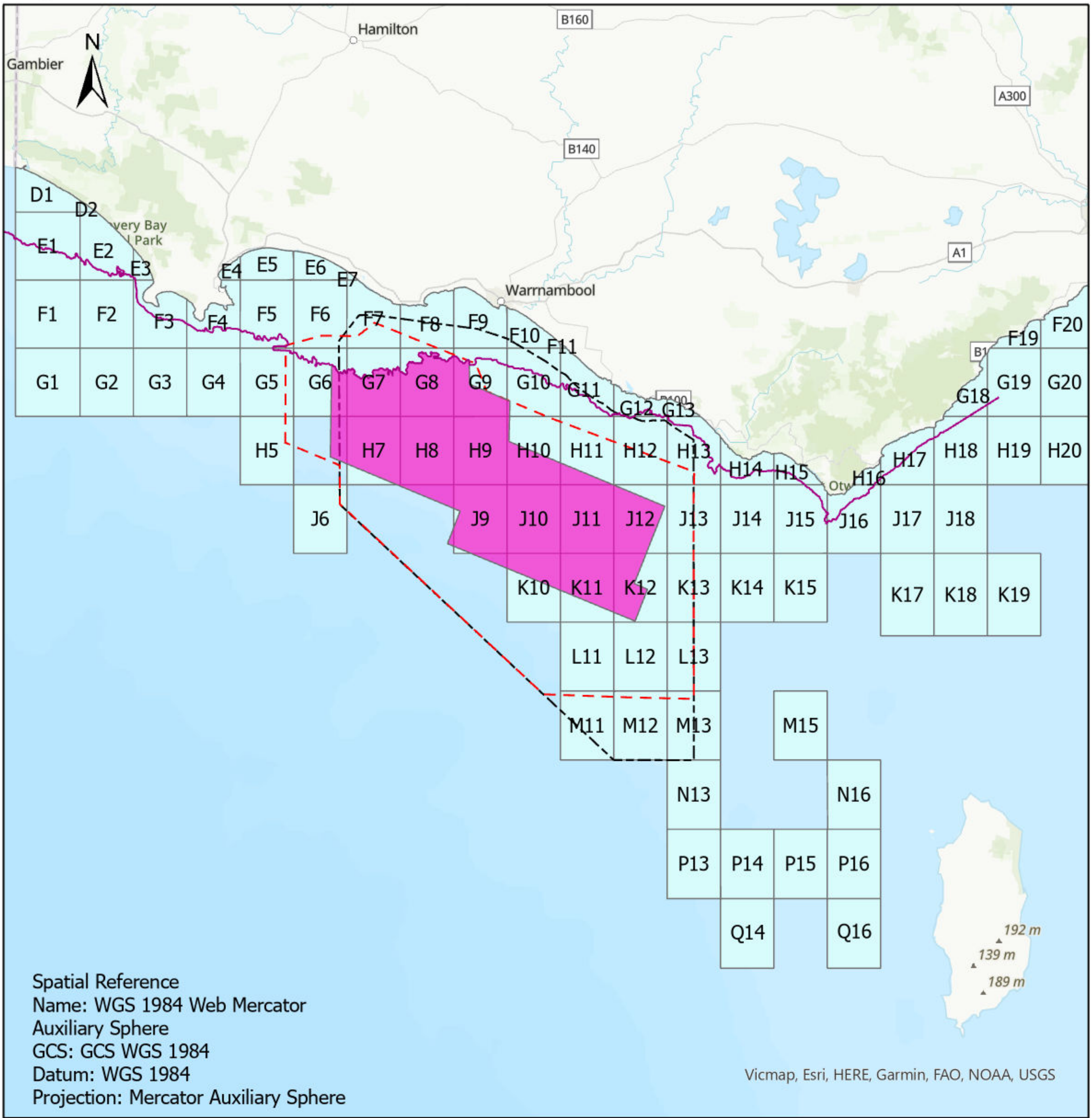
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Rock Lobster 2018-2022_RFI
- 50m Contour

0 15 30 60 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-036_A

Regia MSS - Rock Lobster 2018-2022 - Blocks



Legend

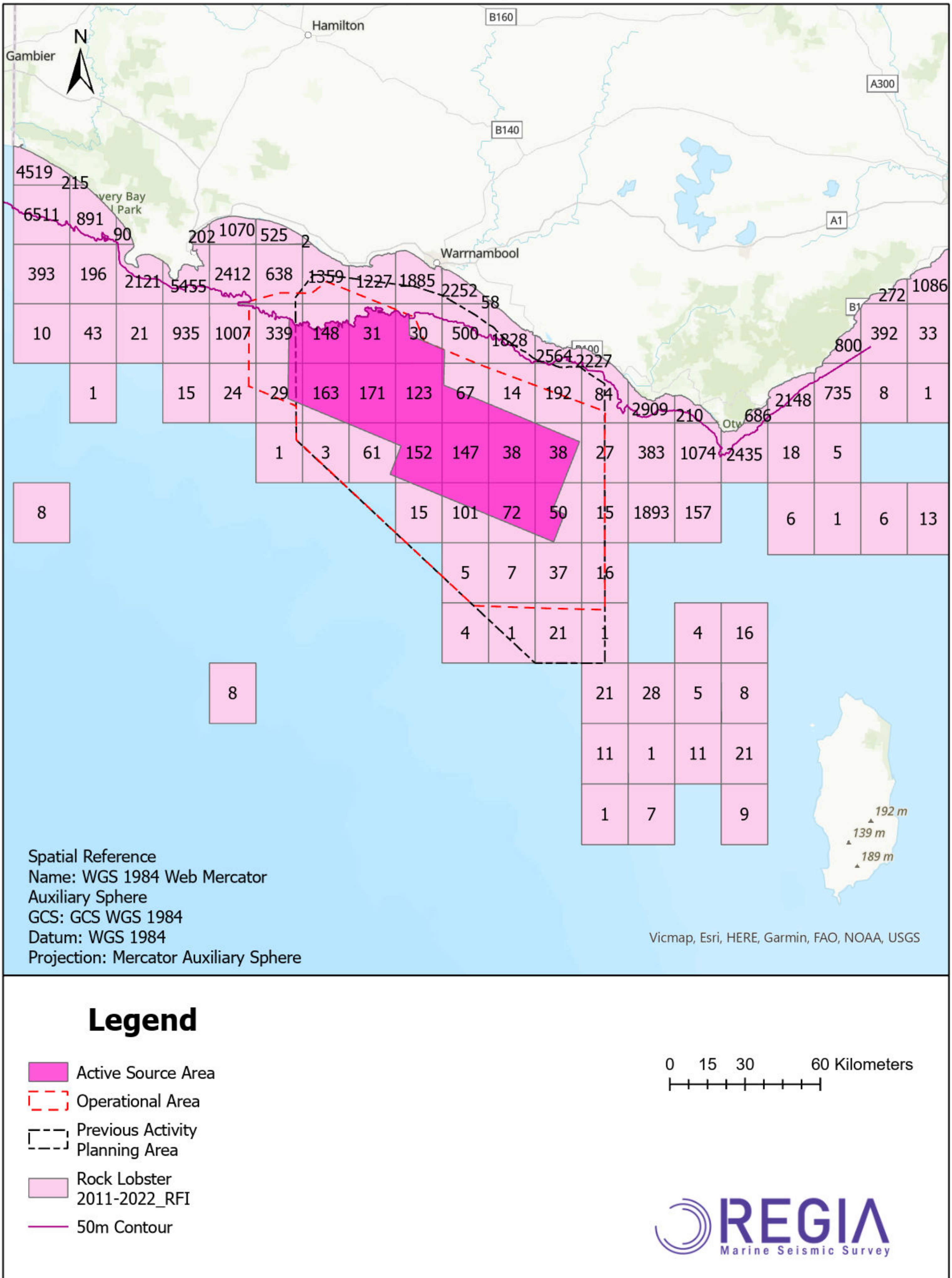
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Rock Lobster 2018-2022_RFI
- 50m Contour

0 15 30 60 Kilometers

REGIA
Marine Seismic Survey

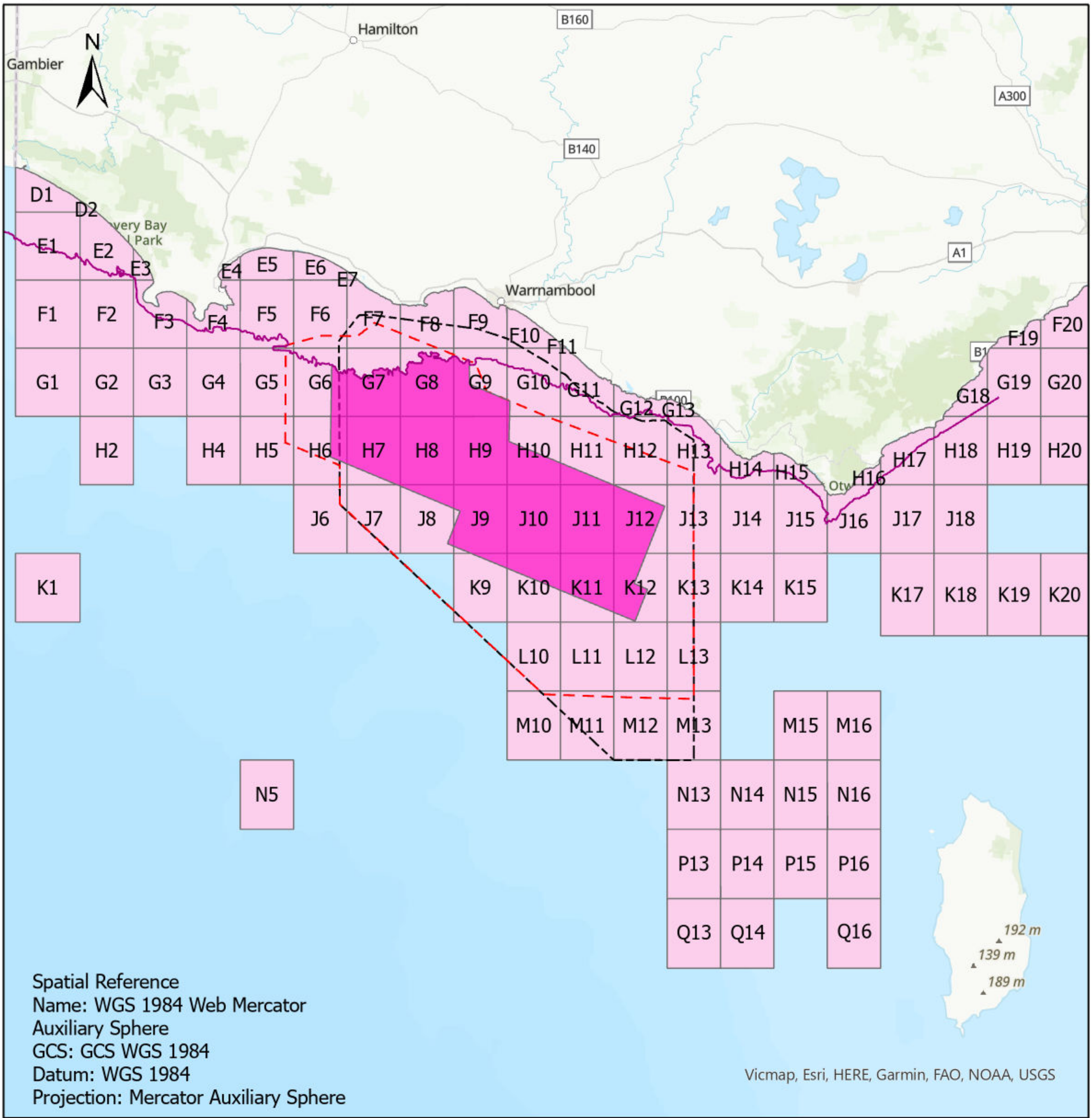
MAP-REG-EPM-037_A

Regia MSS - Rock Lobster 2011-2022 - Days Fished



MAP-REG-EPM-038_A

Regia MSS - Rock Lobster 2011-2022 - Blocks



Legend

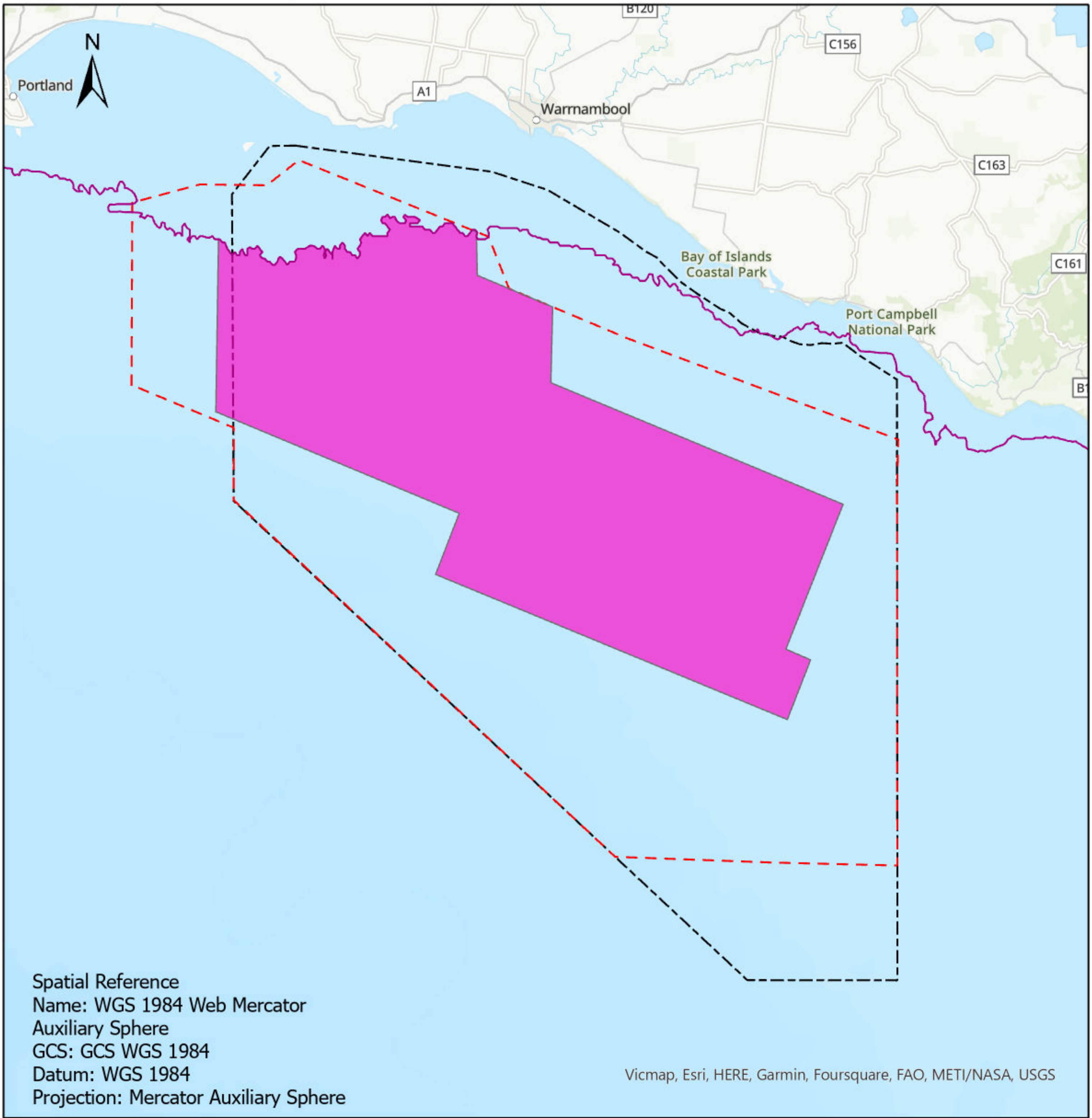
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Rock Lobster 2011-2022_RFI
- 50m Contour

0 15 30 60 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-039_A

Regia MSS - Base Map



Spatial Reference
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Auxiliary Sphere
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere

Legend

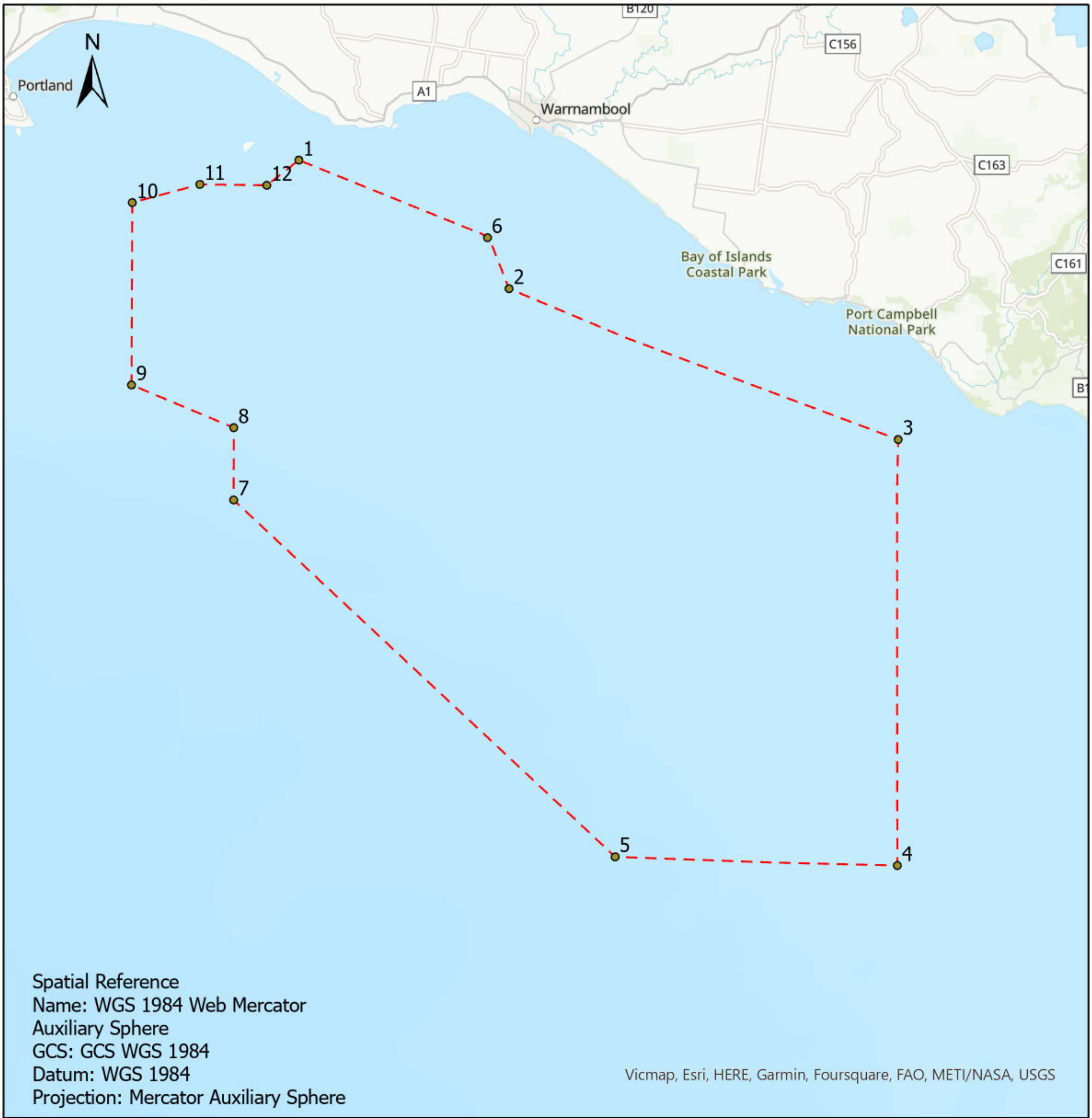
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-040_A

Regia MSS - Operational Area Co-ordinates



Legend

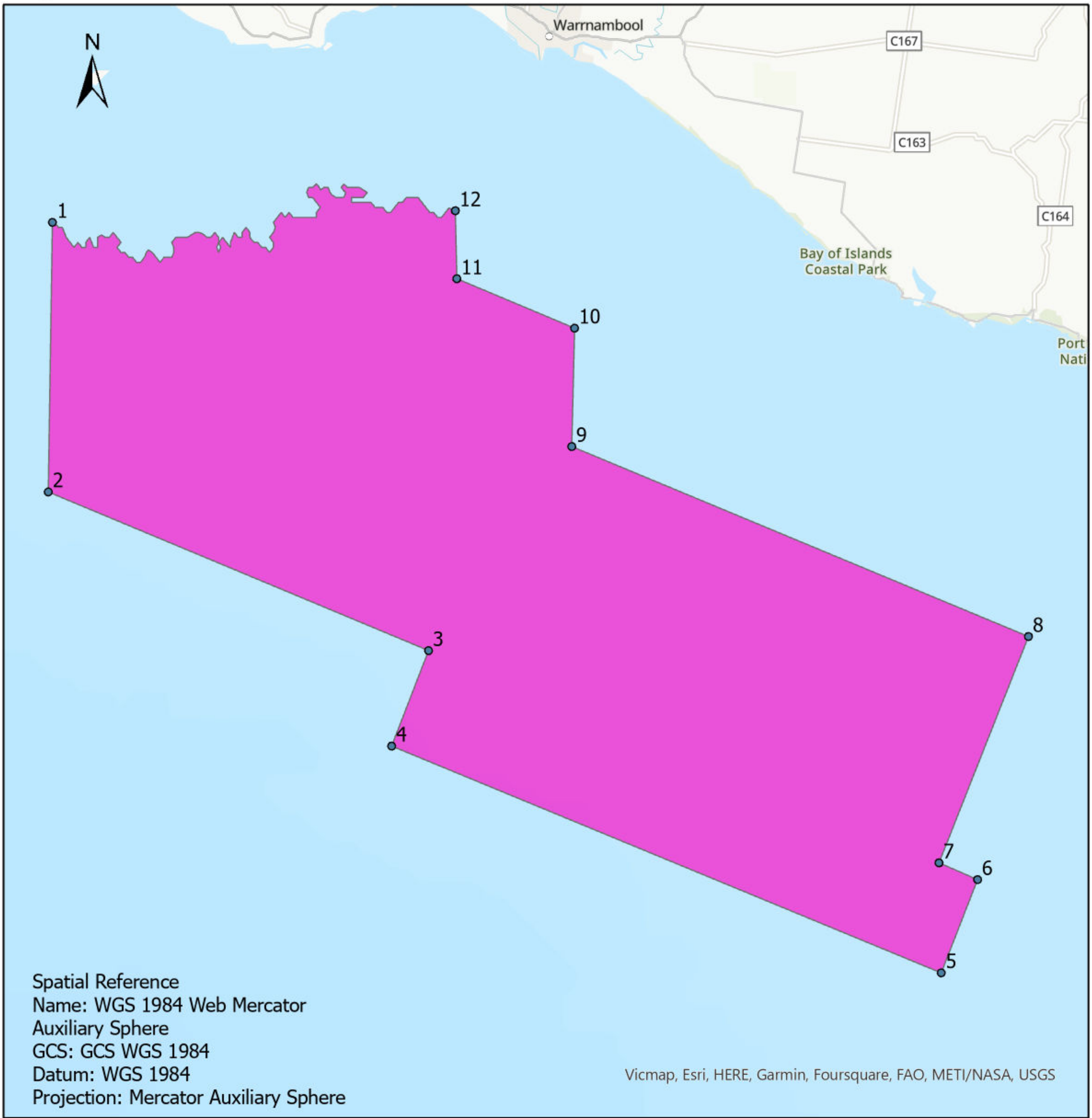
Operational Area

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-041_A

Regia MSS - Active Source Area Co-ordinates



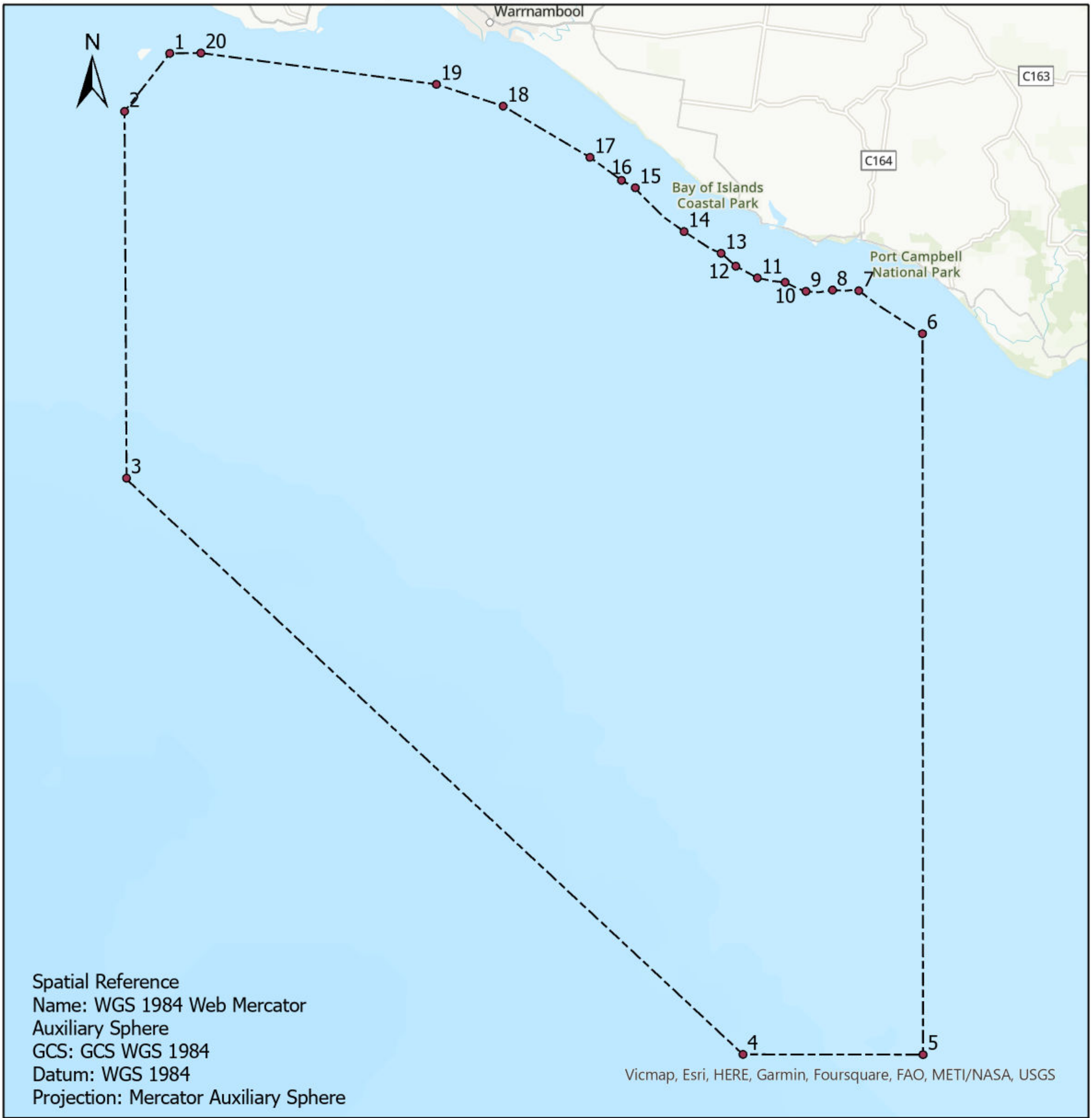
Legend

Active Source Area

0 5 10 20 Kilometers

MAP-REG-EPM-042_A

Regia MSS - Previous Activity Planning Area Co-ordinates



Legend

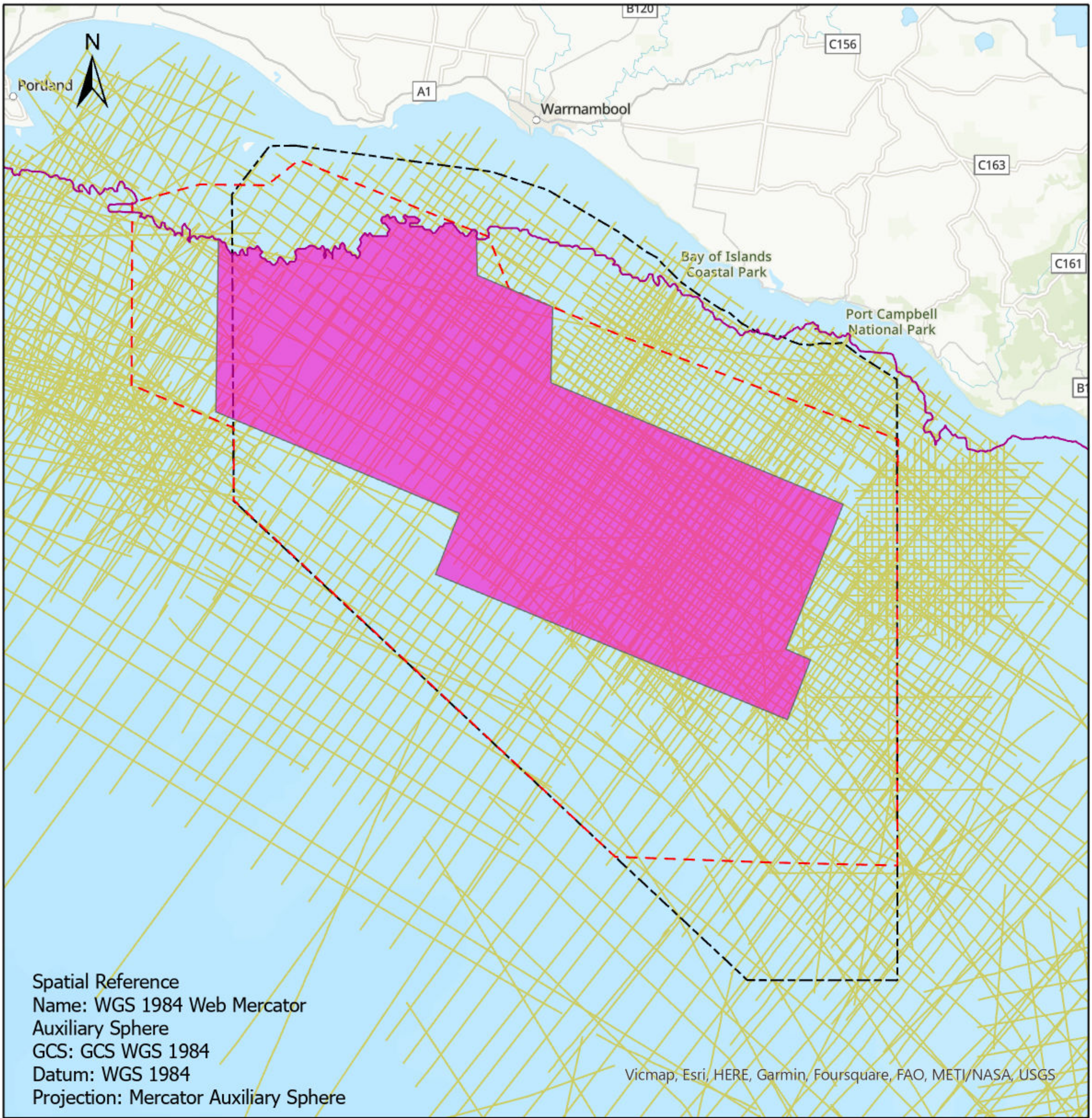
Previous Activity Planning Area

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-043_A

Regia MSS - NOPIMS 2D Seismic Survey Lines



Legend

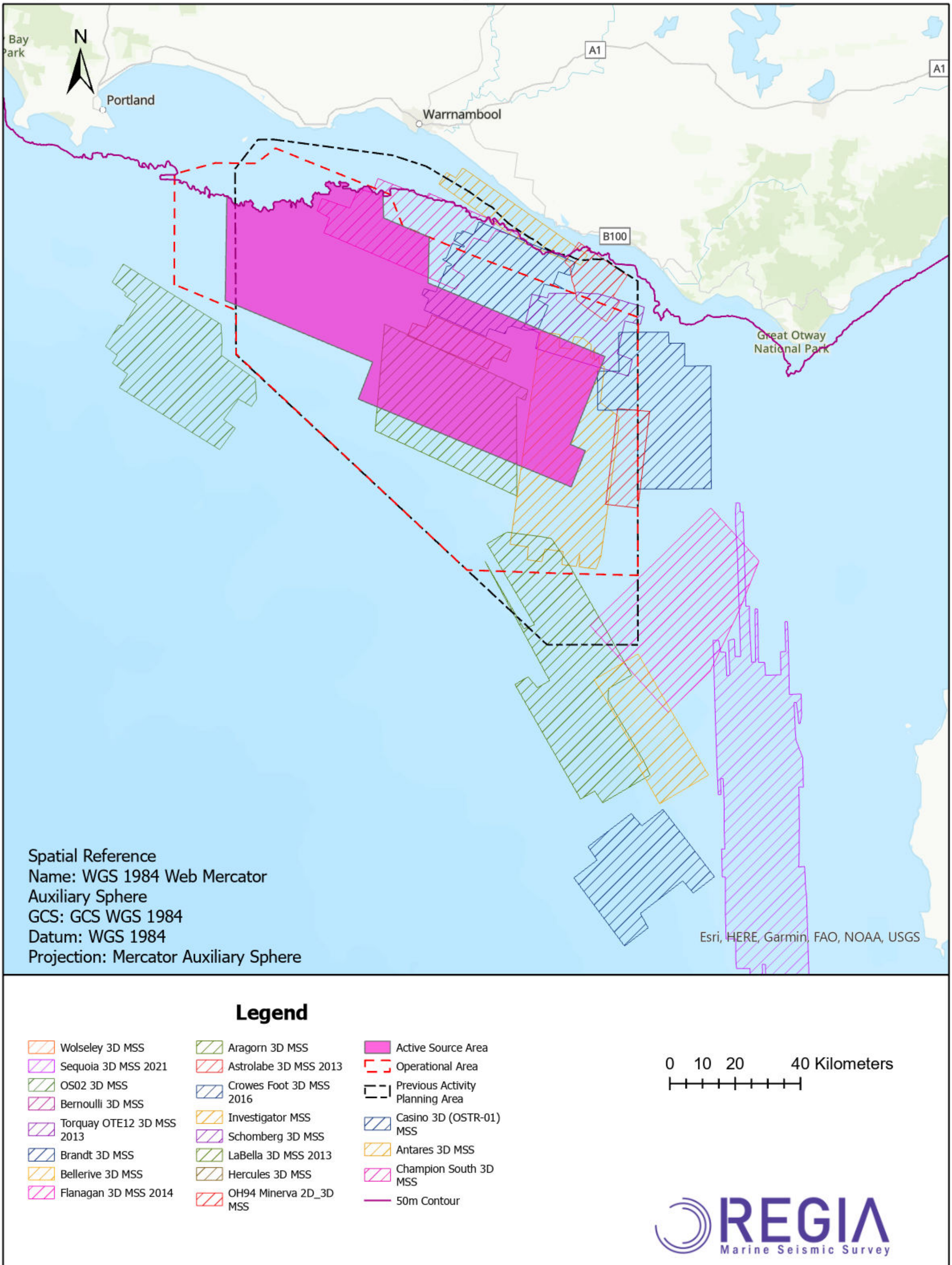
- NOPIMS 2D Seismic Survey Lines
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

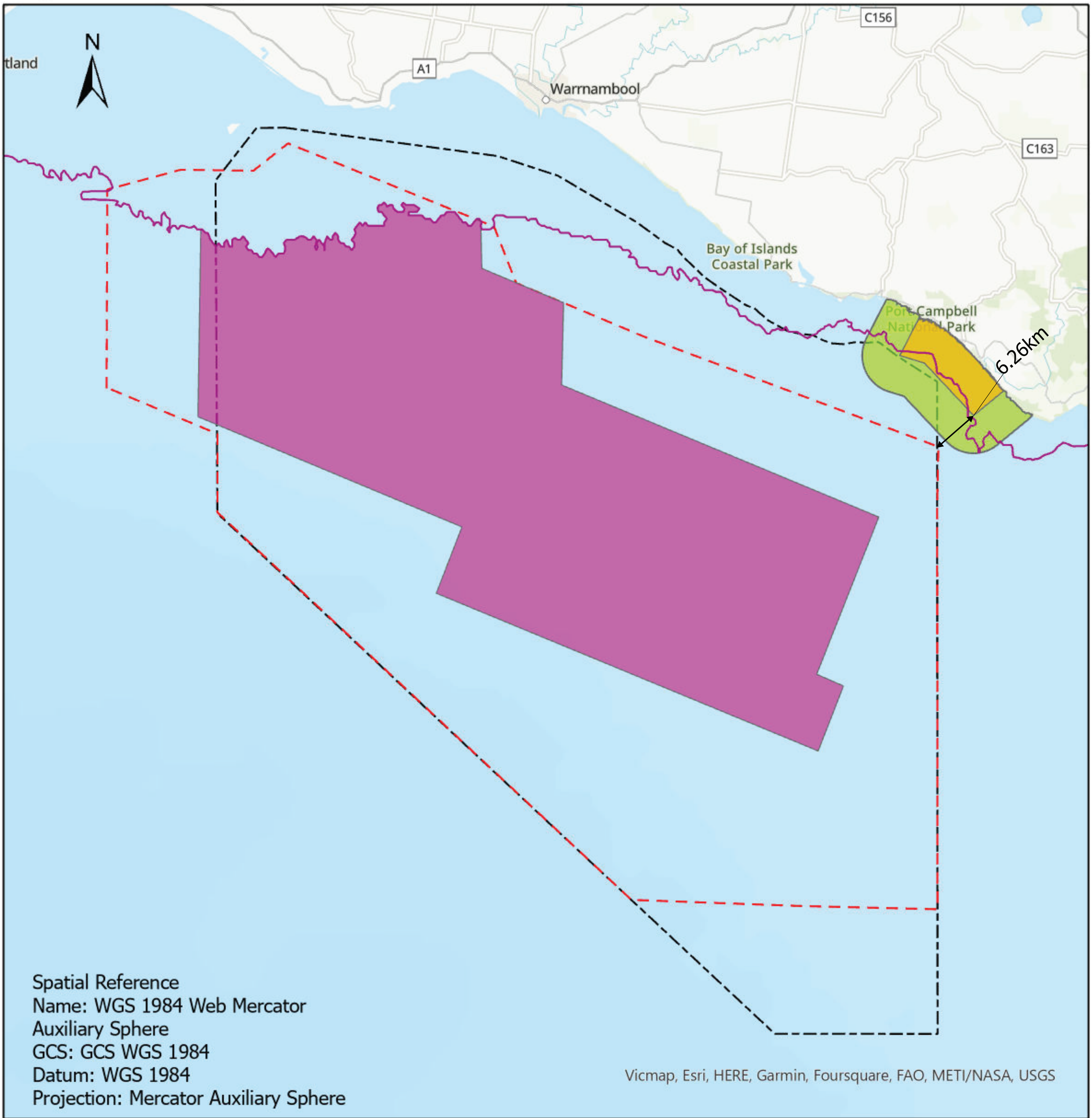
MAP-REG-EPM-045_A

Regia MSS - NOPIMS 3D Seismic Survey



MAP-REG-EPM-046_A

Regia MSS - 12 Apostles Marine Park 5km Buffer



Legend

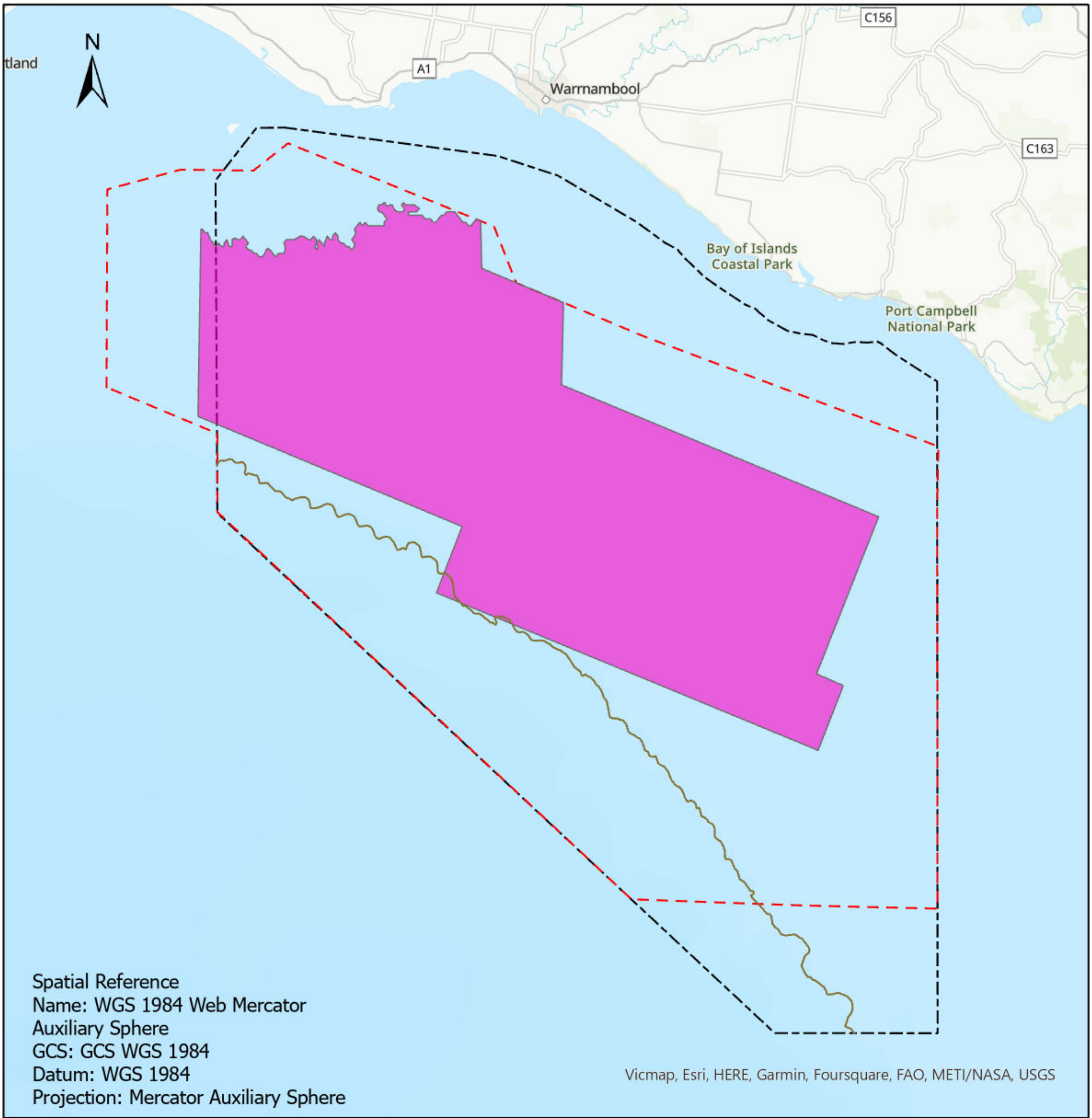
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour
- 12 Apostles Marine Park
- 12 Apostles 5km Buffer

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-047_B

Regia MSS - Active Source Area with 200m Contour



Legend

- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 200m Contour

0 5 10 20 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-048_A

Regia MSS - TGS Survey & Regia MSS Overlays

Legend

- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Active Source Area - TGS
- Operational Area - TGS

Notes:

1. The TGS survey will not acquire the entire area but rather discrete smaller surveys within the acquisition/active source area.

2. The TGS survey and the Regia MSS will not occur within 40km of each other in the unlikely event the activities occur simultaneously.

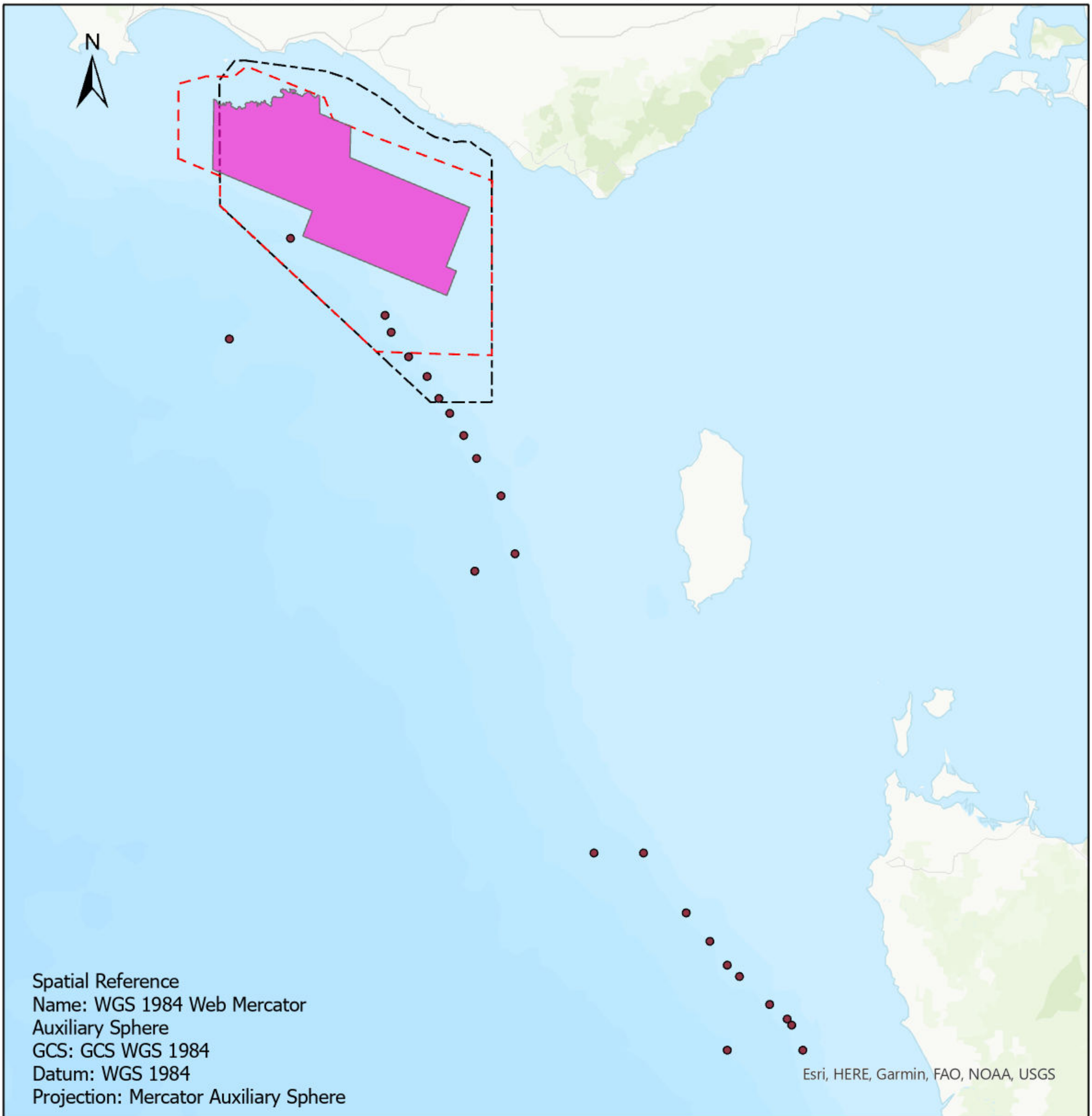
3. The Regia MSS final acquisition area will be smaller than the active source area presented.

0 20 40 80 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-049_A

Regia MSS - Orange Roughy Study: New Timing



Legend

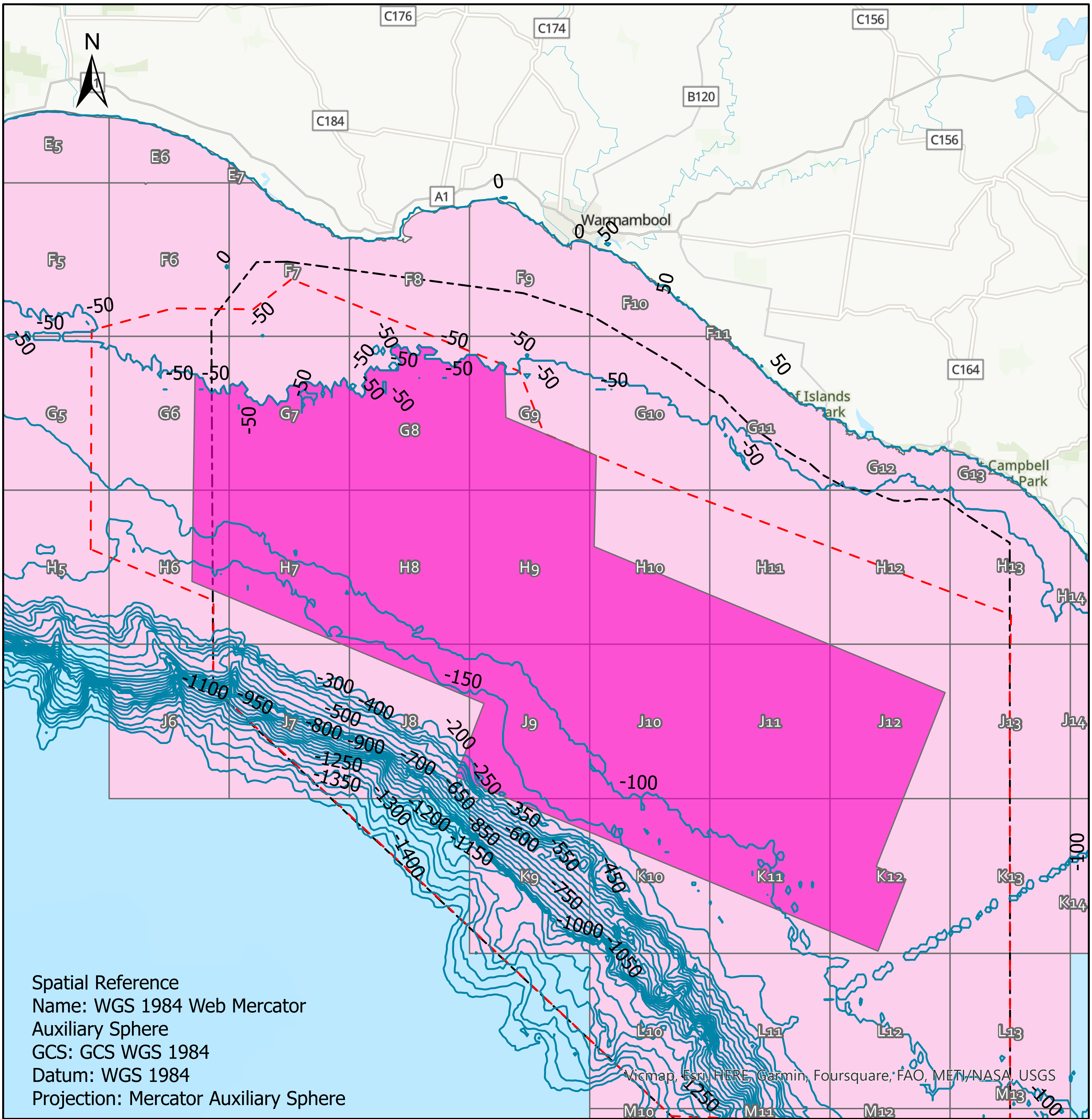
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Orange Roughy Study

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-050_A

Regia MSS - Rock Lobster 2011-2022



Legend

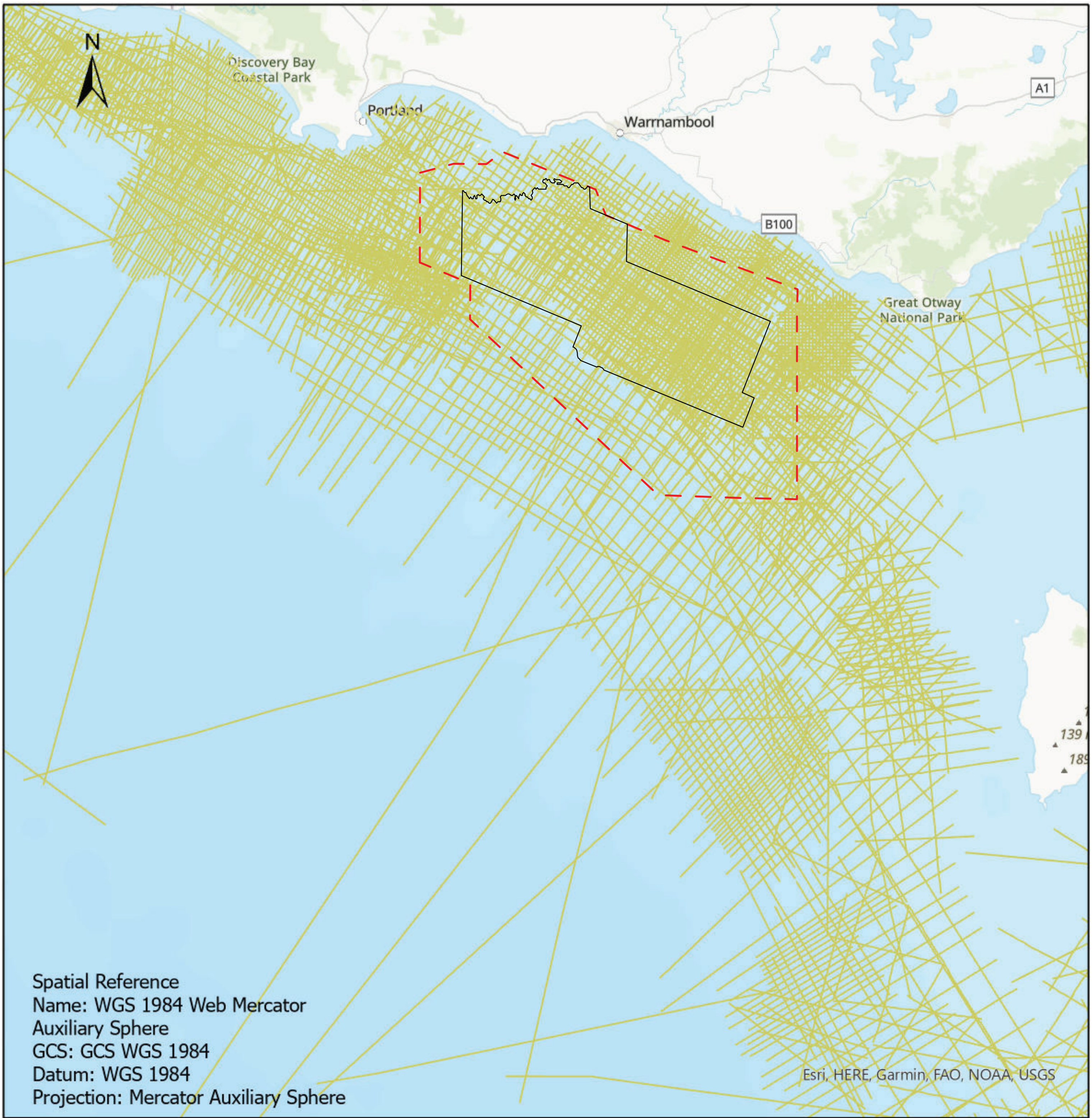
- Active Source Area
- Operational Area
- Previous Activity Planning Area
- Rock Lobster 2011-2022_RFI
- 50m Contour
- full bathy

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-051_A

NOPIMS 2D Seismic Survey Lines



Legend

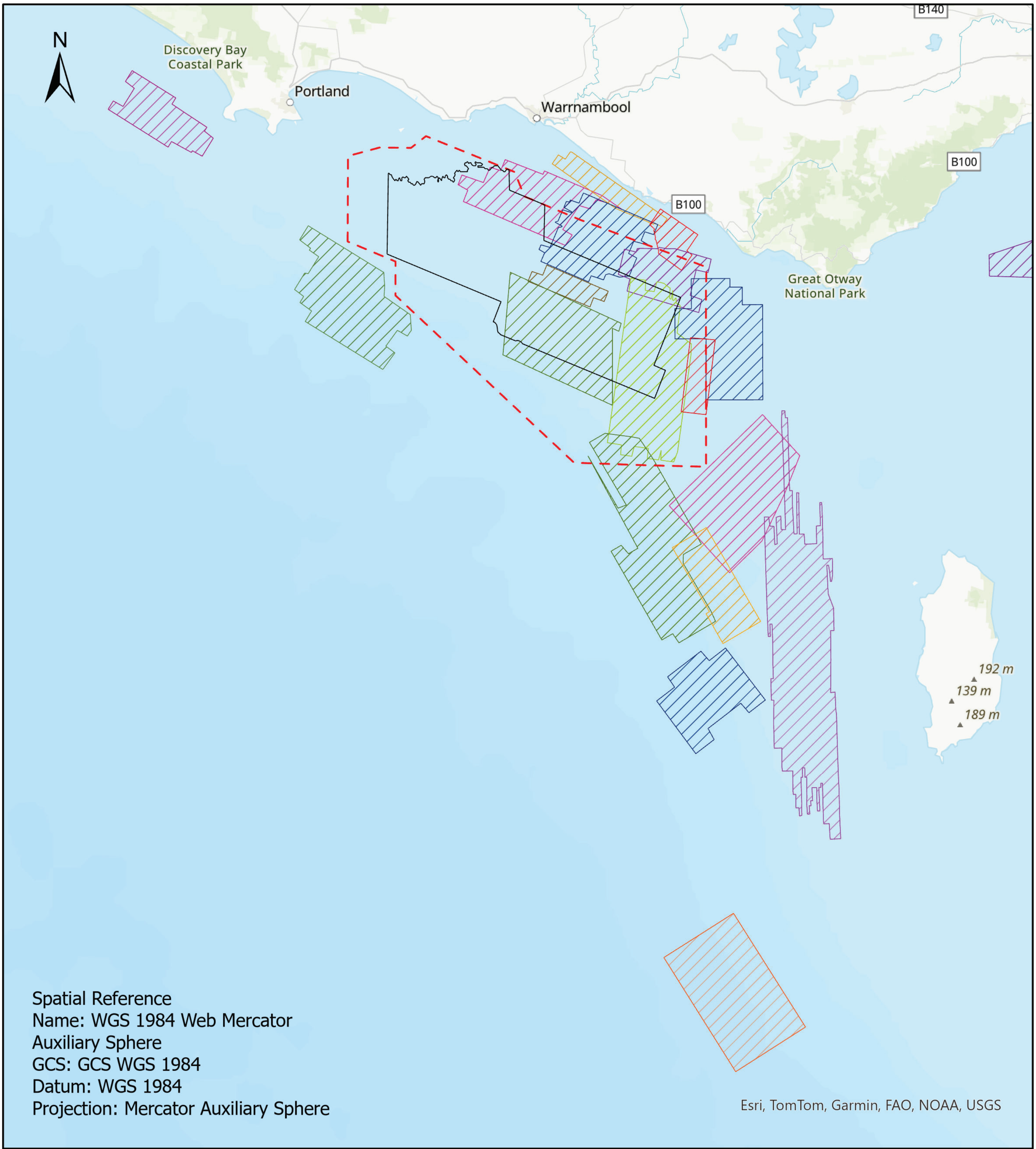
- NOPIMS 2D Seismic Survey Lines
- Active Source Area
- Operational Area

0 15 30 60 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-053_B

NOPIMS 3D Seismic Survey Lines



Legend

- Active Source Area
- Operational Area
- Wolseley 3D MSS
- Sequoia 3D MSS 2021
- OS02 3D MSS
- Bernoulli 3D MSS
- Torquay OTE12 3D MSS 2013
- Brandt 3D MSS
- Bellerive 3D MSS
- Flanagan 3D MSS 2014
- Aragorn 3D MSS
- Astrolabe 3D MSS 2013
- Crowes Foot 3D MSS 2016
- Investigator MSS
- Schomberg 3D MSS
- LaBella 3D MSS 2013
- Hercules 3D MSS
- OH94 Minerva 2D_3D MSS
- Casino 3D (OSTR-01) MSS
- Antares 3D MSS
- Champion South 3D MSS

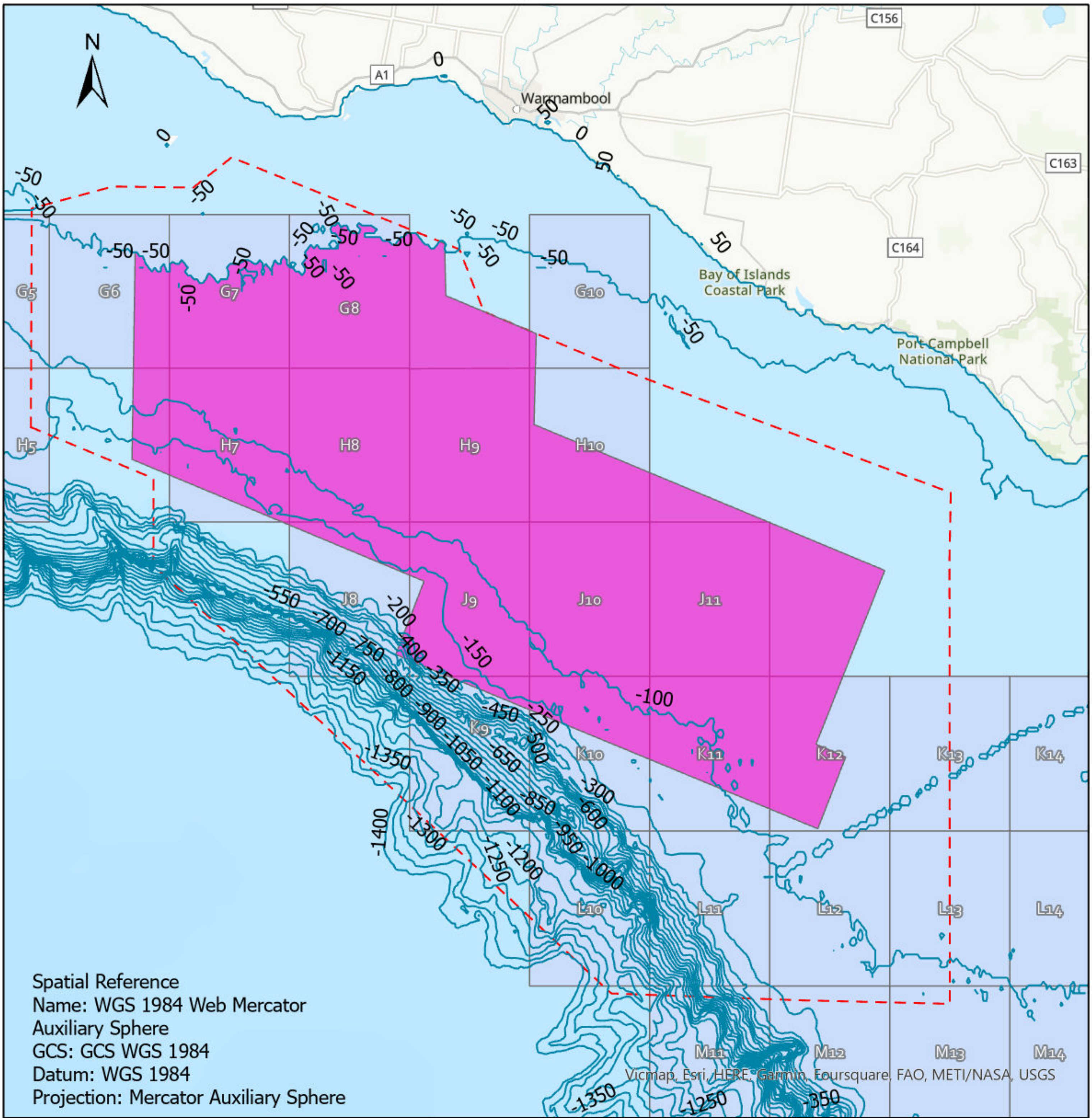
0 15 30 60 Kilometers

REGIA Marine Seismic Survey

The previous seismic surveys overlap the Active Source Area by 55.31%

MAP-REG-EPM-053_B

Giant Crab 2011-2021 with Bathymetry



Legend

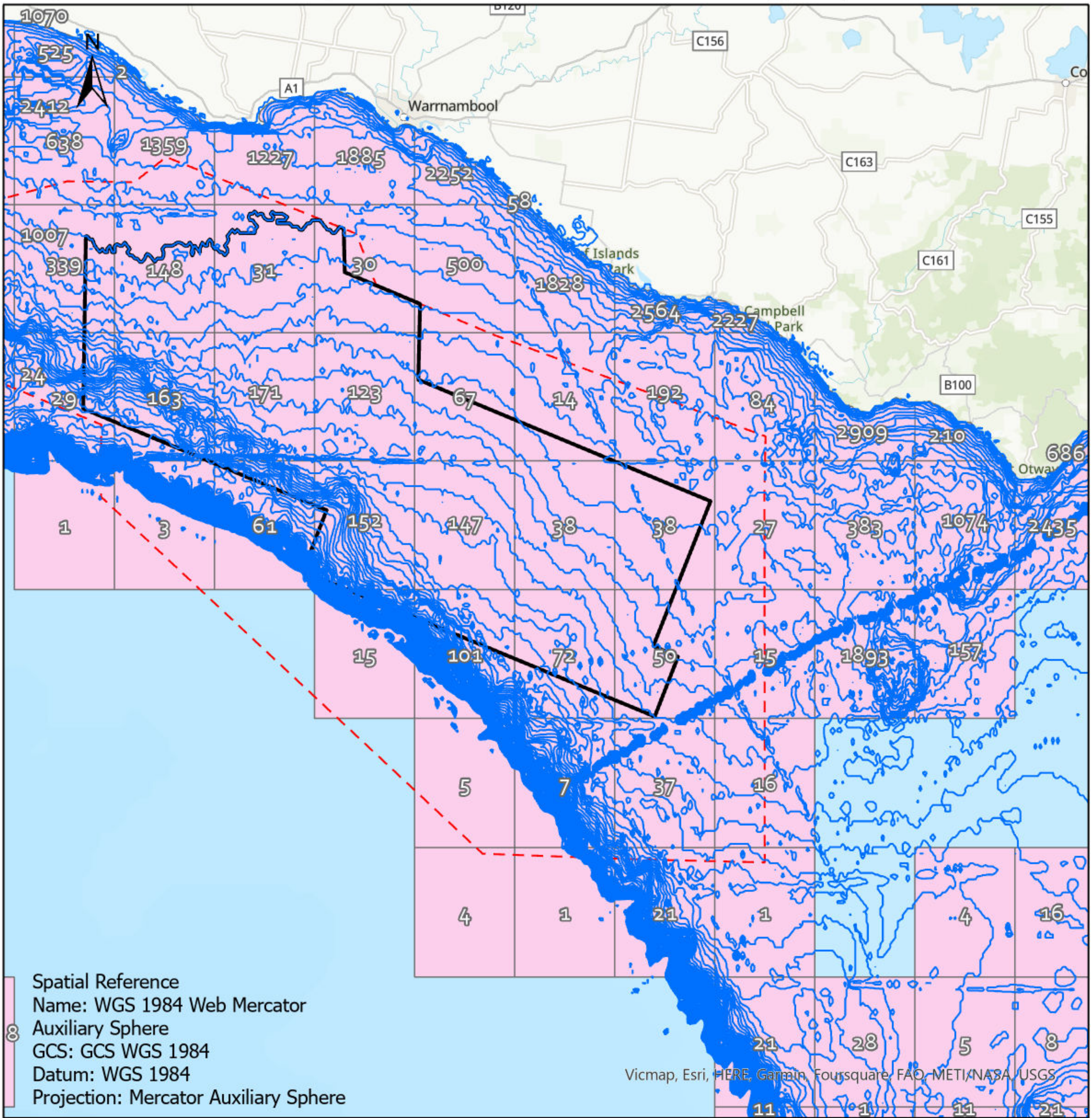
- Active Source Area
- Operational Area
- Giant Crab 2011 2021 FD
- 50m Bathymetry

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-054_A

Regia MSS - 5m Bathymetry & Rock Lobster Fishing Days



Legend

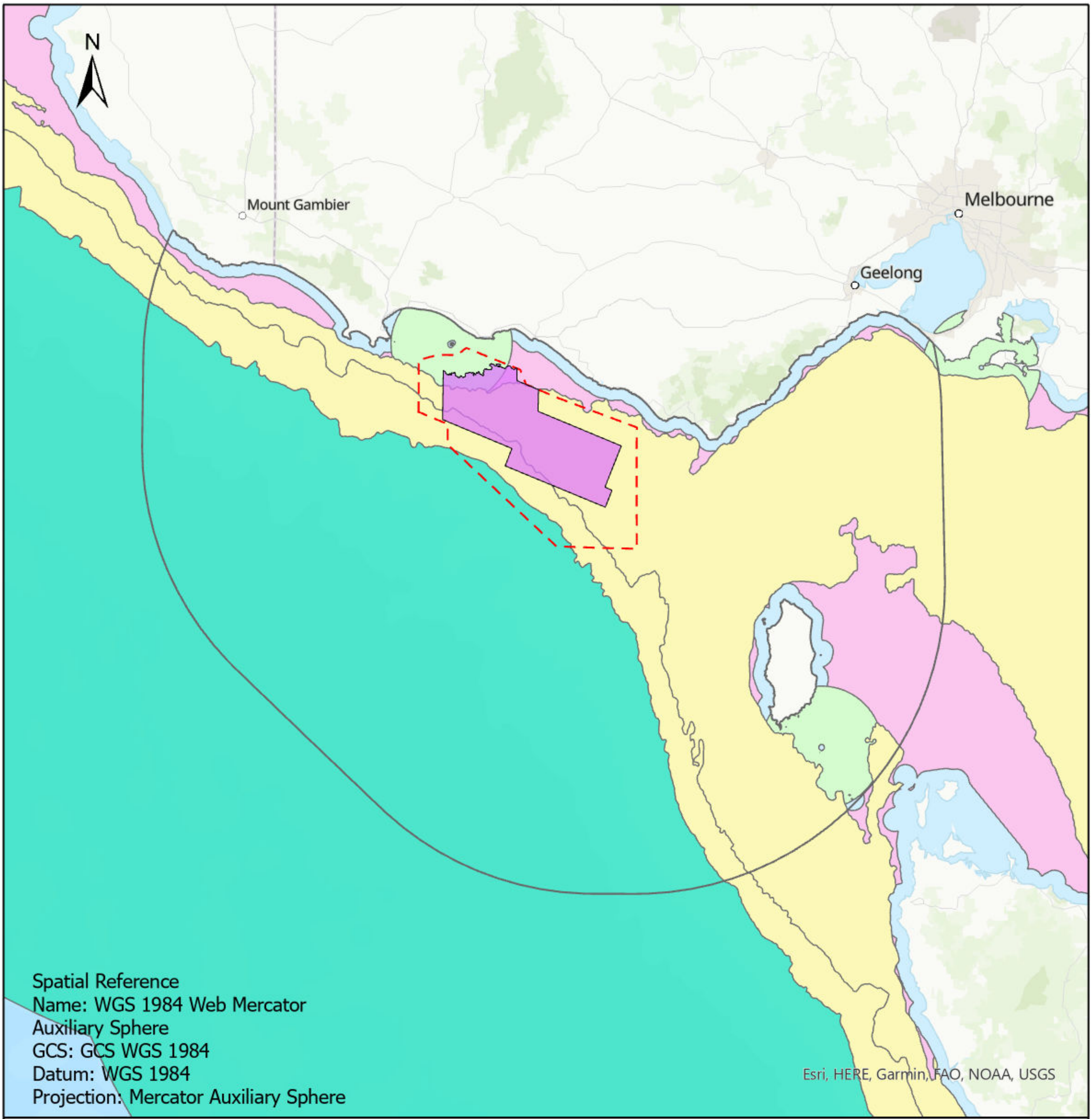
- Active Source Area
- Operational Area
- Rock Lobster 2011-2022_RFI
- 5m Bathymetry

0 5 10 20 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-055_A

Regia MSS - White Shark Biologically Important Areas



Legend

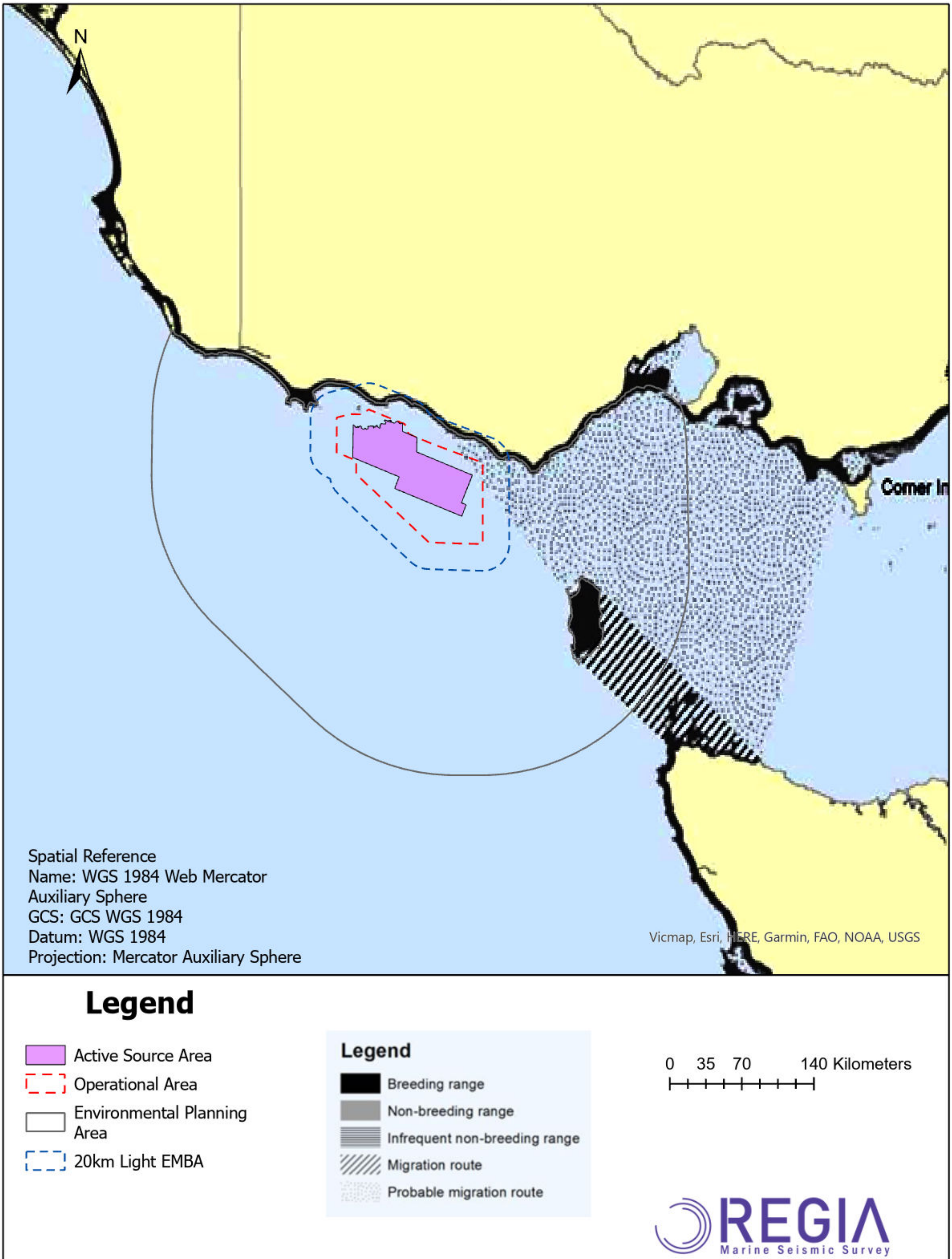
- Active Source Area
- Operational Area
- Environmental Planning Area
- White Shark Distribution
- White Shark Distribution Low Density
- White Shark Known Distribution
- White Shark Foraging

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

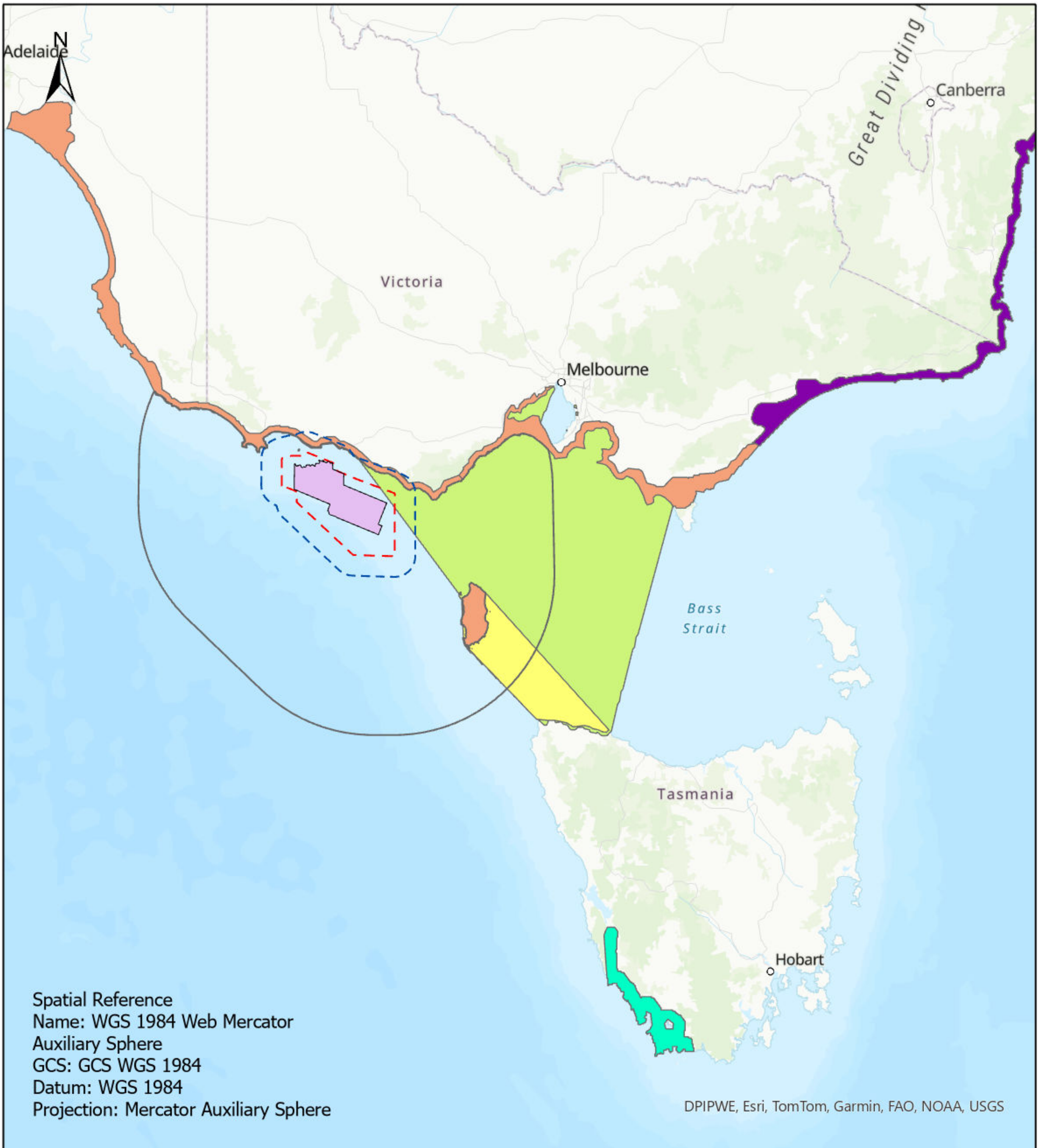
MAP-REG-EPM-057_A

Regia MSS - Orange Bellied Parrot Migration Route



MAP-REG-EPM-058_A

Regia MSS - Orange Bellied Parrot Distribution & Migration Route



Spatial Reference
Name: WGS 1984 Web Mercator
Auxiliary Sphere
GCS: GCS WGS 1984
Datum: WGS 1984
Projection: Mercator Auxiliary Sphere

Legend

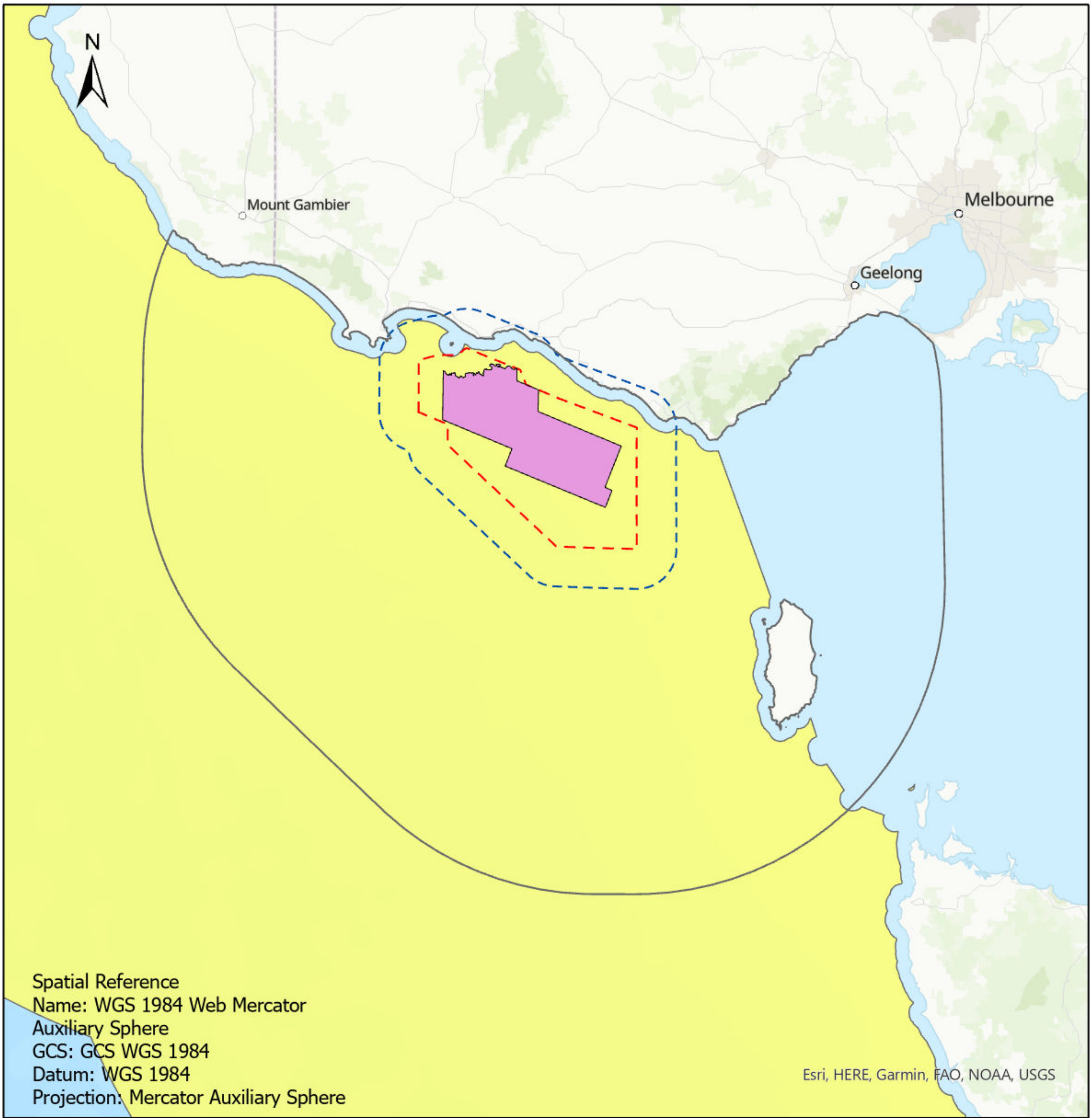
- Active Source Area
- Operational Area
- Environmental Planning Area final
- 20km Light EMBA
- Breeding Range
- Non Breeding Range
- Migration Route
- Probable Migration
- Infrequent Non Breeding

0 50 100 200 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-058_B

Regia MSS - Antipodean Albatross Biologically Important Areas



Legend

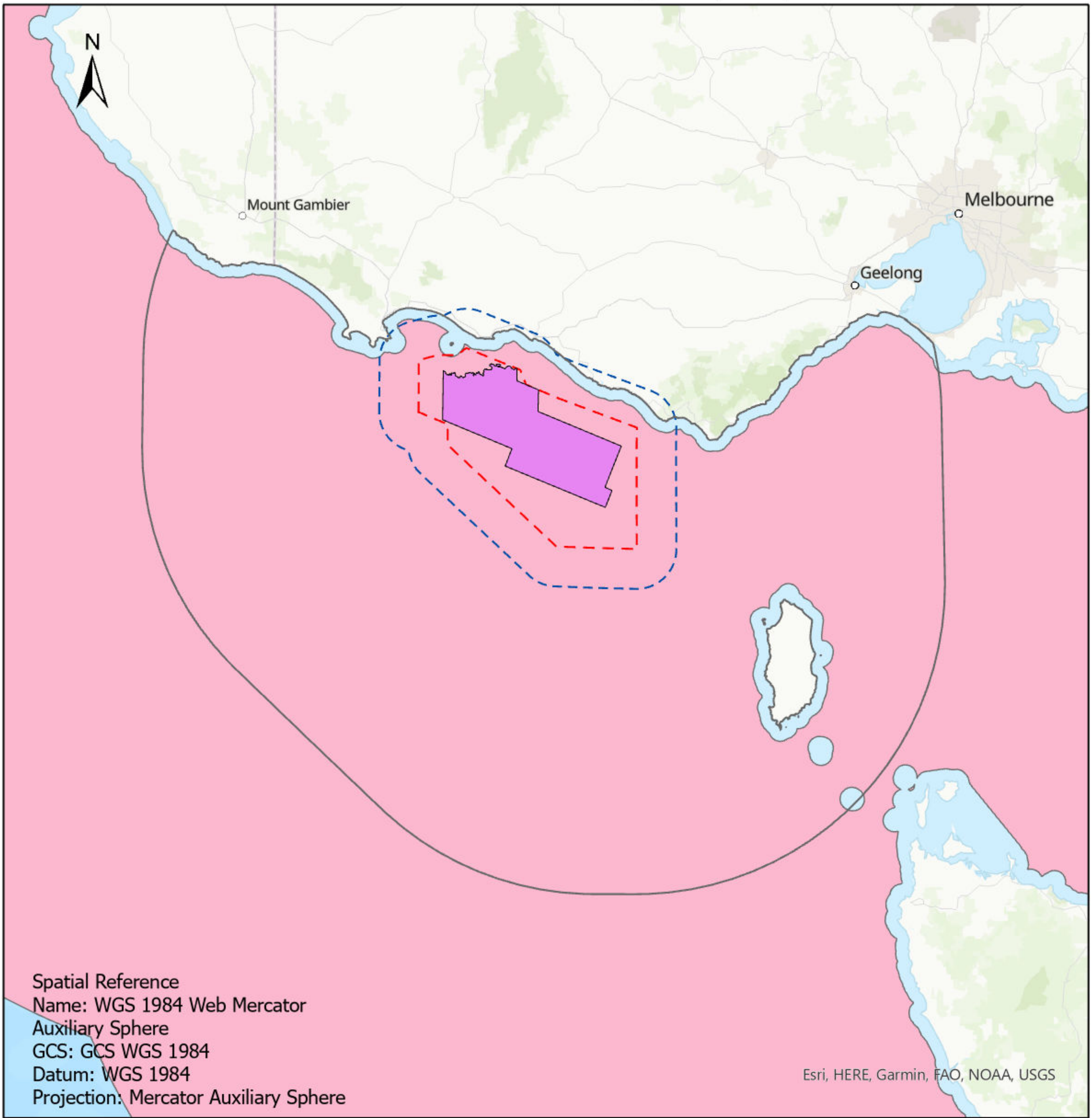
- Active Source Area
- Operational Area
- Environmental Planning Area
- Antipodean Albatross - Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-059_A

Regia MSS - Black Browed Albatross Biologically Important Areas



Legend

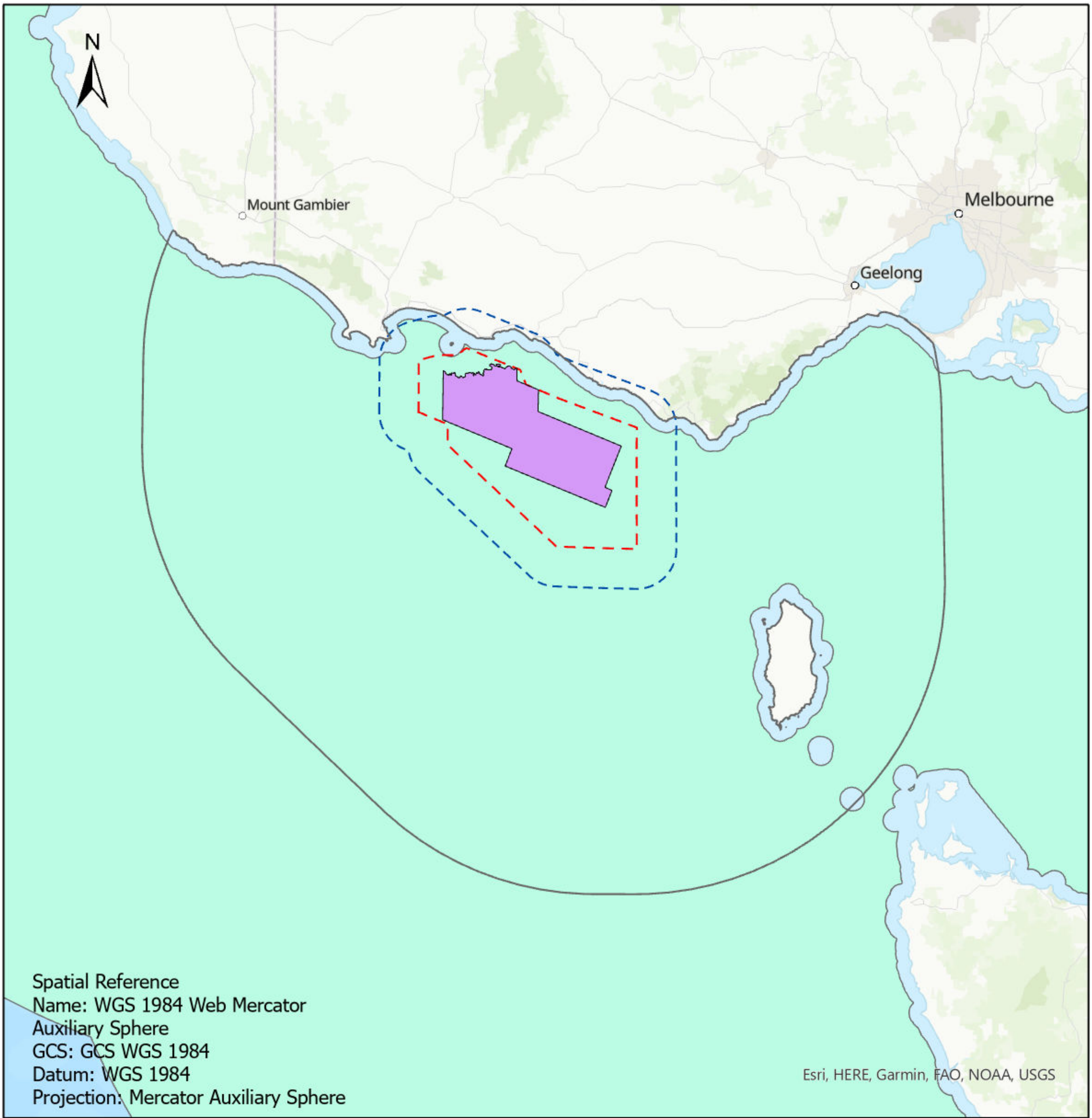
- Active Source Area
- Operational Area
- Environmental Planning Area
- Black Browed Albatross Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-060_A

Regia MSS - Campbell Albatross Biologically Important Areas



Legend

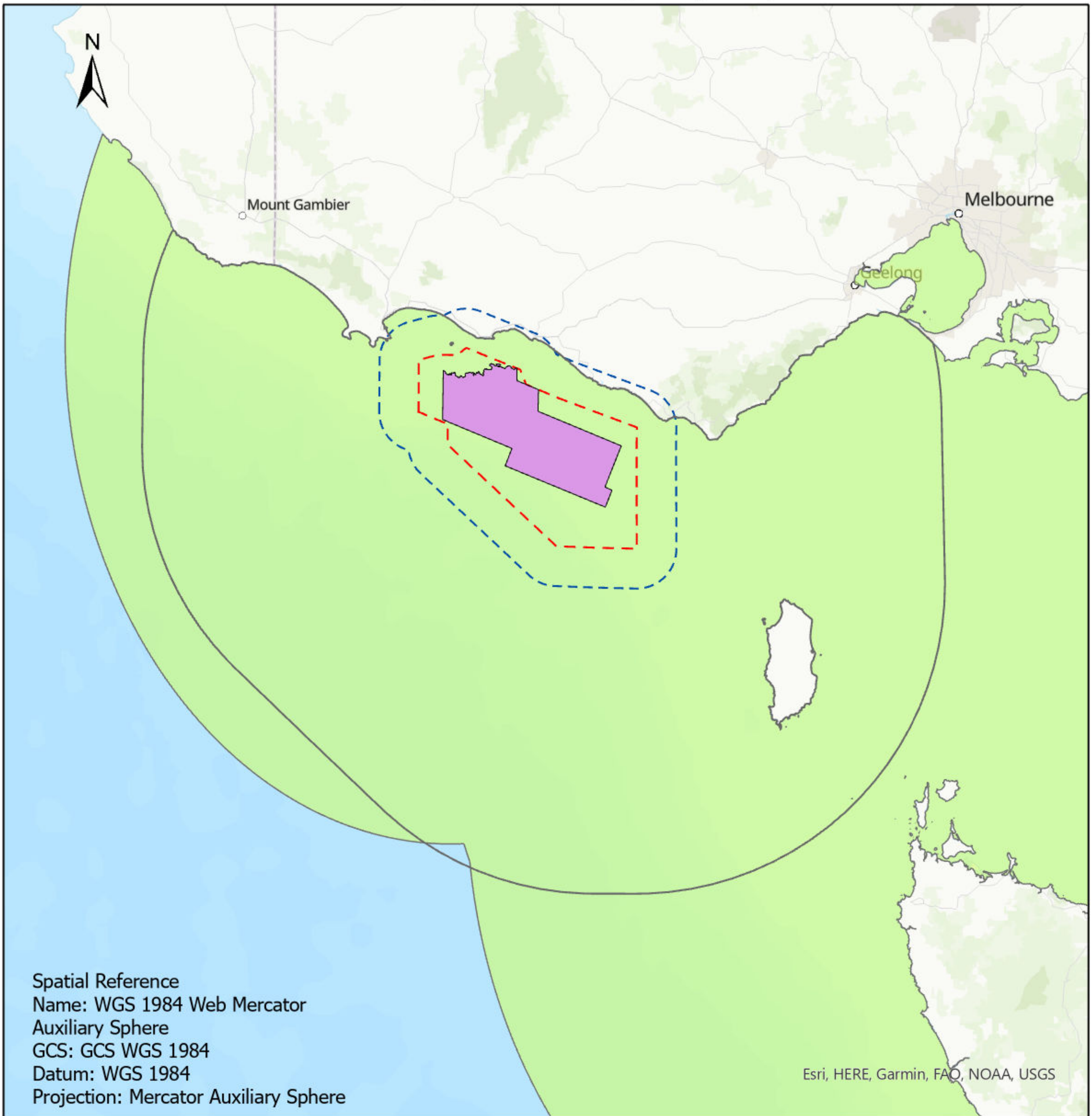
- Active Source Area
- Operational Area
- Environmental Planning Area
- Campbell Albatross Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-061_A

Regia MSS - Common Diving Petrel Biologically Important Areas



Legend

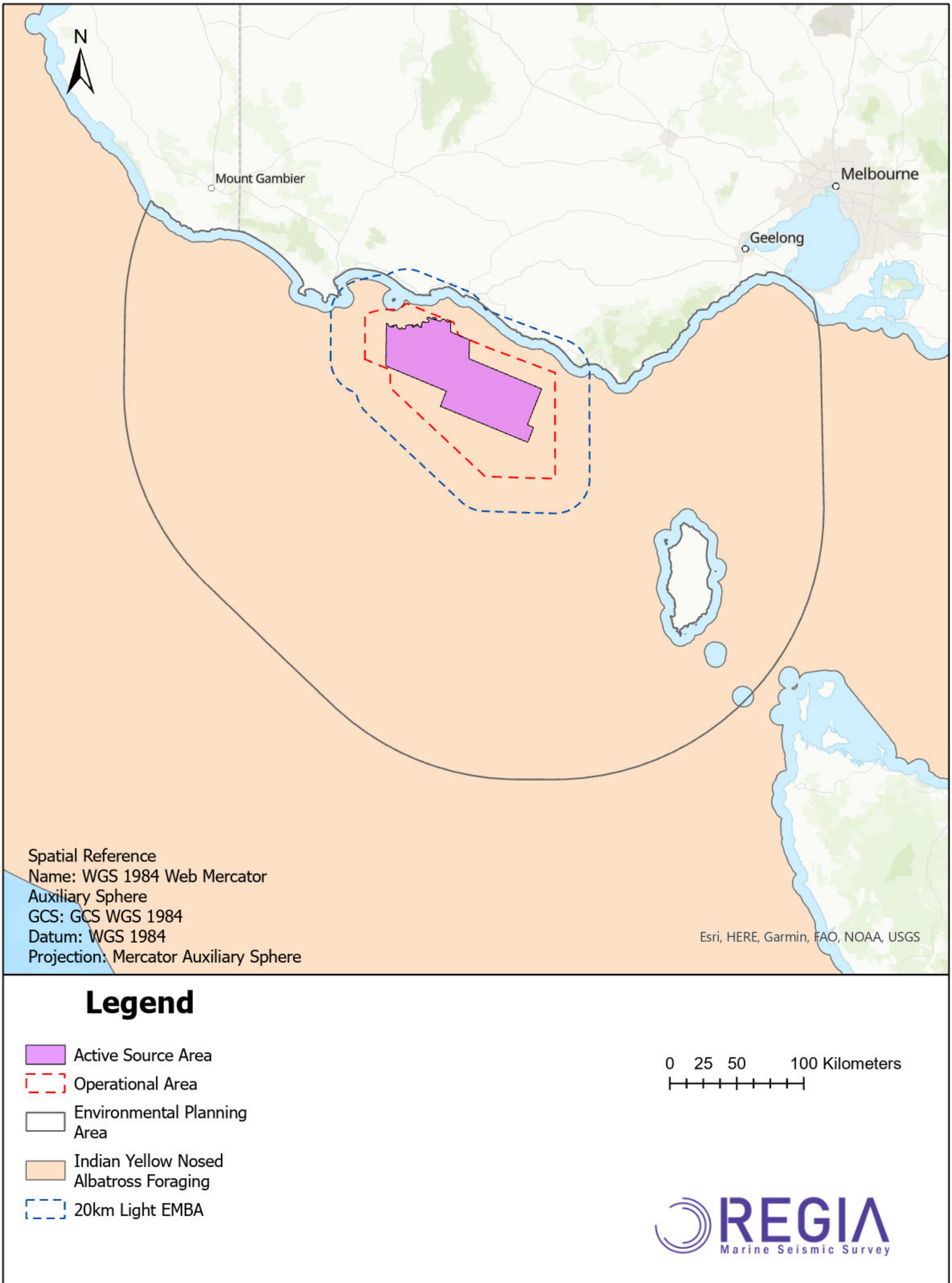
- Active Source Area
- Operational Area
- Environmental Planning Area
- Common Diving Petrel Foraging
- Common Diving Petrel Breeding
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

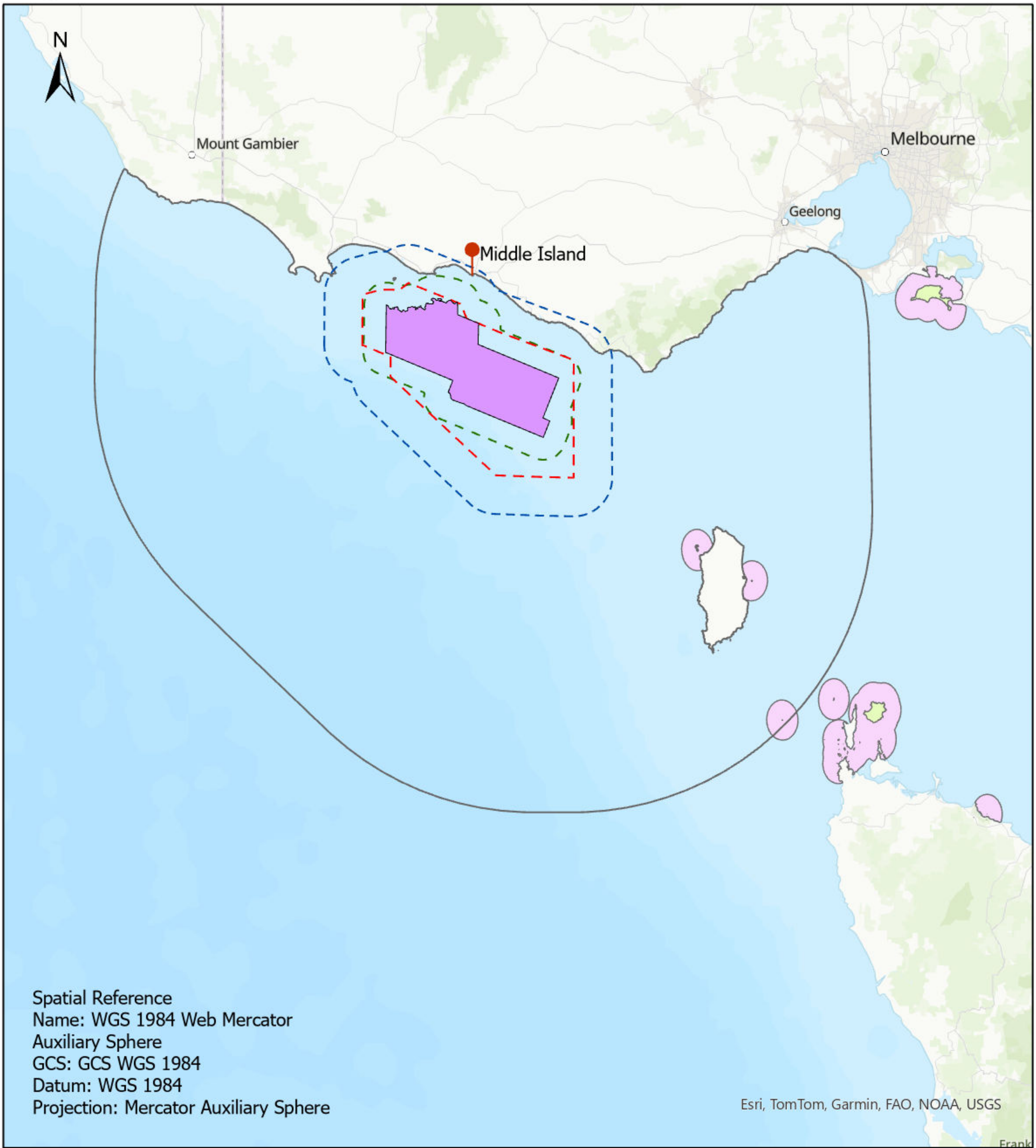
MAP-REG-EPM-062_A

Regia MSS - Indian Yellow Nosed Albatross Biologically Important Areas



MAP-REG-EPM-063_A

Regia MSS - Little Penguin Biologically Important Areas



Legend

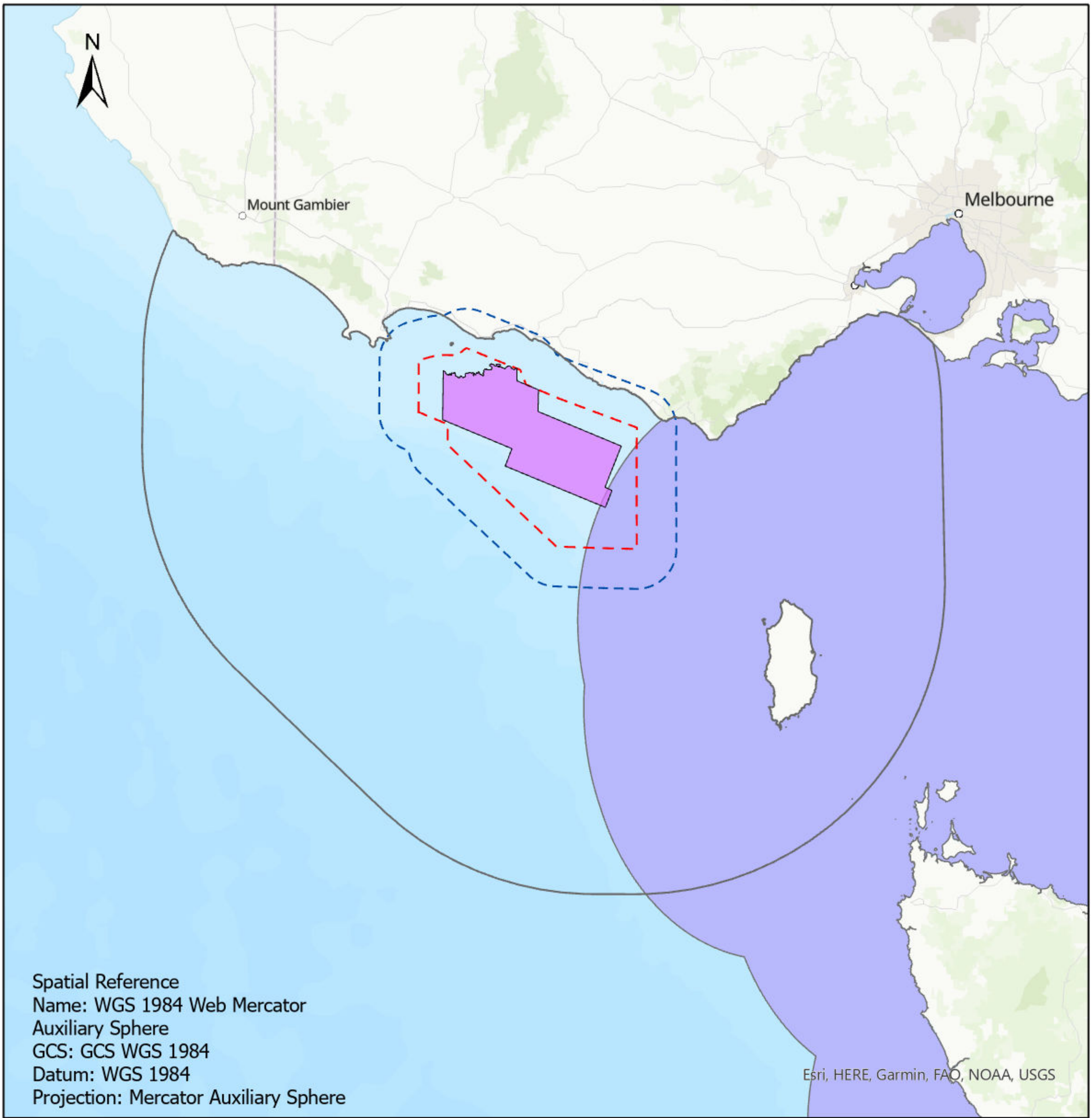
- Active Source Area
- Operational Area
- Environmental Planning Area final
- Little Penguin Breeding
- Little Penguin Foraging
- 20km Light EMBA
- 11.6km Noise EMBA
- Middle Island

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-064_B

Regia MSS - Short Tailed Shearwater Biologically Important Areas



Legend

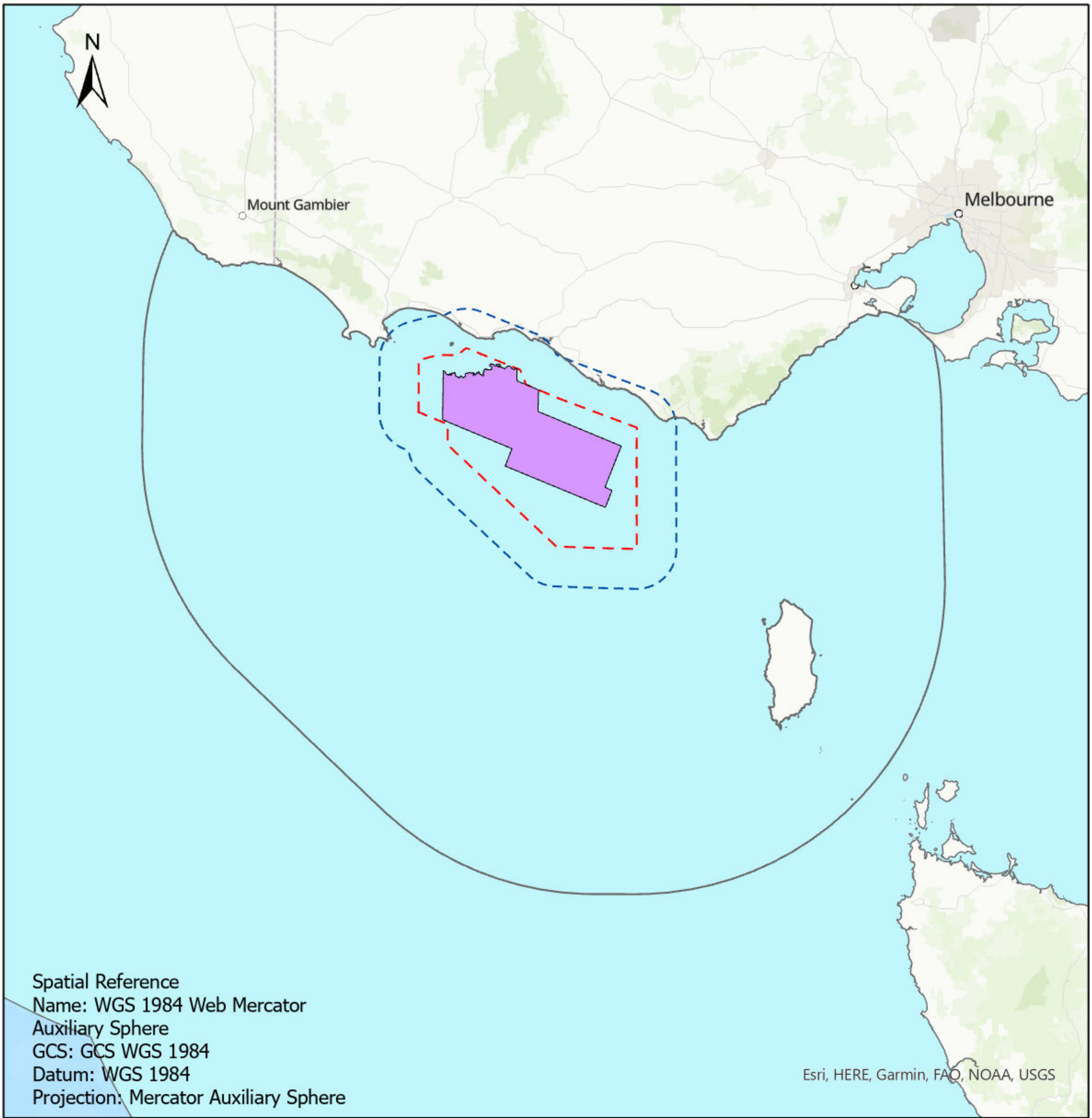
- Active Source Area
- Operational Area
- Environmental Planning Area
- Short Tailed Shearwater Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-065_A

Regia MSS - Shy Albatross Foraging Biologically Important Areas



Legend

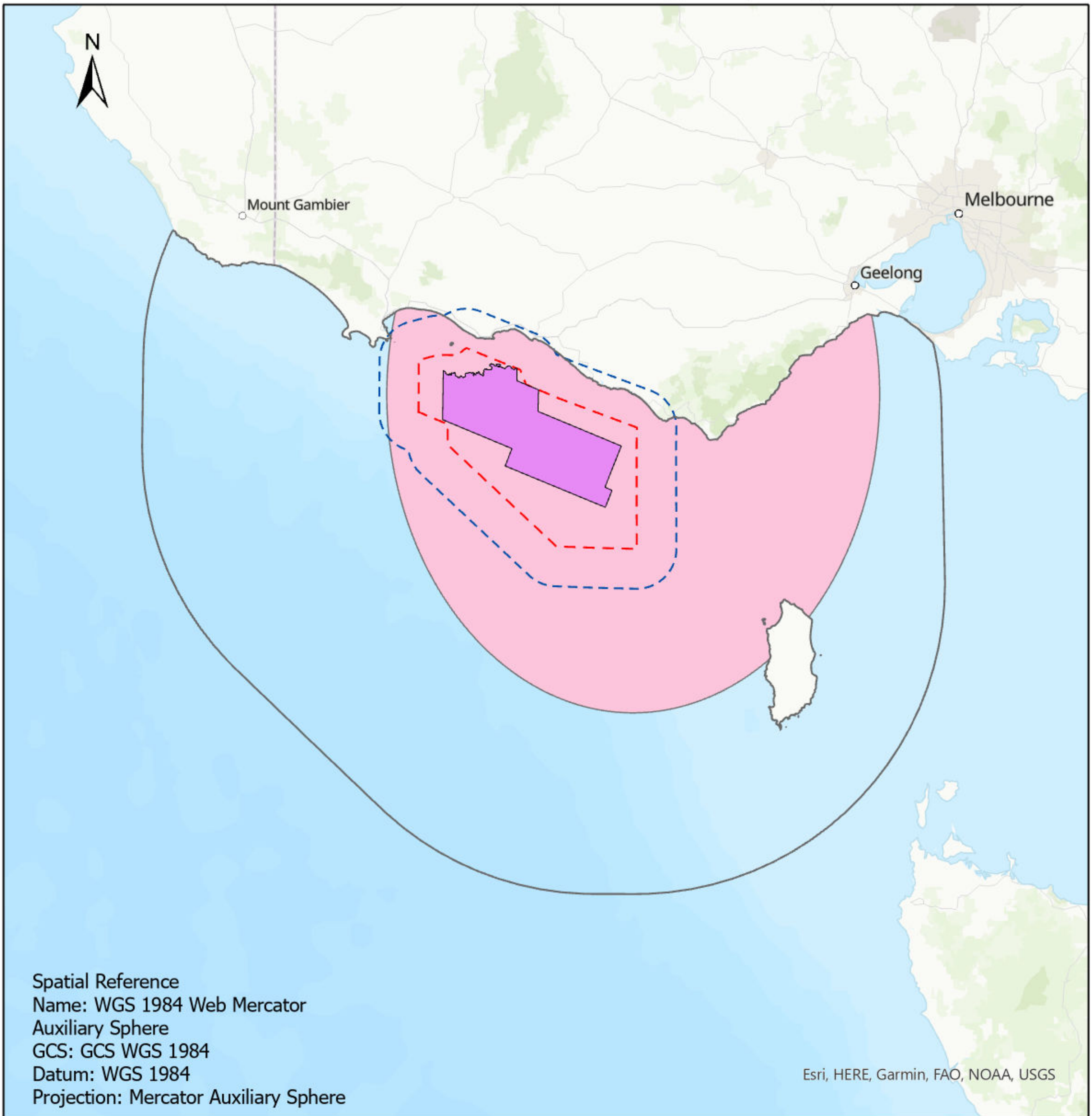
- Active Source Area
- Operational Area
- Environmental Planning Area
- Shy Albatross Foraging Likely
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-066_A

Regia MSS - Wedge Tailed Shearwater Biologically Important Areas



Legend

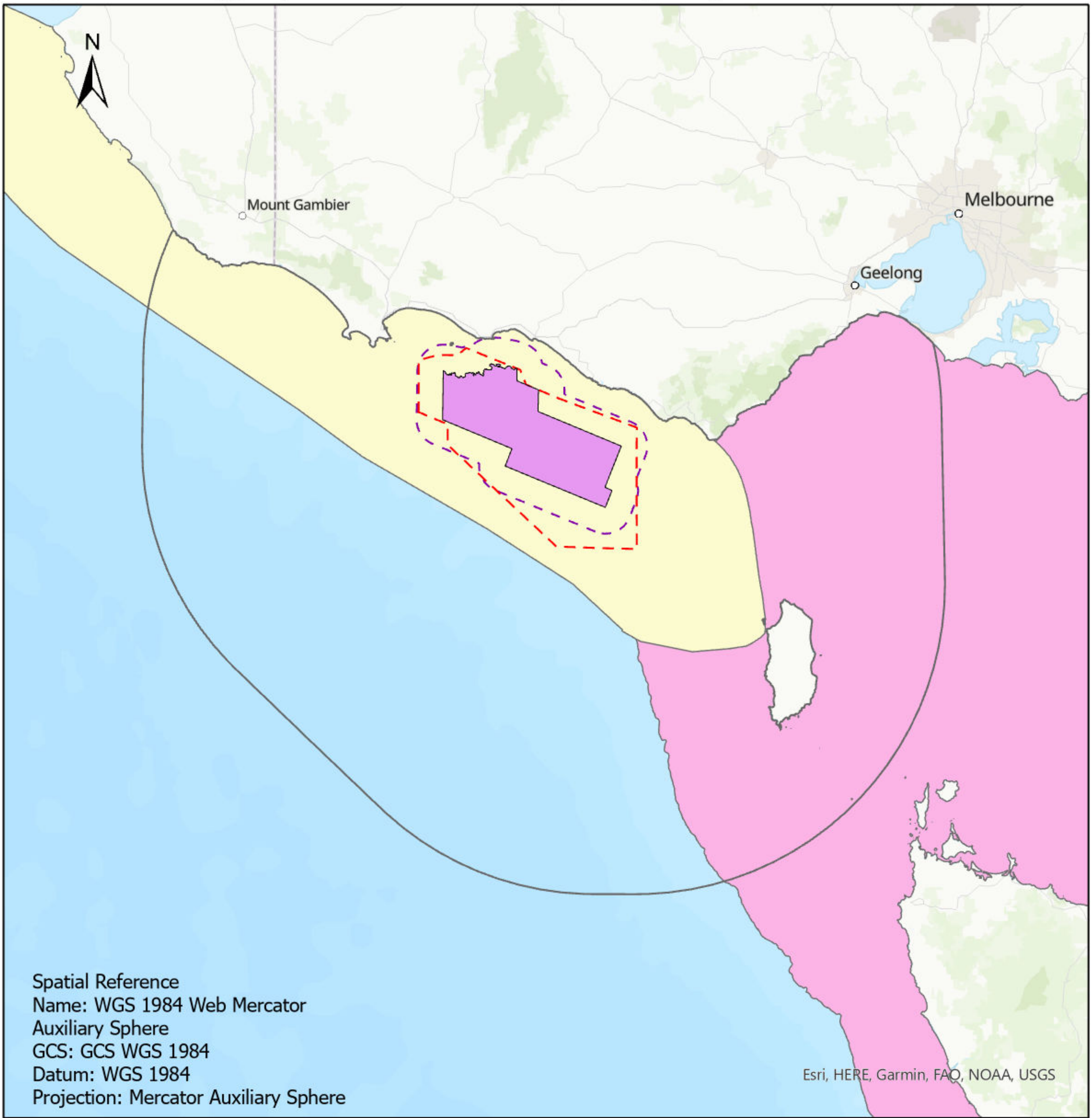
- Active Source Area
- Operational Area
- Environmental Planning Area
- Wedge Tailed Shearwater Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-067_A

Regia MSS - Pygmy Blue Whale Biologically Important Areas



Legend

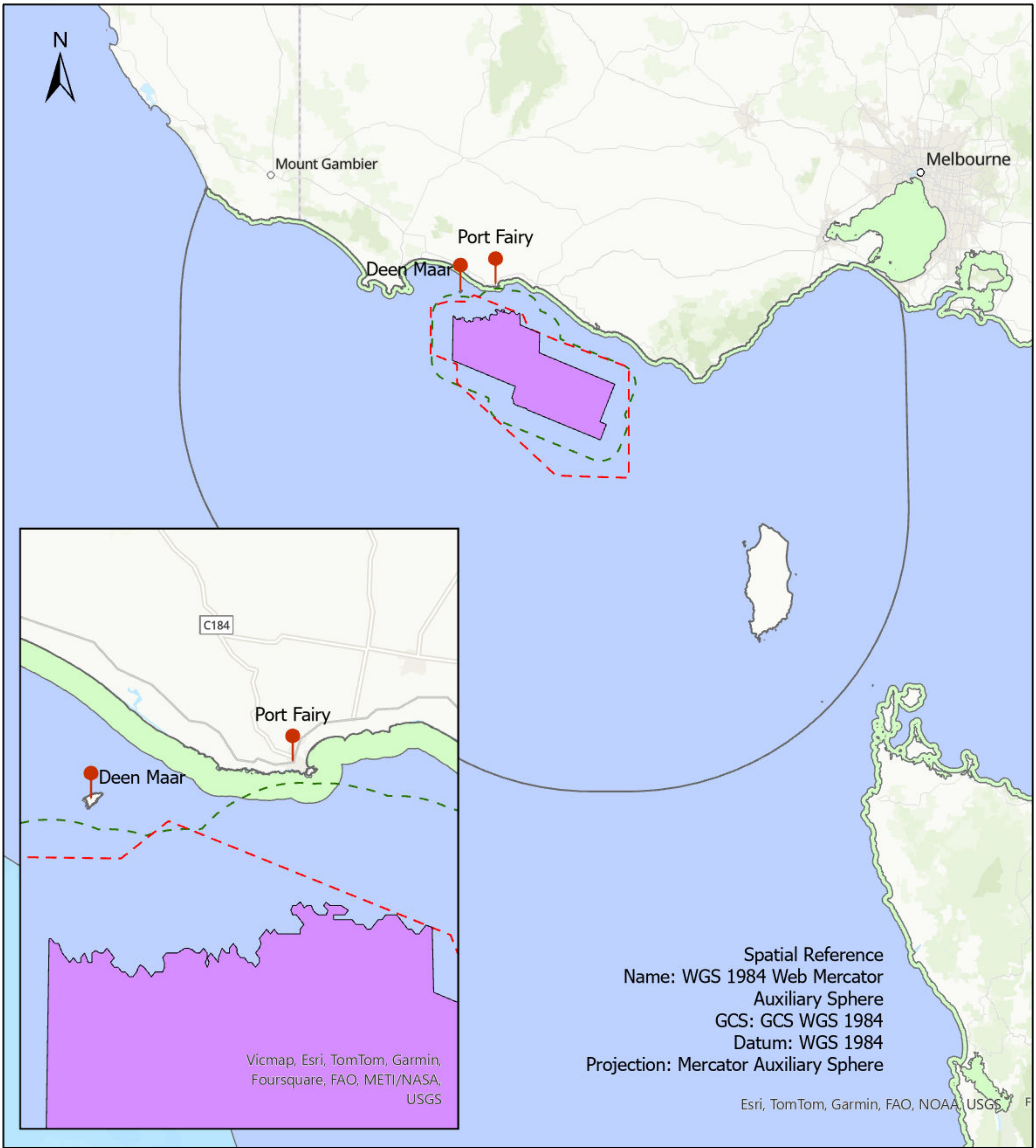
- Active Source Area
- Operational Area
- Environmental Planning Area
- Pygmy Blue Whale Foraging (abundant food source / annual high use area)
- Pygmy Blue Whale Known Foraging Area
- 13.2km Noise EMBA

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-068_A

Regia MSS - Southern Right Whale Biologically Important Areas



Legend

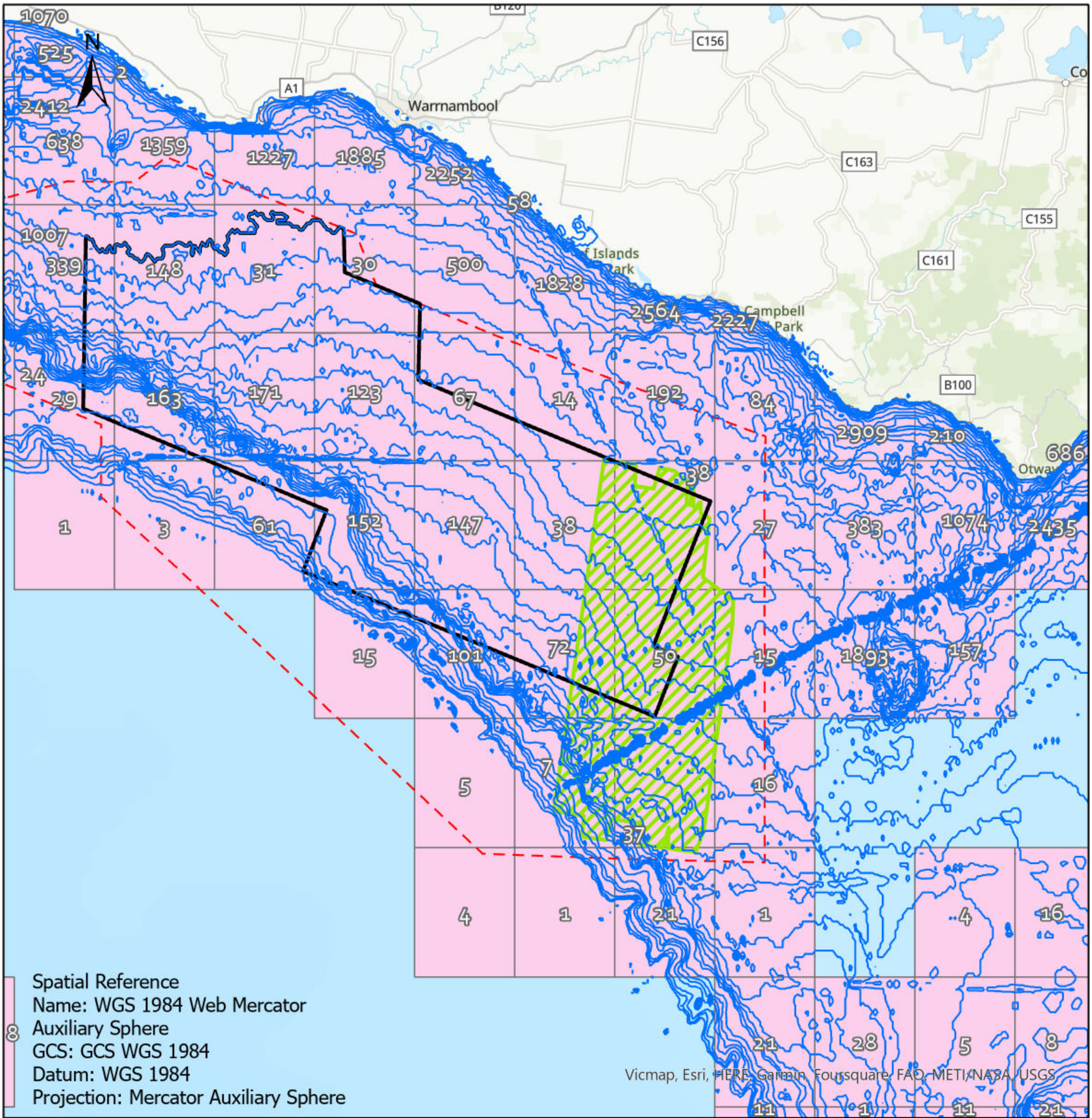
- Active Source Area
- Operational Area
- Environmental Planning Area final
- 11.6km Noise EMBA
- Southern Right Whale Reproduction BIA
- Southern Right Whale Migration

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-069_B

Regia MSS - 5m Bathymetry & Rock Lobster Fishing Days - Investigator



Legend

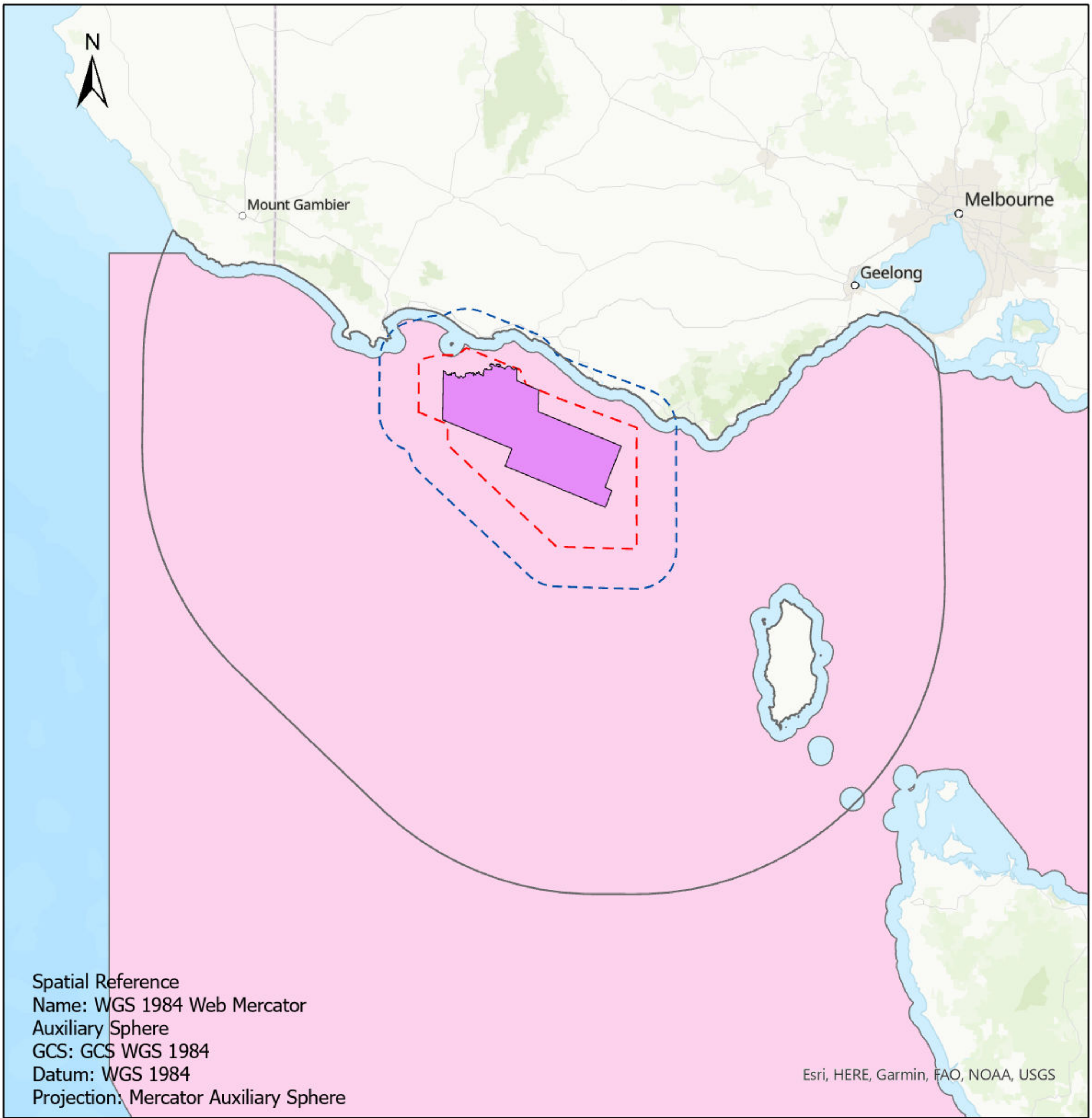
- Investigator MSS
- Active Source Area
- Operational Area
- Rock Lobster 2011-2022_RFI
- 5m Bathymetry

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-070_A

Regia MSS - Buller's Albatross Biologically Important Areas



Legend

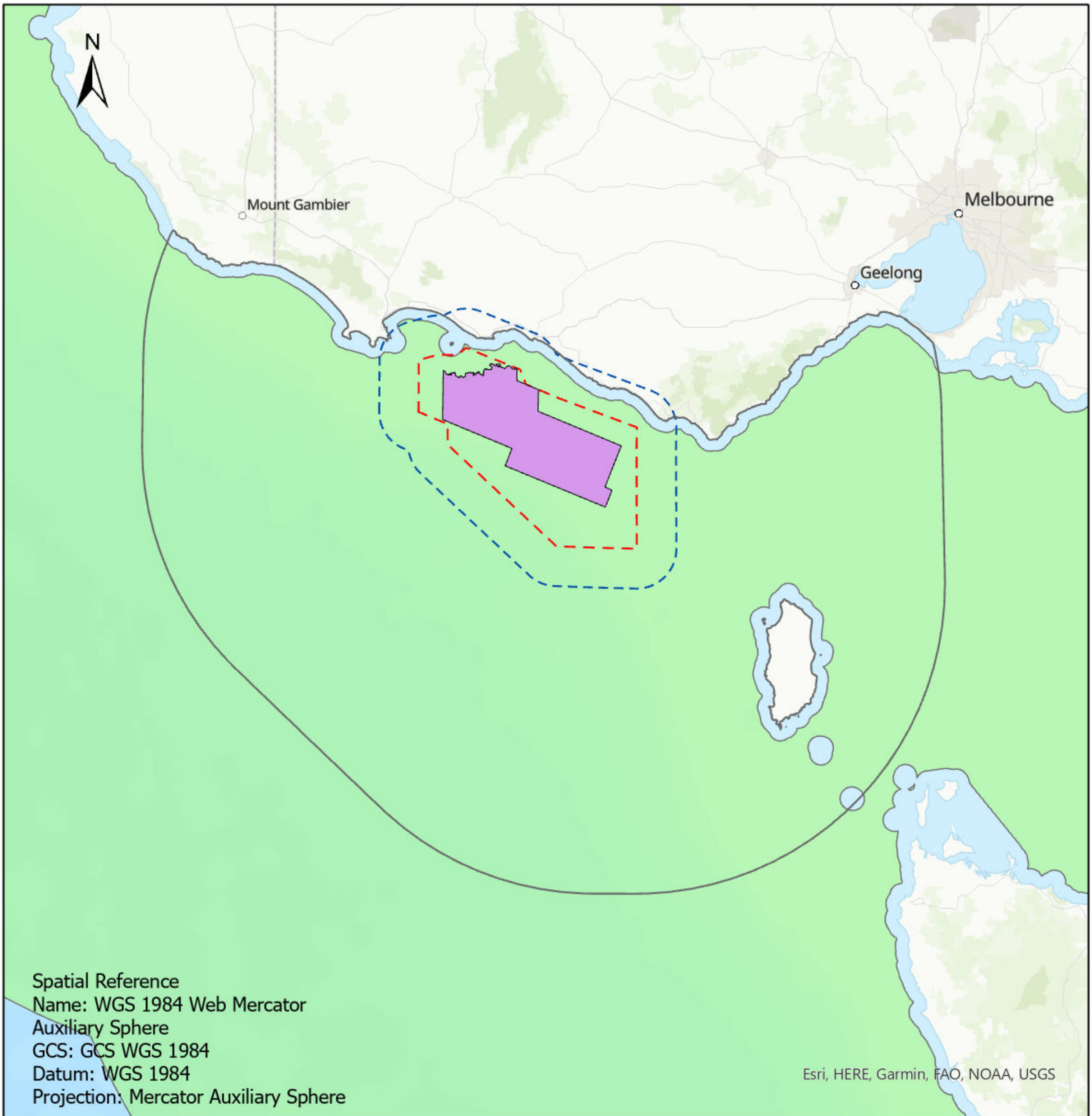
- Active Source Area
- Operational Area
- Environmental Planning Area
- Bullers Albatross Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-071_A

Regia MSS - Wandering Albatross Biologically Important Areas



Legend

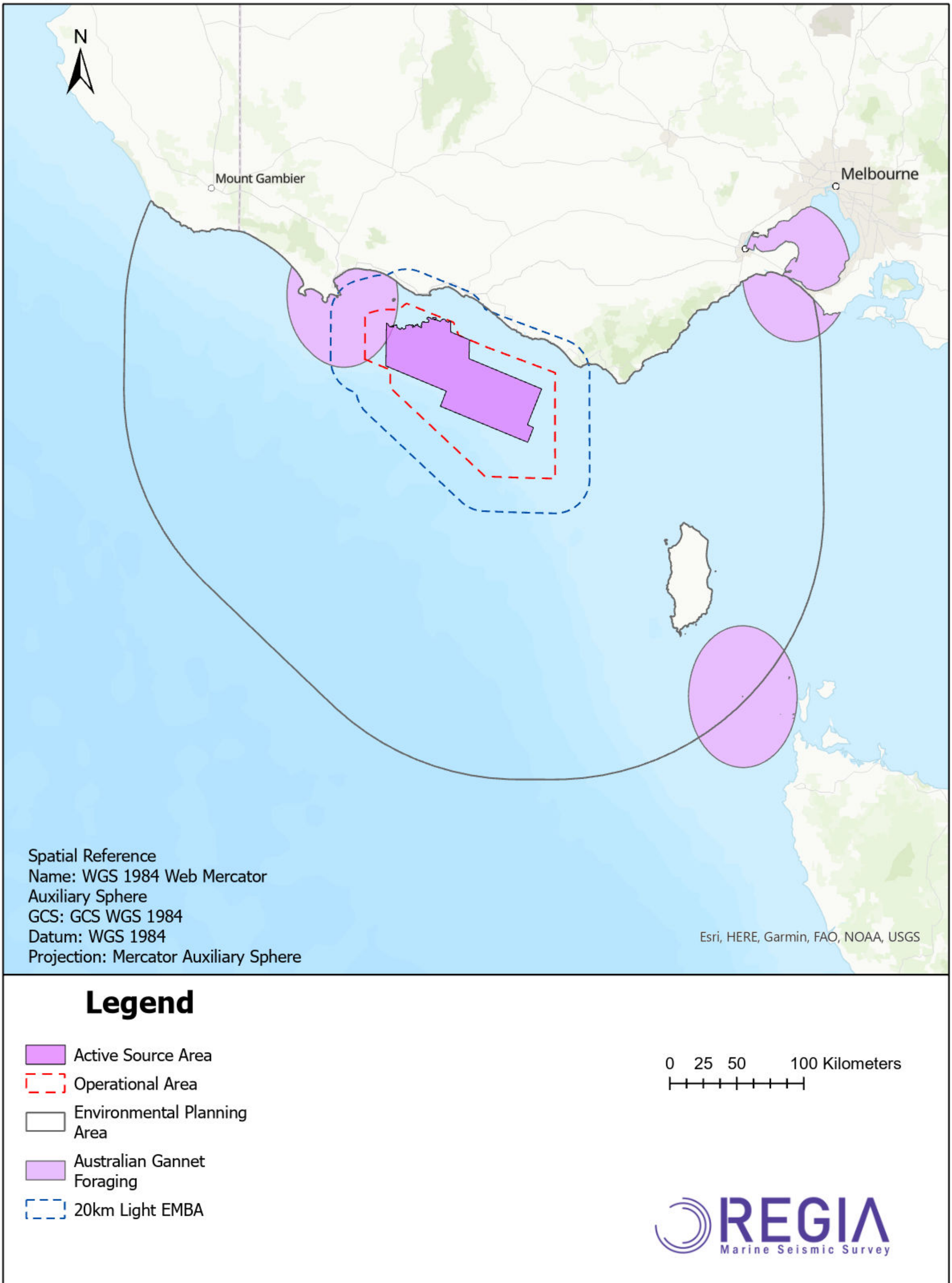
- Active Source Area
- Operational Area
- Environmental Planning Area
- Wandering Albatross Foraging
- 20km Light EMBA

0 25 50 100 Kilometers

REGIA Marine Seismic Survey

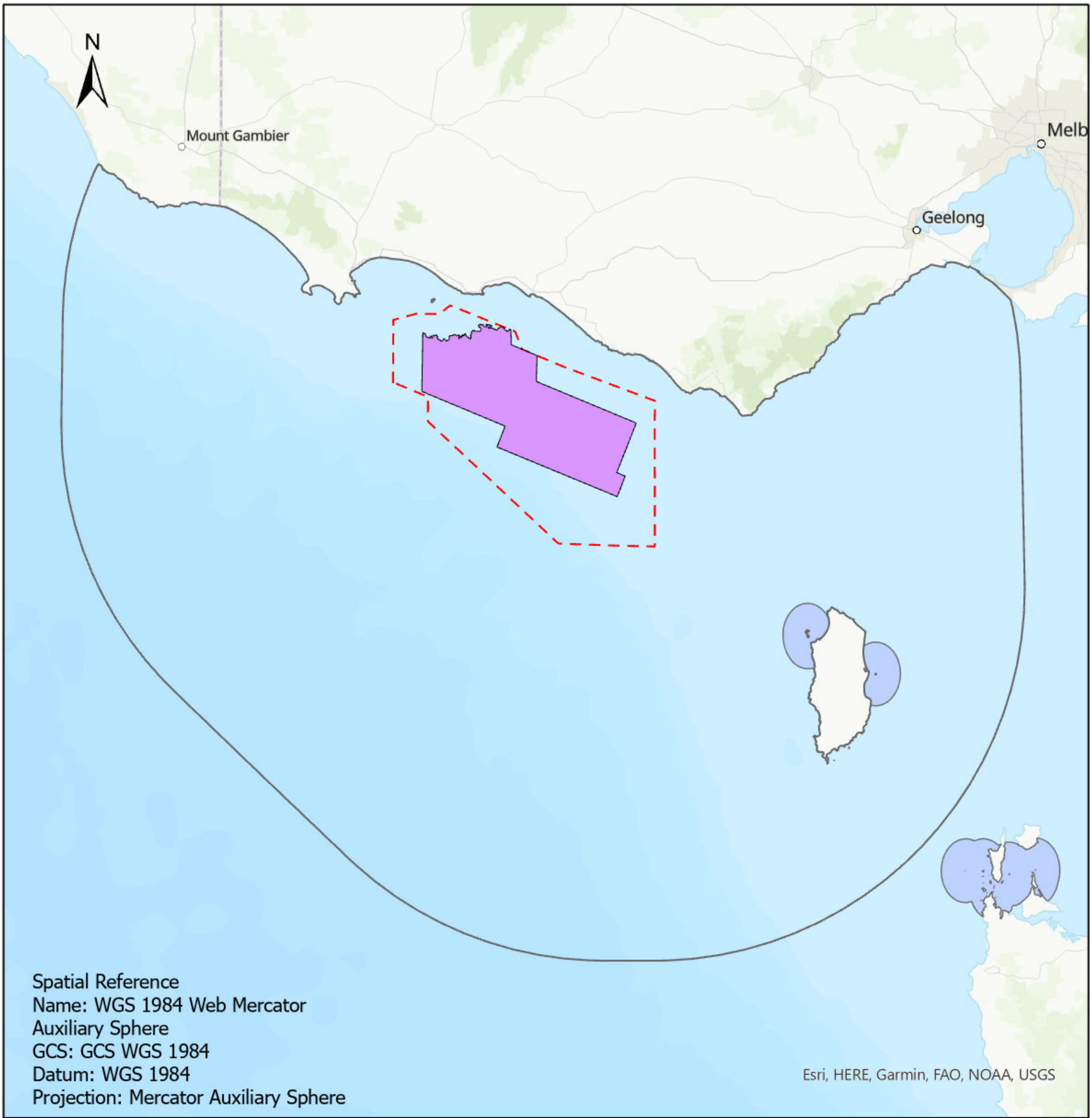
MAP-REG-EPM-072_A

Regia MSS - Australasian Gannet Biologically Important Areas



MAP-REG-EPM-073_A

Regia MSS - Black Faced Cormorant Biologically Important Areas



Legend

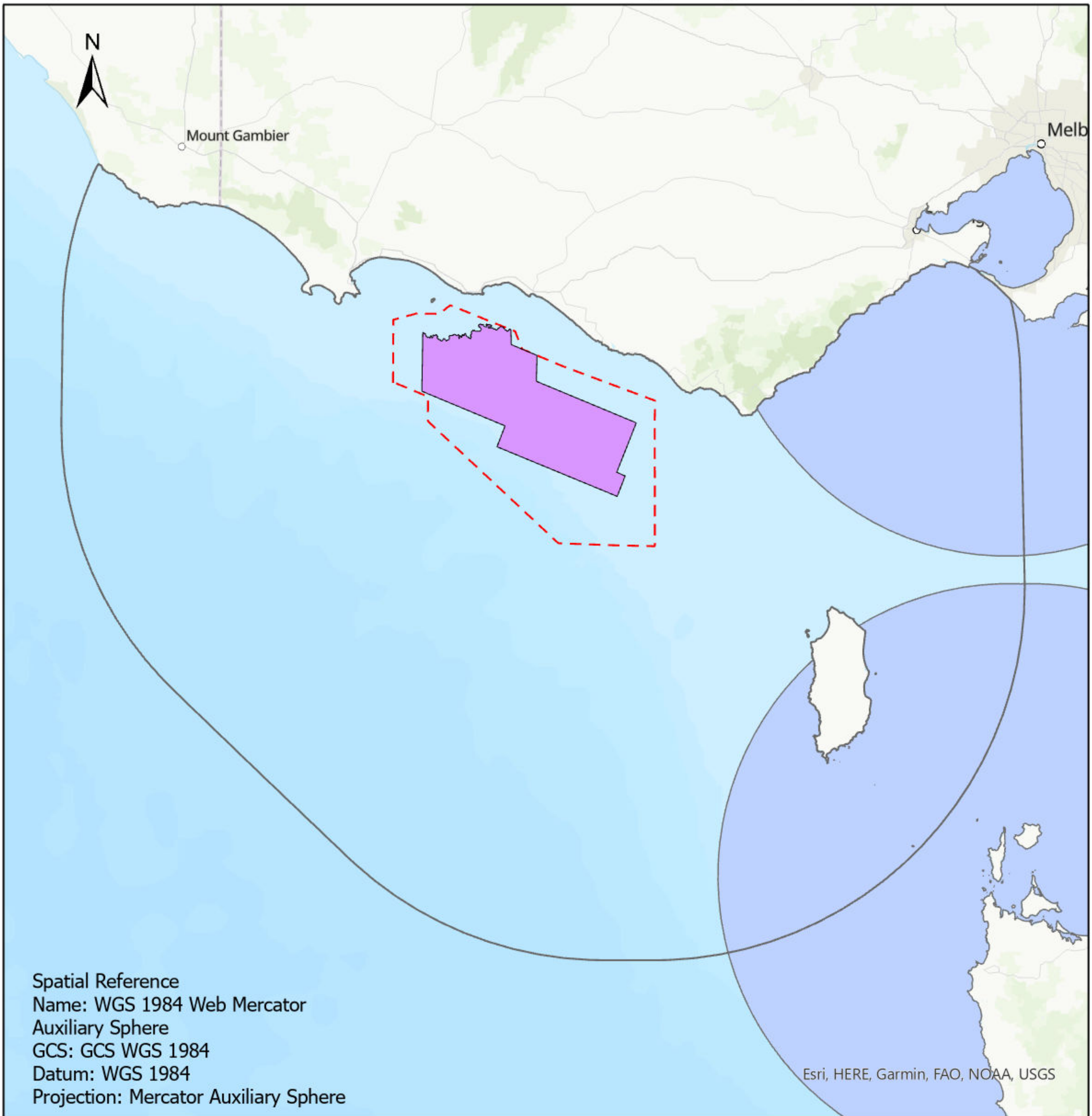
- Active Source Area
- Operational Area
- Environmental Planning Area
- Black Faced Cormorant Breeding
- Black Faced Cormorant Foraging

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-074_A

Regia MSS - White Face Storm Petrel Biologically Important Areas



Legend

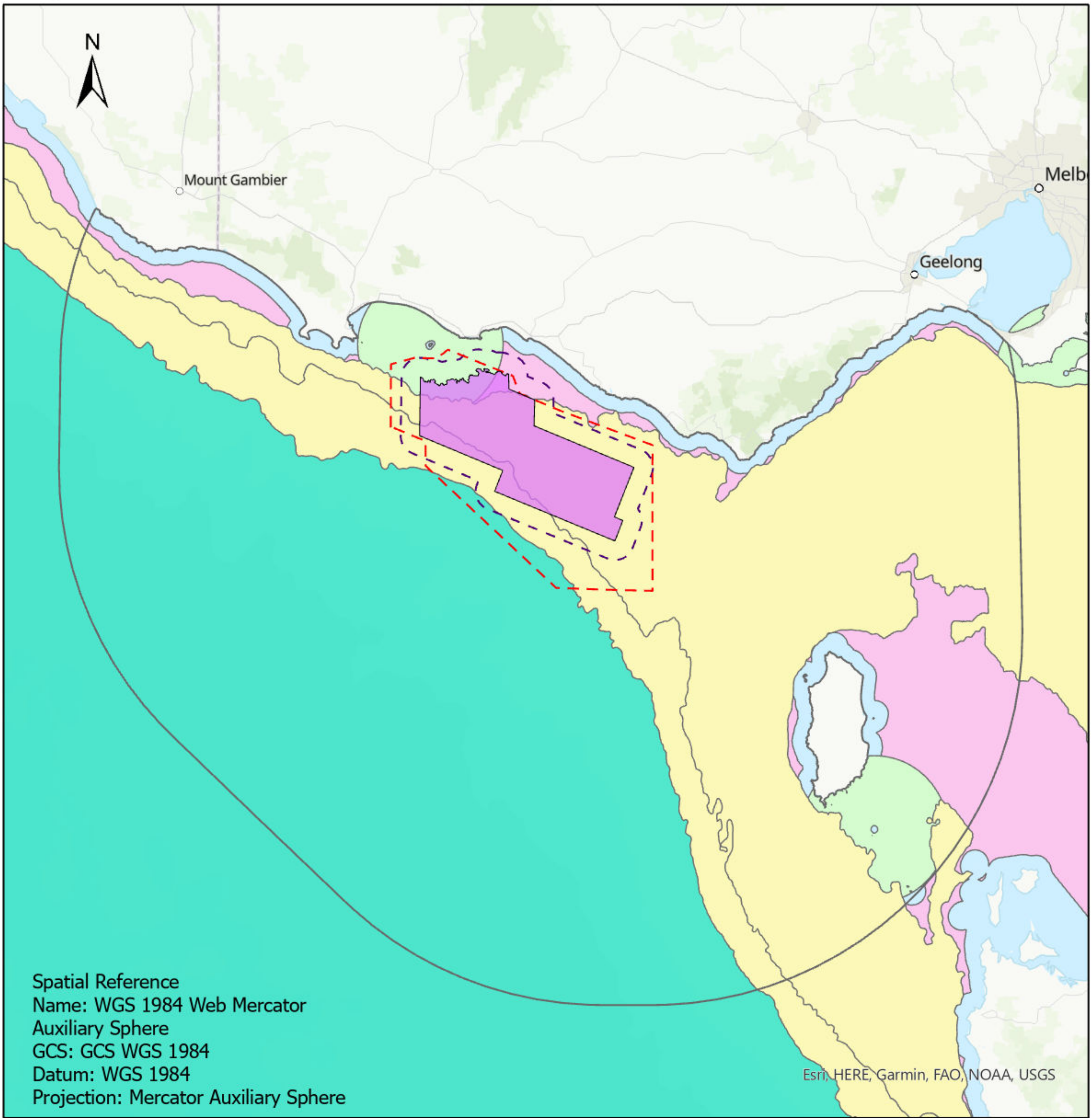
- Active Source Area
- Operational Area
- Environmental Planning Area
- White Faced Storm Petrel Foraging

0 20 40 80 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-075_A

Regia MSS - White Shark Biologically Important Areas and Sound



Legend

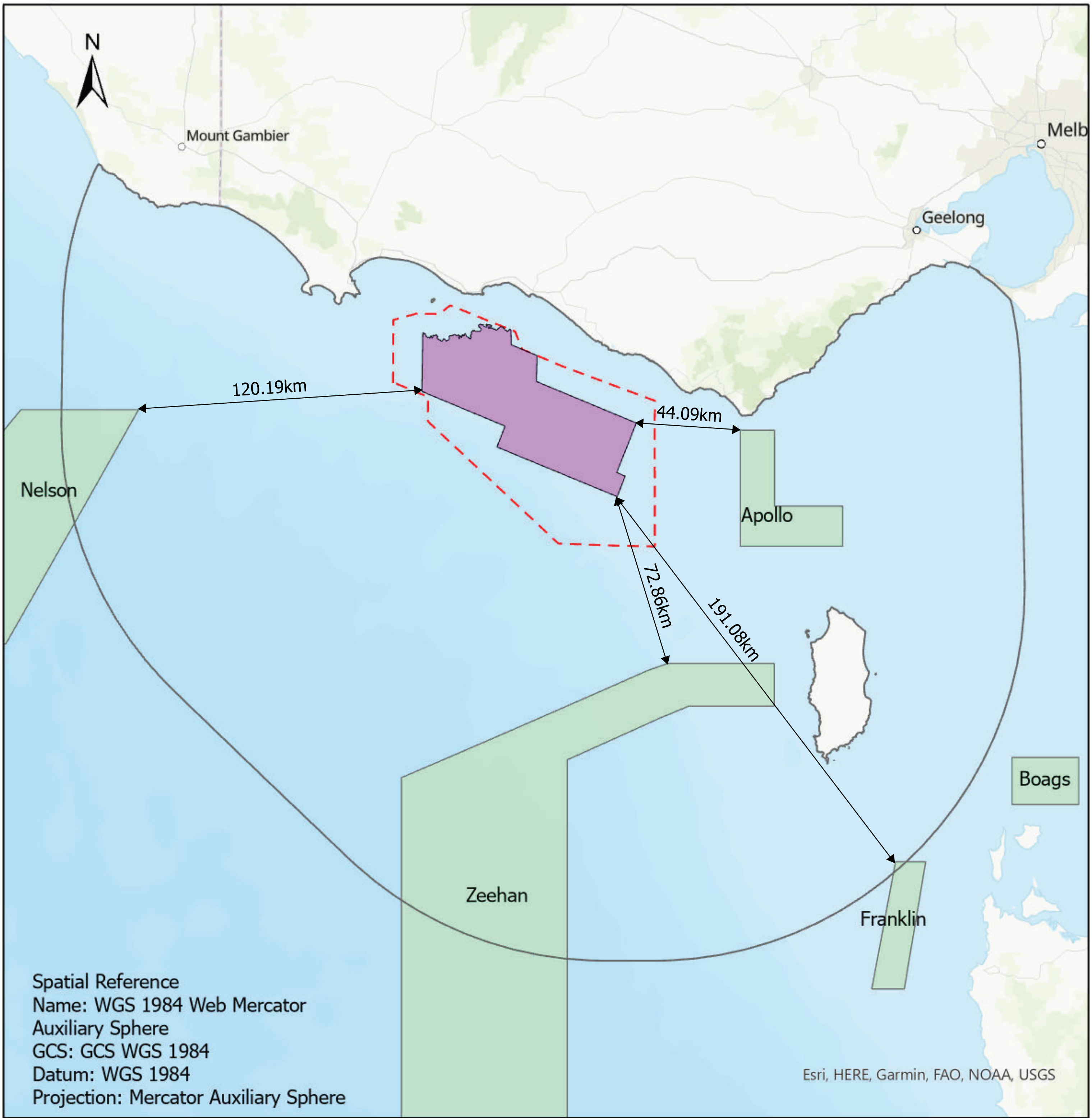
- Active Source Area
- Operational Area
- Environmental Planning Area
- White Shark Distribution
- White Shark Distribution Low Density
- White Shark Known Distribution
- White Shark Foraging
- 8km Noise EMBA

0 20 40 80 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-077_A

Regia MSS - Australian Marine Parks



Legend

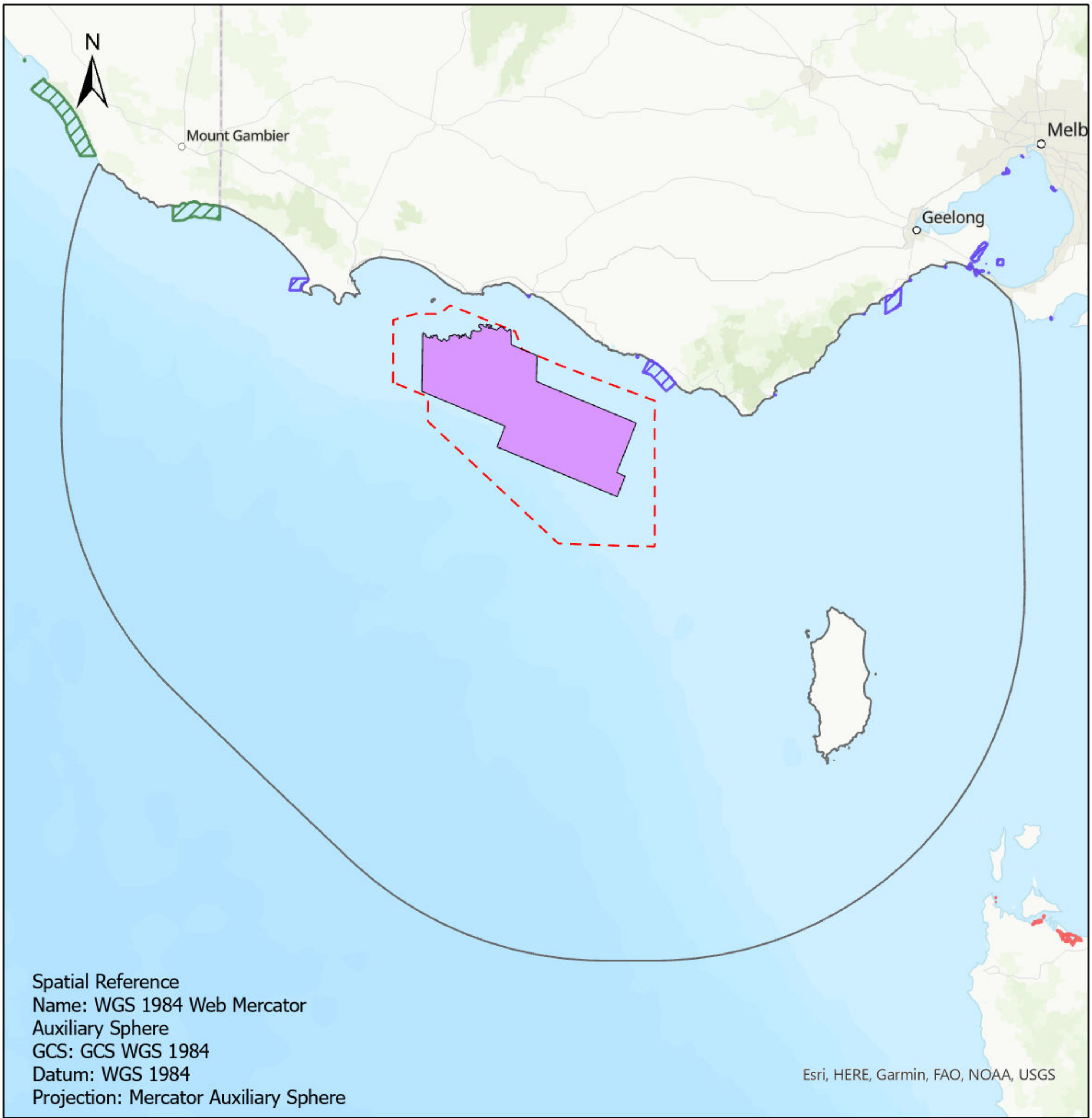
- Active Source Area
- Operational Area
- Environmental Planning Area
- Australian Marine Parks

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-078_B

Regia MSS - State Marine Protected Areas



Legend

- Active Source Area
- Operational Area
- Environmental Planning Area

State Marine Parks

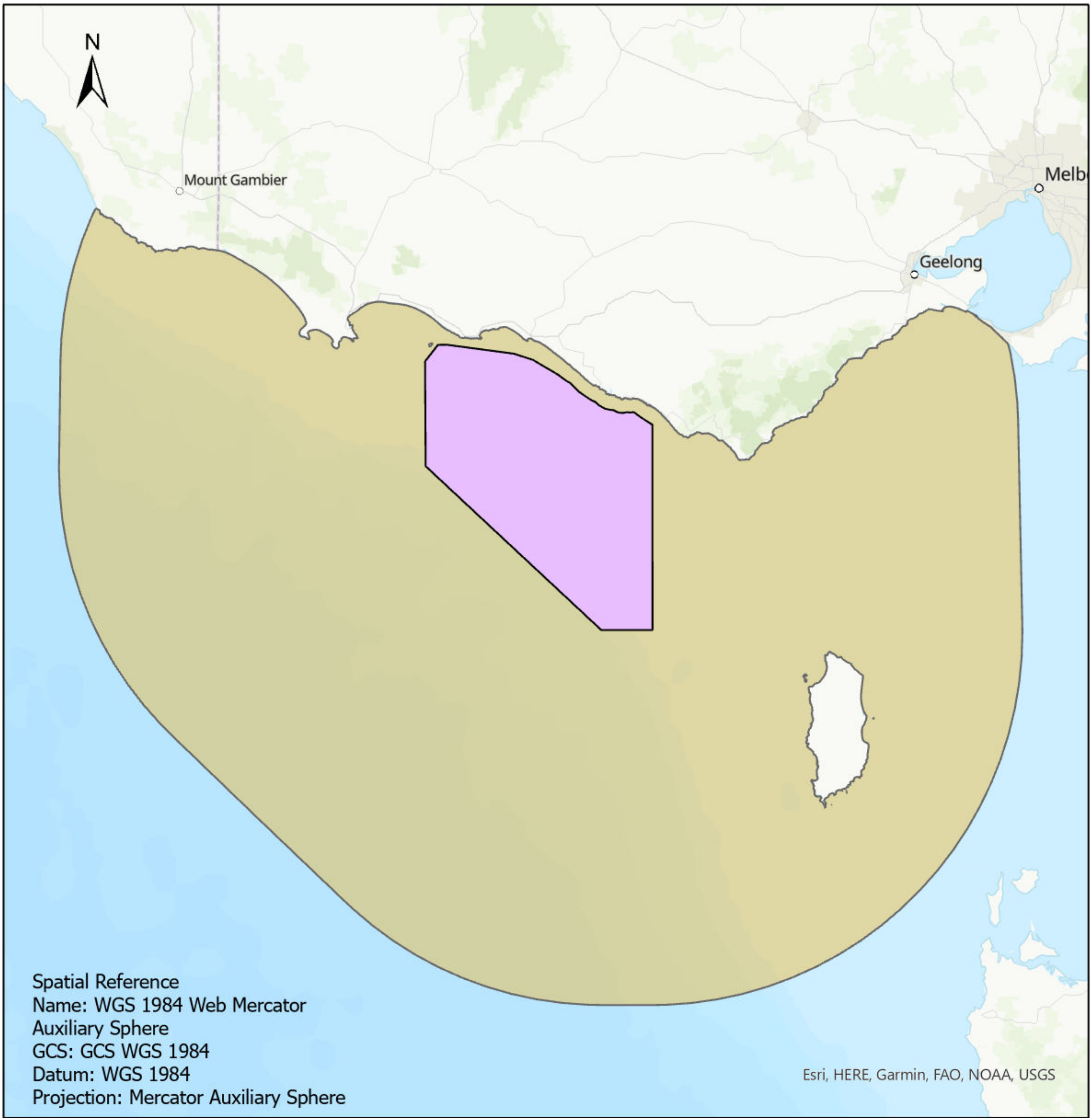
- South Australia
- Tasmania
- Victoria

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-079_A

Regia MSS - Initial Planning Areas



Legend

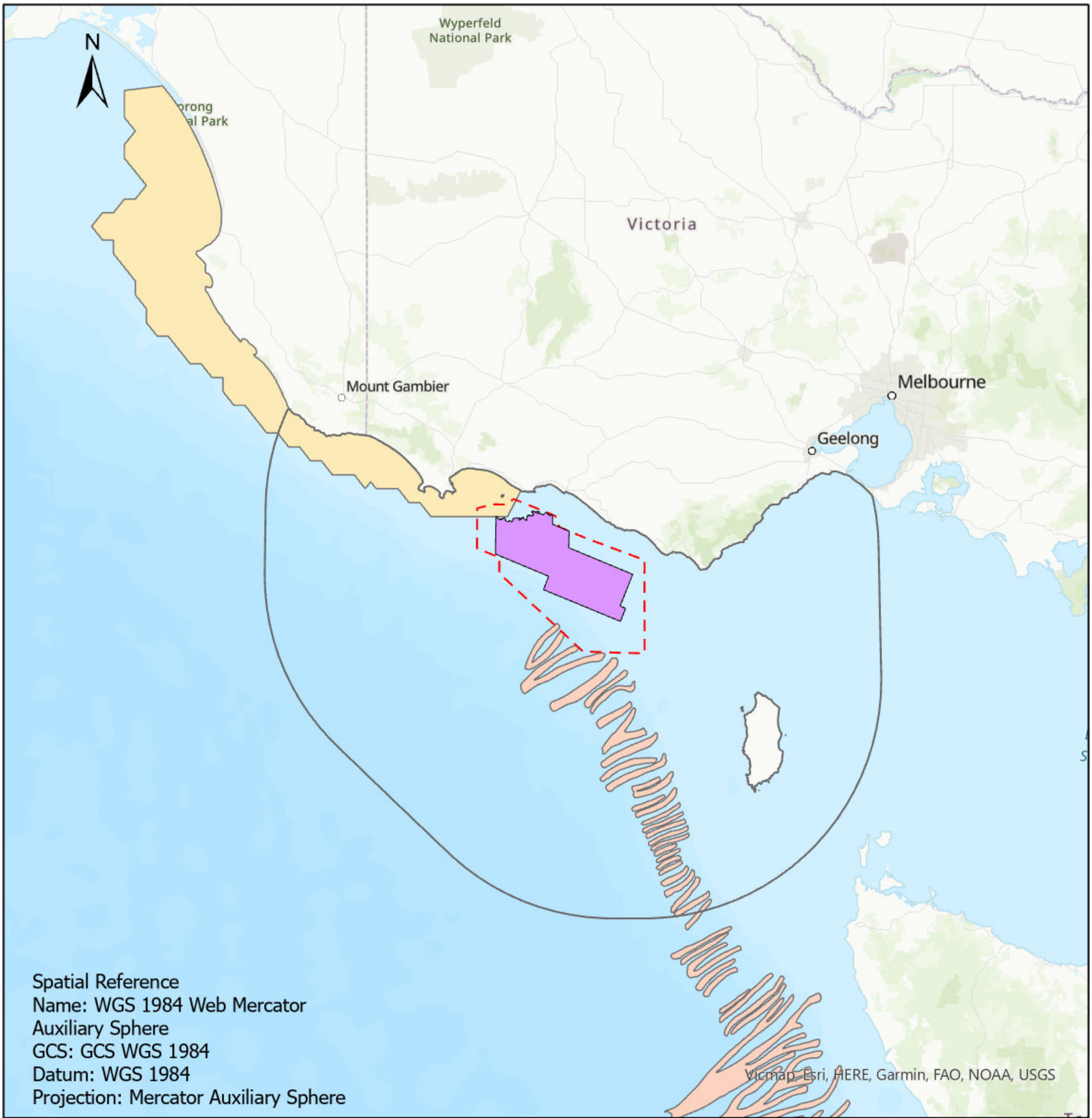
- Previous Activity Planning Area
- Environmental Planning Area

0 20 40 80 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-080_A

Regia MSS - Key Ecological Features



Legend

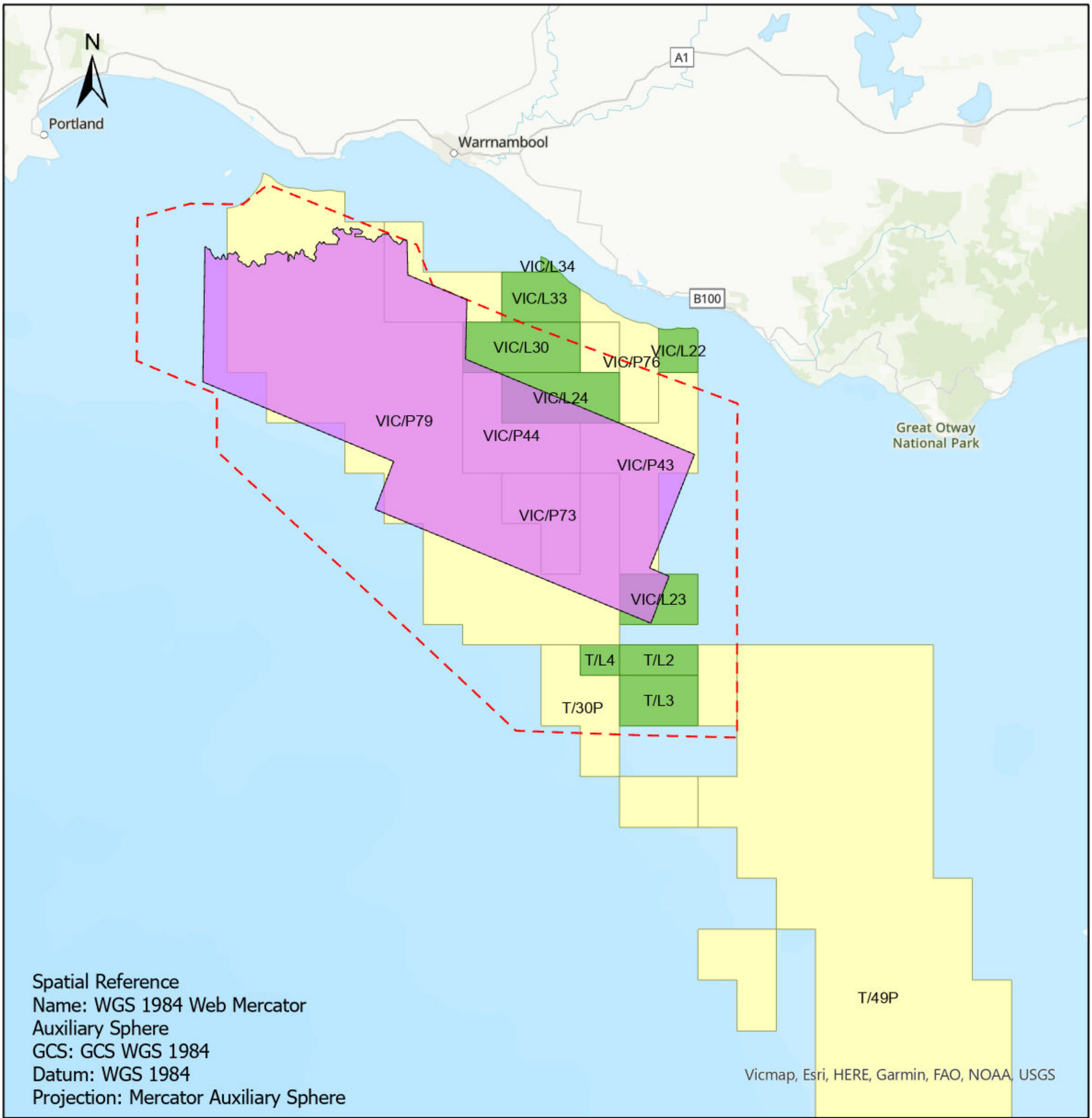
- Bonney Coast Upwelling Key Ecological Feature
- West Tasmanian Canyons Key Ecological Feature
- Active Source Area
- Operational Area
- Environmental Planning Area

0 35 70 140 Kilometers

REGIA
Marine Seismic Survey

MAP-REG-EPM-081_A

Regia MSS - Active Source Area & Titles & Permits



Legend

Active Source Area

Operational Area

Titles and Permits

Current

Exploration Permit

Production Licence

REGIA Marine Seismic Survey

MAP-REG-EPM-082_A

Regia MSS - Operational Area & Environmental Planning Area

Legend

Operational Area

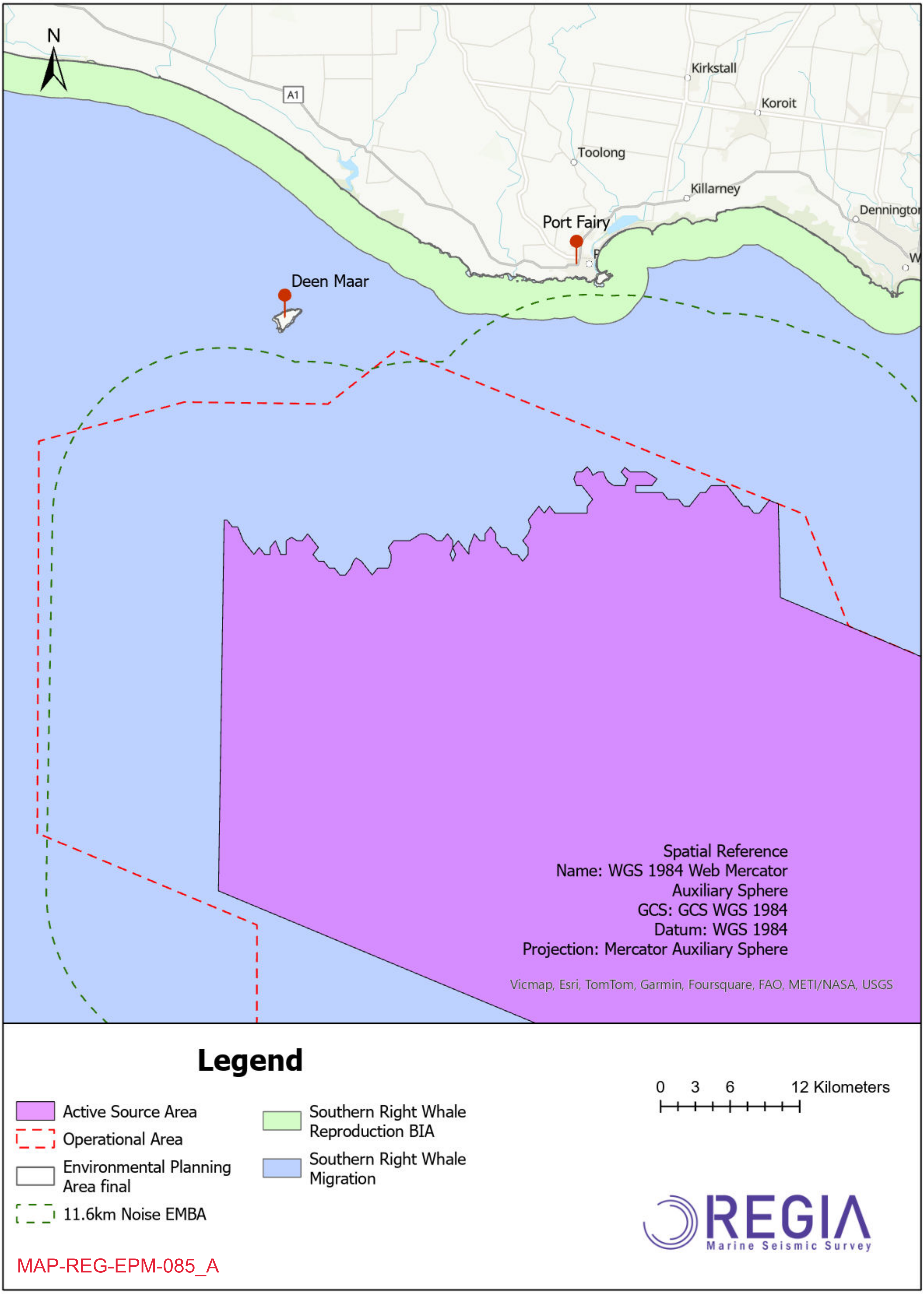
Environmental Planning Area

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

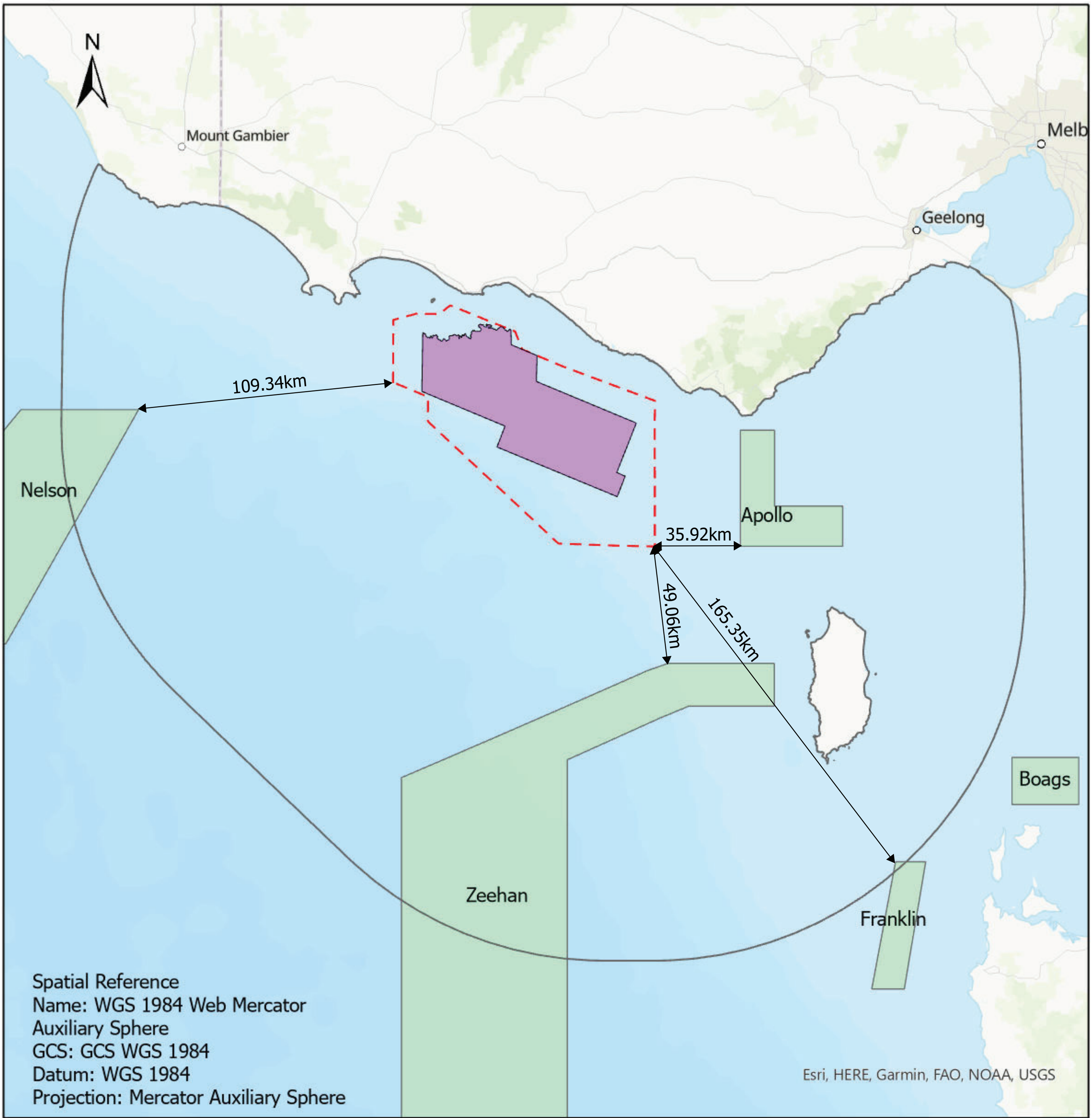
MAP-REG-EPM-083_A

Regia MSS - Southern Right Whale Biologically Important Areas & Noise EMBA



MAP-REG-EPM-085_A

Regia MSS - Australian Marine Parks



Legend

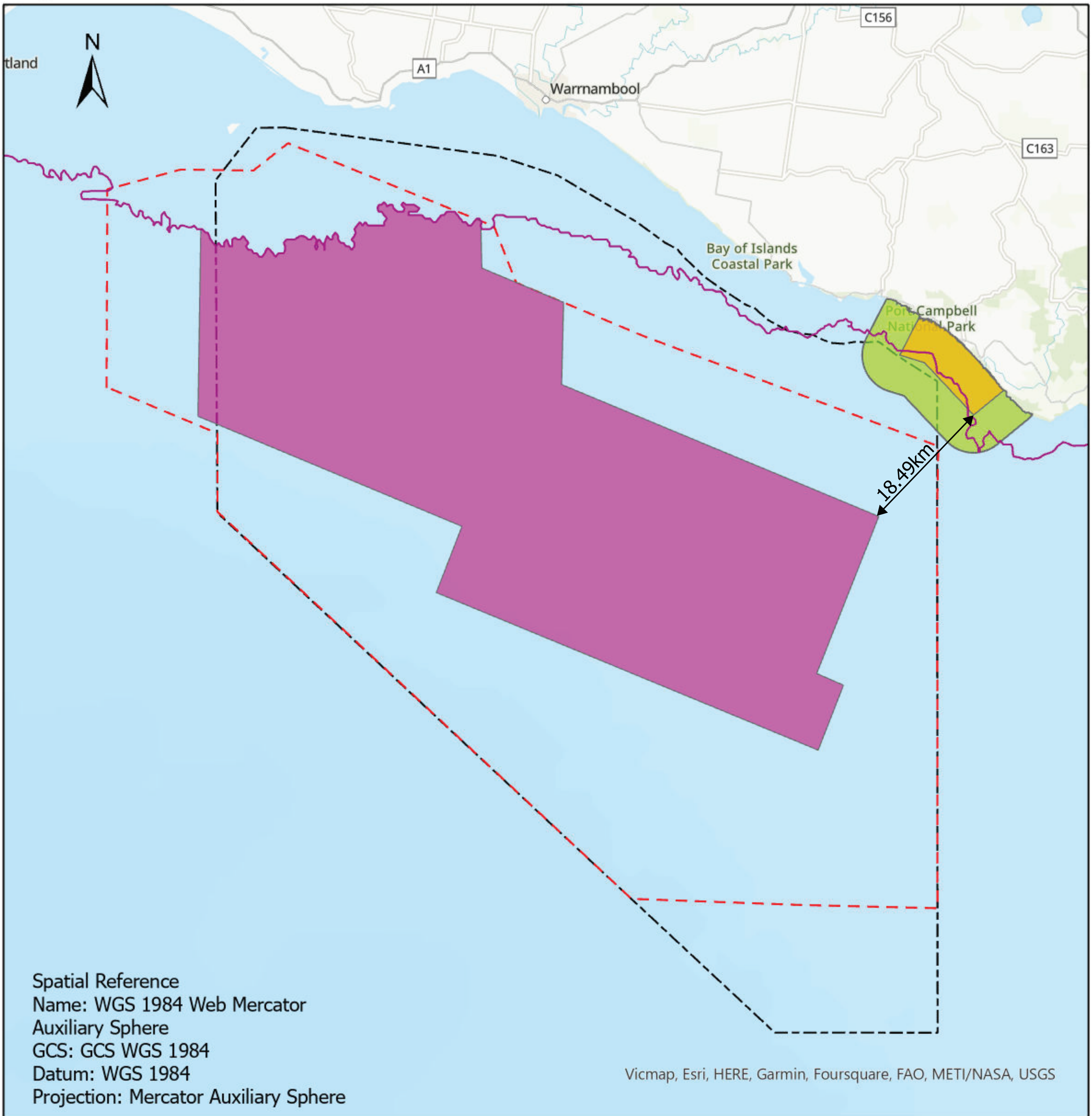
- Active Source Area
- Operational Area
- Environmental Planning Area
- Australian Marine Parks

0 20 40 80 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-086_A

Regia MSS - 12 Apostles Marine Park 5km Buffer



Legend

- Active Source Area
- Operational Area
- Previous Activity Planning Area
- 50m Contour
- 12 Apostles Marine Park
- 12 Apostles 5km Buffer

0 5 10 20 Kilometers

REGIA Marine Seismic Survey

MAP-REG-EPM-087_A

REGIA

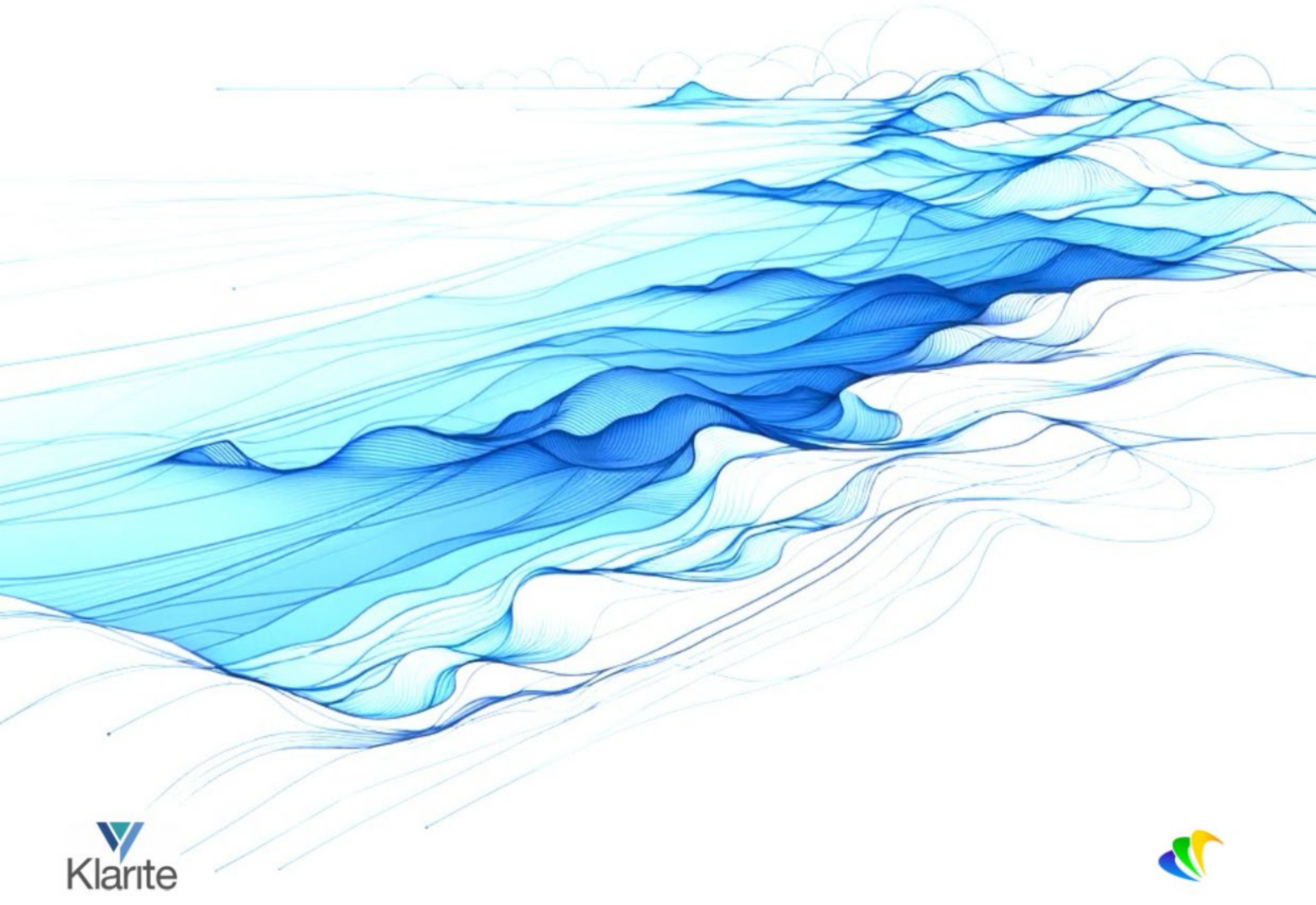
Marine Seismic Survey

Consultation and Engagement

Appendix C1: REG-EP-012-C1

Rev 2

May 2024



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1 Introduction

Pursuant to Part 4 Division 3 of the *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023* (**the Regulations**) and considering recent case law, CGG Geophysical Services Pty Ltd (**CGG**) has performed consultations as required. This appendix aims to document how CGG undertook the consultation process, managed risks to as low as reasonably practicable and an acceptable level, and appropriately responded to, incorporated, and adopted measures based on relevant persons objections, claims, and other feedback.

By capturing sufficiently broad people and information through desktop research, community outreach events, and various targeted media and advertising techniques, CGG were able to identify relevant persons, provide them with sufficient information on the possible consequences of the activity on their functions, interests, or activities, allow a reasonable period for consultation, respond appropriately, and document details of such process.

This chapter will outline the guidelines set out by NOPSEMA, legislation and case law and demonstrate CGG has capably satisfied these requirements. The following appendices should be read in conjunction with the consultation chapter.

Appendix C2: Consultation Report

Section 24(b) requires an environment plan contains a report on all consultations under Section 25 of any relevant person by the titleholder. This report must include the following:

- A summary of each response; and
- An assessment of the merits of objections and claims regarding adverse impacts of activities proposed; and
- A statement of CGG's response as titleholder where they were given.
- This appendix is sorted separately by organisations and persons, so each specific case by case response by the titleholder and the relevant person can be assessed on their merits and easily referred to.

Appendix C3: Sensitive Information Part (16(b)(iv))

To comply with sub-section 26(8) of the Regulations, the full text of all responses by relevant individuals engaged under Section 25 and any other sensitive information (if applicable) must be included in a sensitive information report.

This report satisfies the remainder of section 24 and sub-section 26(8) by containing full text responses by relevant persons and any additional sensitive information. This report will not be published.

Appendix C4: Full Text copies

Full text copies of consultations with relevant persons. This information will not be publicly available.

Appendix C5: Consultation Materials

CGG have a further appendix which highlights the other efforts and methods used to find every possible relevant person in the community and raise awareness of the ability to self-identify through several mediums, such as the Regia website.

Appendix C6: Public Comment Report

CGG received nearly 15,000 submissions through public comment. This document provides a summary of the process used to ensure all submissions have been considered in the EP.

2 Background

CGG are required by legislation to prepare an Environment Plan (**EP**) to carry out the Regia Marine Seismic Survey (**Regia MSS**). This EP must then be accepted by the National Offshore Petroleum Safety and Environmental Management Authority (**NOPSEMA**). A key part of this EP is the consultation and co-design process, that must be carried out in preparation for the EP. CGG adhered to an iterative consultation process that was developed with consideration and in accordance with legislation, case law and NOPSEMA guidelines.

The foundations of this consultation process included:

- Maximising the broad capture of relevant persons through appropriate, targeted and subject-specific advertisement; and
- Allowing multiple channels for relevant persons to self-identify; and
- Encouraging relevant persons to share activity details with others; and
- Gathering knowledge about specific environmental, cultural, and societal values; and
- Providing concise yet sufficient information allowing relevant persons to make informed decisions; and
- Communicating with relevant persons through their preferred medium and in appropriate language through established information channels; and
- Allowing appropriate timeframes and encouraging feedback and queries; and
- Incorporating relevant persons input into the EP where appropriate; and
- Ensuring all relevant persons are aware of the consultation period and process, and affording the opportunity to participate in preparation and co-design of the EP.

The following principles outlined in Table C1-1 from the former Ministerial Council on Mineral and Petroleum Resources were also pillars of CGG's communication and consultation procedures.

Table C1-1 - Principles of Consultation

Principle	CGG's approach
Communication	Undertook effective two-way engagement to encourage feedback on relevant, accurate information provided.
Transparency	Transparency was fundamental in the consultation process and continues to be so. All feedback was addressed, and comments posted on the Regia website were responded to, and EP documents uploaded into the public document library hosted on the activity website.
Collaboration	Relevant persons were heard and collaborated with, which helped to adapt approaches and outcomes based on merit. The collaborative approach resulted in outcomes beneficial to both relevant persons and the titleholder.
Inclusiveness	All identified relevant persons were involved in the consultation process. This will last throughout the life of the Regia MSS through CGG's implementation and ongoing consultation strategies.
Integrity	The process fostered respect through freedom of information on the Regia website and trust through tailored two-way communication.

2.1 Legislation and Requirements

The following legislation was strictly adhered to during the consultation process:

- *Offshore Petroleum and Greenhouse Gas Storage Act 2006*
- *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009/2023*
- *Environmental Protection and Biodiversity Conservation Act 1999*

The following NOPSEMA guidelines were also considered and complied with:

- NOPSEMA Guideline GL2086 – Consultation in the course of preparing an environment plan – May 2023
- NOPSEMA Guidance Note GN1847 – Responding to public comment on environment plans – July 2022
- NOPSEMA Guidance Note GN1344 – Environment plan content requirements – December 2022
- NOPSEMA Guideline GL1721 – Environment Plan Decision Making Guideline – December 2022
- NOPSEMA Guidance Note GN1488 – Oil pollution risk management – July 2021
- NOPSEMA Guidance Note GN1785 – Petroleum activities and Australian Marine Parks – June 2020
- NOPSEMA Guideline GL1887 – Consultation with Commonwealth agencies with responsibilities in the marine area – January 2023
- NOPSEMA Brochure – Consultation on offshore petroleum environmental plans – May 2023
- NOPSEMA Policy PL2098 – Engaging gender-restricted information Draft Policy – May 2023
- NOPSEMA Policy PL1347 – Environment Plan Assessment Policy – December 2022
- Recent case law developments also moulded CGG's consultation process:
- *Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193
- *Cooper v National Offshore Petroleum Safety and Environmental Management Authority* (No 2) [2023] FCA 1158

Other resources and guidelines used:

- *NOPSEMA* Guidance framework: Supporting cooperative coexistence of seismic surveys and commercial fisheries in Australia's Commonwealth marine area.
- Victorian Aboriginal Heritage Council: Registered Aboriginal Parties (RAPs) - Fact Sheet.
- Victorian Aboriginal Heritage Council: Victorian Aboriginal Heritage Council - Fact Sheet.

2.2 CGG Consultation Principles

During the consultation process there was significant clarification about the consultation requirements that apply to preparing an EP arising from case law. As this clarification was delivered over time, CGG decided to create consultation principles that supported communicating the purpose of consultation with relevant persons. These principles were:

1. **Co-design:** Incorporating a co-design principle into the consultation process emphasises collaboration and mutual agreement on how consultations are conducted. This principle is

essential when relevant persons may have their preferred engagement processes that may or may not align with the regulatory requirements of the Regulations. By adopting a co-design approach, CGG aimed to ensure that all parties had a say in shaping the consultation methodology, fostering a sense of ownership and acceptance among all relevant persons.

2. **Voluntary Participation:** Ensuring that participation in the consultation process is voluntary respects the autonomy of all relevant persons. This principle recognises that while input and engagement are highly valued, mandating participation could lead to procedural compliance rather than genuine dialogue. Voluntary participation encourages more meaningful and constructive contributions from those who choose to engage, ensuring that any feedback is driven by a genuine interest in the outcomes of the project rather than compulsion.
3. **Not Seeking Consent:** By not seeking explicit consent through the consultation process, CGG acknowledges that the purpose of consultation is to inform, discuss, and consider the perspectives and feedback of relevant persons, not to obtain approval. This approach aligns with the regulatory framework under which CGG operates, where the final decision-making authority rests with regulatory bodies like NOPSEMA, not with the relevant persons, nor the public. This distinction helps maintain clarity in the roles and responsibilities within the consultation process.
4. **Regulatory Permission for Impacts:** The principle that regulations allow NOPSEMA to permit impacts underscores the structured regulatory environment within which environmental impacts are assessed and managed. It highlights that while relevant person input is crucial and valued, there are established legal and scientific frameworks in place to evaluate and mitigate environmental impacts. This ensures that decisions are made based on comprehensive environmental assessments and best practice standards, balancing economic, cultural, and social factors. CGG often encountered a misconception that 'no impact' was the requisite standard that had to be met.
5. **Absence of Requirement for Universal Participation:** Acknowledging that not every relevant person must participate in the consultation process recognises the practical limitations of engagement and avoids the logistical and procedural complexities that attempting to achieve full participation would entail. It ensures that the process remains efficient and manageable while still being inclusive and comprehensive. This principle also respects the diversity of interest and the varying degrees of impact on different relevant persons, allowing for a focus on those most affected or most knowledgeable without diluting the quality of engagement with mandatory universal participation.
6. **Multidimensional Nature of Relevant Persons:** CGG decided it was important to acknowledge the multidimensional nature of relevant persons and not to assume the primary reason for contacting a relevant person was the exclusive reason they were a relevant person. For instance, a commercial fishers may also be a recreational diver and have different pathways to being affected. This approach ensures a comprehensive understanding of how the Regia MSS affects all aspects of relevant persons lives, fostering more meaningful engagement and building trust. This holistic view not only enhances stakeholder participation but also ensures that strategic decisions are informed by a broad spectrum of perspectives, leading to more equitable and sustainable outcomes.

These principles were frequently referred to during the community consultation forums and subsequent consultations with relevant persons.

3 Consultation Methodology

CGG proposed a process that allowed relevant persons to co-design both the development of the consultation process and the preparation of the EP. This process was designed with the context of the objects of the Regulations.

As stated by Justice Lee in *Santos NA Barossa Pty Ltd v Tipakalippa* [2022] FCAFC 193 at [141], these objects are "best achieved by a consulting process that is practicable but is sufficiently broad so as to collect available input into the possible risks and environmental impacts of the activity and ways of reducing those risks and impacts and managing them to an acceptable level." CGG adapted this statement to include the following:

1. Broad capture of all relevant persons.
2. Develop knowledge of and describe relevant values and sensitivities of the environment that may be affected.
3. Provide sufficient information.
4. Create two-way channels for communication from relevant persons.
5. Allow a reasonable period for relevant persons assessment and feedback.
6. Respond to each claim or objection where appropriate.
7. Continue ongoing consultation throughout the life of the project.

This approach was underpinned by and upholds the principles of the International Association for Public Participation spectrum (IAP2 spectrum), which helped to achieve the goals set out by the NOPSEMA guidelines and legislation. The project-specific Regia website not only helped with community engagement and co-design of consultation, but further aligned goals and outcomes between CGG's consultation methodology and the IAP2 spectrum.

The decision-making criteria was captured in a document (Decision Making Criteria in the Environmental Assessment Process – March 2023). This document was uploaded in to the 'Establishing Context' section of the activity webpages' document library. It was also featured on the landing page, with a feedback function that facilitated public discourse regarding the decision-making criteria.

The Environmental Planning Area (EPA) was established to frame the initial studies and community consultation effort. Set at 155 km around the Activity Planning Area, this distance has been selected using professional judgement and a review of previous impact and risk assessments for similar activities in the region. Further justification for this distance can be found in Appendix B11.

CGG identified several subject-centred groups in its planning process and the consultation methodology was tailored to the cultural, social, and economic features of these people and communities. The discussion in the subsequent sections of this document apply to all subject-centred groups. Through the consultation process two subject-centred groups (Commercial Fishers and First Nations Australians) warranted elevated tailoring of the consultation method. Therefore, demonstrations of compliant consultation with these groups have been provided in Annex 1 – Commercial Fishers and Annex 2 – First Nations Australians.

3.1 Relevant Person Identification

Titleholders are required to identify and consult with each authority, person or organisation who fits the definition of a relevant persons pursuant to Section 25 of the Regulations. This section clearly demonstrates who is a relevant person, and the rationale used to determine that status. Key factors considered by CGG in this process included the nature of the activity, the environment in which it is being undertaken and the impacts and risks associated with it.

3.1.1 Broad Capture of People and Information

Identifying relevant persons is essential in designing a consultation method that is inclusive, effective, and legally compliant. It promotes fairness, transparency, and accountability in decision-making processes and can lead to more successful outcomes and reduced risks for all parties involved. CGG's process for relevant persons identification provided for the broad capture of relevant persons such that each relevant person who can be identified, was identified (GN1344: Section 12.3; GL2086: Section 6). CGG also understands that despite our best endeavours, there may still be some unidentified relevant persons. Despite this, the methodology used by CGG was capable of identifying each relevant person.

By categorising people within the community, engagement was tailored to specific subject-centred groups. The legislation provides guidelines to this effect using four categories: the public, authorities, organisations, and persons. For the purposes of Part 4 Division 3, there is a clear, explicit difference between the public and *relevant persons* (organisations, authorities, and persons) who unlike the public, are mandatory consultees in preparation of the EP.

CGG has identified and evaluated all potential environmental impacts and risks based on the information and relevant persons identified. If new information or relevant persons are identified, CGG has appropriate change management procedures in place, which are outlined in our ongoing consultation strategy (See Appendix B3).

3.1.2 Opportunity to Self-Identify

To combat the challenges faced by a requirement to identify every relevant person, CGG launched the Regia website, which created two channels of communication with the public and with relevant persons. This website, advertised at community events, and via print (both link and QR code), social, radio and television media, helped reach and locate interested members of the public and provided a simple survey to determine if a person was relevant for Section 25. This survey helped self-identification as it enabled individuals to provide their functions, interests, and activities, or request more information to determine if they were relevant. In total, the website reached over 3700 unique users, with over 12,200 total visits, 852 document downloads, and the consultation survey was taken 121 times, identifying 108 relevant persons.

To facilitate use of the Regia MSS website, 13 social media boosted adverts were run, the audience being 18-65+ within the Environment Planning Area (**EPA**) and matching potentially affected interests. The adverts encouraged people to visit the Regia MSS website to self-identify, access or request information and submit comments. These advertisements were through Facebook (META), LinkedIn and Instagram, with an estimated target audience of 270,300-318,000. A full report detailing Thruplay, Reach and Impressions is available in Appendix C5. A total of 10 advertisements were run through traditional media, with a QR code and written website link, and 13 through social media, which were also used to publicise community information sessions.

3.1.3 Raising Awareness

CGG published a total of 299 notices in local and national print media, social media, and local radio and television interviews to:

- Provide sufficient information to allow individuals to make informed decisions on potential impacts on their functions, interests, or activities.
- Facilitate information and consultation requests.

- Promote self-identification through the Regia website.
- Notify the public of commencement of the EP and consultation process.
- Advertise information sessions.
- Access recordings of previous webinars.
- Allow individuals to sign up for newsletters and webinars.
- List 'Frequently asked questions' and, as engagement progressed, thematic 'What we've heard so far' feedback, with assessment of merit and measures adopted.
- Publish summaries, implementation strategies and risk assessments.
- Allow individuals to make both public (interactive map) and private instant feedback.

The notices were placed in media where the audience were potentially relevant to the activity, such as located in the EPA and a First Nations newspaper. In addition, the initial community sessions were run jointly with another titleholder who also had a proposal in the Otway, they placed 4 print adverts and 142 radio spots within the EPA to advertise these sessions.

All identified relevant persons were contacted via email and/or phone or post and informed of their rights and the role they play as a relevant person. Each person was also asked what their preferred line of communication was and how they would like to co-design the consultation in a way which best suits their interests, availability, and needs. A full record of these communications can be found in Appendix C2 and C3, but some of the techniques employed by CGG included:

- 11 Community information sessions.
- 6 online webinars, which were recorded and uploaded to the activity website.
- 10 Campaign email project newsletters.
- 23 Letters via postal service.
- 121 Consultation surveys.
- Feedback surveys.
- 7 Instant feedback.
- 11 Commercial fisher engagement surveys.
- 17 Webinar series registrations.
- 38 Newsletter registrations.
- 78 Interactive map comments.
- 13 Boosted social media targeted adverts.
- 25 Face-to-face meetings.
- 19 Virtual meetings.
- 10 print advertisements.
- 272 radio adverts over 6 local stations and their websites.
- 9 Tailored information summaries.
- Commercial fisher group meetings.
- 1 ENGO group meeting.

- Local radio and television interviews/comments.

In addition to this, the project-specific website, which can be accessed at www.regiamss.com.au, was designed to create an open-book space where people can publicly or privately raise concerns, share and/or access information and stay informed. On the website, the consultation survey empowered CGG and the public to determine the best way for them to engage with the Regia project and if they are a relevant person for the purposes of Section 25 of the Regulations. The Regia website goes beyond industry standards for consultations, and assisted CGG in locating a further 118 relevant persons through self-identification on the website.

In a bid to mitigate consultation fatigue, initial community information events were held in conjunction with another proponent who was also promoting an offshore activity in the Otway. Following these events, CGG received feedback from some attendees that this was confusing and requested Regia MSS only events (Event ID806 & ID919). CGG worked with these groups and held the standalone events (Event ID's 4112, 1731), working with them to ensure the location and date was suitable, and advertising via email notice (ID987 & ID1020) and in the local newsletter a community member suggested during the first community event (ID762 & ID1199).

During these information events, individuals were informed of the ways they could participate and the classification of a Relevant Person. They were encouraged to self-identify by contacting the Regia team via one of the points of communication, and to forward information to any potentially relevant person they may know.

In three of the community events (Event ID1481, ID1731 & ID4112) an attendee requested that a vote be taken on who opposes the project, at all events the majority were against the activity. The Regia Environment Manager re-iterated that a 'for and against' vote is not part of the community or relevant person engagement, however he would record this in the consultation. This was reiterated to individuals who were unable to attend the event and subsequently emailed in a 'no vote'.

In total there were 37 in-person engagements with the Regia Environmental Manager in the south-west region, this included visiting wharfs and local fishing businesses to raise awareness of the activity.

3.1.4 Tailored Engagement Methods

CGG employed a range of communication techniques which were tailored based on different audiences, preferred mediums, and technological availability. Consultation consisted of two-way dialogue, where relevant persons were given sufficient information through a medium of their choice, allowing them to make an informed decision on the potential consequences of the Regia MSS on their functions, activities, or interests. These mediums included emails, phone calls, face-to-face meetings, tailored presentations, webinars, and website interactions. An outline of the engagement methods used by CGG is in Table C1-7 in Annex 3.

3.1.5 Reasonable Period of Raising Awareness

To promote best practice, CGG took a broad interpretation of the reasonable period required in sub-section 25(3) to mean not only a reasonable period with sufficient information but a reasonable period of raising awareness as well. CGG commenced consultation on 03 February 2023, over 330 days before first submission to NOPSEMA, this is considered a reasonable period of raising awareness.

3.1.6 Statutory categories

Section 25(1) demonstrates that a relevant person can fall into any one of these categories:

(a) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;

(b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;

(c) the Department of the responsible State Minister, or the responsible Northern Territory Minister;

(d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan;

(e) any other person or organisation that the titleholder considers relevant.

3.1.7 Section 25(1)(a), (b) and (c)

Identifying relevant persons under these categories is simple as they are all government agencies and statutory authorities that have functions, interests, or activities within the EPA. The exhaustive list of these relevant persons and a summary of communications can be found in Appendix C2.

3.1.8 Section 25(1)(e)

Nobody was identified under this section as all identified relevant persons fit into 25(1)(a)-(d). This is because CGG has treated everyone engaged as a relevant person and only people who positively opted out of consultation have not been subject to the full methodology.

3.1.9 Section 25(1)(d)

The factors in Section 3.1 helped determine which individuals, authorities and persons had functions, interests or activities that may be affected. The terms "functions", "activities" and "interest" are defined below in Table C1-3 as per the Regulations, Federal Court and NOPSEMA guidelines. CGG contacted persons whose functions, interests or activities could not be easily ascertained and validated any assumptions about whether they may be affected by the Regia MSS.

Table C1-2 - Functions, activities, and interests

Term	Definition
Functions	Refers to "a power or duty to do something"
Activities	To be read broadly and is broader than the definition of 'activity' in section 4 of the Environment Regulations and is likely directed to what the relevant person is already doing.
Interests	To be construed as conforming with the accepted concept of "interest" in other areas of public administrative law. Includes "any interest possessed by an individual whether or not the interest amounts to a legal right or is a proprietary or financial interest or relations to reputation"

Contrary to section 25(1)(a), (b) and c, the list of relevant persons here was and is non-exhaustive, as it can change as the project develops, but the Regulations and NOPSEMA understand and cater for this. Over 260 people were identified as relevant persons for the purposes of this regulation. Every single one of these individuals was engaged in two-way dialogue through their preferred medium, whether it be email or an in person, face-to-face meeting. See Appendix C2 for a summary of these consultations and Appendix C4 for full text responses.

3.1.9.1 Subject-centred groups

CGG used subject-centred groups and tailored consultation strategies to identify relevant persons and subsequently engage with them in a way that was appropriate to their cultural, social, and economic needs. Table C1-3 outlines the strategies used.

Table C1-3 - Subject-centered groups

Subject-centred group	**Tailored identification strategies**	**Relevant persons identified**
Commerce	Contacted the local Chamber of Commerce to identify relevant businesses. Online searches conducted for news articles or press releases about marine-based businesses in the area.	7
Commercial Fishers	Requested data from the Victorian Fisheries Authority to understand historical fishing activity within the EPA, this was used to inform Commercial Fisheries Analysis Report. Visited local ports and found local fishers who operated. Contacted industry related organisations. Undertook fee-for-service arrangements with Fishing Associations.	17 (fee for service arrangements with 4 associations to engage on their members behalf).
Commercial Shipping	Contacted relevant harbourmasters and shipping agents and enquired about frequent users. Performed online searches for business located at wharves in regional ports.	2
Conservation Groups	Previously submitted EP's on the NOPSEMA website were reviewed and relevant conservation groups compiled. Online searches performed for conservation groups with interests in similar activities. Online searches performed for articles and current campaigns related to similar activities.	14
Educational Bodies	Exposure thresholds for monitoring potential impacts of the activity were used as this is more relevant to research institutions. Contacted the Department of Education and identified relevant institutions and research programs. Contacted the universities and identified relevant research programs.	5
Fishing Associations	Research allowed the target species within the EPA to be identified (see Appendix B6). The peak fishing associations were also able to identify other species-specific associations. Contact details of license holders were requested from AFMA.	10
Government Agency	Previous databases perused. Desktop research conducted.	13
Heritage Groups	Contacted Victorian heritage organisations to identify other relevant persons. Accessed the Australian Heritage Database to compile potential relevant persons. Queried the Australasian Underwater Cultural Heritage Database.	6
Interested member of the public	List compiled through project awareness raising, including local adverts (print, social, media, TV adverts), and community information sessions	174

Subject-centred group	Tailored identification strategies	Relevant persons identified
Local councils	Searched the Victorian Electoral Commission database and found relevant councils, shires and cities close to the activity.	7
First Nations Australians inc. Native title land councils	Contact details of land councils were sourced from the National Native Title Council which will be expanded on below.	19
Petroleum title holders	Utilised the NEATS database to find titles and titleholders within the EPA. Used the NOPSEMA EP database to find other titleholders with activities in the area. Subscribed to NOPSEMA EP submissions pages for all activities in Victoria.	2
Other marine and Port users	Relevant harbourmaster's contacted to enquire about frequent users Online searches conducted for business located at wharves in regional ports. Performed online searches for groups who use or have a connection to the marine environment, the searches were heavily focused on those users proximate to the EPA.	59
Ports and harbours	Automatic information system data of vessel activities along the coast was reviewed and frequented ports were established. Reviewed the Victorian boat ramp database which helped to identify ramps within the EPA. Contacted local councils, cities and shires for local boat ramp listings and users.	2
Recreational fishers	Engaged with recreational fishing associations and used newsletters/circulars and websites to spread information about the activity and identify relevant persons. Requested contact details for license holders. Engaged with advisory bodies and reference groups to establish the best approach to identify relevant persons.	16
Tourism operators	Online searches for marine tours and recreational experiences such as marine mammal observations, diving and outdoor extreme sports. Enquired with Chambers of commerce, local and regional tourism centres to help identify marine based tourism operators in the EPA region. Online and in person searches for marine-based community or sporting events.	7

3.1.10 Relevant Persons Identified

In the process of consultation, 1126 individuals and organisations were contacted during the preparation of this EP. Of these points of contact, 140 individual relevant persons and 177 relevant organisations were identified, full details of these persons can be found in Appendix C3. Following 11 months of consultation and research, CGG has discharged its duty by providing all identified relevant persons with sufficient information and a reasonable period to engage in the co-design of both the consultation process and the environmental plan.

3.2 Give Sufficient Information

Under sub section 25(2) of the OPGGE(S)R, titleholders must give relevant persons with sufficient information to allow them to make an informed assessment of the possible consequences of the proposed activity on their functions, activities, and interests.

As a minimum, all relevant persons were given initial information including:

- An activity description summary.
- A map indicating the activity planning area and environmental planning area.
- An overview of the consultation process proposed by CGG.

The initial information pack was specifically designed to provide sufficient information for readers to understand if they may be affected, and if they wanted to participate in the consultation process. In giving this information CGG informed each relevant person of their rights in the consultation process and that they could request information provided be kept confidential.

When it became available the Preliminary Environmental Impact and Risk Assessment (PEIRA) was used to provide further information in a digestible shortened format. CGG were able to empower relevant persons to make informed decisions and engage in the construction of positive outcomes by:

- Tailoring information, responses, and communication mediums to relevant persons; and
- Providing further information when requested to ensure relevant persons understanding and comprehension; and
- Published Decision Making Criteria: and
- Offering summaries or further explanation if required; and
- Producing receptor and industry specific reports and summaries; and
- Directed relevant persons to the NOPSEMA guidelines; and
- Published all relevant information on the Regia MSS website document library; and
- Community information sessions; and
- Webinars; and
- Group and individual meetings.

A detailed list of information requests and how they were addressed is captured in Appendix C2 and Appendix C4.

Project newsletters were utilised as a tool to capture important information, within a single correspondence to limit consultation fatigue, and to provide information on changes made throughout the consultation process. The newsletters provided information such as when the team would be in the area and inviting meeting requests, how to refer a potentially relevant person, changes to timings, how to request information is kept sensitive, distribute the NOPSEMA community consultation brochure, and to inform of, and request feedback on, measures implemented through the engagement process. Project newsletters were sent to all organisations and people in the database (both relevant and non-relevant) and uploaded to the project website. Located on the project website was also a link to provide details to sign up for the newsletter.

3.2.1 Information Formatting

The original provision of information was broad, simplistic, and easily accessible to the public to engage and capture the maximum possible number of relevant persons. Once these groups and individuals had been identified, they were consulted regarding which communication channel they prefer, the detail of information they require and helped build the framework for ongoing consultation with CGG.

Rather than using a one size fits all approach, CGG understands that different people digest and respond to information differently. Information was uniquely tailored to different requirements through multiple techniques, some of these include:

- **Changing the format of information flow depending on the person's needs:** For example, some First Nations groups (Event ID 1891) required in person, face-to-face meetings, whereas some groups preferred online (Event ID 2937).
- **Changing the content and complexity of the information based on a person's needs:** Rather than overwhelming people with information, CGG provided concise, to the point information and evidence surrounding the function, interest or activity that was being affected by the Regia MSS. Information was broken down into themes, topics and receptors, to mitigate concerns of information being inaccessible. For example, the environmental impact and risk assessments were both published online, in chapters, relating to their specific receptors. This allowed information relating to a specific concern to be easily accessed and reviewed. These chapters were also released with cover letters requesting feedback, directing the reader to context documents, relevant studies, and offering a summary and/or to discuss further with a member of the Regia team.
- **Subject-specific information summaries:** Flyers were produced to complement the consultation process and assist in capturing a broad group of relevant persons. These flyers were unique to the subject-centred groups previously discussed, to facilitate the understanding of risks and response from interested persons.
- **Regia website:** The project-specific Regia website allowed all members of the public and persons with interest to access every piece of information they would need to make informed decisions and objections, or request information in a form and delivery method appropriate to their needs. There are multiple industry-exceeding features of this website which include:
- **An interactive map for the Regia MSS:** This map included a boundary of the EPA and invited members of the public to place a 'marker' and share feedback for the activity. There were also instructions indicating that leaving a marker is a contribution as a member of the public and not as a relevant person pursuant to the Regulations. These instructions also provided an email, phone number, and a link to the consultation survey should someone believe they were a relevant person and mandatory consultee. Where questions were asked, they were responded to in a thread, so answers were available for public viewing.
- **Consultation survey:** This key feature provided members of the public a non-confrontational, simplistic way to check if they were a relevant person under the Regulations.

Through the design and nature of this publicly available information, interested parties were able to access the exact information they required to make informed decisions, without needing to request it, however, were afforded the opportunity to request the information in a format suitable to their specific needs. The information available on the Regia website is detailed in Table C1-7 in Annex 4.

A total of 40 relevant documents (and a further five TBC post-submission) are published and publicly available for review and comment on the Regia website. The full list of documents available on the Regia website can be found in Annex 4 along with the original publication dates. This transparency employed by CGG promoted trust within the community and far exceeds the level of sufficient information required to make an informed decision.

3.2.2 Further Information

In addition to the efforts put into tailoring the delivery and content of information to the relevant persons requirements, CGG invited relevant persons to request further information, in their preferred form, and engage in two-way consultation. Where requested, further relevant information was provided and relevant persons were referred to the Regia website, if necessary, which is supported in the full text responses annexed in Appendix C3.

3.2.3 Iterative Process for Reaching Sufficient Information

CGG has adopted an iterative and collaborative approach to provide relevant persons with sufficient information to allow an informed assessment of any possible effects of the activity on their functions, interests, or activities. When a relevant person requested further information, CGG promptly provided it. The iterative nature of the consultation process is best demonstrated where there were multiple occasions of information, questions, and feedback exchange between CGG and relevant persons.

3.2.4 Community sessions

The community sessions were not only incredibly valuable in identifying relevant persons, but they provided an open format to provide and receive information. A total of 11 community sessions were held at strategic locations based on the EPA. Information exchange at, and following, these events allowed engagement to be co-designed. Initially, in a bid to mitigate consultation fatigue, events were held with another titleholder who had a proposal in the area. When requests were made to hold standalone events, in requested areas, these were organised (Event ID's 1005, 806).

The sessions were advertised in 9 local print newspapers, 3 targeted social media adverts and 272 radio adverts over 6 local stations and their websites. In addition, the collaborating titleholder placed 4 print adverts and 142 radio spots within the EPA to advertise these sessions.

3.3 Reasonable Period with Sufficient Information

Pursuant to sub-section 25(3) of the Regulations, relevant persons must be afforded a reasonable period for consultation. NOPSEMA guidelines reiterate that for consultation to be genuine and meaningful, relevant persons must be given a reasonable period with sufficient information to allow them to make an informed assessment of the possible consequences of the activity on their functions, interests, or activities (GL2086: Section 9).

CGG understood that a reasonable period is contextually different for different groups and subsequently applied different interpretations of the term 'reasonable period' to different subject-centred groups and relevant persons. The provision of a reasonable period is therefore closely linked to the iterative nature of consultation and can change on a case-by-case basis. It is also inappropriate to assimilate the term reasonable period with a strict time frame as both relevant persons and a titleholder could misuse this interpretation against the spirit of consultation and the regulations. Subsequently and as an example, CGG considered multiple attempts to engage and the provision of subsequent information and project updates as a reasonable period.

CGG also considered the subjective context affecting a relevant person's communication important to determining what a reasonable period might be. For example, due to the professional nature of a government agency, an initial email and a 30-day minimum period may constitute a reasonable period. By comparison, a First Nations organisation may have technological or cultural barriers preventing the application of an email and 30-day minimum being appropriate. Full details of these communications, efforts and timeframes can be found in Appendix C2 and C4.

When stakeholders expressed concern and burden, due to other proposed activities with similar engagement timelines and internal resourcing (Event ID 3413 & 3384), the decision was made to cancel the consultation pause, moving intended Public Comment period to 2024, and keeping engagement open (Event ID 3331).

All identified potentially relevant persons were contacted on a minimum of two separate occasions and timeframes were extended on a case-by-case basis. Consultation time frames and response times were highly variable between different relevant persons, and as such a standard period is difficult to conclude. What can be said is that as an absolute minimum, all relevant persons were afforded a 30-day minimum for consultation, and where no response was received after 30 days, project updates continued to be provided, inviting engagement as the project design evolved. Further, phone calls were made to confirm receipt where details were available, and a final written or SMS follow-up was made.

3.4 Relevant Person Feedback

Another expectation of the titleholder is to utilise consultation and feedback to improve the predictive outcomes for the environment. CGG used multiple approaches to engage relevant persons and seek feedback on how the activity conducted would affect their interests, activities, or functions. These approaches were tailored to different subject-centred groups and individuals to ensure that feedback was encouraged and facilitated in an appropriate manner. There were multiple feedback channels available to relevant stakeholders, which included face-to-face meetings, phone calls, emails, and the Regia website to name a few.

3.4.1 Types of Feedback

Feedback was received in writing, verbally during meetings, and through the public comment process. In all cases, feedback was assessed to determine its type so that it could be processed properly. The feedback types were determined to be either an objection, a claim, a request, a statement, a compliant, or public comment submission. All feedback was assigned a type and processed in a standardised way within the Consultation Management System. The full record of each assessment has been provided in Appendix C2 – Feedback.

3.4.2 Tailored and Appropriate Feedback

CGG recognised that relevant persons have varying information requirements and preferred channels of communication. To avoid overloading relevant persons with irrelevant content, information was customised to provide the necessary material for informed decision-making in a manner that best suited each RP. For instance, Government agencies were primarily contacted via email with periodic project updates, while some First Nations organisations requested face-to-face meetings on Country, which CGG accommodated as a sign of respect for cultural values. Appendix C2 contains a list of all events undertaken by CGG in consultation with relevant persons. Where feedback was revealed from any event, Appendix C2 also provides a summary of the feedback(s) arising from that event.

Occasionally CGG has extensive engagement with relevant persons (e.g. Org ID 98/195 and Person ID 1715) which elicited multiple instances of similar, potentially repetitive, feedback. It can be easy to dismiss feedback that appears repetitive at first glance and miss nuance and deeper substantive issues. CGG was careful not to make this mistake and always engaged further with the relevant person to reveal underlying objections and claims.

3.4.3 Assessment of Merit

The merit of all feedback received from relevant persons during consultation was assessed. A record of all feedback received, the assessment of merit, and the response provided is included in Appendix

C2. A relevant person's feedback was deemed to have merit when one or more of the following criteria was met:

- About the adverse effects of the activity.
- About the provision of sufficient information and a reasonable period.
- An information request that supports the management of environmental impacts and risks.
- Relevant to the persons functions, interests, and activities.
- Can be resolved through the adoption of additional control measures, an activity design variation/limitation, or through changes to the implementation strategy for the EP.

Where feedback had merit CGG considered what measures could be adopted and separately recorded what measures were adopted because of the consultation. Mostly, the measures adopted because of the consultations were an activity limitation, a legislative requirement, a control measure (or part thereof), a performance standard, or implementation strategy commitments that had already been adopted through the environmental assessment process. Those that were new measures were often characterised as an activity limitation, a control measure, a performance standard, or implementation strategy commitment for ease of compliance monitoring. Requests were usually related to further information required by the relevant person and this information was subsequently provided. Where feedback did not have merit CGG did not progress through the process beyond the assessment of merit.

CGG has informed, or has a planned response, to every relevant person who raised feedback about the outcome of this process. The information provided includes whether the feedback was substantiated, how it was assessed, and what measures, if any, were put in place to manage the impact or risk.

3.5 Appropriate Measures Adopted

By adhering to the fundamental principles of section 25 and conducting meaningful consultation, CGG adopted appropriate measures resulting from:

- Addressing the feedback from relevant persons and responding on a case-by-case basis.
- Assessing objections or claims made by relevant persons for merit.
- Where input was considered to have merit, using this input in the assessment of the environment and the construction of the EP.
- Adopting reasonably practicable measures in the presence of valuable objections.
- Providing relevant persons with CGG's response to their objection of claim. Whether it be an assessment of merit, a continuance in consultation or a reasonably practicable measure.

These processes ensured that CGG has ascertained, understood, and addressed all the environmental impacts and risks that might arise from the Regia MSS.

3.5.1 Input Used and Measures Adopted

As set out by NOPSEMA (GL2086), the key purpose of consultation under section 25 is the ensure that authorities, organisations, and persons (relevant persons) who are potentially affected by activities conducted by the titleholder are consulted, and their input considered in the development of environment plans. CGG received numerous communications strengthening the understanding of the environmental values and sensitivities that could be affected by seismic exploration.

During the consultation process, the significant information was received from relevant persons which helped contribute to the EP that is submitted. Full text responses from these parties that facilitated the EP changes can be found in Appendix C4.

When objections or claims were submitted to CGG, they were assessed on a case-by-case basis. Where objections or claims were meritorious and not addressed by a previously established control measure, they were implemented by CGG. Some examples of the measures adopted by CGG in response to relevant persons are as follows:

- Heritage Victoria suggested that if during the surveys or analysis, any anomalies (such as shipwrecks, crashed aircrafts etc) are identified in Victorian or Commonwealth waters, Heritage Victoria must be notified in accordance with s80 of the *Heritage Act 2017* (Vic) or under *Underwater Cultural Heritage Act 2018* (Cth).
    - Not only was this implemented into the EP, but it was noted that a notification must be given to the Minister as per s40 of the *Underwater Cultural Heritage Act 2018* (Cth). More details of this can be found in the implementation strategy (Appendix B3) (Feedback 260)
- Appendix F2 addresses all control measures implemented in response to consultation feedback to reduce risk and potential impacts of Regia MSS to ALARP. Some of these control measures are outlined in Table C1-8 below, full details can be found in Appendix F2.
- Appendix G1 addresses all control measures implemented in response to consultation feedback related to environmental performance. These measures can be found in tabular format at Table G1-1 of Appendix G1.
- Management and mitigation measure M#01 is the activity limitations detailed in Appendix A2. Appendix F1 (The Environment Plan) also provides a summary of how the description of the activity and the existing environment has evolved almost exclusively in response to consultation and feedback from relevant persons.

Table C1-4 - Feedback promoting ALARP decision making

Theme	Feedback ID's	Input used/Measure Adopted
The concept of ALARP.	271	Although this request was not implemented for a multitude of discussed reasons, the input was used in developing Appendix F2 and elaborating on the concept of ALARP.
Protection of Biodiversity.	99, 128, 135, 164, 190, 203.	Excluding January, February and March from acquisition, where biodiversity is much higher in the shallow waters.
Protection of Marine Users.	232, 262.	Exclusion zone taken from 30m depth to 40m depth, then further extended to 50m depth upon further consultation.
Management Areas.	259.	Impact management zone adopted excluding all activities from the park plus a 5 km buffer area.
Cultural Heritage Values and Sensitivities.	180, 209, 217, 222.	Impact management zone of 10.3 km around Deen Maar and eliminating vessels transiting between the island and the mainland.
Protection of Other Marine Users.	245.	Exclusion of certain fishing blocks.
Ecologically Sustainable Development	218	Prepare an assessment of the application of the principle of intergenerational equity (Appendix F4, 5.2)

4 Record Keeping

CGG created and maintained a confidential database of relevant persons using a bespoke consultation management system, an ISO27001/9001 compliant product, to ensure accurate record-keeping. Viewing access is only granted to authorized persons by CGG's authorised Administrator.

5 Ongoing Consultation

It is a requirement that ongoing consultation is part of the titleholder's implementation strategy, as stipulated by section 14(9) of the Regulations. External communications with relevant persons will occur on an ongoing basis, with the intent to understand and cater for how relevant persons functions, interests and activities are being affected. CGG's implementation strategy includes ongoing consultation procedures that are in place to manage and fulfil this requirement (see Appendix B3).

Further, ongoing consultation remains a requirement in the presence of increased or changing environmental impacts and risks that arise before, during or after the activity. CGG has change management processes and control measures in place in these circumstances (MoC), which continue to reduce safety and environmental risks to ALARP and environmental impacts to an acceptable level. This process adheres to the requirements set out in section 17 of the OPGGS(E)R. As part of CGG's ongoing consultation, relevant persons will be notified of any of these changes, notified of CGG's proposed response, and involved in the decision-making process where appropriate.

As well as maintaining an updated list of relevant persons, Consultation Manager is used to provide relevant persons with new information, project developments, and any other updates or changes that may affect their functions, interests and activities. Each relevant person has their previously established preferred method of communication which will be used in this process.

CGG will continue to promote relevant persons' self-identification throughout the life cycle of the activity. This will occur through the public comment process and regular updates on the Regia website.

6 Document Control

Table C1-5 - Revision History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	20 December 2023	MS	Initial preparation for CGG review.
0.1	5 January 2024	LB/SR	Review and update.
1.0	9 January 2024	MS	Review and update for submission.
2.0	**11 May 2024**	**MS**	**Updated following public comment.**

Annex 1 – Consultation with Commercial Fishers and Commercial Fishing Associations

Introduction

In the planning and execution of the Regia MSS, CGG recognised the critical importance of engaging with commercial fishers, a key subject-centred group directly affected by maritime activities. Understanding the unique challenges and operational realities of commercial fishing, CGG committed to a tailored and co-designed consultation approach. This strategy was developed to ensure that the consultation process was not only compliant with the Regulations, but also respectful and responsive to the specific needs of the commercial fishing community and drew from NOPSEMA's 'Supporting cooperative coexistence of seismic surveys and commercial fisheries in Australia's Commonwealth marine area' guidance framework.

Consultation Methodology

A tailored and co-designed consultation approach was applied to allow for a broad capture of commercial fishers who operate in the activity area, and for sufficient information to be provided to allow for assessment of the potential impacts of Regia MSS on their functions, interests, and activities. Underpinned by CGG's consultation methodology (Appendix A3) engagement was adapted and co-designed to remain fit-for-purpose (Table C1-7), understanding that due to the nature of the industry some methods may be more suitable than others. For example, for a government fishing agency an email with information attached would be appropriate, however for a commercial fisher, an SMS with a link to the information is likely easier to access.

Table C1-7 outlines the methods and outcomes of communication that were used to facilitate two-way information share with commercial fishers and their associations, allowing for co-design of both the engagement and activity, minimising any potential impacts.

Table C1-6 - Commercial fisheries communications

Method	Description	Outcome
Email	Emails sent to/from dedicated activity inbox.	Fishers able to send and receive information, can also be accessed by others involved in running the fishing operation
Phone	Calls to landline or mobile.	Used to confirm receipt of information and on request
SMS	SMS to mobile.	Links to relevant information were sent to mitigate accessibility when undertaking fishing operations, and confirm receipt of data
Online consultation surveys	In addition to the general consultation survey hosted on activity website, identified commercial fishers through AFMA were provided with a link to a tailored survey.	Allows for self-identification, to request information, and preferred contact method. The commercial fishers specific survey allowed fishers to indicate if they wanted to be contacted directly, through their association or opt-out, and state if functions, interests, or activities outside of commercial fishing

Online instant feedback	Instant feedback posted on activity website.	Offers opportunity to make instant private comment, feedback or requests
Registered letter	Printed letter to fishers (Event ID 4098), with commercial fishers' information sheet.	Registered letters were sent to fishers where an email or SMS second form of contact was not available
Fee-for-service arrangements	Associations engage on behalf of their members, providing two-way information exchange in the appropriate manner for their members.	Fee-for-service arrangements were undertaken with four fishing associations, allowing for co-design of consultation and EP.
Commercial Fishing Information sheet	Comprehensive information sheet with activity overview, timing, map, coordinates, identified fisheries, potential impacts and measures in place, schematic of vessel and streamers, photo of tail buoy, links to website, fisheries report and contact details.	Provided to all identified commercial fishing associations, commercial fishers, and fishing industry organisations, providing a further opportunity for informed assessment of relevancy. Also available on the activity website and promoted on activity social media
Commercial Fisheries Analysis Report (Appendix B6)	Commercial Fisheries Analysis Report produced using Australia Fisheries Management Authority (AFMA) and Victorian Fisheries Authority (VFA) data to identify Commonwealth and State fisheries that have the authority to fish within the activity and/or environmental planning area	Available on the project website and supplied to individuals upon request/when appropriate to engagement.
Local presence	In person visit to commercial fishing related locations by Environment Manager	The Environment Manager made multiple visits to local areas, including drop in's to fishing industry related businesses and wharf's
Individual meetings	In person or online one on one meetings offered	In person and online meetings with activity Environment Manager were held with fishers and their associations
Group meetings	In person or online group meetings offered	Where requested group meetings for commercial fishers and their associations were held
Social media	Instagram, Facebook and LinkedIn activity dedicated pages	Project announcements and updates, including promotion of fishing specific items (information sheet and NERA feedback). Information shared to association Facebook under fee-for-service arrangement
Website	Dedicated activity website	Allowed for easy access of up-to-date activity information, comprehensive document library, alternative contact methods, and hosted tools such as interactive map and consultation surveys (Appendix C5).
Interactive Map	Hosted on the activity website	The map being interactive allowed fishers to focus on their area of

		interest, facilitated public comments and questions as well.
NERA protocol document link and instant feedback	Located on the landing page of the website, the NERA protocol document was made available with an instant feedback comment box	This allowed for easy access to the document and a convenient way to submit feedback. Commercial fishers and associations were notified when this became available

Identification and Initial Contact

Contact information for Commonwealth commercial fishers was obtained through a data request to AFMA. Contact information for State license commercial fishers was obtained through multiple meetings with commercial fishers at local ports and word of mouth.

Fishing associations were provided with information to provide to their members, under fee-for-service agreements (Event ID's 3901, 3898, 3899)

Once contact details were obtained, fishers were contacted via two points of contact, with information, including the comprehensive Commercial Fishing Information sheet, allowing an informed assessment to be made. It was also highlighted in the communications that they may have functions, activities, or interests, that may be affected by the activity, in addition to their commercial fishing activities (respecting the multidimensional nature of relevant persons).

Commercial fishers, as community members, were also able to self-identify and refer others, through the broad capture undertaken by CGG, including public information sessions. A representative of CGG's also visited wharfs and dropped into related businesses in the local areas, to inform of the proposed activity and upcoming community events (Event ID 1280, 1500).

Industry related organisations and local industry related businesses, such as co-ops, national associations, and government agencies, were also contacted, provided with initial information, and invited to engage on a co-design design basis, with project updates being provided as planning progressed.

Giving Sufficient Information

Once contact details for a commercial fisher were obtained, for fishers' convenience, a link to a survey was provided, where the individual was able to state if they were a relevant person, choose their form and method of engagement, including through their association, and indicate other functions, interests, and activities. They were also able to opt-out of receiving any communications.

A Commercial Fisheries Analysis Report (Appendix B6) was produced, using Australia Fisheries Management Authority (**AFMA**) and Victorian Fisheries Authority (**VFA**) data to identify Commonwealth and State fisheries that have the authority to fish within the activity and/or environmental planning area. This allowed for initial identification of relevant fisheries and the relative fishing intensity.

The report was made available publicly, through the Consultation Hub Document Library, and contained detailed effort maps to assist with determining how functions, activities, and interests may be impacted. This report and the maps within were printed and shared during in person meetings and provided electronically to fishing associations. Fishing associations were also employed to provide information about the Regia MSS and their nominated engagement process followed, with four fee-for-service arrangements being undertaken. These services include providing their members directly with supplied information, social media posts, and engaging on members behalf to provide a two-way information exchange and feedback on engagement, the activity, and proposed measures. A commercial fishers information brochure to support the consultation efforts with commercial fishers was provided to fishers and fishing associations, as well as being made available publicly on the activity website, with this availability highlighted on social media.

For full transparency, the environmental assessments, including those about the predicted impacts on fish and invertebrates, were made publicly available on the website, with feedback encouraged, and commercial fishers informed when they were available (e.g. Event ID 1182 & 2561). Detailed analysis was shared with relevant fishers during the group meetings held on location.

Reasonable Period with Sufficient Information

To discharge the commercial fishers and commercial fishing associations consultation obligation, CGG understood that they must demonstrate that these groups have been afforded a reasonable opportunity to be consulted with. Further, all group members should be afforded a reasonable opportunity to participate in consultation with clear, simple, and directly expressed terms. The fulfillment of this duty is evidenced in the consultation records (Appendix C).

Recognising the seasonal and often prolonged nature of fishing trips, CGG extended the typical consultation period to many months over multiple engagements. This adjustment accounted for the time fishers spent away from home, ensuring they had ample opportunity to review and respond to consultation materials upon their return. This consideration was crucial for inclusivity, ensuring that those who were away at sea were not disadvantaged or excluded from the consultation process.

Relevant Person Feedback

Throughout the consultation process, CGG made a concerted effort to ensure that all feedback received was carefully considered and, where appropriate, integrated into the project planning and execution. This feedback significantly influenced several aspects of the project, including the mitigation strategies employed to protect commercially productive areas.

Nearly every fisher and fishing association consulted with identified the long-term effects on fishery recruitment from the known mortal effects on zooplankton arising from seismic surveys as a concern. CGG performed numerous additional studies on key target species, plankton communities, and upwelling events to look for scientific corroboration of anecdotal feedback. In all cases, CGG has not found any statistically significant or measurable effect to fish populations. Notwithstanding this effort CGG remains willing to complete further analysis however to do so fishing data from individual fishers will be required for analysis. To date, no fisher has agreed to provide permission for CGG to access such data.

CGG committed to ongoing engagement with the commercial fishers and commercial fishing associations, ensuring that consultation did not end with the initial regulatory approval but continued throughout the lifecycle of the Regia MSS.

Appropriate Measures Adopted

There are several measures adopted through feedback received during the consultation process with commercial fishers and commercial fishing associations. These include measures to avoid interference between the Regia MSS and historical commercial fishing efforts such as:

- Depth limitations on the active source area.
- Spatial restrictions around productive fishing grounds.
- Seasonal avoidance of the productive summer months.
- Notification procedures to avoid interference.

CGG recognised that the Regia MSS may not be able to avoid all interference with commercial fishers and other commercial marine users. Hence a commitment to an evidence-based adjustment protocol for reasonable compensation claims was adopted early. CGG recognises that the details of the protocol need to be refined through ongoing consultation and is collaborating with other titleholders in the region, and fishing associations, to institute a fit-for-purpose compensation protocol.

Culturally Appropriate Engagement and Tailored Consultation Strategies

To engage effectively with commercial fishers in a culturally appropriate manner, CGG adopted a nuanced and tailored approach that recognized the unique aspects of their work life and community dynamics. The strategies employed aimed to provide a conducive environment for meaningful dialogue and ensure that all information pertaining to the Regia MSS was accessible and comprehensible to this subject-centred group.

1. **Small Group Meetings:** Recognising the close-knit nature of the fishing community, CGG organized small group meetings which provided a comfortable and secure setting for fishers to voice their concerns and opinions. These smaller and less formal settings encouraged participation by offering an atmosphere where individuals could express themselves without feeling isolated or spotlighted. This approach facilitated more open exchange of ideas and the adoption of measures to protect their interests.
2. **Individual Meetings:** CGG recognised that due to commercial confidentiality concerns, some fishers may require one-on-one meetings to divulge sensitive information.
3. **Facilitation Through Respected Representatives:** To further enhance the engagement process, CGG worked through respected representatives from sub-communities within the fishers' communities, categorised by target species or fishing methods. These representatives, who were well-regarded and trusted within their groups, played a crucial role in mediating discussions and gathering collective input. By leveraging these established relationships, CGG ensured that the consultations were respectful of community hierarchies and communication norms, leading to more effective and representative feedback.
4. **Progressive Information Sessions:** Over several months, CGG conducted multiple in-person group sessions, each providing progressively more detailed information about the project. This gradual dissemination allowed fishers to digest complex information over time and develop informed questions and feedback in subsequent sessions. Such a structured yet less formal approach ensured that fishers could engage with the consultation process at a deeper level, building their understanding and involvement as the project details became more comprehensive.
5. **Extended Timeframes for Engagement:** As previously discussed.
6. **Multiple Forms of Correspondence:** Given the transient lifestyle, lack of digital literacy of some fishers and the importance of ensuring that every individual received and acknowledged the receipt of consultation documents, CGG utilised multiple communication channels (see Table C1-7, above), respecting the fishers' need for tangible, accessible information best suited to their needs. These culturally appropriate engagement strategies were carefully designed to respect the unique characteristics and preferences of the commercial fishing community, ensuring that the consultation process was not only effective but also respectful of the fishers' working conditions and community norms.

Challenges in Consulting with Commercial Fishers and Commercial Fishing Associations

In general, CGG has been able to develop strong relationships with individual commercial fishers in the region. CGG notes most engagements were positive and respectful of each other's rights and activities. There were some engagements that were less productive with circular arguments about the anecdotal impacts from seismic activities (particularly related to long-term productivity) and what the scientific evidence produced by CGG indicated.

During consultation with some commercial fishing associations, it was strongly preferred that we only engage with fishers through their peak associations. CGG remained open to this preference and agreed to the fee-for-service arrangements for the provision of information to fishers through these associations.

There were several challenges to utilising the fishing associations as consultative bodies on behalf of their members, these challenges included:

- Some associations were not willing to provide a written record of the consultation they intended to carry out.
- Some associations agreed to provide general feedback and information on behalf of their members but could not produce evidence of the individual member providing authority to their association to act on their behalf.
- Most of the associations were not able to represent all the diverse functions, interests, and activities for their members beyond their status as commercial fishers, which is an issue considering the principle of the multidimensional nature of relevant persons.
- Some associations did not engage further once the fee-for-service agreements had been signed. CGG recognises that fishing associations have other priorities than supporting consultation for petroleum titleholders.
- Engagement with many individual fishers occurred where CGG was instructed to consult only with the fisher and explicitly asked not to consult thorough the fishing associations.

There was no instance where a fishing industry association was able to entirely satisfy CGG that using them exclusively to consult with their members was an appropriate and sufficient method of consultation. As a result, CGG decided to expand its efforts to consult with each commercial fisher directly. CGG recognises that this diminished the role of fishing associations in the consultation process, could lead to duplicative consultation with some individuals, and risked overloading fishers with too much information. However, given the nature and scale of potential effect on commercial fishers, these drawbacks were insufficient to warrant reliance on fishing associations to perform the consultations. CGG decided to engage fishing associations who agreed to provide information and raise awareness about the Regia MSS with their members on fee-for-service arrangements.

SETFIA/SSIA/Atlantis Consulting

Our consultation process has faced significant challenges, particularly with the Southeast Trawl Fishing Industry Association (SETFIA, Org ID 98), the Southern Shark Industry Alliance (SSIA, Org ID 195), and Atlantis Consulting (Org ID 127). The primary concerns raised by SETFIA/SSIA have centred around the perceived inadequacy of the data provided by CGG, which they argue is crucial for accurately assessing the impacts of our survey operations on trawl fishing activities.

Throughout the consultation, SETFIA/SSIA has consistently requested more detailed information on the overlap of our survey activities with fishing zones, emphasizing the importance of this data in understanding, and mitigating economic impacts on the fishing community. This is despite CGG providing the information in its own form (from another reputable consultancy using the same ABARES data obtained via AFMA) and explaining that that the information being requested had no utility in managing impacts on commercial fishers.

CGG noted the sensitivities around conflicts of interest present in the information request and this is crucial in understanding our engagement with SETFIA/SSIA. Throughout the consultation process, concerns were raised regarding data accuracy and the perceived impartiality of the analysis provided. This scepticism was partly due to historical instances where SETFIA/SSIA believed that data might have been selectively presented or interpreted to minimise impacts on fishing activities. CGG consulted with AFMA to validate use of the ABARES data to ensure its accuracy and reliability (Event ID 3672).

In response to these initial challenges, CGG adopted several strategic measures aimed at addressing the concerns raised by SETFIA/SSIA. One of the earliest measures was the adoption of a compensation protocol, which aimed to provide financial redress for any displacement of fishing activities. This protocol will be designed with other Titleholders in the region, in consultation with the fishing communities to ensure it adequately compensates for any economic disruptions, whilst reducing burden on stakeholders. To further our efforts in fostering a productive relationship, we implemented several operational adjustments based on direct feedback from the fishing communities. This included modifying our survey timelines and exclusion zones to minimize overlap with peak fishing periods and critical depths, as detailed in Feedback ID 173 and 172.

However, consultation with SETFIA/SSIA has not been without its setbacks. CGG's attempts to provide more localised and specific data were met with continued requests for even more detailed analysis, particularly concerning the tonnage and economic value of the catch in the proposed survey areas. These ongoing requests highlighted a critical tension between the need for detailed impact assessments and the practical challenges of providing highly specific data that would not alter the mitigation strategies already in place.

The concessions made by CGG in co-designing the activity to minimise interference with commercial fishers were communicated through a series of email updates and consultations, where CGG provided revised maps and operational plans to demonstrate our commitment to reducing the impact on local fisheries.

Despite these efforts, challenges persisted, particularly in maintaining consistent and productive communication. As noted in several emails, there were moments of frustration, which underscored the need for even more robust communication strategies. In response, CGG provided a comprehensive summary of the consultations that included not only regular updates but also proactive outreach to ensure that all parties were informed and engaged throughout the process.

In conclusion, our consultation process has been a complex interplay of addressing detailed data requests, adapting operational plans, and enhancing communication strategies to foster a cooperative and mutually beneficial relationship with the fishing communities affected by our survey operations. Through a combination of compensation measures, operational adjustments, validated data sharing, and comprehensive stakeholder engagement, we have strived to maintain a productive relationship despite the significant challenges encountered. These efforts are ongoing, and we remain committed to continuous improvement and adaptation in response to feedback and environmental considerations.

Annex 2 – Consultation with First Nations Australians

Introduction

In accordance with the requirements outlined in the Regulations, CGG undertook extensive consultations with First Nations Australians to ensure their deep cultural connections, values, and environmental concerns were identified and comprehensively addressed in the planning of the Regia MSS. Recognising the unique consultation needs of First Nations groups, CGG adopted a multi-faceted approach to engage in a culturally appropriate way.

Consultation Methodology

As part of the Regia MSS consultation, this method was developed to ensure that the consultations were not only compliant with regulatory requirements but also respectful and inclusive of the cultural protocols of the First Nations communities involved.

Identification and Initial Contact

For clarity, the broad capture process (section 3.1.1), the opportunity to self-identify (section 3.1.2), and the awareness raising activities (section 3.1.3) all apply to First Nations Australians.

The tailored consultation process for First Nations Australians began in parallel to the previously referenced activities with comprehensive desktop research aimed at identifying First Nations groups who might be impacted by the Regia MSS. CGG undertook to identify and contact First Nations organisations in and around the Environment Planning Area. Understanding that First Nations interests may be direct and/or indirect, such as a spiritual connection to Sea Country, this was undertaken with a broad capture approach, identifying not-for-profit and First Nations groups and organisations, in addition to those with functions related to native title and Country management.

This research was crucial in ensuring that all potentially relevant groups were included from the outset. CGG employed a variety of sources, including databases of registered native title claims, Indigenous government agencies, and lists of local land councils, to compile a comprehensive list of contacts.

Following this identification phase, CGG initiated contact through a series of initial outreach efforts, including sending detailed letters and making follow-up phone calls. These communications were designed to explain the scope of the Regia MSS, the nature of potential impacts, and the reasons these groups were being contacted. The letters invited recipients to engage in the consultation process and offered various forms of follow-up, including face-to-face meetings, to discuss the project in further detail. The opportunity to co-design the consultation process was explicitly offered at the commencement of consultation.

The other methods of raising awareness about the proposed activity and the opportunity to consult with CGG apply equally to all Australians and they should be considered when deciding whether the broad approach taken to finding all relevant persons has suitably contributed to finding each First Nations group and individual.

Table C1-8 lists the organisations identified through the dedicated First Nations Australians searches and initial contact. First Nations individuals also had the opportunity to engage as relevant persons. In addition to outreach advertising covered in (3.1.3), an additional First Nations focused placement was made in the Koori Mail (Appendix C5), a National First Nations newspaper. This was a further step taken to help raise awareness, and allow self-identification of, relevant First Nations people inside and outside of Victoria. The list of First Nations persons is available in the Sensitive Information Report (Appendix C3).

Table C1-7 - First Nations organisations identified and consulted

Id	Name of organisation	Functions, Interests, Activities
12	National Native Title Tribunal	Providing for the recognition and protection of native title
26	Gunaikurnai Land and Waters Aboriginal Corporation	Represent the Gunaikurnai people
27	Barengi Gadjin Land Council	Trustee for the Native Title rights and interest of the Wotjobaluk, Jaadwa, Jadawadjali, Wergai and Japagulk peoples
28	Gunditj Mirring Traditional Owners Aboriginals Corporation	Works to progress rights and interests in cultural identity, social justice, native title, cultural heritage, and land justice
29	Eastern Maar Aboriginal Corporation	Traditional Owners of South-Western Victoria
30	Federation of Victorian Traditional Owner Corporations	Advocates for the rights and interests of Traditional Owners
31	First Nations Legal & Research services	Work with groups who wish to pursue land justice outcomes in Victoria
33	Right People for Country program	Supporting Traditional Owners to make agreements between and within groups.
34	The Koling wada-ngal Aboriginal Corporation (Wyndham City)	Engage in an equal partnership with the Wyndham Aboriginal community and key stakeholders to work towards providing a culturally safe Aboriginal Community Centre.
35	Department of Justice & Community Safety Koori Justice Unit)	Native title is the recognition in Australian law that some Aboriginal and Torres Strait Islander people continue to hold rights and interests in land and water.
36	National Indigenous Australians Agency	Native title recognises the traditional rights and interests to land and waters of First Nations people.
143	Boon Wurrung Foundation	Represents the traditional people and custodians of the lands from the Werribee River to Wilson Promontory,
144	Bunurong Land Council Aboriginal Corporation	Registered Aboriginal Party for an on behalf of the Bunurong People, with lands and waters across greater Melbourne, Mornington Peninsula, and the Bass Coast.
145	Flinders Island Aboriginal Association Inc. (FIAAI)	An Aboriginal Community Controlled Organisation. Established in 1971 by a local Aboriginal group, FIAAI is governed by an Aboriginal Board of Management, elected by the local community.
146	Tasmania Aboriginal Centre	Represents the political and community development aspirations of the Tasmanian Aboriginal community
32	Victorian Aboriginal Heritage Council	Helping the community respect and understand Aboriginal Cultural Heritage and Traditional Owner responsibilities.
316	Southern Ocean Protection Embassy Collective	Southern Ocean Protection Embassy Collective in their fight to protect Southern Sea Country from seismic blasting

These organisations were contacted with an initial letter and supporting information, and phone calls were placed to confirm receipt. This initial letter described the activity, why they are being contacted, offering further information, and requesting co-design of the consultation process and activity. Non-respondents were followed up with periodically, restating the reason for contact, confirming if there is an alternative preferred contact, and were provided with project updates including measures put in place around Deen Maar, after consultation feedback and research that the island and area between the island and mainland is culturally significant (Event ID 1891 & Desktop Research: Org ID 316 & Person ID 1163 in Appendix C3), and the Sea Country Protection Plan (Appendix G4).

If contact continued to be unsuccessful, further attempts were made to find alternate contact details at the organisations, these included government (Org ID 32, Event ID's 2331, 2332, 3008), and online resources. It was understood that many of the land councils and traditional owners' corporations were under resourced for engagement with offshore proponents, so collaborative meetings with other titleholders were offered when appropriate (Event ID: 1891, 2608 & 2386). Where organizations had preferred booking processes, these were adhered to, for example via booking forms (Event ID 2791 & 3894).

Pursuing a co-design of consultation, organisations were offered and encouraged to request information specific to their group, for example, a map was produced to assist in understanding impacts (Event ID 2386) and a requested summary explaining the differences between our activity and that of another titleholder (Event ID 3887). This helped ease burden on the groups when determining potential impacts. During engagement, groups were also asked to provide input and feedback on best practice for information sharing, including use of appropriate language and method (e.g. Event ID 1891, 3678, 3674).

Giving Sufficient Information

Throughout the planning and execution of the consultation process for the Regia MSS EP, CGG has demonstrated a commitment to providing comprehensive and understandable information to all relevant persons. The processes and information in section 3.2 apply to First Nations Australians as much as they do all other relevant persons.

During consultations with First Nations organisations there were requests made for more information either in writing or during meetings. In each case listed below CGG gave the additional information to the relevant person.

1. The Eastern Maar Aboriginal Corporation (EMAC) requested information on the differences between the Regia MSS and the proposed TGS Otway MSS. This included a map request.
2. The GMTOAC requested a presentation on the activity, the assessment process, and the protection measures adopted for Sea Country values and sensitivities.
3. The GMTOAC requested a detailed assessment of how the Outstanding Universal Values of the Budj Bim World Heritage Area had been assessed.

Reasonable Period with Sufficient Information

To discharge the First Nations consultation obligation, CGG understood that they must demonstrate that First Nation groups have been afforded a reasonable opportunity to be consulted with. Further, all group members should be afforded a reasonable opportunity to participate in consultation with clear, simple, and directly expressed terms. The fulfillment of this duty is evidenced in the consultation records (Appendix C).

Relevant Person Feedback

Throughout the consultation process, CGG made a concerted effort to ensure that all feedback received was carefully considered and, where appropriate, integrated into the project planning and execution. This feedback significantly influenced several aspects of the project, including the mitigation strategies employed to protect culturally sensitive areas and the environmental management plans developed to minimize impacts on natural resources important to First Nations communities.

CGG committed to ongoing engagement with the First Nations groups involved, ensuring that consultation did not end with the initial regulatory approval but continued throughout the lifecycle of the Regia MSS. This ongoing dialogue is aimed at maintaining trust and transparency and allows CGG to promptly address any new concerns or issues that arise as the project progresses.

Appropriate Measures Adopted

All interactions, feedback, and the measures adopted were meticulously documented, with CGG ensuring that each concern raised by GMTOAC was met with a detailed and considered response. This thorough documentation was critical in showcasing CGG's commitment to a transparent and responsive consultation process.

Through engagement and this research, the Sea Country Protection Program was devised (Appendix G4). The plan was provided to identified First Nations organisations and persons, and they were offered the opportunity to co-design, co-implement, and provide feedback on the program. The opportunity to make public comment or to join the consultation process at any time was also reiterated.

The Sea Country Protection Program is the primary measure adopted to protect cultural values of the existing environment. It is by no means the only measure that serves this purpose. All control measures adopted through the impact and risk assessment process will have some influence on the protection of the physical characteristics of the existing environment which have a protective function on cultural values. In addition, activity limitations adopted provide significant distance away from known culturally significant sites and buffers around totemic species important behaviours.

Culturally Appropriate Engagement and Tailored Consultation Strategies

Recognising the diverse needs and preferences within First Nations communities, CGG offered multiple engagement formats. These included traditional meetings, community gatherings on Country, and virtual meetings to accommodate remote participants. Each meeting was designed to facilitate open dialogue and ensure that community members could express their views and concerns in a culturally appropriate setting.

CGG recognised that in the vastly deep culture of Indigenous Australians, there is often different cultural and consultation requirements that exist in the different jurisdictions, Indigenous communities, and representative bodies. These differences create potential challenges in processing and responding to information through traditional methods such as email or phone. In response to this, CGG sought input and feedback from the First Nations groups, on how they require consultation to be undertaken, including considerations to reduce burden and consultation fatigue. All available methods of communication were offered, including meetings on Country and in groups, and bespoke information was encouraged to be requested.

First Nations groups and organisations, such as land councils, traditional owners' corporations, local environmental groups, and individual, may have a function, interest or activity that may be affected by the Regia MSS. Further, these groups may provide advice in relation to which other First Nations groups or individuals may need to be consulted with. This connection of traditional owners is represented in the Native Title Act 1993 (**NT Act**), that demonstrates consultation with First Nations people is workable through the communal interest they hold with their respective groups. Through this communal interest, the authorities require reasonable notice to group members but not an exhaustive communication with every person.

CGG provided opportunities for all relevant persons to co-design the consultation process. This approach ensured that the methods employed were not only respectful but also effective in capturing the full range of feedback from the communities. The consultation sessions were structured to be interactive, with CGG representatives providing information on the environmental planning process and listening to the concerns and suggestions from the community members.

CGG recognised through the consultation process that the consultation materials could be improved to use of First Nations language and as a result edits were made to support the preservation of language. In addition, CGG consistently invited further questions or requests for First Nations organisations to provide the opportunity to further tailor the consultation, or the information given.

Challenges in Consulting with First Nations Australians

The consultation process with First Nations Australians, while structured to be inclusive and respectful, presented several significant challenges, particularly when engaging with registered corporations. Despite CGG's commitment to a culturally appropriate consultation method, the response from many First Nations groups was less than optimal, impacting the overall timeline and effectiveness of the engagement efforts.

One of the primary challenges faced was the unresponsiveness of several registered First Nations corporations. Despite multiple attempts at contact through letters, emails, and phone calls, responses were infrequent and tardy. When responses were received, internal resource constraints were highlighted as a barrier to further consultation. Therefore, CGG assumed this lack of engagement was not due to a lack of interest but rather a reflection of the limited resources available to many First Nations corporations, which are often stretched thin across numerous obligations. CGG was willing to provide resourcing support to facilitate consultations provided there was a clear schedule of fees for such services. When such fees were required/requests they were paid by CGG.

Additionally, when First Nations groups did engage, there were some requests for CGG to "wait for instruction" before proceeding. While these requests were made to ensure that the engagement process was aligned with the cultural protocols and timelines of the communities, they introduced significant delays into the consultation timeline. The consultation period was extended on three separate occasions to attempt to accommodate First Nations Australians requests. CGG was prepared to accommodate these requests within reasonable limits, but these delays posed challenges, especially given the timelines associated with regulatory and environmental planning processes.

CGG is required to consult in a manner that is culturally appropriate and respectful of the traditions and practices of First Nations Australians. However, CGG experienced a complex set of circumstances when trying to balance the discharge of its legislative duties in a reasonable timeframe when First Nations groups were unresponsive or when we were requested to wait for consultation preferences. While CGG remained committed to respecting cultural protocols, the company also needs to adhere to regulatory timelines, its consultation principles, and project schedules.

In instances where prolonged unresponsiveness occurred, CGG had to make difficult decisions about how to proceed, always striving to keep open channels for late engagement and to document all efforts and communications thoroughly. In particular, the voluntary participation principle and the absence of universal participation principle were thoroughly considered during engagement with First Nations Australians.

Southern Ocean Protection Embassy Collective

CGG became aware of the Southern Ocean Protection Embassy Collective (Org ID 316), founded by Person ID 1163, through social media posts in opposition of the activity. A direct phone number or email could not be found, so social media was utilised to send a direct message (Event ID 2807), stating the purpose of contact and engagement, and confirming that participation on the engagement process would not be seen as consent and objections would be recorded. Information exchange was offered to be in the individuals preferred method, including the suggestion of a group meeting with their network. Public responses to social media posts concerning the activity and consultation process (Event ID’s 2804, 3327) were also made, to reinforce the aim of engaging to protect and preserve Country and culture and reconfirming that consultation would not be seen as consent.

Contact networks were also requested to facilitate contact information exchange (Event ID's 2813, 2723, 2975, 3416, 3890, 4016). The project email was not removed from a reply all sent by person ID61, so received emails in error (Event ID 4057, 4058), but these included Person ID 1163 and confirmed receipt and no intention to respond (Event ID 4061). CGG responded to these by reinforcing how the individuals' concerns had been considered, what measures had been put in place, and restating how participation in the activity can be undertaken if they do wish to engage in future.

Whilst direct engagement was not undertaken by the organisation or individual, desktop research and learning was used to inform management and mitigation measures to minimise potential consequences of the activity on the persons' functions, interests, and activities. Relevant organisations and individuals' publicly published writing, websites, public social medias, and interviews, on First Nations matters, their functions, interests and activities, Sea Country and the reason for their objection to the activity, were valuable resources in both understanding appropriate consultation and activity design approaches (see Appendix C3, Desktop Research: Org ID 316 & Person ID 1163).

Gunditj Mirring Traditional Owners Aboriginal Corporation

CGG's consultation efforts with the Gunditji Mirring Traditional Owners Aboriginal Corporation (GMTOAC) highlighted several key interactions that underscored both the proactive outreach efforts and the engagement responses from GMTOAC. These consultations were fundamental in addressing specific concerns related to the impact of the project on sensitive ecological and cultural areas.

The consultation process initiated with a well-structured approach, leveraging multiple communication platforms to ensure thorough engagement. Early interactions included emails (Event IDs 46, 672) and phone calls (Event ID s 439, 3031), setting a precedent for open and continuous dialogue. CGG's team was proactive, seeking to establish a foundational understanding of GMTOAC's perspectives and concerns from the outset.

An initial meeting was held (alongside ConocoPhillips to ease burden) on 30 May 2024 (Event ID 1891) to discuss the activity and plan the consultation process for Gunditjmara people represented by GMTOAC. GMTOAC representatives provided information to CGG on the cultural values of Budj Bim (both onshore and offshore) and highlighted the significance of Deen Maar. When further inquiries about the characteristics of the cultural values were made, CGG were informed that it is not appropriate to ask for this information and only to recognise the significance of the island.

CGG were asked to wait for further instruction on a GMTOAC facilitated consultation day where all petroleum titleholders would be invited to consult with a broader audience of Gunditjmara people and GMTOAC staff. CGG respectfully awaited information about the consultation day. When no invitation was forthcoming CGG attempted to reestablish a communication channel through email, phone calls, and offering meetings whilst staff were on Country.

CGG received an invite to a consultation day on 7 December 2023, over 6 months after the initial meeting. CGG had progressed with its preparation of the EP, as described in project update emails received by GMTOAC, and discovered more information about the cultural values and sensitivities of Sea Country from other sources.

CGG attended the GMTOAC open day which we understand was a properly notified meeting under the Native Title Act. However, the GMTOAC did specify that the event was an information sharing meeting only and, in their view, did not represent consultation. CGG presented information previously provided to GMTOAC staff to attendees at the consultation day. This included information about the activity, the impact and risks of the activity, and detailed assessments of the predicted effects and management measures for totemic species and significant area of Sea Country (such as the World Heritage Values of Budj Bim, the short-finned eel and the Southern Right Whale).

During the consultation day, GMTOAC representatives requested specific information, challenging CGG to demonstrate that there would be no measurable effects on the World Heritage values of Budj Bim. In response, CGG provided comprehensive documents and factsheets (Event ID 4794), ensuring that all data was transparent and accessible to GMTOAC representatives. This demonstrated CGG's commitment to not only meet regulatory requirements but also to respect the cultural and environmental concerns of the Traditional Owners.

Shortly after the consultation day, CGG received formal correspondence from Environmental Justice Australia, acting on behalf of GMTOAC. This communication was significant as it outlined specific legal and environmental concerns that GMTOAC felt were not adequately addressed during the initial consultations.

The letter from Environmental Justice Australia highlighted several key points. The letter reiterated GMTOAC's concerns about the potential impacts of the seismic survey on significant cultural sites and sensitive marine environments. Environmental Justice Australia provided a statement suggesting that the measures proposed by CGG might not be sufficient to protect the World Heritage Values of Budj Bim and other culturally significant areas. The correspondence requested that CGG consider additional mitigation measures and more robust environmental protection strategies to minimise any potential harm.

In response to the correspondence from Environmental Justice Australia, CGG acknowledged the concerns raised and committed to reviewing the suggested additional measures. This response was part of CGG's commitment to maintaining a transparent and constructive dialogue. CGG indicated willingness to continue consultation to explore further enhancements to its mitigation strategies, particularly focusing on the areas of greatest concern to GMTOAC. CGG assured GMTOAC and Environmental Justice Australia of its intent to continue engaging with the community and legal representatives to ensure that all concerns are thoroughly addressed and that the project aligns with both community expectations and regulatory requirements (Event ID 4797).

CGG has diligently endeavoured to discharge its consultation duties with the GMTOAC by seeking to use culturally appropriate methods and adapting to the specific needs and protocols of the community. Recognizing the challenges of timely and constructive engagement due to various constraints on the part of GMTOAC, CGG proactively informed itself about the cultural values and sensitivities relevant to the affected environment. This was achieved through extensive desktop research, Cultural heritage desktop assessment report (Appendix B10) and public documentation to ensure a thorough understanding of the cultural landscape. Additionally, CGG implemented measures to facilitate ongoing dialogue, offering multiple avenues for continued engagement and feedback. These efforts reflect CGG's commitment to respecting and integrating First Nations perspectives and concerns throughout the activity, reinforcing its dedication to fulfilling its ongoing consultation obligations responsibly and respectfully.

CGG recognise that the GMTOAC does not agree that consultation with them or their members is complete. CGG acknowledges GMTOAC's desire to progress with further consultation and CGG will duly participate in ongoing discussions to further refine the Sea Country Protection Plan for the Regia MSS.

CGG acknowledges the role that GMTOAC play in preserving the communal interests of the Gunditjmara people. However, CGG has taken extensive further actions to reach all relevant persons (including First Nations individuals) and consult with them, reducing the reliance on GMTOAC facilitating access to individuals and knowledge (cognisant of the absence of a universal participation mandate). Further, the information likely to be revealed through the GMTOAC consultation process has already been found in sufficient detail to identify and protect cultural values of the existing environment. These were identified through considering the Biosis Cultural Heritage Report (Appendix B10), studying the Nyamat Mirring Plan 2023 – 2033, mining social media representations of First Nations individuals, reviewing information and documents available on First Nations groups websites, review of management plans which include Sea Country values (Twelve Apostles Marine National Park The Arches Marine Sanctuary), and in the meetings held with GMTOAC, government organisations and other First Nations organisations. Notwithstanding, CGG acknowledges the importance of providing ongoing engagement throughout the life cycle of the activity to allow GMTOAC and Gunditjmara people to continue to share information and make decisions about cultural heritage protection, as captured above in '5. Ongoing Consultation'.

Annex 3 – Record of Engagements

Table C1-8 - Record of Engagements

Method	Summary	Total engagement
Community/Information sessions	Located in local towns along the activity area. Presented during these events: project description, engagement process, definition of Relevant Person, functions, interests and activities, the process and requirements for an EP. Discussion and information share with attendees. Attendees encouraged to register their details for updates and to self-identify as relevant persons.	176 registered attendees (please note not all attendees registered).
Project Outreach	Potentially relevant persons and organisations who appear to have functions, interests or activities that may be affected, found through desktop research and referral. Initial letters, sent via email or post, contained information on why recipient was being contacted, the applicable regulations, summary of the activity, link to the activity website, description of intent of an EP, invitation to co-design their consultation, commitment to provide sufficient information in appropriate manner, opt-out information, explaining sensitive information can be kept confidential on request, ongoing updates, request that they forward information to contacts that may have interested in the activity. Attachments to initial letter: • Activity Overview • Map of planning areas • Consultation Framework If no response phone calls and/or follow up emails were undertaken to attempt to confirm receipt. For organisations found through desktop research, or suggested referral, whose relevancy was uncertain, an email was sent with an activity description, link to the comprehensive website to determine if potentially affected. Follow up communications were sent to non-responders.	Over 260 individuals and organisations initially contacted through the project outreach.
Government agencies	Relevant government departments and agencies were identified under Section 25(1) using a combination of guidance documents and desktop research.	29 agencies identified and contacted.
Titleholder search	National Electronic Approvals Tracking System (NEATS) perused for other titleholders.	2 other titleholders found and contacted.
Conservation groups	Reached out to local community groups, such as those focused on environmental conservation or fishing, to identify members whose interests or activities could be affected by the activity.	42 conservation groups contacted.

Method	Summary	Total engagement
First Nations groups	The activity may have an impact on the cultural or spiritual functions, interests and activities of First Nations groups. Therefore, it was considered important to conduct meaningful and effective consultation to establish genuine, ongoing, and effective relationships. The methods used for consultation are elaborated below.	17 First Nations groups contacted.
Local (within EPA) newspaper and radio	The public was notified about the planned activity and asked to come forward if they had any specific functions, interests or activities that may be affected by the activity through advertisements in local newspapers and on local radio stations.	23 advertisements placed across social and traditional media. 272 radio spots over 6 stations. 4 radio and TV interviews/comments given (with direction to activity website).
Other marine users	These include petroleum titleholders, Ports, Coastguards, surf clubs, diving associations, subsea communications, and yacht clubs.	21 Other marine users.
Commercial fishing license holders (Cth)	Through engagement with AFMA and information found during the commercial fisheries review, fishers' details were obtained, and they were contacted via two points of contact.	321 commercial Commonwealth fishers contacted.
Fishing Industry Associations	Industry associations were contacted and engaged with, both on behalf of their members and as relevant organisations. Fee for service arrangements were undertaken where appropriate.	23 fishing industry associations.
Local Businesses & Tourism operators	We contacted local businesses and umbrella organisations, including Chambers of Commerce and tour operators, to engage members and customers through business networks whose interests or activities could be impacted by the activity.	21 businesses contacted.
Educational Institutions & Research bodies	We reached out to local educational institutions, such as universities or research centres, to engage with researchers or students whose interests or activities could be affected by the activity.	4 educational institutes & Research bodies contacted.
Engagement Feedback Survey	Released in the November project update, the survey requested feedback on the engagement process, including timing and information received (ID:3811).	Sent to 413 individuals, 2 surveys completed.
Social media	An activity Instagram, Facebook (META), and LinkedIn were established, providing activity information, and updates, available to be shared. 13 posts were boosted as adverts to targeted local relevant audience, advertising community sessions and important updates. Social media was also used to privately message and comment to potentially relevant persons who were unable to be reached via traditional communication methods.	Estimated audience size of 270,300-318,000, with over 600 link clicks to the activity website.
Webinars	Live as well as recorded and uploaded onto the website and YouTube channel.	6 webinars.

Method	Summary	Total engagement
Consultation Hub/project specific website	The project-specific Regia website allowed all members of the public and persons with interest to access every piece of information they would need to make informed decisions and objections. There are multiple industry-exceeding features of this website which are expanded on in section 1.4.1.	A total of 12124 visits, 3700 unique users, interacted on the website 274 times, and 825 document downloads.
Hosted industry-specific group meetings	Accommodating a co-design engagement process, when requested, commercial fishers group meetings were held in their locality and an online meeting for multiple NGO representatives.	5 group meetings.
Presence in locality	The activity Environment Manager spent 44 days visiting the local areas to raise awareness and identify potentially relevant persons. Local businesses, such as those involved in recreational diving and commercial fishing, were visited. They also attended a locally held climate event, where they identified themselves, responded to an audience question regarding seismic and invited the member, who stated they were with a local conservation group, to meet at the events conclusion (Event ID 3778).	21 local in person meetings. 11 community information sessions. 4 wharf visits. 4 local in person group meetings. 2 door knocks/business visits. 1 attendance at relevant local event.

Annex 4 - Information available on the Regia MSS website

Table C1-9 - Information available on the Regia MSS website

Documents Published	EP Appendix	Date First Published	Description
Preparatory Information			
CGG Environmental Policy	A1	1 February 2023	This policy applies to CGG in all its operations as well as contractors and site visitors within CGG's prevailing influence.
Description of Activity	A2	31 March 2023	This document outlines the proposed activity and was updated over time.
Community Consultation and Engagement Plan	A3	1 February 2023	This document explains how we intend on seeking community input into our environmental assessments.
Establishing Context			
Decision-Making Criteria	B1	31 March 2023	This document proposes the acceptable levels of impact and risk for consultation.
Requirements that Apply	B2	31 March 2023	This document captures the legislative and other requirements that will apply to the activity.
Implementation Strategy	B3	6 April 2023	This document describes our management systems along with our monitoring and review processes.
Preliminary Environmental Impact and Risk Assessment	B4	31 March 2023	This document provides an overview of the types of environmental impacts and risks CGG have to manage.
Commercial Fisheries Analysis Report	B6	9 August 2023	This Environmental Impact Assessment focusses on Commercial Fisheries Analysis Report.
Modelling Report – Sound Emissions	B7	6 June 2023	This Environmental Impact Assessment focusses on Sound Emissions.
Seismic Sound Studies Report	B8	6 June 2023	Comprehensive description of the effects from seismic on marine flora and fauna.
Environmental Assessment Method	B9	4 April 2023	This document explains how we will assess the predicted levels of impact and risk.
Risk Assessments			
Accidental Release of Waste Overboard	D1	11 September 2023	This Environmental Risk Assessments focuses on the accidental release of waste overboard.
Fauna Interactions	D2	11 September 2023	This Environmental Risk Assessments focuses on fauna interactions.
Invasive Marine Species	D3	11 September 2023	This Environmental Risk Assessments focuses on invasive marine species.
Oil Pollution	D4	11 September 2023	This Environmental Risk Assessments focuses on oil spill risks.
Impact Analyses			
Physical Presence	E1	22 September 2023	This Environmental Impact Assessment focusses on Vessel Physical Presence.
Underwater Sound - Plankton	E2	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on Plankton.

Documents Published	EP Appendix	Date First Published	Description
Underwater Sound - Fish	E3	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on fish.
Underwater Sound - Birds	E4	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on birds.
Underwater Sound - Invertebrates	E5	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on invertebrates.
Underwater Sound - Turtles	E6	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on Turtles.
Underwater Sound – Surfers, Divers and Swimmers	E7	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on Surfers, Divers and Swimmers.
Underwater Sound – Marine Mammals	E8	22 September 2023	This Environmental Impact Assessment focusses on the effects of underwater sound on marine mammals.
Artificial Light	E9	22 September 2023	This Environmental Impact Assessment focusses on Light Emissions.
Impact and Risk Treatment			
Oil Pollution Emergency Plan and Operational and Scientific Monitoring Plan	G3	28 September 2023	The Regia MSS OPEP serves as a blueprint for responding effectively to potential oil and chemical spill emergencies that may arise during our operations at sea.
Information Summaries			
Information Summary – Seismic Surveys and Diving Summary	See Appendix C5	21 June 2023	This information summary focuses on seismic surveys and diving.
Information Summary – Protection of Marine Mammals Summary		21 June 2023	This information summary focuses on the protection of marine mammals.
Information Summary – Activity Overview		1 February 2023	This information summary gives an overview of the Regia MSS activity.
Information Summary – What is a seismic survey?		1 February 2023	This information summary describes and defines what a seismic survey is.
Information Summary – Consultation Framework		1 February 2023	This information summary provides the framework for CGG's consultation.
Information Sessions 29-31st May		18 June 2023	This information summary is the presentation slides presented during the information sessions dates 29-31st May.
Information Sessions 14th and 16th June		18 June 2023	This information summary is the presentation slides presented during the information sessions dates 14th and 16th June.
NOPSEMA Consultation on offshore petroleum environment plans		24 May 2023	Point of easy access for the NOPSEMA brochure which provides information for the community.

Documents Published	EP Appendix	Date First Published	Description
brochure			
Commercial Fishing Information Sheet		8 December 2023	This information summary focuses on Commercial Fishers.
Newsletter 1		28 February 2023	The first iteration of the Regia MSS newsletter.
Newsletter 2		31 March 2023	The second iteration of the Regia MSS newsletter.
Newsletter 3		9 May 2023	The third iteration of the Regia MSS newsletter.
Newsletter 4		26 May 2023	The fourth iteration of the Regia MSS newsletter.
Newsletter 5		3 July 2023	The fifth iteration of the Regia MSS newsletter.
Project Update 14/9/2023		14 September23	September project update.
Project Update 03/10/2023		03 October2023	First October project update.
Project Update 20/10/2023		20 October2023	Second October project update.
Project Update 30/11/2023		30 November2023	November project update.
Project Update 22/12/2023		22 December 2023	December project update: next steps and plan to submit EP in NY
Webinars 1-6		01 March2023 – 12 December2023	All 6 webinars were recorded and uploaded to YouTube.
Regia MSS Base Map 1	See Appendix C5	1 February 2023	Map of the Regia MSS project.
Regia MSS Base Map 2		1 February 2023	Closer map of the Regia MSS project.
NOPIMS 2D Seismic Survey Lines		1 February 2023	Map of the 2D seismic survey lines.
NOPIMS 3D Seismic Survey		1 February 2023	Map of the 3D seismic survey lines.

REGIA

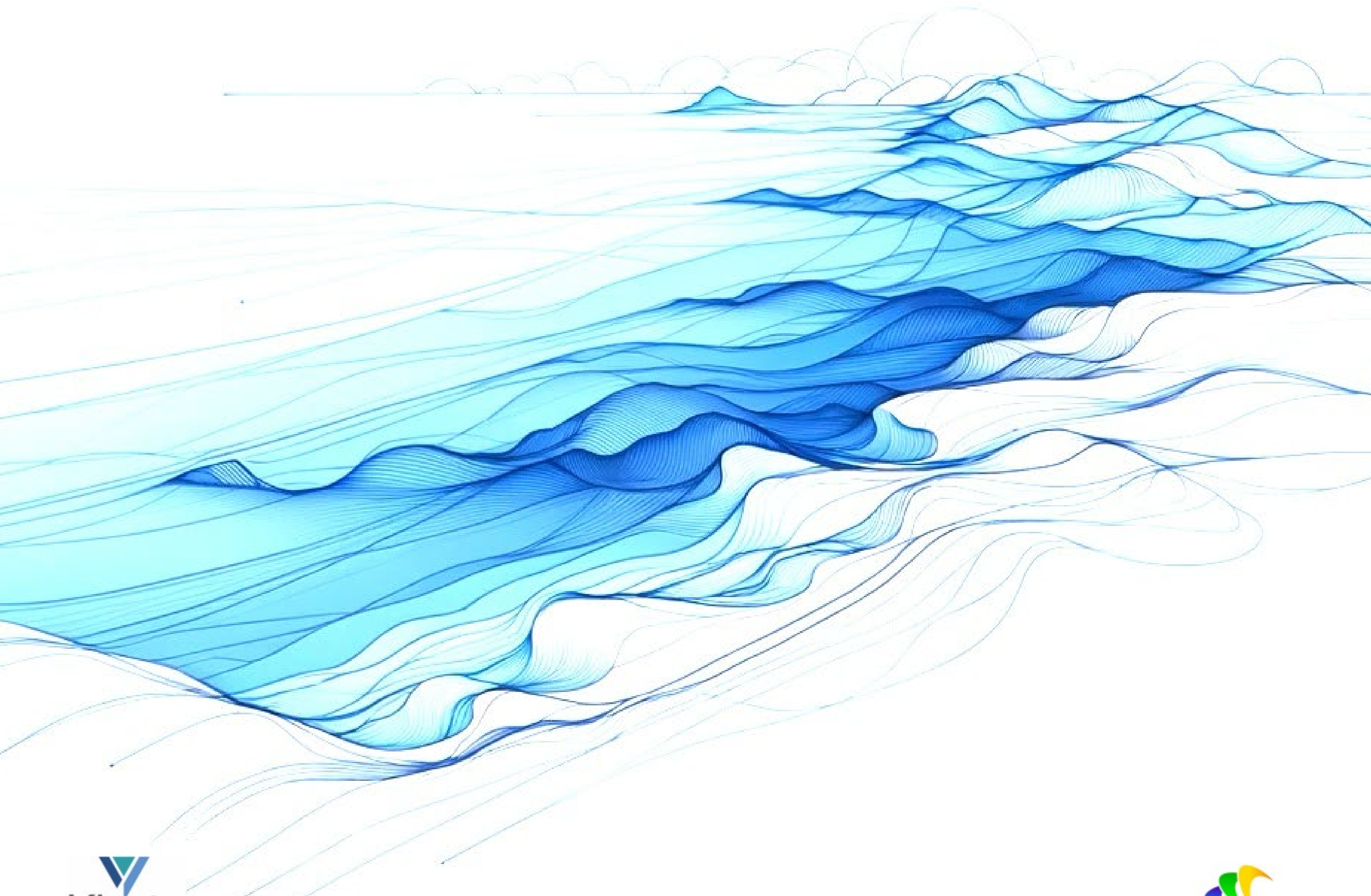
Marine Seismic Survey

Report on Consultations

Appendix C2: REG-EP-013-C2

Rev 2

June 2024



Klarite

1 Introduction

This report on consultations has been prepared to comply with Section 24 of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023. The extensive nature of the consultations makes efficient presentation of the records challenging. To comply with the regulatory guidelines a PDF of the tables has been provided. To improve transparency a filterable Excel worksheet has been provided where possible. The PDF and Excel files are copies of one another.

Consultations occurred with many individuals on behalf of their employer. These records have been prepared and organised by the relevant employer except when the individual indicated that they wish to be consulted as a relevant person. When this occurred, all records of correspondence with the individual have been presented collectively in the individuals report.

The purpose of each document within this report is as follows:

Item	Document Title & Purpose	Double Click Paperclip to Open PDF	 Excel
1	**Organisation Master List** This document is a list of all relevant persons who are authorities or organisations. It is ordered by regulatory category, and then by subject-centred category. This document also shows the identification method and the functions, interests, and activities of the relevant person. A unique 'Organisation ID' is assigned to each entity. Any authority or organisation who voluntarily participated in consultation was considered a relevant person. The Excel sheets are exact copies of the PDF.		
2	**Person Master List** This document is a list of all relevant persons who are not authorities or organisations. It is ordered by subject-centred category and all individuals are considered relevant persons under Section 25(1)(d). This document records the identification method and functions, interests, and activities of the individual, if ascertainable. Any individual who voluntarily participated in the consultation was considered a relevant person. The Excel sheets are exact copies of the PDF.		
3	**Report On All Consultations – Organisations** This document is the primary record of all events for authorities and organisations. It is ordered by regulatory category (Section 25), then by subject-centred category, then by date order (oldest to newest). The report contains all interactions (called Events), the event type, an event summary, and assigns an Event ID. If feedback (objections or claims etc.) was received this is shown against the corresponding event along with how the feedback has been processed in accordance with Section 24(b). Where multiple feedback was received in one Event, the Event has been duplicated. The Excel sheets are exact copies of the PDF with additional columns included to provide reference numbers and some additional information.		
4	**Report On All Consultations – Persons** This document is the primary record of all events for individuals. All entries are assigned to regulatory category 25(1)(d). The data is ordered by subject-centred category and then by date order (oldest to newest). The report contains all interactions (called Events), the event type, an event summary, and assigns an Event ID. If feedback (objections or claims etc.) was received this is shown against the corresponding event along with how the feedback has been processed in accordance with Section 24(b). Where multiple feedback was received in one Event, the Event has been duplicated. The Excel sheets are exact copies of the PDF with additional columns included to provide reference numbers and some additional information.		

Item	Document Title & Purpose	Double Click Paperclip to Open PDF	Excel
5	**Feedback Master List** Each feedback was categorised into either an objection or claim (as required by the Regulations), or a complaint, a request (usually for information), or was a public comment made by a relevant person. This report shows the systematic treatment of feedback from relevant persons and provides more detail on the consideration of the feedback than is shown in report Items 3 & 4.		

In addition to the above, there are several documents that are more efficiently shown collectively to reduce duplication in the Sensitive Information Report, or as they relate to the consultation process that was undertaken in preparation of the Environment Plan. The following items are available in this consultation report:

Item	Document Title & Purpose	Double Click Paperclip to Open PDF	Excel
6	**Website Report** This document shares the content that was available for relevant persons through the Consultation Hub. Statistics for the use of the website are shown. It also contains an electronic copy of the consultation survey provided to support visitors determine if they may be affected by the activity.		N/A
7	**Social Media Report** Report provides copies of the posts made through various social media platforms and the statistics associated with their uptake from viewers.		N/A
8	**Print Media Report** Report provides copies of adverts place in regional and national papers raising awareness about the consultation opportunities for relevant persons. Evidence of advertising the EP's public comment period is also provided.		N/A
9	**Interactive Map Comment Report** Members of the public were able to make comments on an interactive map on the Eureka Consultation Hub. This report provides a record of the comments received and a response. Commenters acknowledge that comments were not being made as a 'relevant person'. All commenters were contacted to ascertain if they were relevant persons.		N/A
10	**Information Sessions and Webinar Report** This report is a copy of the slide presented at the community information sessions and during webinars. Videos of the webinars were made available on the Consultation Hub.		N/A
11	**Campaign Email Report** This document provides copies of emails to subscribers and known relevant persons. After each email event a report provides a summary report for the success of the campaign.		N/A

The sensitive information report is provided as a repeat of this public report, plus additional fields to aid NOPSEMA's assessment. The following materials are provided to NOPSEMA and are not included in this public report.

Item	Document Title & Purpose	Double Click Paperclip to Open PDF	Excel
12	**Consultation Survey & Instant Feedback Report** The consultation survey was available on the Consultation Hub and contains personal information meaning it must be kept confidential. Instant feedback was available for anyone to quickly raise concerns.		N/A

Item	Document Title & Purpose	Double Click Paperclip to Open PDF	Excel
13	**Information Given During Consultation Report** This document provides copies of all documents and information given by Pilot Energy to relevant persons. It is a large compilation of documents and is provided separately to this report. It is organised by relevant person and date (oldest to newest).	Provided separately	
14	**Full Text Copies of Correspondence** This report is confidential and contains: • Information requested to kept confidential by relevant persons. • Full text copies of all correspondence and documents sent & received.	Confidential and provided separately	

2 Feedback

Item 5 of this report provides a compilation of feedback from consultation such that it is easy to see the consistent application of a methodological way of assessing feedback provided though the consultation process. Feedback could have been received through any event with any relevant person and was categorised as either a:

- Complaint
- Objection
- Claim
- Request
- Public comment

Once assigned a type of feedback, a member of the Regia MSS EP team assessed the merit of each individual feedback. The output provided in this report contains an assessment of merit of each feedback within the following category structure:

Feedback of Merit:

Adverse Effects Concerns: This category includes any feedback that directly relates to the adverse effects of the activity, such as impacts on marine species, sound effects, visual impacts, and concerns related to oil spills.

Consultation Process Feedback: Includes feedback relevant to the quality of the consultation process and how stakeholders feel about the engagement efforts.

Specific Request: This would cover reasonable requests from relevant persons, requests for further information about the activity, and any specific concerns or requirements stakeholders have mentioned.

Miscellaneous Meritorious Concerns: For feedback that doesn't neatly fit into the other categories, such as errors in distances quoted or general statements needing clarification.

Feedback of No Merit:

Objections Not Related to Adverse Effects: Contains objections that are not about the adverse effects of the activity. This might include objections to the type of title or general objections to oil and gas activities that do not specifically address adverse effects.

Not Relevant - Other: For any feedback that lacked substance, was abusive, or otherwise lack specific feedback.

This categorisation evolved from the original, narrower, assessment of merit process outlined in the Community Consultation and Engagement Plan (Appendix A3) once feedback was received (i.e. to simply assign a high or low merit to feedback.

The data reported encompasses a variety of feedback entries, each uniquely identified by an "ID" number. Feedback is categorised based on its type, summary, and shows additional information about the consideration of measures before reasonable measures were adopted. The following assessment record shows how each feedback was assessed and treated and ultimately lead to changes to the environmental management of the activity.

Impact/Titleholder Report on Public Comment

CGG Services Australia (CGG) is proposing to undertake the Regia three-dimensional (3D) marine seismic survey (MSS) in Commonwealth waters of the Otway Basin. The purpose of the Regia 3D MSS is to collect high-quality geophysical data about rock formations and structures beneath the seabed and assess potential for new oil and gas discoveries.

The Regia 3D MSS is a typical 3D survey using methods and procedures like others conducted in Australian waters. No unique or unusual equipment or operations are proposed. The active source area comprises the area within which 3D seismic acquisition will be undertaken and has a maximum sail line distance of 1,700 km. The active source area is surrounded by a larger operational area (approximately 4,000 km^2), for the purpose of line turns, run-ins, run-outs, seismic testing, and support activities. The operational area at its closest is approximately 12 km south of Port Fairy. The seismic survey will be undertaken in water depths no shallower than 50 m, and no deeper than 200 m.

The Regia 3D MSS will take a maximum of 90 days to acquire, and may be undertaken in any month except January, February, and March. The precise timing of the survey is subject to vessel availability, weather conditions and other operational considerations, and will consider the seasonality of environmental sensitivities, where practicable.

The following Titleholder's Report on Public Comment applies to the Regia 3D MSS Environment Plan (EP), as required after completion of the public comment process. The Regia 3D MSS EP was submitted to NOPSEMA for completeness check and accepted as complete on 25 January 2024. Following acceptance, the EP was published on the NOPSEMA website for a 30-day public comment period. The EP was available for public comment from 25 January to 26 February 2024. CGG would like to thank the submitters for their responses pertaining to the Regia 3D MSS EP. A total of 14,879 public submissions were received from NOPSEMA.

The following report details the issues or themes raised from the received public comments grouped by key matters and matters. CGG has identified the sections of the EP that correspond to the matters raised, where the matters have been accounted for in the EP. Where applicable, CGG has indicated (by underlining), where updates have been made to the EP in response to the submissions received.

The titleholder and nominated liaison person contact details for the Regia 3D MSS EP are provided below.

__Details of titleholder and liaison person__

Details	Titleholder
Name	CGG Services (Australia) Pty Ltd
Business Address	Level 2, 1060 Hay Street, West Perth, WA 6005
Telephone Number	08 9214 6200
Email Address	contact@regiamss.com.au
ABN	70 081 777 755
Website	www.regiamss.com.au
Nominated Liaison Person	
Name	Paul Rheinberg
Business Address	Level 2, 1060 Hay Street, West Perth, WA 6005
Telephone	08 9214 6200
Email	contact@regiamss.com.au

Contents

1. Impact and Risk Assessment and Mitigations

	THEME	IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)
#	***Comments received***	***Titleholder response***
Key Matter: Assessment and mitigation (general)		
I01	**Matter**: Inadequate assessment and mitigation measures (general) **Claim**: This EP needs to be refused outright as the impacts to our ocean environment and marine life have not been adequately considered, and measures to mitigate impact have not been detailed to a degree sufficient to demonstrate that marine life will not be harmed; and the continued existence of species not jeopardized. **Claim**: This Environmental Plan needs to be stopped as the impact on our oceans and marine life which have not been adequately reported on and mitigation procedures to our ocean environment and marine life have not been adequately considered, and measures to mitigate impact are not able to guarantee that marine life will not be harmed. **Claim**: CGG's assessment of risks and mitigation measures is questionable, lacking transparency and public consultation. **Claim**: The proposed Environment Plan (EP) does not include adequate measures to mitigate the impact of such an activity on the ocean environment and the marine life. **Claim**: Within the environment plan numerous threatened, endangered and critically endangered species are identified. The measures proposed to mitigate impacts on these species are acknowledgement of the dangers associated with seismic blasting, and at the same time fail to provide any assurance that these impacts will be adequately mitigated. **Claim**: The EP has failed to offer adequate mitigation strategies to protect cetaceans, seals and sea lions, or invertebrates. **Claim**: The Risk Management Plan and risk mitigation strategies are not fit for purpose. **Claim**: CGG\'s environmental plan lacks any proper harms it will cause and how these will be mitigated. **Claim**: It is the submitters view that the proposal to conduct seismic blasting in the location off the coast of Victoria outlined in the CGG Regina MSS proposal will cause significant harm to marine wildlife that is not adequately accounted for nor mitigated for in the CGG Environment Plan (EP). **Claim:** There is nothing in the EP that proposes a solution to the likely impacts that this operation will have on the range of marine species within the OA or the EMBA. **Claim:** The blast of an airgun of the type used in seismic surveys can reach a distance of up to 300,000kms and raise the background decibel level of the ocean by as much as 100 times (Torres, Klinck, Geospatial Ecology of Marine Megafauna Laboratory, 20174). The EP provided by Klarite for this project only considers an EMBA envelope of 150km beyond the operating area. Despite falling well short of the reach of the blasts from the airguns used to undertake seismic surveys, the environment planning area still takes in several sensitive marine ecosystems – including four RAMSAR listed areas - which sustain numerous threatened, endangered and critically endangered species.	CGG acknowledges claims regarding the identification, assessment and reduction of impacts and risks associated with the Regia MSS and has reviewed the Environment Plan (EP) in response to these claims. The environmental impact and risk assessment methodology is comprehensively described in EP Appendix B9 (Environmental Assessment Methodology) and is consistent with International Standards Organization (ISO) 31000:2009 Risk Management – Principles and Guidelines and NOPSEMAs guidelines and guidance notes, as described in Sections 1.1 and 2. CGG published its Environmental Assessment Methodology on the Regia MSS Consultation Hub website on 4 April 2023 so that identified relevant persons, and unidentified relevant persons in the community, could understand and comment on the quality of the methodology. Further, the methodology was adapted over time to reflect relevant person feedback and information discovered through the impact and risk assessment process. CGG has provided extensive information on: - Environmental impacts and risks associated with the proposed Regia MSS (EP Appendices D1-4 and E1-10) - Decision-making processes (including the ALARP, Acceptability and ESD assessments) (Appendix F1-4), and - Environmental performance and treatments (mitigation and management measures) that will be implemented and monitored for the duration of the Regia MSS to ensure control measure consistently perform to reduce impacts and risks to ALARP and Acceptable Levels (EP Appendix G1-5). CGG has considered these claims and is satisfied that the potential impacts and risks, and mitigation measures have been adequately addressed in the EP Appendices outlined above. As a result, the EP has not been updated in response to these claims.
I02	**Matter**: Impacts on local/ international ecosystems and migratory species	CGG acknowledges claims regarding impacts on regional ecosystems and migratory species and has reviewed the Environment Plan (EP) in response to these claims. Claims regarding impacts on international ecosystems are not considered credible given the spatial extent of predicted impacts and risks does not extend into international waters.

	THEME	**IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)**
#	***Comments received***	***Titleholder response***
	Claim: The full levels of impacts on local and International ecosystems and migratory animals has not been sufficiently modelled or understood or accounted for in the Environment Plan (EEP).	As explained in Appendix F1 Section 5.3.3 (Compliance with the EPBC Act), the primary environmental legislation within Australia is the Environmental Protection and Biodiversity Conservation Act 2002 (EPBC Act). NOPSEMA's authorisation processes have a Part 10 approval that applied to offshore petroleum activities as per the NOPSEMA EPBC Act Program. This program ensures that impacts on matters protected under Part 3 of the EPBC Act are not unacceptable. Matters protected by the EPBC Act, and considered in this EP, relevant to the stated claim include 'listed threatened species and ecological communities' and 'listed migratory species'. These are identified using the Commonwealth government's Protected Matter Search Tool (PMST), as documented in EP Appendix B5 (PMST Reports). Each impact and risk assessment (EP Appendices D1-4 and E1-10) has considered these matters and provides evidence that the proposed activity is not in conflict with any recovery plans or threat abatement plans for listed threatened/ migratory species or ecological communities, and show that the activity will not have unacceptable impacts on the values of these protected areas, nor on threatened/ migratory species. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, as outlined above. As a result, the EP has not been updated in response to these claims.
I03	**Matter**: Failure to acknowledge the mobile and unrestricted nature of ocean dynamics. **Claim**: The proposal by CGG explicitly states the extent of their operational areas. With respect to this, they submit that the entire extent of their activities, and the impacts, will be confined within these areas. The EP states that survey vessel navigation lines will follow GPS systems to ensure that they navigate accurately within the permit areas. Submitter submits that this amounts to a disconnect between the alleged impact and the actual environmental impact. Large bodies of water are subjected to widespread water movements (currents and tides, resulting in different volumes of water being impacted by each seismic blast, all determined by the direction and speed of oceans currents and tides present at each specific time at each specific location. The currents in the operational areas vary from <0.1 m/s up to approximately 0.8m/s or more. A current running at 0.8m/s is moving at 2.88km/h. See: <http://www.bom.gov.au/oceanography/forecasts/idyoc300.shtml?region=VICTAS&forecast=Current#>. In other words, the sub-benthic surveys Regia wish to conduct are static, but the environment above them is not static. It is therefore not possible for Regia to accurately claim that the impact of their proposal will be restricted to the zones they identify. Regia have failed to acknowledge that the environment in which they intend to operate is a mobile one. And that the effects of that operation are also mobile; they are not restricted. As large bodies of water are continuously in motion, the environmental impact of CCG's proposal is potentially thousands of times larger than the defined operational areas – thousands of times greater than their EP attests.	CGG acknowledges the claims regarding the mobile and unrestricted nature of ocean dynamics and has reviewed the Environment Plan (EP) in response to these claims. We concur that ocean dynamics are central to performing a rigorous impact assessment. Ocean dynamics are an input into independent sound modelling reports and have been considered within the impact assessments (Appendices E1-10). Based on the assessment conducted for the EP and feedback from consultation with marine scientists and environmental experts, we understand that the natural dynamics of ocean currents and tides plays a crucial role in the ocean's resilience to anthropogenic impacts, including those from seismic surveys. When assessing the impacts of seismic surveys on marine environments, it is crucial to avoid the assumption that such effects equate to destruction or are ubiquitous within the ocean environment. A proper evaluation of impacts is far more nuanced and involves a comprehensive understanding of the resilience, sensitivity, and recoverability of marine species and habitats to such activities. Ocean dynamics play a significant role in the assessments. For instance, the resilience of a species—or its ability to withstand disturbances—helps determine how impactful a seismic event might be. This resilience is often enhanced by the very mobility of water, which can help disperse and dilute energy. Additionally, the sensitivity of different species to specific disturbances varies greatly, with some capable of rapid recovery and adaptation in the face of temporary changes to their environment. Finally, the potential for recovery post-impact is a relevant consideration where we find the natural regenerative processes of the ecosystem, which are often aided by water currents, facilitate the return of ecological balance. Ocean currents and tidal movements are essential in dispersing and diluting effects from a range of pressures on the marine environment. These large-scale natural processes reduce (not increase) the overall severity of any potentially harmful effects. The continuous movement of water facilitates the recovery of marine environments by replenishing nutrients and oxygen levels and removing pollutants. This dynamic ensures that the affected areas are not isolated, allowing for faster natural rehabilitation and resilience against disturbances. The flow of ocean currents supports ecological connectivity by enabling the migration of species and the dispersal of larvae and nutrients, which are vital for maintaining healthy marine populations and ecosystems. This connectivity helps ensure that any localised impacts from the Regia MSS would not lead to long-term detrimental effects on marine biodiversity. The environmental planning and impact assessments incorporate these oceanic dynamics, both in modelling reports and impact assessments. The EP development process has adhered strictly to regulatory frameworks that mandate comprehensive assessments and minimise environmental footprint. The adopted strategies include seasonal and temporal adjustments to operations to avoid critical periods for marine fauna and technological enhancements in equipment to reduce sound levels and physical disturbances. These measures ensure that impacts from the survey remain within acceptable limits and do not exceed modelled predictions. While we acknowledge that the ocean's dynamic nature means that impacts can be spread over a larger area, the same dynamics also contribute to reducing the intensity and likelihood of significant adverse effects. The resilience of ocean ecosystems, supported by their inherent mobility, is a crucial factor that helps buffer and mitigate the impacts of offshore operations. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, as outlined above. As a result, the EP has not been updated in response to these claims.
I04	**Matter**: Flawed argument regarding animals moving away	CGG acknowledges claims regarding impacts to species associated with movement away from the Regia MSS and has reviewed the Environment Plan (EP) to ensure these impacts were appropriately assessed.

	THEME	IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)
#	***Comments received***	***Titleholder response***
	Claim: CGG has consistently presented the argument that animals (cetaceans, fish, birds) will move away from the seismic source during acquisition. CGG conclude that by moving away from the seismic source, the impact of seismic to these animals will be minimised. This argument holds significant flaws. For example: • Animals will undergo increased energy expenditure to move away from their preferred foraging/breeding grounds. • Animals will undergo increased energy expenditure to find alternative food sources and breeding locations. • By foraging and breeding in other regions, there is a displacement of foraging pressure, resulting in detrimental impacts to surrounding foraging/breeding areas. • The spatial scale CGG intends to create an acoustic disturbance is extensive, resulting in cetaceans, fish and seabirds having to move up to (or more than) 350 kms away before they are out of the OA. • Increased energy expenditure to avoid disturbances are known to result in decreased reproductive success for many species (Thorne et al., 2015).	CGG acknowledges that displacement is a possible consequence for some marine fauna exposed to underwater seismic survey noise. These consequences are discussed in EP Appendices: - E3 (Underwater Sound (Fish)) where impacts are not predicted to be distinguishable from annual variability in recruitment and catch rates. - E5 (Underwater Sound (Birds)) where the temporary increase in foraging distances associated with a seismic survey is considered unlikely to have a significant impact on individual penguins or the population. - F3 (Acceptable Levels of Impact and Risk), for example, Section 5.2.1.2 (Magnitude of Effect) which describes the potential for disturbance of migrating southern right whales mother which could increase their energy expenditure and result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51 km, the energetic costs would be extremely low if avoidance behaviour occurred. CCG will implement the requirements of EPBC Act Policy Statement 2.1— interaction between offshore seismic exploration and whales (for which the Regia MSS will implement all Part A and all Part B measures). These measures have been deemed as an effective mitigation within the updated draft National Recovery Plan for Southern Right Whales (DCCEEW 2023) to minimise the risk of acoustic injury to whales in vicinity of seismic survey operations and to minimise the risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important areas (e.g., breeding, calving, resting areas or confined migratory routes or feeding areas) or during critical behaviours (e.g., breeding, feeding, and resting). Based on the detailed assessment provided in the EP, displacement of individuals over long distances (≥ 350 km as claimed by submitter/s) is not predicted; however, CGG recognises that displacement may occur over tens of kilometres for some species and that the acoustic source may be audible beyond these distances. **CGG has considered these claims and has updated the EP Appendices E2 -E7, F1 and F3 to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.**
I05	**Matter**: Aligning key threats with risk assessment **Claim**: Submitter recommends aligning key threats stipulated within the risk assessment with the protection laws for protected species.	CGG acknowledges claims regarding the importance of aligning the impact and risk assessments with the EPBC Act management plans for protected species and has reviewed the Environment Plan (EP) to ensure that this was done. CGG has aligned legislative and other requirements in Annexes for impact and risk assessments where threatened species have been identified with relevant management plans in place, i.e. EPBC Act Conservation Management Plans, Recovery Plans and Conservation Advice. For example, Annex 1 (Legislative and Other Requirements Relevant to Sound Emissions and Marine Mammals) of EP Appendix E7 (Impact Assessment – Underwater Sound (Marine Mammals)), provides the name of the relevant plan for each threatened species, a description of the requirements of the plan, an overview of the relevance of the plan to the environmental management of the Regia MSS, and information on how the requirements will be met. CGG has considered these claims and is satisfied that impact and risk assessments have been aligned with EPBC Act management plans for protected species, as outlined above. As a result, the EP has not been updated in response to these claims.
Key Matter: Assessment and demonstration of ALARP (as low as reasonably practicable) and acceptability		
I06	**Matter**: Compliance with Environment Regulations **Claim**: The EP is not appropriate for the nature and scale of the activity, it does not demonstrate that the environmental impacts and risks of the activity will be reduced to as low as reasonable practicable and it does not demonstrate that the environmental impacts and risks of the activity will be of an acceptable level, as is required by regulation 34(a), (b) and (c) of the Regulations. **Claim**: The Environmental Plan provided does not meet criteria for NOPSEMA's acceptance, set out under regula3on 10A of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (Cth), sub-clauses (a) - (f). The EP does not sufficiently demonstrate the environmental impacts, or that the impacts will be of an acceptable level, with appropriate outcomes.	CGG acknowledges claims regarding compliance with the Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 and has reviewed the Environment Plan (EP) to ensure these impacts were appropriately assessed. CGG has provided an assessment against each of the acceptance criteria for EPs as follows: - EP Section 5.1 (The EP is appropriate for the nature and scale of the activity). - (Appendices D1 – D4 and E1 – E10), and in the proposed management of environmental impacts and risks associated with the activity (Appendix G1 – G5). - EP Section 5.2 (The EP demonstrates that the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable). - EP Section 5.3 (The EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level). The environmental impact and risk assessment methodology is comprehensively described in EP Appendix B9 (Environmental Assessment Methodology) and is consistent with International Standards Organization (ISO) 31000:2009 Risk Management – Principles and Guidelines

	THEME	**IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)**
#	***Comments received***	***Titleholder response***
	Claim: The CGG EP submission presents several areas of concern, particularly regarding the project's potential cumulative impacts, adherence to environmental principles, and methodological transparency. In line with these concerns, this submission recommends a comprehensive review and adjustment of the project's environmental plan to ensure ecological sustainability and adherence to regulatory standards.	and NOPSEMAs guidelines and guidance notes, as described in Sections 1.1 and 2. CGG published its Environmental Assessment Methodology on the Regia MSS Consultation Hub website on 4 April 2023 so that identified relevant persons, and unidentified relevant persons in the community, could understand and comment on the quality of the methodology. The methodology was then adapted to reflect relevant person feedback and information discovered through the impact and risk assessment process. Further, to demonstrate methodological transparency, drafts of the full impact and risk assessments were published as soon as they were complete (Appendices D1 – D4 and E1 to E10), and Appendix E10 – Cumulative Impact Assessment was prepared in response to requests from relevant persons and will be published alongside submission of the EP for public comment. CGG has considered these claims and is satisfied that the EP demonstrates compliance with the Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023, as outlined above. As a result, the EP has not been updated in response to these claims.
I07	**Matter**: The explanation of ALARP is unhelpful **Claim**: Relevant person notes that while CGG included a chapter in the EP addressing ALARP and the setting of 'acceptable/unacceptable' levels, the explanation presented remains unintelligible and unhelpful to lay audiences seeking to understand the decision making process surrounding activities that impact iconic Australian biodiversity and habitats.	CGG acknowledges claims regarding the complexity of 'ALARP' and has reviewed the Environment Plan (EP) to ensure that this requirement was appropriately explained. The decision-making criteria for the Regia MSS are comprehensively described in EP Appendix B1 (Decision Making Criteria) which introduces the concepts of managing environmental impacts and risks to As Low As Reasonably Practicable (ALARP) and Acceptable Levels, in consideration of the principles of ecologically sustainable development, features of the existing environment, legislative and other requirements, and internal and external context. Decision Making Criteria were published on the Regia MSS Consultation Hub website on 31 March 2023 so that identified relevant persons, and unidentified relevant persons in the community, could understand and comment on the quality of the criteria. No feedback on this document or the criteria themselves was received despite promotion of the importance of these documents at community information sessions, webinars, and during consultation activities (See Appendix C1). The lack of comment has not been used to assume relevant persons tacitly agree with these criteria. Notwithstanding, the criteria were derived from industry standards and from previously accepted Environment Plan thus giving them sufficient credibility to be used for this activity. CGG has considered these claims and is satisfied that the decision-making criteria for the Regia MSS are appropriately described, as outlined above. As a result, the EP has not been updated in response to these claims.
I08	**Matter**: The definition of ALARP conveys an unwillingness to comply **Claim**: CCP (sic) explains ALARP as an assessment of " assessing the level of impact or risk in relation to the sacrifice involved in adopting measures to avert an impact or risk. In weighing the two sides of an ALARP assessment measures that provide a level of impact or risk reduction that is commensurate to the sacrifice must be adopted." The use of the term "sacrifice" is an odd use of language, and conveys a concept of unwilling compliance, rather than proactively seeking to minimise environmental harm.	CGG acknowledges claims regarding 'ALARP' and has reviewed the Environment Plan (EP) to ensure that this concept and the language used to describe this concept was appropriate. The term 'sacrifice' is provided in NOPSEMA's guideline: Environment plan decision making guideline.pdf (nopsema.gov.au), which explains that "Reducing impacts and risks to ALARP is based on the concept of reasonable practicability; the weighing up of the magnitude of impact or risk reduction against the cost of that reduction. The 'cost' in this context means the sacrifice associated with implementing a control measure which includes an evaluation of the benefits versus the impost such as money, time and/or effort required to implement a particular control measure. The titleholder must adopt additional control measures or increase effectiveness of existing control measures if the cost of doing so is not grossly disproportionate to the environmental benefit gained. An EP needs to demonstrate, through reasoned and supported arguments, that there are no other practical measures that could reasonably be taken to reduce impacts and risks any further." The decision-making criteria for the Regia MSS, comprehensively described in EP Appendix B1 (Decision Making Criteria) were published on the Regia MSS Consultation Hub website on 31 March 2023 so that identified relevant persons, and unidentified relevant persons in the community, could understand and comment on the quality of the criteria. No feedback on this document or the criteria themselves was received despite promotion of the importance of these documents at community information sessions, webinars, and during consultation activities (See Appendix C1). The lack of comment has not been used to assume relevant persons tacitly agree with these criteria. Notwithstanding, the criteria and definitions of those criteria, were derived from industry standards, NOPSEMA guidelines and from previously accepted Environment Plan thus giving them sufficient credibility to be used for this activity. CGG has considered these claims and is satisfied that the definition of ALARP is consistent with NOPSEMA's guideline, as outlined above. As a result, the EP has not been updated in response to these claims.
I09	**Matter**: Decisions to reject mitigation measures **Claim**: CGG can decide not to implement a mitigation measure if it is deemed 'grossly disproportionate', meaning it is too expensive. However, this does not mean that the impacts of the activity have been fully mitigated, only that CGG has decided it has spent	CGG acknowledges claims regarding decisions to adopt or reject mitigation measures and has reviewed the Environment Plan (EP) to ensure that these decisions are appropriately evaluated. The concerns raised in some claims suggest that any level of environmental impact from petroleum activities is unacceptable and that impacts should be 'fully mitigated'. However, it is important to clarify that the legal and regulatory framework in Australia does not require a no-impact standard for petroleum activities. Instead, operators like CGG are mandated to establish an acceptable level of impact based on

	THEME	IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)
#	***Comments received***	***Titleholder response***
	enough money to lower the impact level and will not spend any more to decrease the impact further. **Claim**: In the EP, these decisions to forgo mitigation measures are made without placing the cost in context of total project costs, or its projected profits, because "disclosing project costs and assumptions in publicly available documents is not in CGG's overall best interests, nor is it a legislative requirement." (p.3101). This makes it impossible for NOPSEMA and the public to understand the process by which CGG deemed a mitigation measure to be 'grossly disproportionate', as there is no requirement to prove that the cost may negatively affect CGG at all. This lack of transparency must be explained, if not in publicly available documents, then directly to NOPSEMA as part of the approvals process. **Claim**: Noting that impacts on the environment that may be affected (EMBA) are required to be kept as low as reasonably practicable (ALARP), there is nothing in regulation that defines "low", "reasonably" or practicable, although we are given to understand from industry led consultations that "practicable" emphasises cost effectiveness. Members of the general public could be forgiven for imagining that practicable instead refers to preferring technology that is minimum impact, irrespective of cost considerations. These failures to define key considerations for the purposes of the consultation process can result in public confusion around the scope of what the proponent is prepared to consider for a project under consultation. **Claim**: Disappointingly, but not surprisingly, the management of risks and impacts appears to have a guiding criteria of maximising financial gain for CGG, rather than genuinely managing the risks of harm to marine creatures. Whilst risks may be reduced using management strategies if there was a genuine desire to do so, they cannot be eliminated. The potential harm from seismic blasting therefore poses an unacceptable risk to animals and this proposal must be rejected. Submitter recommends - Ensure that the guiding principles for the development of management plans are animal welfare rather than profit.	comprehensive, up-to-date technical and scientific studies, informed government advice, and extensive consultations. Then, as an additional and separate test, consider additional, alternative, and improved measures to reduce impacts and risks further. Therefore, the ALARP test is a test that is already driving impacts and risks below what has already been demonstrated to be of an acceptable level. This process is clearly described in the CGG assessment process and decision-making criteria document. In our operations, CGG carefully predicts potential environmental impacts and compares these predictions against predefined acceptable levels. This rigorous assessment process is scrutinized by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to ensure that our Environmental Plan (EP) demonstrates that the environmental impacts and risks are reduced to a level that is As Low As Reasonably Practicable (ALARP) and that they meet the standards outlined in the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023. Appendix F2 of the EP, which is dedicated to the ALARP Assessment, provides a thorough explanation of the ALARP principle, detailed in Section 4, and elaborates on how decisions regarding what is considered 'grossly disproportionate' are reached, as discussed in Section 4.1. The document emphasizes that cost consideration is multifaceted, involving not just the financial expenditure but also evaluating the broader implications such as time, effort, and the potential disruption to operations. The criteria for deeming a cost 'exorbitant' involve a comprehensive evaluation of these factors against the scale of environmental benefit achieved. Furthermore, NOPSEMA's guidelines, as detailed in the 'Environment Plan Decision Making Guideline' available on their website, outline that reducing impacts and risks to ALARP involves a balance of impact or risk reduction against the sacrifices necessary to achieve these reductions. The 'cost' in this context is broadly defined to include all sacrifices related to implementing a measure, such as financial costs, time, and effort. It is incumbent upon the titleholder to implement additional control measures or enhance the effectiveness of existing measures unless the cost is grossly disproportionate to the environmental benefits derived. The EP must demonstrate, through reasoned and supported arguments, that no other practical measures could reasonably be taken to further reduce impacts and risks. This framework ensures that environmental management is both effective and feasible, balancing ecological integrity with practical operational considerations. CGG is committed to continuous improvement and transparency in this process, striving to achieve the highest standards of environmental stewardship. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***Reference:*** *Environment plan decision making guideline.pdf (nopsema.gov.au)*
I10	**Matter**: Disclosure of project costs to weigh ALARP **Claim**: Appendix F2 uses the concept of a baseline where a 1.0x "sacrifice factor" represents implementing mitigation measures that meet, but do not exceed, compliance with relevant legislation. Additional measures are then accepted or rejected on the basis of additional imposition of sacrifice over this baseline measure. Given we do not know the absolute costs of proposed control measures and only understand the costs in terms of a baseline comparison to (ostensibly) legislative compliance, the public, nor the regulator, can be certain that such cost/sacrifice measures are of appropriate size to the environmental benefit. Submitter requests that project costs are not kept commercial-in-confidence and are instead made transparent to the public and the regulator so that objective assessment of "Gross disproportion" can be made.	CGG acknowledges claims regarding the disclosure of project costs and has reviewed the Environment Plan (EP) in response to these claims. In response to concerns regarding the necessity for NOPSEMA to know the absolute costs of proposed control measures to make informed decisions on Environmental Plans, it's important to clarify the regulatory focus and assessment methodology. It is critical to understand that the disclosure of total project costs, while transparent, would not substantially influence the assessment of whether environmental risks and impacts have been reduced to ALARP. In the context of the ALARP principle, the 'cost' considered is specifically about the feasibility and proportionality of implementing each specific mitigation measure relative to the environmental benefit it provides. In accordance with regulatory requirements and best practice, CGG is obligated to adopt any mitigation measure that provides a significant environmental benefit, irrespective of its impact on overall project costs. This is why the approach of establishing a baseline cost factor for environmental protection was used and not the total project cost. The decision to implement a control measure is based on its ability to effectively reduce impacts and risks and its practicability, which includes considerations of cost, time, and effort. However, if a mitigation measure is deemed necessary to significantly reduce environmental impacts, it must be adopted even if it renders the project less economically favourable. This principle ensures that essential environmental protections are not bypassed merely due to their cost implications. NOPSEMA's guidelines are clear: the focus is on whether any additional reasonable and practicable measures could further reduce risks. This does not imply maintaining economic efficiency at the expense of environmental protection. Thus, while total project costs provide a broader financial context, they do not have a direct bearing on the evaluation of whether specific mitigation measures should be implemented under the ALARP criteria. Furthermore, in addressing concerns about need for absolute cost information in evaluating Environmental Plans, it's essential to highlight the regulatory focus and assessment methodology. NOPSEMA primarily conducts a comparative analysis, assessing whether proposed

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		mitigation measures are proportional to impacts/risks reductions achievable in the context of legislative requirements (which have a mandatory cost) and the additional measures proposed by CGG. In addition, this approach ensures decisions are economically viable and effective without requiring detailed financial disclosure. If CGG were to disclose the full financial cost of the project we risk influencing NOPSEMA with irrelevant information that might undermine the administrative quality of their decision making. CGG has undertaken to consider and evaluate all reasonable control measures that are relevant to the evaluation of impacts and risks using a systematic approach throughout the impact and risk assessments. There is an incorrect assumption that this principle relates to the public having the ability to assess whether the principles of ESD have been adequately prioritised. The public are not the appointed assessor, nor decision maker for EP's and the document has not been prepared for this purpose. CGG has considered these claims and is satisfied that the demonstration of ALARP is appropriate, as outlined above. As a result, the EP has not been updated in response to these claims.
I11	**Matter**: An independent assessment of ALARP should be undertaken. **Claim**: The assessments of what constitutes ALARP, and the binary decision making process of 'acceptable/unacceptable' appear to be measured on what the proponent considers to be an acceptable level of probability of a threat (such as a hydrocarbon spill) taking place, measured against what they consider an acceptable amount of money spent to avoid that threat, rather than what should be the standard measurement of what the harm would be to the environment, EPBC listed species, Key Ecological Feature (e.g. Marine Parks), social, cultural and associated industries (e.g. fisheries and tourism) should the threat occur. From that baseline, an independent assessment should be undertaken of the decision of what is 'acceptable' or 'unacceptable' and if ALARP has been met.	CGG acknowledges claims regarding the assessment of ALARP and has reviewed the Environment Plan (EP) in response to these claims. CGG's assessment of ALARP is scrutinised by NOPSEMA who determine if the EP demonstrates that the environmental impacts and risks of the activity will also be of an acceptable level and that the EP meets the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA's regulatory processes have long been regarded as world-class. CGG is required to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999, among other considerations and requirements. While public consultation is a crucial component of the environmental planning process, the final determination of whether an EP has satisfactorily demonstrated that environmental impacts and risks have been reduced to ALARP rests with NOPSEMA. This approach is grounded in the necessity for a highly technical and scientifically rigorous evaluation that leverages expert knowledge in environmental science, engineering, risk assessment, and compliance with stringent regulatory standards. The complexities of such assessments require a level of technical expertise that goes beyond the scope of public knowledge. NOPSEMA's assessors are professionals with extensive experience in offshore petroleum operations, environmental protection, and risk management. Their role ensures that all decisions are made based on sound scientific principles, detailed analysis, and adherence to established laws and regulations designed to protect the environment. By incorporating public feedback, NOPSEMA considers community concerns and values in its decision-making process, but it maintains the necessary objectivity and technical scrutiny required to ensure that all activities meet the high standards of safety and environmental care expected in the industry. This structured process ensures a balanced and informed approach, integrating public input with expert assessment to achieve the best possible outcomes for environmental management and public safety. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I12	**Matter**: Claims of unacceptable impacts **Claim**: CGG will not deny that their actions will have a negative effect on the marine life to some degree, but they will see it as being acceptable as long as the different species as a whole will recover eventually, even if millions of individual marine animals are killed, stressed or hurt in the process. This is not okay to me. **Claim**: Seismic blasting causes extremely significant damage to the marine environment. **Claim**: The proposal to conduct seismic blasting for oil and gas is aborrant and is set to destroy the ocean ecosystems in the area.	CGG acknowledges claims regarding unacceptable impacts associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that predicted impacts were adequately described and assessed. In accordance with the applicable regulatory requirements, CGG has prepared an evidence-based case that the impacts and risks arising from the Regia MSS can be managed to below an acceptable level. A similar evidentiary burden would be required to influence CGG's position away from the effects of this activity being anything other than short-term, localised, and recoverable, as detailed in EP Appendix E (Environmental Impact Assessments). Some claims relate to a believe that no impact is acceptable from these activities. This is not the legal standard in Australia and it not a reasonable standard to apply. Petroleum activities do not operate to a no-impact standard. Instead, titleholders are required to define the acceptable level of impact and work below that level. Acceptable levels of impact are established based on relevant up-to-date technical and scientific studies, government advice, and are considerate of the information gathered through the consultation process. CGG predicts the levels of impact expected to occur and compares that to the previously defined acceptable levels. This assessment is then scrutinised by NOPSEMA who will determine if the EP demonstrates that the environmental impacts and risks of the activity will be of an acceptable level and that the EP meets the requirements of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023.

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		CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
Key Matter: Insufficient /inadequate/ inappropriate information		
I13	**Matter**: Insufficient information (general) **Claim**: The current information provided on ecological, cultural, and economic impacts of the proposed activity is insufficient, and NOPSEMA should enforce that the proponent supply clear, comprehensive and comprehensible information on these environmental areas of relevance to allow fully informed public comment on the EP. Furthermore, the proposed survey poses an unnecessary and unacceptable risk to these sensitive features with very little benefit. **Claim**: There is a common theme that this submission has identified regarding the identification and evaluation of environmental impacts and risks as discussed in the EP, which is that in many areas there is simply not enough information available. This lack of information has the flow on effect that risk management and mitigation plans cannot be adequately designed, as they are being developed using incomplete information. Therefore as further information is gathered, these strategies may need to be comprehensively overhauled **Claim**: Approving this proposal and allowing seismic testing to commence based on insufficient and inadequate information and directly flouting evidence of known negative and even unlawful impacts on wildlife, is not only irresponsible, but potentially criminal. **Claim:** Producing evidence of whole of marine ecosystem impacts is hard. Nearly every single peer reviewed study mentions the lack of research into broad based consequences of seismic blasting on marine environments. Each study mentions that they are just looking at the one species or genus and that none of these species exist in isolation from the ecosystem of their habitats and beyond. Environment Plans such as the behemoth produced by Klarite on behalf of CGG Regia can only rely on selectively gathered information, isolated data and information opacity to paint an incomplete picture of the impacts of this industry.	CGG acknowledges claims regarding the provision of information associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that adequate information was provided. The environmental impact and risk assessment methodology described in EP Appendix B9 is a systematic, evidence-based approach to evaluate and interpret the impacts and risks associated with the Regia MSS activity. The methodology is consistent with international standards and NOPSEMAs guidelines, as described in Sections 1.2 (Overview). Extensive information on the identification of values and sensitivities that may be affected by relevant aspects of the Regia MSS is provided within each impact and risk assessment, in Appendices to the EP. For example, marine mammals that may be present within the area affected by underwater sound are extensively described in EP Appendix E7, Section 4 and the predicted levels of impact to these species is detailed in Section 6; fish species that may be present within the area affected by underwater sound are extensively described in EP Appendix E3, Section 4, etc. CGG commissioned independent studies on the effects of seismic sound on the environment prior to completing the analyses found in Appendices E2 to E8 in recognition that these assessments are historically one of the higher order impacts for seismic survey environment plans. The first study used to inform the analysis were a quantitative modelling report to establish the most appropriate sound exposure thresholds and effect level distances. This study focused on a highly prospective area that was critical to meeting the geological objectives of the study. The second study was a literature review of relevant peer reviewed papers in relation to the effects of sound on various environmental components. Both studies were extensively referenced using peer reviewed published literature and were published as soon as CGG received them to support the provision of sufficient information to relevant persons. The impact analyses of underwater sound found that there were no major or catastrophic levels of effect identified to any environmental component. The effects to different species ranged from no effect, through to some effect levels that were ranked as moderate, meaning additional management and mitigation measures are required to ensure impacts are of an acceptable level. The analyses also considered the uncertainty in the predictions of impact and found that after the application of quantitative modelling from an independent expert there was generally low levels of uncertainty in the predictions of impact. However, in some cases the level of uncertainty was rated as medium, meaning there were still gaps or uncertainties that need to be addressed. Further assessment was conducted for key environmental values and sensitivities which allowed for the ongoing assessment of these higher order impacts and provided increase in confidence in the assessment process. CGG considered that cumulative impacts were properly considered because the overview of the existing environment step in each analysis was carried out considering the existing and future pressures on the environment. However, CGG also recognised that there was insufficient transparency given the scale of proposed future activities in the Otway region. This lead CGG to work with other titleholders known to be proposing petroleum activities in the region to prepare the Cumulative Impact Assessment (Appendix E10). CGG has considered these claims and is satisfied that the information provided in the EP is sufficient, comprehensive, and comprehensible for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
I14	**Matter**: Insufficient information/ mapping on areas of conservation value **Claim**: The EP by CGG must be refused based on the failure to provide adequate information in the form of a map outlining the Ramsar areas, National Parks, Indigenous Protected Areas, Wilderness Zone, and World Heritage Areas relevant to the Environment Planning Area. The entire footprint of the Environment Planning Area contains Biologically Important Areas for EPBC-listed species and this must be provided for public consultation and comment. **Claim**: The Environmental Plan has failed to adequately map and consider the impacts of seismic surveying on important environmental areas. **Claim:** REGIA has failed to identify and describe key environmental features in the Environmental Plan, there is a clear lack of detail provided and therefore lack of understanding of the environment of the Operational Area and surrounding zone.	CGG acknowledges claims regarding information and mapping for areas of conservation value and has reviewed the Environment Plan (EP) to ensure that adequate information and maps were provided. Extensive information on the identification of values and sensitivities that may be affected by relevant aspects of the Regia MSS is provided within each impact and risk assessment, in Appendices to the EP. For example, marine mammals that may be present within the area affected by underwater sound are extensively described in EP Appendix E7, Section 4 and the predicted levels of impact to these species is detailed in Section 6; fish species that may be present within the area affected by underwater sound are extensively described in EP Appendix E3, Section 4, etc. Extensive mapping has been provided in EP Appendix B12 (Regia MSS Maps). In total, 83 figures have been provided in support of the EP showing locations of, and overlap of the operational area and the environment that may be affected (EMBA) with a range of values and sensitivities and aspects including: • MAP-REG-EPM-001, 2, 57, 59-69, and 71-77 – Biologically Important Areas • MAP-REG-EPM-078: Australian Marine Parks

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	Claim: It is imperative that all potentially impacted features are identified and discussed, or the resultant environmental plan is incomplete and thus void. Submitter recommends CGG ensure all environmental features are included in the development of the Environment Plan. **Claim:** The proposed Operational Area overlaps with sensitive ecological zones and lacks comprehensive mapping.	• MAP-REG-EPM-047 and 79: State Protected Areas • MAP-REG-EPM-003, 4 and 81: Key Ecological Features • MAP-REG-EPM-030, 32-39, 50, 54, 55: Fisheries data Additional figures are provided through-out the EP Appendices. CGG is not required to provide a description of the environment for parts of the environment which are not affected. CGG has considered these claims and is satisfied that the provision of information and mapping for areas of conservation value has been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
I15	**Matter**: Inappropriate information **Claim:** Regia's application represents a wilful misapplication of the relevant science with citations of unpublished material and references to entirely incorrect literature. **Claim**: Were we to exclude the industry funded material to which they have referred, the argument to support their application becomes extremely difficult to sustain. Further, we cannot find any published, scientific literature that supports their position. **Claim:** The work relied on in the Regia proposal has lost credibility as it was funded by Australian Petroleum Production and Exploration Association (APPEA) and the majority of sources involved are employees of that organisation. It is not a truly unbiased scientific report. **Claim:** It is obvious that Regia and the gas industry deliberately ignore the papers quoting genuine scientific evidence against seismic surveys and the need for change that were expressed in our previous responses. **Claim**: The Environmental Plan submitted by Regia MSS ignores reputable and published scientific studies, from around the world and in Australia, that have been done in recent years. Those studies show widespread harm from seismic testing. The studies cited by Regia are not based on real-life scientific studies but are based on modelling which Regia themselves say is not a reliable way to source data. **Claim**: The Environment Plan submitted by CGG is an inadequate, deficient, inaccurate evaluation of the mounting scientific evidence about the destruction caused by seismic surveys. **Claim**: The Environment Plan is deeply flawed from a scientific perspective failing to acknowledge the science around the impacts seismic blasting has on whales and other marine life. **Claim**: It is important that rigorous scientific research isn't misrepresented by seismic survey companies and gas drilling companies to further their means. One can't assume that they will choose the morally correct path, if left unchecked.	CGG acknowledges claims regarding the interpretation and use of information/ scientific research in the preparation of the Environment Plan (EP) and has reviewed the EP to ensure that relevant information sources were appropriately identified and referenced. The information presented in the EP and pertaining to the existing environment has been amassed via published and unpublished sources (studies, data, and reports) to produce a comprehensive baseline understanding of the environmental sensitivities in the region. In all instances, the source of the information presented throughout the EP is fully referenced to ensure transparency of the information that has been relied upon. Any uncertainty, bias, or unreliability that has been identified has been duly identified and discussed. EP Appendix B8 (Seismic Studies Report) provided a comprehensive evaluation of the available literature that was used to inform the acoustic impact assessments and included over 16 pages of references specific to the impacts of seismic surveys on relevant marine fauna and other marine users. CGG acknowledges that, as with all activities, there are data gaps and a level of uncertainty within the science relating to the potential effects of seismic surveys on the marine environment and marine species. However, based on scientific literature that has been carried out on the impacts of seismic surveys, including the most up to date published literature, CGG does not believe that the data gaps and level of uncertainty around potential effects of marine seismic surveys is such that reasonable conclusions and decisions regarding such impacts and the level of risk involved cannot be made. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I16	**Matter**: Geographic range and all species need to be defined and considered **Claim**: The area that is considered under this proposed seismic testing plan contains a diverse range of species, all of which need to be considered when risks and impacts are being assessed. Considering that even the geographical range that needs to be considered is still not adequately defined, it becomes even more difficult to compile an exhaustive list of potentially affected species. **Claim**: Submitter recommends: 1. Evaluate the quality of data on risks and impacts on all species within the OA and determine where there is a need for additional data. 2. Ensure studies on risks are of research grade quality and have been subjected to peer review.	CGG acknowledges claims regarding the extent of the relevant geographical range and the evaluation of impacts and risks on relevant species within that area and has reviewed the Environment Plan (EP) to ensure that these were adequately addressed. CGG acknowledges that we will never be in a position to characterise every species that may be present in the area, but rather we rely on published peer-reviewed literature, government advice (including relevant management plans, conservation management plans, recovery plans and conservation advice established under the Environment Protection and Biodiversity Conservation Act 1999, among others), and feedback from the consultation process to inform our understanding of the existing environment and potential impacts and risks. Information on the environmental values and sensitivities that may present within relevant areas is publicly available and can be accessed via the Commonwealth government's Protected Matter Search Tool (PMST). PMST's provide information on the likely/known presence of a species within an area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours and are provided in full in EP Appendix B5. Additional information, for example, on proposed changes or additions to BIAs, can be obtained through the review of draft plans and through federal government consultation processes and are referenced within the EP. The peer review process for publication is

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	3. Establish an independent panel to review the quality of studies to date and to create a comprehensive list of where the gaps in knowledge exist.	considered to provide for an appropriate level of independent review. Titleholders are also required to take newly published peer reviewed literature into consideration, where relevant, for the duration of the activity. Regarding claims about the geographical range that needs to be considered, the geographical range of impacts and risks is described in EP Appendix A2 (Description of Activity), which includes a description of the Environmental Planning Area used to frame initial studies and community consultation effort. Figure B4-1 shows the Activity Planning Area which was established to frame the maximum geographical limits of the activity. Further, aspect specific geographic extents are defined in each of the impact and risk assessments (Appendices D and E), typically based on quantitative assessment outcomes. CGG commissioned an environmental services company with relevant expertise to prepare EP Appendix B8 (Seismic Studies Report) which provides a comprehensive evaluation of available published, peer reviewed literature that was used to inform the acoustic impact assessments. This report includes over 16 pages of references specific to the impacts of seismic surveys on relevant marine fauna and other marine users. CGG acknowledges that, as with all activities, there are data gaps and a level of uncertainty within the science relating to the potential effects of seismic surveys on the marine environment and marine species. However, based on scientific literature available on the impacts of seismic surveys, including the most up to date published literature, CGG does not believe that the data gaps and level of uncertainty around potential effects of marine seismic surveys is such that reasonable conclusions and decisions regarding such impacts and the level of risk involved cannot be made. **CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.**
I17	**Matter**: Lack of detail on EPBC-listed species and enforceable measures **Claim**: The Environment Plan (EP) submitted to NOPSEMA by CGG is a convoluted and incomprehensible 3,332 page document that is nonetheless lacking in sufficient detail on the impacts of seismic blasting on noted species in the area. In particular, there is a lack of detail on the presence of several EPBC-listed species, including Endangered southern right whales and Endangered Australian sea lion, and what enforceable measures will be taken to ensure that the key ecological features and threatened species in the proposed project areas will not be harmed. **Claim**: The Environment Plan submitted by CGG lacks sufficient detail on the potential impacts of seismic blasting on marine life and ecosystems. Despite its convoluted and incomprehensible 3,332-page length, the plan fails to provide adequate information on the presence of endangered area and the enforceable measures that will be taken to protect them. **Claim**: It fails to clearly state what enforceable measures will be taken to ensure that the threatened species in the proposed project areas and the key ecological features of the area will not be harmed. **Claim**: At present Australia leads the world in species extinction and yet here is another submission with little regard for endangered animals such as the Southern Right Whale ,the pygmy blue whales the Australian Sea Lion. There is not sufficient detail here to ensure that proper research and safe guard mechanisms will be enacted. **Claim**: It fails to demonstrate management practices that would guarantee the health and wellbeing of whales and other marine life.	CGG acknowledges claims regarding the level of detail provided on EPBC-listed species and mitigation and management measures to protect these, and has reviewed the Environment Plan (EP) to ensure that these were adequately addressed and detailed. EPBC-listed species were identified using the Commonwealth government's Protected Matter Search Tool (PMST), as documented in EP Appendix B5 (PMST Reports). Detail on listed species that were identified as sensitive to aspects of the Regia MSS, for example species sensitive to underwater sound, are included in the relevant impact and risk assessments in EP Appendices D and E. The level of detail provided for species that were identified as sensitive to aspects of the proposed Regia MSS is dependent on the level of sensitivity and the legislative requirements specific to the aspect identified. Significant detail is provided on southern right whales and the Australian sea lion in EP Appendix E7 (Impact Assessment – Underwater Sound), including a description of their presence within the region, relevant sound effect criteria, the predicted level of impact based on acoustic modelling and comparison to the defined acceptable levels, the identification of mitigation and management measures and demonstration of ALARP. EP Appendix F2 also identified that, while there is literature about the effects of seismic on marine mammals there has been a high level of concern throughout the consultations with relevant persons, particularly regarding the effects of seismic sound on Southern Right Whale and Pygmy Blue Whale as the Operational Area are area affect by sound overlap BIAs associated with both species. Consequently, CGG undertook additional assessment looking at the effects of the activity and the level of uncertainty on these species in EP Appendix F3 (Acceptable Levels Assessment). **CGG has updated EP Appendix F3 (Acceptable Levels Assessment) to include an assessment for the Australian sea lion in response to these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.**
I18	**Matter**: Lack of specific information on impacts of seismic on marine species **Claim**: The submitted Environment Plan (EP) , a 3,332 page document has arguably been created to obfuscate and confuse those who oppose this seismic exploration and gas and oil extraction. While overly long, it lacks specific and sufficient detail of the known impacts of seismic blasting on marine species in the marked areas for testing.	CGG acknowledges claims regarding the detailed information/ scientific research on impacts of seismic on marine species and has reviewed the Environment Plan (EP) to ensure that predicted impacts were adequately described and assessed. EP Appendix B8 (Seismic Studies Report) provided a comprehensive evaluation of the available literature that was used to inform the acoustic impact assessments and included over 16 pages of references specific to the impacts of seismic surveys on relevant marine fauna and other marine users. CGG acknowledges that, as with all activities, there are data gaps and a level of uncertainty within the science relating to the potential effects of seismic surveys on the marine environment and marine species. These uncertainties have been considered in each impact assessment E1-E9. As stated in those documents, based on scientific literature available on the impacts of seismic surveys, including the

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	Claim: The Environment Plan (EP) submitted to NOPSEMA by CGG contains 3,332 pages, but it lacks of sufficient details about the impact of seismic blasting on the sea life. **Claim**: The EP lacks detail on the impacts of seismic blasting on endangered species and fails to provide adequate mitigation measures. **Claim:** There is no evidence to support claims that seismic blasting can be conducted in a way that has minimal impact on marine life. **Claim**: Not enough independent scientific research has been done in relation to how seismic blasting affects marine species and ecosystems as a whole to inform us as to whether it is a sensible idea. **Claim:** More independent scientific study needs to be done on the effect of seismic blasting on marine species and ecosystems before allowing it to be conducted in our oceans. **Claim**: There have been insufficient studies performed on the potential impacts of seismic testing on marine and other animals to be confident that any proposed mitigations to keep them safe from harm will be sufficient. **Claim:** No more seismic blasting should be done until there is an understanding of the broader impacts of seismic testing on marine ecosystems. **Claim:** NOPSEMA should reject the use of seismic blasting as proposed by CGG as it will harm marine life and ecosystems. There is not enough independent scientific research done to prove otherwise. **Claim:** Until extensive scientific research is done to prove to that the effects of seismic serveys does not have a huge, detrimental effect on the marine environment.	most up to date published literature, CGG does not believe that the data gaps and level of uncertainty around potential effects of marine seismic surveys is such that reasonable conclusions and decisions regarding such impacts and the level of risk involved cannot be made. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I19	**Matter**: Additional studies needed **Claim**: Submitter recommends: 1. Conduct comparative research into all studies on the impacts of seismic blasting to determine the range to which impacts have been observed. Noting the limitations of many of these studies, apply the precautionary principle to determine a correction factor which will create a safety buffer zone around that distance. **2.** Conduct thorough observational studies at varied times of day and across all seasons to determine all species found in this impact area. A minimum of a full 12 months of data is especially important to ensure data on migratory species is captured. **3.** Compare data against reputable citizen science sites such as E-bird and I-naturalist. Ensure all listed species are included.	CGG acknowledges claims regarding additional studies and has reviewed the Environment Plan (EP) to ensure that predicted impacts were adequately described and assessed. CGG commissioned an environmental services company with relevant expertise to prepare EP Appendix B8 (Seismic Studies Report) which provides a comprehensive evaluation of available published, peer reviewed literature that was used to inform the acoustic impact assessments. This report includes over 16 pages of references specific to the impacts of seismic surveys on relevant marine fauna and other marine users. CGG acknowledges that, as with all activities, there are data gaps and a level of uncertainty within the science relating to the potential effects of seismic surveys on the marine environment and marine species. However, based on scientific literature available on the impacts of seismic surveys, including the most up to date published literature, CGG does not believe that the data gaps and level of uncertainty around potential effects of marine seismic surveys is such that reasonable conclusions and decisions regarding such impacts and the level of risk involved cannot be made. Regarding claims recommending observational studies and citizen science, information on the environmental values and sensitivities that may present within relevant areas is publicly available and can be accessed via the Commonwealth government's Protected Matter Search Tool (PMST) and Species Profile and Threats (SPRAT) database, as well as the Atlas of Living Australia (ALA) and South-East Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP 2013). PMST's provide information on the likely/known presence of a species within an area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours and are provided in full in EP Appendix B5. Additional information, for example, on proposed changes or additions to BIAs, can be obtained through the review of draft plans and through federal government consultation processes and are referenced within the EP. The peer review process for publication is considered to provide for an appropriate level of independent review. Titleholders are also required to take newly published peer reviewed literature into consideration, where relevant, for the duration of the activity. Note: The Atlas of Living Australia (ALA) is a collaborative, digital, open infrastructure that pulls together Australian biodiversity data from multiple sources, including citizen science data. For example, the ALA manages the Australian node of iNaturalist and harvests observations made in Australia on a weekly basis. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

	THEME	**IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)**
#	***Comments received***	***Titleholder response***
Key Matter: Cumulative impact assessment		
I20	**Matter**: Failure to address cumulative impacts of this proposal **Claim**: Submitter does not consider that the EP has adequately or comprehensively considered the cumulative impacts of this proposal, nor demonstrated that efforts to meet ALARP have been undertaken. Submitted does not consider the cumulative impacts of this repeated seismic blasting exploration on the marine environment and marine life to be Acceptable, and urges NOPSEMA to reject this EP. **Claim**: The EP as put has not considered whole of marine impacts, although these will certainly exist. **Claim**: Multiple projects have been, and are, submitted by proponents to be assessed by NOPSEMA in isolation. The figures provided above demonstrate that the impact of each project should not be considered in isolation from others but viewed as a single, ongoing process. When viewed in this manner, the scale of potential impact and ecosystem damage is much more evident. **Claim**: The EP fails to address the cumulative impact of seismic blasting and marine noise on marine life. **Claim**: There is no whole-of-ecosystem assessment of the full range of impacts of seismic blasting. **Claim**: Considering the failures of the EP to consider the full scope of the impacts presented by this project under proposal we urge the Authority to request that the EP be resubmitted and then to reject the EP and refuse a title to the proponent if the titleholder is unable to satisfy the reporting requirements within their EP. **Claim**: We believe that the company underestimates the level of anthropogenic noises during the proposed timeframe for their seismic testing. The decibels ranges will vary but will likely run between 180 dB and up. Therefore the impact of each EP should not be considered in isolation. When all EP plans are viewed as a whole the potential damage to our marine environments becomes even more evident and alarming. **Claim:** Please consider carefully the longterm damage you might wreck with this decision. Besides the arguments below there is much unknown about the effects of seismic blasting on delicate ecosystems that have an intimate interaction with all else.	CGG acknowledges claims regarding cumulative impacts and has reviewed the Environment Plan (EP) to ensure these were appropriately identified and assessed. Consideration of cumulative effects of multiple historic seismic surveys is provided in EP Appendix F3 (Acceptable Levels of Impact and Risk). For example, Section 5.2.1.1 states that the draft National Recovery Plan for SRW (DCCEEW 2023) details there is an increase in long-term population trend for southern right whales, albeit slowly for the eastern population, and that this has been achieved whilst co-existing with marine seismic surveys as there have been >80 marine seismic surveys in the last 60 years in the Otway region. This includes at least 10, 3D surveys in the last 20 years. Consideration of cumulative effects of the Regia MSS in conjunction with reasonably foreseeable future activities/ projects is provided in EP Appendix E10 (Otway Cumulative Impact Assessment). The cumulative impact assessment concluded that the potential for cumulative impacts is considered low in full consideration of historic seismic surveys, the Regia MSS and reasonably foreseeable future activities/ projects. Further, a 'whole of ecosystem' assessment was conducted in EP Appendix F3 (Acceptable Levels of Impact and Risk), Section 5.4 Search for unacceptable environmental impacts), which identified the importance of evaluating impacts from the survey more holistically to understand if there are unacceptable impacts. This search concluded that no measurable changes to ecological integrity or population structures are likely because of the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I21	**Matter**: Assessment to recognise tipping points/ existing pressures **Claim**: Direct impacts of Regia MSS are stated many times to be relatively small when compared to other environmental pressures by way of minimising the importance of their cumulative impact to the reader. For example: "…any potential impact will be subsumed into the far larger natural and fishing mortality schedules that already exist." [CGG, p.3143]. This is a false logic since it implies that Regia MSS will not significantly alter the burden of cumulative impact to the environment in relation to other impacts. Assessment of cumulative impact should recognise that any additional impact has the chance to push aspects of an already vulnerable marine environment past tipping points. **Claim**: I am also horrified that in this changing climate that all our sea life, and creatures as precious & as endangered as whales, will be put under such extra and unnecessary stress.	CGG acknowledges claims regarding existing pressures and threats to species and ecosystems and has reviewed the Environment Plan (EP) to ensure that these were adequately considered. Appendix F3 (Acceptable Levels of Impact and Risk) included several species-specific sensitivity analyses to evaluate the potential for the Regia MSS, in conjunction with existing pressurise and threats, to result in cumulative impacts on those species, for example: - Section 5.2.1.3 (Cumulative impacts) assesses the cumulative impacts of the Regia MSS with the other highest rated threats identified within the updated draft National Recovery Plan for the southern right whale (DCCEEW 2023), which includes anthropogenic climate change and climate variability. - Section 5.2.3.3 (Cumulative impacts) assesses the cumulative impacts of the Regia MSS on southern rock lobster considering the long-range forecast for sea surface temperatures. - Section 5.2.4.1 (Species-specific sensitivity) assesses the cumulative impacts of the Regia MSS on giant crab considering the southerly shift of the austral subtropical high-pressure belt, with models predicting more upwelling-favourable winds which has the potential to increase productivity at the population level. Appendix F3, Section 5.4 (Search for unacceptable impacts) provides for additional consideration of potential ecosystem vulnerabilities to ensure that ecosystem integrity, meaning the ability of all species within an ecosystem to survive and reproduce such that the overall health of their ecosystem, is maintained and that potential unacceptable impacts are identified. This included an evaluation of potential ecosystem weaknesses including vulnerability to climate change, genetic diversity, dependence on keystone species, regenerative capacity, other

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		threatening practices, life-cycle event timings and sensitivities, and abundance and range restrictions. This assessment concluded that no measurable changes to ecological integrity or population structures are likely because of the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I22	**Matter**: Cumulative impacts of successive seismic surveys **Claim**: The submitter does not consider the cumulative impacts of this repeated seismic blasting exploration on the marine environment and marine life to be Acceptable, and urges NOPSEMA to rejerveysect this EP. **Claim:** There is clear and growing evidence that seismic blasting permanently and cumulatively harms a very broad range of marine life. **Claim**: The EPBC act requires proponents to consider cumulative impacts over time of activities such as Regia MSS. Following "60 years" [CGG, Appendix F3, p3134] of seismic acquisition in the Otway Basin. The cumulative impacts of successive seismic surveys have not been presented in this EP. The EP asserts that the impact of Regia on the recovery of multiple species will not have multi-year effects, and so direct impacts are localised, temporary and recoverable. [p3136 Appendix F3]. This is a mechanism to negate the effect of previous surveys and limit the need to consider the cumulative impacts of successive seismic surveys to a marine ecosystem. Additionally, CGG necessarily cannot consider future seismic impacts, thus negating the argument that a single season seismic survey is "recoverable". It cannot be known if another seismic project will be approved in the following season.	CGG acknowledges claims regarding cumulative impacts of successive seismic surveys and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. Consideration of cumulative effects of multiple historic seismic surveys is provided in EP Appendix F3 (Acceptable Levels of Impact and Risk). For example, Section 5.2.1.1 states that the draft National Recovery Plan for SRW (DCCEEW 2023) details there is an increase in long-term population trend for southern right whales, albeit slowly for the eastern population, and that this has been achieved whilst co-existing with marine seismic surveys as there have been >80 marine seismic surveys in the last 60 years in the Otway region. This includes at least 10, 3D surveys in the last 20 years. Consideration of cumulative effects of the Regia MSS in conjunction with reasonably foreseeable future activities/ projects is provided in EP Appendix E10 (Otway Cumulative Impact Assessment). The cumulative impact assessment concluded that the potential for cumulative impacts is considered low in full consideration of historic seismic surveys, the Regia MSS and reasonably foreseeable future activities/ projects. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I23	**Matter**: Precautionary principle for cumulative impacts **Claim**: Given the relationship between impacts directly caused by Regia MSS and the tight relationship between existing impacts used to minimise the effect of Regia MSS, the Precautionary Principle should apply until the cumulative impacts of seismic are assessed in conjunction with other significant stressors of marine ecosystems intersecting the operating area. **Claim**: According the Precautionary Principle we must exercise caution and allow for the worst case scenario that successive years of seismic will have a deleterious effect on multiple species recovery.	CGG acknowledge claims regarding the application of the precautionary principle for cumulative impacts and has reviewed the Environment Plan (EP) to ensure the cumulative impact assessment was adequately described. The application of the precautionary principle, particularly in environmental management, is triggered under conditions where there are threats of serious or irreversible environmental damage and where scientific certainty about these impacts is lacking. This principle does not require the cessation of all activities that could potentially cause harm; rather, it mandates the implementation of proactive measures to prevent or minimise potential damage. In the case of the Regia MSS, CGG's approach adheres to this principle by engaging in extensive research, applying adaptive management strategies, and incorporating real-time environmental monitoring to mitigate impacts and risks. These measures ensure that impacts are managed and that operations can be adjusted in consideration of new scientific data, thereby upholding the responsibility to protect the marine environment against significant threats while acknowledging the inherent uncertainties that come with predicting environmental impacts. Appendices E1-E9 (Impact Assessments) have considered each cause-effect pathway, and the uncertainties present in the assessment. EP Appendix B9 (Environmental Assessment Method) detail the robust methodology applied to understand if there was a threat of serious or irreversible environmental damage. There was no occasion that both preconditions for activities to cease existed. Further, the precautionary principles have also been routinely applied throughout the assessment. This is described in detail in Appendix F4 (ESD Assessment) which clearly outlines comprehensive measures taken to adhere to the precautionary principle, namely that: • The Regia MSS project has implemented proactive measures to mitigate environmental harm despite uncertainties, including robust monitoring and evaluation strategies, and flexible mitigation approaches. • Significant scientific consultation and adaptive management has been integrated into the planning and execution of the Regia MSS. This ensures that potential environmental impacts are continuously assessed and addressed, keeping within defined acceptable levels of environmental impact and risk. EP Appendix E10 (Cumulative Impact Assessment) explicitly addresses the management of cumulative impacts, detailing how other activities in the area are factored into the overall assessment of potential impacts from the Regia MSS. Concerns regarding the potential long-term deleterious effects of successive years of seismic activity on multiple species recovery, suggesting a need for caution per the precautionary principle have been addressed in the aforementioned documents. For example, EP Appendix F3 (Acceptable Levels of Impact and Risk) describes that, although there have been multiple seismic surveys conducted across the greater region for over 20 years, there is no stock-recruitment relationship for Southern Rock Lobsters that can be linked to a seismic survey

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		and that the scale of impact associated with seismic is overwhelmed by the scale of climate events, spatial distribution of habitat and fishing; and that, although there have been >80 marine seismic surveys conducted in the Otway Region the last 60 years, the draft National Recovery Plan for Southern Right Whales (SRW) (DCCEEW 2023) details there has been an increase in the long-term population trend for this species, albeit slowly for the eastern population. These actions are grounded in a scientifically informed approach and adhere strictly to the principles of Ecologically Sustainable Development (ESD), especially the precautionary principle, to ensure that potential impacts are managed responsibly and with consideration of the worst-case scenarios over the long term. The application of these principles demonstrates a commitment to sustainable and responsible environmental management, aligned with regulatory and community expectations. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I24	**Matter**: Surveying previously surveyed areas is unnecessary **Claim**: Furthermore, the proposed survey poses an unnecessary and unacceptable risk to these sensitive features with very little benefit. Submitter understands that about half of the proposed OA overlaps with areas already surveyed by previous 3D seismic blasting projects. In 2023, the data captured by these previous surveys were merged by Geoscience Australia into one publicly available dataset (see the Otway 3D Mega Merge project). In light of this, the proposal by CGG to re-survey these areas represents a failure to consider the need for putting marine life at risk to re-collect seismic data that is already publicly available. In this regard, the submitter does not consider that the EP has adequately or comprehensively considered the cumulative impacts of this proposal, nor demonstrated that efforts to meet ALARP have been undertaken. **Claim**: The OA defined by CGG Regia in their EP has already been mapped and we would argue that there is absolutely no reason to repeat the operation.	CGG acknowledges claims regarding resurveying areas where seismic data has already been acquired and has reviewed the Environment Plan (EP) to ensure that an explanation of the need to resurvey areas was adequately described. As explained in EP Appendix A2 (Description of Activity), the Otway Basin has been producing hydrocarbons since the 1990's and has seen the discovery of several gas fields. Since that time, seismic acquisition and processing technologies have advanced dramatically. The Regia MSS aims to survey areas where 3D geophysical data has not been acquired previously or applying new technologies to overlapping areas of existing 3D data, to improve our understanding of the geophysics of the area. We understand concerns about repeated marine seismic surveys in the one area. The Labella 3D MSS, conducted in 2013, was acquired over a small proportion of the proposed Regia MSS activity action zone. Overlap with the Labella survey is required to ensure the data from the two surveys can be connected, i.e. tied in. In addition, some 2D seismic data was also acquired over part of the survey area, however, the bulk of this data was acquired between 1960s and the early 2000s. 2D data represents discrete widely spaced lines of seismic data that is not able to be used for detailed assessment of the subsurface and eventual drilling well placement. 3D seismic data allows a near complete picture of the subsurface which in turn allows appropriate assessment and well placement. **<u>CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above but has undertaken to update EP Appendix B12 (Regia MSS Maps), namely Figures MAP-REG-EPM-052 (2D NOPIMS) and MAP-REG-EPM-053 (3D Surveys) to show the overlap of the operational and activity action zone and previous survey data in response to these claims.</u>**
Key Matter: Principles of ecologically sustainable development (ESD)		
I25	**Matter**: Consistency with the EPBC Act **Claim**: The proposal to conduct seismic surveying for oil and gas dealt with by this Environmental Plan poses an unacceptable risk to marine life and ecosystems. Relevant consideration has not been made in relation to the plans' consistency with the objectives and principles of the Environment Protection and Biodiversity Conservation (EPBC) Act 1999. **Claim:** Enacted on 16 July 2000, the EPBC Act serves as a cornerstone for protecting and conserving Australia\'s unique biodiversity and natural heritage. By allowing seismic blasting activities that pose a clear threat to marine ecosystems and endangered species, proposal directly contravenes the objectives and principles outlined in Under the EPBC Act, activities that likely to have significant impact on matters of national environmental significance, including threatened species and ecological communities, require rigorous assessment and approval processes. However, the inadequacies of the Environment Plan submitted by CGG fail to meet the standards set forth in this legislation.	CGG does not concur with claims that the Environment Plan (EP) is inconsistent with the Environment Protection and Biodiversity Conservation Act 1999. The primary environmental legislation within Australia is the Environmental Protection and Biodiversity Conservation Act 2002 (EPBC Act). NOPSEMA's authorisation processes have a Part 10 approval that applied to offshore petroleum activities as per the NOPSEMA EPBC Act Program. This program ensures that impacts on matters protected under Part 3 of the EPBC Act are not unacceptable. The primary legislation governing the exploration project is the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act) and the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (the Environment Regulations). The OPGGS Act provides the regulatory framework for all offshore exploration and production activities in Commonwealth waters (those areas beyond three nautical miles from the Territorial Sea baseline and with the Commonwealth Petroleum Jurisdiction Boundary). The Environment Regulations have been made under the OPGGS Act for the purposes of ensuring (as described in section 3) that any petroleum activity or greenhouse gas activity carried out in an offshore area is: • Carried out in a manner consistent with the principles of ecologically sustainable development set out in section 3A of the EPBC Act; and • Carried out in a manner by which the environmental impacts and risks of the activity will be reduced to as low as reasonably practicable; and • Carried out in a manner by which the environmental impacts and risks of the activity will be of an acceptable level". Furthermore, CGG believed that the EP meets the criteria for acceptance of and Environment Plan. Consistency with legislative and other requirements forms part of the acceptable levels demonstrated in EP Appendix F3 (Acceptable Levels of Impact and Risk). Under the

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		Commonwealth government streamlining arrangements, NOPSEMA's assessment of this EP provides an appropriate level of consideration of the impacts to matters of national environmental significance (MNES) protected under Part 3 of the EPBC Act. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
I26	**Matter**: Application of the precautionary principle **Claim**: There is no evidence of the precautionary principle in the application from Regia. **Claim**: The precautionary principle should be applied to any reasonable threat of environmental damage, not just a threat of serious or irreversible environmental damage, and should be applied in favour of the environment, not in favour of exploration and commercial interests. **Claim**: I respectfully request that NOPSEMA reject the EP given the unacceptable risk to marine life and on the basis of the Precautionary Principle under the EPBC Act section 391. **Claim**: As the evidence pours in on the effects of seismic blasting on marine life, it is no longer acceptable to say \'we don\'t know\'; at the very least your Authority should, at last, begin applying the PRECAUTIONARY PRINCIPLE and not let the need for further evidence stop you preventing further accumulating and irreversible harms. **Claim**: A lack of scientific certainty should not be used as a reason for allowing this project to proceed, rather there is the need to take precautionary measures to prohibit this project from going ahead. We request that the application of the precautionary principle (under the EPBC Act under section 391) be enforced with regards to approval of this Environmental Plan. **Claim**: There is a need for the precautionary principle to be put into practice now that knowledge of the effects of seismic surveys is widely known in the academic, fishing, and community sectors. **Claim**: There remain information gaps about the environmental impacts of seismic blasting, and the EPBC Act is clear that the precautionary principle applies when there is a lack of scientific knowledge. Despite this CGG compensates fishers for their reduced catch rather than acting to avoid ecosystem harm. **Claim**: This submission advocates applying the precautionary principle when considering projects of such known deleterious consequences for multiple marine species and their ecosystems, as well as unknown impacts.	CGG acknowledges claims regarding the application of the precautionary principle and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. CGG has provided detailed consideration of the precautionary principle and been precautionary in its assessments, applying conservative criteria, rounding up buffer zones, underestimating effectiveness of control measures etc. These are techniques that are good practice in environmental assessments. Evidence of the application of the precautionary principle can be found in EP Appendix F4 (ESD Assessment) and throughout the rest of the EP as referenced in that Appendix. The comments received seem to apply one facet of the precautionary principle to try to stop the activity proceeding. Part of the precautionary principle requires that, 'if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation'. CGG notes the absence of a definition of 'serious' environmental damage in relation to the Principles of ESD under the Environment Protection and Biodiversity Conservation Act 1999 and considers a serious impact to have the potential to result in a threat to population or community viability. The Regia MSS EP routinely assessed and identified where there was a lack of full scientific certainty and where there were serious threats to environmental values and sensitivities at a population level. There were no instances where threats were predicted to be irreversible. In these circumstances the precautionary principles have been applied and justified. In all cases CGG has effectively demonstrated that, with the control measures adopted, the seriousness of the threat has been effectively removed and the values and sensitivities in the marine environment can coexist with the presence of anthropogenic sounds, including those from the Regia MSS. Beyond these regulatory-required instances, CGG has routinely applied precaution in its assessment, for example selecting conservative effect thresholds for sound, adjusting the activity design to avoid overlap with sensitive species protected areas (e.g. KEFs), and buffers around marine protected areas. CGG has considered these claims and is satisfied that as the preconditions for application of the precautionary principle that prevents the activity from proceeding have been satisfactorily removed, as demonstrated in the EP, the concerns raised have been adequately addressed. As a result, no changes have been made to the EP in response to these claims.
I27	**Matter**: Application of the precautionary principle for low-frequency cetaceans **Claim**: According to Appendix E7 - Impact Assessment Underwater Sound: Marine Mammals, "the predicted level of impact based on the effect (moderate) and uncertainty (high) levels is assessed as high. For Low-freqquency (LF) cetaceans - those listed above - the predicted level of impact is close or like the pre-defined acceptable levels and/or there is enough uncertainty to apply the precautionary principle". While this is a convoluted sentence, the bottom line is that high level of uncertainty relating to a moderate effect (subjective) is sufficient to warrant application of the precautionary principle. https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_CONF.151_26_Vol.I_Declaration.pdf **Claim**: Furthermore, the EPBC Act Policy Statement 2.1 does not consider cumulative noise exposure from multiple noise sources and periods. The precautionary principle should be applied in these cases when a lack of full scientific certainty exists.	CGG acknowledges claims regarding the application of the precautionary principle for low-frequency cetaceans and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. The precautionary principle has been applied in relation to low frequency cetaceans as described in the Regia MSS EP Appendix F3 (Acceptable Levels of Impact and Risk): - Section 5.2.1.1 which describes the eastern population of southern right whales. The consequence of the Regia MSS was assessed as moderate, which is defined as population recovery slows or stalls. The likelihood of occurrence was assessed as likely, expected to occur at least once every five years, resulting in a risk level of as high requiring additional mitigation action and an adaptive management plan required; the precautionary principle should be applied. - Section 5.2..2.1 which states that for pygmy blue whales the likelihood of occurrence was assessed as almost certain, expected to occur every year, resulting in a risk level of very high for which immediate additional mitigation action required; and for Antarctic blue whales the likelihood of occurrence was assessed as possible, the event might occur at some time, resulting in a risk level of as high requiring additional mitigation action and an adaptive management plan required; the precautionary principle should be applied. The claims cite high uncertainty and moderate effects as a basis for applying the precautionary principle. CGG acknowledges the inherent uncertainties in predicting environmental impacts, particularly concerning underwater sound and marine mammals. However, the approach taken aligns with the precautionary principle not by ceasing the activity but by mitigating potential harms through robust measures. The Regia

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	Claim: If there is scientific uncertainty about the impacts of an action, and potential impacts are serious or irreversible, the precautionary principle is applicable. A lack of scientific certainty will not itself justify a decision that an action is not likely to have a significant impact on the environment.	MSS has incorporated extensive monitoring, real-time adjustments, and a comprehensive Fauna Management System and Plan, including Marine Fauna Observers (MFOs) and Passive Acoustic Monitoring (PAM) operators, to ensure that impacts remain within acceptable levels. The claim regarding the EPBC Act Policy Statement 2.1 and cumulative noise exposure is addressed through the multi-faceted management strategy. This includes scheduling operations to avoid peak biological activity periods, adopting lower power emissions during sensitive times, and establishing exclusion zones. Further, our detections strategies rely on multiple observation techniques to create multiple lines of evidence to protect these species. These strategies collectively address cumulative noise impacts from multiple sources, ensuring that the precautionary principle is adequately applied through active mitigation rather than cessation of activities. The commitment to the precautionary principle is evidenced by the proactive steps to understand and mitigate potential impacts before they occur, rather than not considering alternative management measures which can effectively mitigate impacts to levels that are as low as reasonably practicable and acceptable, in line with environmental regulatory requirements. The Regia MSS project has been structured to remove uncertainty where possible and to mitigate the seriousness of any predicted effect, ensuring the sustainability and viability of the marine environment. This response has been summarised from content provided in Appendices E7, F2, F3, and F4. CGG has considered these claims and is satisfied that as the preconditions for application of the precautionary principle have not been satisfied, the concerns raised have been adequately addressed in the EP. As a result, no changes have been made to the EP in response to these claims.
I28	**Mater**: The Intergenerational Principle **Claim**: If this is passed you are not just harming the whales and other sea creatures but you are harming your children and their children as we rely on a healthy functioning ocean to thrive. **Claim**: I grew up by this beautiful piece of coastline, learning about the ocean and the endangered species it is home to. All I want is to be able to teach the future generations about the ocean and hopefully they will livSe to see these species bounce back. This wonâ€™t happen if seismic testing & drilling by CGG occurs. **Claim**: Whales are crucial to healthy oceanic ecosystems. It is patently obvious from the above that to approve this blasting would be the height of shortsighted ignorance. Use the power you have to ensure a healthy future for all generations and deny approval for the blasting. **Claim**: This project will have a significant impact on marine life, for generations to come. **Claim**: Please make decisions that impact our children\'s future with their well being in mind. Our children need healthy oceans. As Australians most of us live by the ocean and it is part of who we are. Thank you for reading this and considering the content deeply.	CGG acknowledges claims regarding the intergenerational equity principle and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. The intergenerational equity principle requires that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. Detailed consideration of the Intergenerational equity principle has been provided in EP Appendix F4 (ESD Assessment), which includes, for example, identifying and preventing irreversible environmental damage. CGG understood that once certain ecological harm occurred, it might be impossible to rectify or restore, disproportionately affecting future generations. Consequently, there is no irreversible environmental damage predicted from the Regia MSS. CGG is satisfied that the principle of intergenerational equity has been appropriately considered within the EP. As a result, no changes have been made to the EP in response to these claims.
I29	**Matter:** The Biodiversity Principle **Claim:** Given the critical importance of safeguarding biodiversity, the EP falls short of the necessary standards and should rejected.	CGG acknowledges claims regarding the conservation of biological diversity and ecological integrity (The Biodiversity Principle of ESD) and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. The biodiversity principle requires that the conservation of biological diversity and ecological integrity should be a fundamental consideration in decision-making. Detailed consideration of the biodiversity principle has been provided in EP Appendix F4 (ESD Assessment), which includes, for example, identifying and avoiding activities that could harm biological diversity and ecological integrity wherever possible. This included planning the survey timing, sail lines and other operations to avoid critical areas and sensitive habitats. CGG is satisfied that the biodiversity principle has been appropriately considered within the EP. As a result, no changes have been made to the EP in response to these claims.
I30	**Matter**: The Valuation Principle **Claim**: Misleading assertions to Valuation, Pricing, and Incentives Principle [p3184, Appendix F4]: “locating potential gas reserves is inherently linked to the future valuation and pricing of these resources” If Regia MSS is inherently linked to the future valuation and pricing of gas it is therefore directly related to the consumption of that gas by end	CGG acknowledges claims regarding the valuation principle of ESD and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. The valuation principle requires that improved valuation, pricing and incentive mechanisms should be promoted. Detailed consideration of the valuation principle has been provided in EP Appendix F4 (ESD Assessment).

	THEME	**IMPACT AND RISK ASSESSMENTS AND MITIGATIONS (I)**
#	***Comments received***	***Titleholder response***
	users. Given uncertainty over climate tipping points, the Precautionary Principle should apply. We therefore demand CGG makes a comprehensive analysis of this project's potential to affect climate tipping points. **Claim:** Misleading assertions to Valuation, Pricing, and Incentives Principle [p3184, Appendix F4]: "the EP preparation process ensures that future generations can make informed decisions regarding the utilisation of these resources" Australia's states are currently in the process of banning continued development of offshore gas - there is declining political support for this activitiy across Australia. Yet, a select few continue to green-light new projects despite public opinion. Therefore this project is not congruent with this ESD principle as current nor future generations are able to choose whether this gas is consumed. **Claim**: Misleading assertions to Valuation, Pricing, and Incentives Principle [p3184, Appendix F4]: "ecological sustainability and environmental protection" This project's claim to "ecological sustainability and environmental protection" cannot be claimed given the huge gaps of knowledge being ignored in this environmental plan.	The assertion that locating potential gas reserves is linked to future valuation and pricing indeed reflects the nature of resource exploration. However, this does not imply direct consumption without consideration of environmental impacts. Recognising the global concerns regarding climate change, future approvals are the appropriate place to conduct analysis of potential impacts on climate tipping points associated with a commercial development. It is essential to clarify that while there are discussions and varying degrees of political support concerning offshore gas development, CGG's operations are conducted under current regulatory frameworks that permit such activities. The EP process ensures that the survey is conducted in compliance with current regulatory requirements, and provides future generations with the data necessary to make informed decisions. This approach does not predetermine the utilisation of the gas but rather ensures that future decision-makers have a robust factual basis to assess the viability and desirability of resource development considering environmental, social, and economic considerations at that time. We acknowledge concerns raised about ecological sustainability and environmental protection. CGG has undertaken extensive environmental impact assessments, as detailed in the Regia MSS EP. These assessments are based on current peer reviewed, published scientific knowledge, and mitigation measures have identified and implemented to minimise impacts. Whilst we recognise that scientific knowledge continually evolves and some uncertainties remain, CGG is committed to adaptive management practices that are responsive to new information and ensure that impact on the environment is minimised through continual improvement. This commitment is supported by ongoing monitoring and engagement with scientific experts to fill any knowledge gaps and refine the impact mitigation strategies accordingly. CGG is satisfied that the valuation principle has been appropriately considered within the EP, as described above. As a result, no changes have been made to the EP in response to these claims.

2. Environmental and Ecological Information and Effects

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
Key Matter: Australian Marine Parks		
E01	**Matter**: Unacceptable impacts and Risks to Marine Parks and protected areas **Claim:** This is an unacceptable level of impact on our marine parks, which are gazetted due to their biodiversity and high ecological value, and that the EP should act outside of the marine park and Bonney Upwelling areas. **Claim:** Marine parks, including Commonwealth Marine Parks, are at risk from the proposed activities. **Claim**: The EP inadequately considers the impacts on Commonwealth Marine Parks within the Environment Planning Area. **Claim**: There are 3 Commonwealth Marine Parks within the boundaries of the Environment Planning Area: Apollo, Franklin, and Zeehan (Special Purpose Zone and Multiple Use Zone).These should be protected and excluded from any seismic survey otherwise what purpose is the park? These are areas of high conservation value and destruction of these ecosystems is not only undesirable it is dangerous, if animals cannot be safe within these zones where can they be safe? **Claim:** The proposed project area is alarmingly close to Victoria\'s coastline, raising serious ns about the potential impact on marine parks and coastal communities. **Claim:** The proximity of the proposed survey to sensitive marine parks and protected areas heightens the urgency of addressing these concerns. The potential irreversible damage to fragile ecosystems and endangered species within these areas cannot be overstated.	CGG acknowledges claims regarding impacts and risks to marine parks and reserves and has reviewed the Environment Plan (EP) to ensure that these were adequately assessed. The Regia MSS operational area and activity action zone do not overlap any Australian Marine Parks or state marine reserves. The closest marine protected area is the 12 Apostles Marine Park. Consultation with Parks Victoria resulted in an activity limitation with no operational activity within 5 km of the Twelve Apostles State Marine Park to protect the values of this park in as shown in EP Appendix B12 (Regia MSS Maps – MAP-REG-EPM-047) (Feedback 259). **<u>EP Appendix B12 (Regia MSS Maps) has been updated to include distances from the operational area and active source area to marine parks within the broader environmental planning area as follows:</u>** - **<u>The Regia MSS operational area is 6.26 km, and the active source area is 18.49 km from the 12 Apostles Marine Park (MAP-REG-EPM-047).</u>** - **<u>-The Regia MSS operational area is 35.92 km, and the active source area is 44.09 km from the Apollo Marine Park (MAP-REG-EPM-078).</u>** - **<u>-The Regia MSS operational area is 49.06 km, and the active source area is 72.86 km from the Zeehan Marine Park (MAP-REG-EPM-078).</u>** - **<u>-The Regia MSS operational area is 165.35 km, and the active source area is 191.08 km from the Franklin Marine Park (MAP-REG-EPM-078).</u>** - **<u>-The Regia MSS operational area is 109.34 km, and the active source area is 120.19 km from the Nelson Marine Park (MAP-REG-EPM-078)</u>** - The Regia MSS operational area overlaps 1.21% of the Bonney Coast Upwelling Key Ecological Feature (KEF). Consultation with conservation groups and relevant persons revealed that a change in timing of the survey did not adequately address concerns associated with effects to zooplankton, particularly during upwelling events and the values associated with Key Ecological Features (KEFs) in the region. This resulted in an activity limitation of no acquisition within 500 m of the Bonney Upwelling KEF, nor the West Tasmanian Canyons KEF (see Figure: MAP-REG-EPM-003_B). Risks to marine parks and the Bonney Coast Upwelling KEF in the extremely unlikely event of accidental fuel spill are assessed in EP Appendix D4. The impacts and risks associated with the Regia MSS are considered to be of an acceptable level and do not have the potential to result in long-term, serious, irreversible or cumulative impacts to marine parks or reserves. The adopted control measures are considered effective and appropriate to the temporary, small scale and reversible nature of the predicted environmental impacts and risks. Further, the activity can be managed in a way that is not inconsistent with the South-east Commonwealth Marine Reserves Network Management Plan. **<u>CGG has considered these claims and has updated the abovementioned figures to include distances from operational and activity action zone to marine parks and reserves, and included the percentage overlap with the Bonney Coast Upwelling KEF, thereby providing further context of separation distances.</u>**
E02	**Matter**: Failure to address ecological significance of marine protected areas **Claim**: The OA for this proposed project is within 40 km of the Apollo Marine Park, which contains mesophotic reefs, habitat for the southern rock lobster and seabirds like the shy albatross, and countless benthic species that have not yet been described. Seismic blasting by CGG will potentially impact these fragile habitats, with invertebrates and shellfish affected from over 1km away. The EP fails to address the ecological significance of these marine protected areas and the species known to inhabit it, and most importantly the impacts seismic blasting will have on the species known to be in the area during projected operational periods. **Claim:** There are 3 Commonwealth Marine Parks within the boundaries of the Environment Planning Area: Apollo, Franklin, and Zeehan (Special Purpose Zone	CGG acknowledges claims regarding the ecological significance of marine parks and reserves and has reviewed the Environment Plan (EP) to ensure that these were adequately identified and assessed. The Regia MSS operational area and activity action zone do not overlap any Australian Marine Parks or state marine reserves. The closest marine protected area is the 12 Apostles State Marine Park. Consultation with Parks Victoria (Feedback 259) resulted in an activity limitation with no operational activity within 5 km of this Park as shown in EP Appendix B12 (Regia MSS Maps – MAP-REG-EPM-047). Each impact and risk analyses considers matters protected under the EPBC Act and provides evidence that the proposed activity is not in conflict with the management plans in place for Commonwealth reserves, such as Australian Marine Parks, and upholds the Australian IUCN Reserve Management Principles. They also show that the activity will not have unacceptable impacts on the values of these protected areas. For example, risks to marine parks and the Bonney Coast Upwelling KEF in the extremely unlikely event of accidental fuel spill are assessed in EP Appendix D4.

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
	and Multiple Use Zone). The EP fails to address the ecological significance of the named marine parks and the species known to inhabit them, and the serious impacts seismic blasting will have on them. **Claim:** The EP does not address the ecological importance of these immense marine parks and the species known to inhabit it, and most importantly the impacts seismic surveying will have on the species known to be in the area during projected operational periods.	CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
E03	**Matter**: Excluding Marine Parks/ protected areas **Claim:** If this project were to go ahead the operating area would require a significant redfininition of the area to exclude marine parks [and the Bonney Upwelling], the EP would require a substantial increase in mitigation methods that are backed by strong evidence, and the shutdown zones should be significantly increased to ensure these species are protected. **Claim**: In 2020 the Senate held an Inquiry into the impact of seismic testing on fisheries and the marine environment. One clear recommendation from the Senate Inquiry 'is that seismic blasting must be banned from marine parks, and it doesn't belong in critical marine habitats.	CGG acknowledges claims regarding activity limitations for marine parks and the Bonney Coast Upwelling Key Ecological Feature (KEF) and has reviewed the Environment Plan (EP) to ensure that these were adequately assessed. The Regia MSS operational area and activity action zone do not overlap any Australian Marine Parks or state marine reserves. The closest marine protected area is the 12 Apostles State Marine Park. Consultation with Parks Victoria (Feedback 259) resulted in an activity limitation with no operational activity within 5 km of this Park as shown in EP Appendix B12 (Regia MSS Maps – MAP-REG-EPM-047). The activity will not have unacceptable impacts on the values of marine parks. The Regia MSS operational area overlaps small portions of the Bonney Coast Upwelling and West Tasmanian Canyons Key Ecological Features (KEF). Consultation with conservation groups and relevant persons revealed that a change in timing of the survey did not adequately address concerns associated with effects to zooplankton, particularly during upwelling events and the values associated with KEFs in the region. This resulted in an activity limitation of no acquisition within 500 m of the KEFs (see Figure: MAP-REG-EPM-003_B). Impacts to the Bonney Coast Upwelling KEF and the broader Great Southern Australian Upwelling System, that the Regia MSS overlaps, and the role these upwellings play in ecosystem function and productivity, are not predicted. Risks to marine parks and KEFs in the extremely unlikely event of accidental fuel spill are assessed in EP Appendix D4. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
Key Matter: The Marine Ecosystem and Marine Biodiversity		
E04	**Matter**: Unacceptable impacts on marine life and biodiversity **Claim:** Research has shown that seismic blasting results in serious harm to a variety of marine life, deafening whales and disrupting their feeding and migration, damaging the ability of southern rock lobsters to function and navigate, and causing mortality in small fish and zooplankton. **Claim:** In conclusion, the seismic blasting proposal by CGG must be refused by NOPSEMA due to its adverse impacts on marine life, the inadequacy of the 3332 page Environment Plan, and the confusion surrounding the public consultation process. **Claim:** To conduct seismic blasting between Victoria and Tasmania will harm marine life, and threatened species in these areas. **Claim:** Please DO NOT APPROVE CGGs application to do seismic blasting in the ocean off Victorias coast. It will impact the lives of many sea creatures and a healthy oceanic environment is critical to life on Earth. **Claim:** The severe risk that the seismic survey technique poses to marine life in the area is evident and clear examples of the effects have been seen in Tasmania. **Claim:** These explosions can reach ear-splitting decibel levels of up to 250, causing severe disruption to marine life and habitats. **Claim:** Mechanical intrusions, and in this case, impactful seismic blasting into this precious marine environment and its detrimental impact on various species, and the overall ecosystem and food chain, is seen as highly impactful and should not	CGG acknowledges claims regarding impacts of seismic on marine life and biodiversity and has reviewed the Environment Plan (EP) to ensure that these were adequately assessed. The EP must demonstrate the activity is not inconsistent with a recovery plan or threat abatement plan for a listed threatened species or ecological communities, or a management plan for an Australian Marine Park or Ramsar Wetland. This means that the acceptable level of impact and risk will be consistent with these plans which aim to ensure biological diversity and ecological integrity is maintained. Several mitigation and management measures were adopted in response to feedback provided during relevant persons consultation to protect areas and periods of higher biodiversity. These include exclusion zones for shallower waters and avoiding peak upwelling/ biodiversity periods in summer (Jan/Feb/Mar) as described in more detail in EP Appendix F2 (ALARP Assessment), Sections 6.1.2, 6.2.1 and 6.2.2. CGG has developed Environmental Performance Outcomes, the measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level specific to protecting marine fauna. These including EPO 2: No death or injury to fauna, including listed threatened or migratory species, from the activity; and EPO 3: Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area; among other EPOs that demonstrate their commitment to protecting marine life and biodiversity. Further, a 'whole of ecosystem' assessment was conducted in EP Appendix F3 (Acceptable Levels of Impact and Risk), Section 5.4 (Search for unacceptable environmental impacts), which identified the importance of evaluating impacts from the survey more holistically to understand if there are unacceptable impacts. This search concluded that no measurable changes to biological diversity or ecological integrity are likely because of the Regia MSS. The EP demonstrates a strong commitment to preserving marine biodiversity and ecological integrity, as described in EP Appendix F4 (ESD Assessment) Section 6.2 (Conservation of Biological Diversity and Ecological Integrity Principle). This includes changing operational timings to minimize biodiversity impact, identifying and protecting critical habitats, implementing mitigation measures for sensitive areas, and engaging with experts in marine biology and ecology.

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
	occur. For these reasons I find the proposal of seismic blasting of great concern in respect to the impacts on the ecosystems and wildlife in this precious area. **Claim:** Seismic blasting should not be allowed. The activity results in significant impact to our marine biodiversity. **Claim:** There is overwhelming scientific evidence that seismic blasting is extremely harmful and disruptive to whales and marine life. **Claim:** Seismic blasting does not have community licence. In the proposed operation area, it will impact: whale habitat, endangered marine life, Southern Sea Country, the Zeehan Marine Park, the Budj Bim Eel conservation area, and commercial fisheries. The food chain will be severely affected, with carry-on effects from zooplankton to fish, to whales. **Claim**: Seismic blasting is not safe for any marine creatures. **Claim**: The proposal has significant, irreversible effects on marine life. Approving this proposal would be a complete plight on our whales, marine animals, ocean and all microcosms dependent on an environment free from harmful interference. **Claim**: I personally do not believe that this project is worth potentially eradicating an innocent and incredible species permanently from existence and accelerating the extinction and/or destruction of other species and our natural ocean environment which is an essential source to us humans as well as home to so much beautiful life that has no reason to be denied existence anymore than we have the right to live. **Claim**: Furthermore, the blasting ecosystems and death to hundrends of thousands of marine animals (big or small). **Claim**: SEISMIC BLASTING In the Ocean is CRUEL and DISMISSIVE of these precious Sea Creatures. It is their HABITAT. Clearly, RIGHT ACTION is needed. SAY NO to Seismic Blasting. **Claim**: Such unprecedented seismic blasting by the CGG and the unidentified harm for coastal communities, marine life and our oceans. are significant reasons for refusing this proposal. **Claim**: This seismic blasting proposal by CGG should be refused by NOPSEMA due to the impacts on coastal communities, marine life and our oceans. **Claim:** The flow on effects of the damage whilst not yet known, are predicted to be deadly for many animals. Please reconsider these practices. **Claim:** In conclusion, there is clear evidence that the current EP is unsuitable and does not adequately protect marine species and vulnerable marine environments. **Claim**: We are speaking out to protect our marine life - they can\'t speak for themselves. Once you\'ve destroyed their environment, you destroy them, and you can\'t fix or replace either! **Claim**: This proposed blasting plan is disgraceful and completely ignores the well being of any sea creatures nearby. **Claim:** Approval of this application will have disastrous impacts on marine species, the local fishing industry and, ultimately, the climate. **Claim:** Please DO NOT APPROVE CGGs application to do seismic blasting in the ocean off Victorias coast. It will impact the lives of many sea creatures and a healthy oceanic environment is critical to life on Earth. **Claim:** The Australian people and environment deserve better than this inadequate EP assessment and it's devastating consequences if it were to move forward. If this	CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Climate change contributions are addressed under Theme: Climate Change. Consultation claims are addressed under Theme: Consultation. Impacts to whales are addressed under Theme: Marine Mammals. Impacts to southern rock lobsters are addressed under Theme: Fish, Sharks, Invertebrates and Fisheries. Impacts to plankton are addressed under Theme: Productivity.

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
	abundance of marine life and its breeding and feeding grounds are not protected now, we will lose something beyond measure. **Claim:** Seismic blasting is known to cause temporary and permanent hearing loss, habitat abandonment, mating and feeding disruption and death in marine biota. **Claim:** This proposal is unacceptable across the board. Not only does it endanger the longevity of entire marine species, but it causes distress and trauma to them in a multitude of ways. **Claim**: Seismic blasting is dangerous and cruel to ocean dwelling creatures. **Claim**: The body of evidence that seismic surveying harms marine life is growing. Current research includes the negative impacts of seismic surveying on whales, damage to the hearing apparatus of rock lobster, and significant mortality of zooplankton in surveyed areas.	
E05	**Matter**: Harm or damage to ecosystems and communities **Claim**: The proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause irreparable harm to ocean ecosystems. **Claim:** The submitter believes that the proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause significant, potentially irreparable harm to marine ecosystems. **Claim:** Plans by REGIA to conduct seismic blasting for oil and gas exploration will cause direct harm to marine ecosystems. This claim is now supported by multiple marine scientists. **Claim:** Seismic blasting for oil and gas exploration in our oceans will cause direct harm to ocean ecosystems. **Claim:** Seismic blasting has for the most part been found to be harmful to marine life and ecosystems in the scientific research that has been undertaken thus far. **Claim:** It's already well known how seismic blasting causes irreparable damage to our sensitive marine ecosystem. **Claim:** The proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause irreparable harm to ocean ecosystems and should not be allowed to proceed. **Claim**: I am against the CGG proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause irreparable damage . The known harm to ocean ecosystems - has to be rejected to protect Australian marine life. **Claim:** Equally problematic, is such exploration requires seismic blasting. Such blasting has no safe measure and does and will create irreparable damage to marine life and the ocean where this is taking place, ecosystems. **Claim:** Should this happen, this propose/ it will cause irreparable harm to ocean ecosystems. **Claim**: This proposal is completely unacceptable! It will cause irreparable damage if allowed to go ahead. **Claim:** We feel that sound emitted from seismic blasting and some sonar activities are inhumane and damaging to our marine environments. **Claim:** The submitter's members live along the south western coast of Victoria and we are concerned about the impacts of the Regia three-dimensional (3D) marine seismic survey (MSS) in Commonwealth waters will have on our environments.	CGG acknowledges claims regarding harm or damage to ecosystems and faunal communities and has reviewed the Environment Plan (EP) to ensure that these were adequately assessed. The EP must demonstrate the activity is not inconsistent with a recovery plan or threat abatement plan for a listed threatened species or ecological communities, or a management plan for an Australian Marine Park or Ramsar Wetland. This means that the acceptable level of impact and risk will be consistent with these plans which aim to ensure biological diversity and ecological integrity is maintained. Several mitigation and management measures were adopted in response to feedback provided during relevant persons consultation to protect areas and periods of higher biodiversity. These include exclusion zones for shallower waters and avoiding peak upwelling/ biodiversity periods in summer (Jan/Feb/Mar) as described in more detail in EP Appendix F2 (ALARP Assessment), Sections 6.1.2, 6.2.1 and 6.2.2. CGG has developed Environmental Performance Outcomes, the measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level specific to protecting marine fauna. These including EPO 2: No death or injury to fauna, including listed threatened or migratory species, from the activity; and EPO 3: Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area; among other EPOs that demonstrate their commitment to protecting marine life and biodiversity. Appendix F3, Section 5.4 (Search for unacceptable impacts) provides for additional consideration of potential ecosystem vulnerabilities to ensure that ecosystem integrity, meaning the ability of all species within an ecosystem to survive and reproduce such that the overall health of their ecosystem, is maintained and that potential unacceptable impacts are identified. This included an evaluation of potential ecosystem weaknesses including vulnerability to climate change, genetic diversity, dependence on keystone species, regenerative capacity, other threatening practices, life-cycle event timings and sensitivities, and abundance and range restrictions. This assessment concluded that no measurable changes to ecological integrity or population structures are likely because of the Regia MSS. The EP demonstrates a strong commitment to preserving marine biodiversity and ecological integrity, as described in EP Appendix F4 (ESD Assessment) Section 6.2 (Conservation of Biological Diversity and Ecological Integrity Principle). This includes changing operational timings to minimise biodiversity impact, identifying and protecting critical habitats, implementing mitigation measures for sensitive areas, and engaging with experts in marine biology and ecology. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Climate change contributions are addressed under Theme: Climate Change. Consultation claims are addressed under Theme: Consultation. Impacts to whales are addressed under Theme: Marine Mammals. Impacts to southern rock lobsters are addressed under Theme: Fish, Sharks, Invertebrates and Fisheries. Impacts to plankton are addressed under Theme: Productivity.

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
	Claim: I think it is insanity to under go operations such as this in such a crucial marine ecosystem with total disregard for not only the inhabitants it will effect [but also the devastating impact this and other projects like this one will contribute to the climate crisis]. **Claim:** You can't tell me that seismic testing will have little, to on impact on the delicate ecosystem that we have. And if that ecosystem is damaged or destroyed, so could be the vital tourism that supports much of our population. **Claim:** Seismic blasting for oil and gas exploration in our oceans will cause direct harm to ocean ecosystems. To conduct seismic blasting between Victoria and Tasmania will harm marine life, and threatened species in these areas. **Claim:** The issue here is very simple. The proposal to perform seismic blasting off the coast of Victoria will be hugely damaging to a unique and beautiful marine ecosystem. **Claim**: Seismic blasting poses irreparable harm to ocean ecosystems and is incompatible with global warming and zero extinction targets. **Claim:** The proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause irreparable harm to ocean ecosystems and should not be allowed to proceed. **Claim:** I am extremely concerned that blasting of the sea floor is to be considered near the habitat of any endangered species. **Claim**: The extent and duration of blasting proposed by CGG would cause irreparable harm to many threatened and endangered sea creatures, resulting in further species loss (Australia has already lost more mammal species than any other country on Earth). The removal of species from ecological communities can create fatal imbalances in ecosystems , leading to further species losses and collapse.	
Key Matter: Marine Turtles		
E06	**Matter**: Impacts to marine turtles **Claim:** Turtle behaviour is difficult to interpret as each study is qualitative and interpreting results between studies is problematic, as one study will show no signs of behavioural change, whereas another study will show panic or distress in turtles. (S. E Nelms et al. 2016). **Claim:** There is an absence of knowledge regarding the impact of seismic blasts on turtles and we request the CGG conduct more studies into the impact of seismic blasts on turtles, before conducting any seismic blasts. **Claim:** Recommendation: Request studies into the effects of seismic blasts on turtle populations. **Claim**: Submitter requests NOPSEMA require Regia – and indeed all applicants for these types of surveys – to detail the true extent of the impact of their activities. Specifically, the exact impact on pelagic fauna should be explicitly stated in the EP.	CGG acknowledges claims regarding impacts to marine turtles associated with underwater sound and has reviewed the Environment Plan (EP) to ensure that these were adequately assessed. Impacts on marine turtles from underwater sound are extensively assessed in EP Appendix E6 (Impact Assessment: Underwater Sound: Turtles). The PMST Report identified three turtle species within the area potentially affected by underwater sound, Green (may occur), Leatherback (likely to occur) and Loggerhead turtle (likely to occur). Regarding impacts on marine turtle critical habitat, no BIAs or habitat critical to the survival of these species were identified, although the region is recognised as an important feeding area for the leatherback turtle. The impact assessment predicted temporary / reversible and small-scale behavioural response or recoverable temporary threshold shift for marine turtles, with no population level impacts and high confidence in the prediction of risks. In accordance with the management measures outlined within the EP, the Regia MSS will be managed so that potential impacts and risks to marine turtles are reduced to ALARP and Acceptable Levels in accordance with all environmental regulatory requirements. Information on mitigation measures relevant to marine turtles is provided in response to Matter: E13. A review of the reference provided (S. E Nelms et al. 2016, Seismic survey and marine turtles: An underestimated global threat?) identified concerns for turtles including exclusion from critical habitats, damage to hearing and entanglement in seismic survey equipment. The submitted claim misquotes the literature, inferring that a study showed 'panic and distress'. The referenced literature states: "Turtle behaviour is difficult to interpret (DeRuiter and Larbi Doukara, 2012) and many observational data are often somewhat qualitative. This makes comparing response results among studies problematic. For example, observations from one seismic survey reported <u>no signs of panic or distress</u> and "behaviour consisted of either 'steady swimming' or 'diving' to avoid the vessel" (Pendoley, 1997). However, similar studies have categorised diving as a potential startle response or avoidance behaviour."

	THEME	**ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)**
#	***Comments received***	***Titleholder response***
		CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Impacts of underwater sound on other pelagic fauna, i.e. birds, e.g. albatross and terns, are addressed in Theme: Birds; pelagic fish and invertebrates, e.g. herring and copepods, are addressed in Theme: Fish, Sharks, Invertebrates and Fisheries; and impacts on krill are addressed in Theme: Productivity.
E07	**Matter**: Turtle entanglement with equipment **Claim:** Request studies into the probability of turtle entanglement with seismic testing equipment and the adequacy of known risk.	CGG acknowledges claims regarding entanglement of marine turtles with equipment and has reviewed the Environment Plan (EP) to ensure that these risks were adequately assessed. CGG has provided discussion on the potential for turtle engagement within EP Appendix D2 (Risk Assessment: Collision with Marine Fauna). There have been no reported cases of marine fauna becoming entangled in seismic survey streamers in Australian waters. As the streamers are towed, they have a level of tautness that would not result in entanglement of fauna. Thus, there is no cause effect pathway for entanglement of fauna in streamers. Tail buoys are now of a design that does not represent an entrapment risk to turtles or turtle guards are used as standard equipment if the tail buoy is not of the newer design (M#05: CGG Marine Assurance System). Thus, there is no cause effect pathway for entrapment of turtles in streamer buoys. In addition, the slow speed of the Seismic Vessel are considered to be effective measures against ship strike and entanglement for marine turtles, and any incidents with turtles will be reported, as recommended under the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017a). CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
E08	**Matter:** Effectiveness of mitigation measures **Claim**: There are no documented studies that evaluate the effectiveness of mitigation measures put in place to protect turtles. **Claim:** Request studies into the effectiveness of mitigation measures to protect turtles.	CGG acknowledges claims regarding the effectiveness of mitigation measures for marine turtles and has reviewed the Environment Plan (EP) to ensure that these were adequately described. CGG has described the mitigation and management measures for marine turtles in EP Appendix D2 (Risk Assessment: Collision with Marine Fauna) for vessel collision, and in EP Appendix E6 (Impact Assessment – Underwater Sound: Turtles) for underwater sound. These include reduced vessel speeds and assurance that the tail buoys will be of a design that does not represent an entrapment risk, along with soft-start procedures for underwater sound. In accordance with the management measures outlined within the EP, the Regia MSS will be managed so that potential impacts and risks to marine turtles are reduced to ALARP and Acceptable Levels in accordance with environmental regulatory requirements. **<u>EP Appendices D2 and E6 have been updated to include existing mitigation and management measures that will reduce the likelihood of injury associated with vessel collision and underwater sound including M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure), which provides for marine turtles to move away from the activity before the airguns reach full power.</u>**
Key Matter: Marine Flora		
E09	**Matter**: Awareness of, and impacts on marine flora/ seaweed **Claim**: It was actually quite clear during the consultations that the company officials did not know what marine flora was, or why seaweed would be relevant, even after having this explained to them, which brings into questions their ability to do thorough and transparent consultations. **Claim**: Little research exists around the specific impacts upon seaweed from seismic activities, and the seaweeds in our region remain understudied more broadly, yet as per the guidelines this is not sufficient to not consider risks or plan accordingly. These points were raised numerous times in community consultations but clearly have not been taken seriously in my opinion and experiences. **Claim:** Seismic testing therefore has the potential to wipe out a significant portion of a given generation of a range of seaweed species, with impacts that may not be	CGG acknowledges claims regarding the awareness of marine flora and has reviewed the Environment Plan (EP) to ensure that marine flora were adequately described. A comprehensive description of kelp, including survey findings along the Otway shelf from Warrnambool to Portland, is provided in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages). **<u>Although there is no evidence to suggest that the Regia MSS will have any material effect on marine algae populations in the region, having considered these claims, the research below will be added to Appendix E2 (Impact Assessment – Underwater Sound: Plankton) to ensure that this consideration is captured within the EP.</u>** **<u>In Australia, shallow (<30 m) temperate reefs are defined largely by the distribution of Ecklonia radiata kelp forests, which span more than 8000 km of coastline from the subtropical waters of northern New South Wales down the east coast of mainland Australia, around Tasmania, along Australia's southern coastline and north as far as Kalbarri in Western Australia (Bennet et al 2015). Most of Australia's kelp-dominated temperate reefs lie within the 'coastal zone' under state jurisdiction (3 nautical miles or 5.5 km from shore) (Bennett et al 2015). On the south and west coasts of Australia, *E. radiata* forests typically occur in mosaics of mixed species with large canopy-forming fucoids (e.g. *Cystophora* spp., *Scytothalia dorycarpa*), covering most of the rocky reefs.</u>**

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
#	***Comments received***	***Titleholder response***
	seen for years. Especially when research is already showing that seaweed species are already facing significant population level challenges due to the impacts of climate change, they are at particular risk from these activities. **Claim**: The sounds from seismic blasting travel several kilometres. It has been noted in the literature that plants can absorb and resonate specific sound frequencies which impact the cell cycle of the plant. **Claim**: The effects of seismic testing / blasting on sea grasses and kelp have not been mentioned in the EP which could have a substantial effect on our air quality. **Claim**: Given that Giant Kelp is becoming diminished with the effects of climate change, we are concerned that we are contributing to this decline by allowing further seismic blasts in the area to establish oil and gas rigs. Both of these fossil fuels increase the cause of climate change, and therefore threaten the Giant Kelp forests. (16) 16. https://www.un.org/en/climatechange/science/causes-effects-climate-change#:~:tex t=Fossil%20fuels%20%E2%80%93%20coal%2C%20oil%20and,of%20all%20carb on%2 0dioxide%20emissions. **Claim**: Submitter request studies into the effects of seismic blasts on giant kelp forests growth rates, and density.	**Timing of reproduction is variable across its distribution range with seasonal peaks in Western Australia and more continuous reproduction of sori and zoospores in Tasmania. Water temperature is the key driver of reproductive timing but is also influenced by other variables such as wave action. Once *E. radiata* zoospores are released, they have the ability to swim for at least 24 h (although they often do so for only 1–2 h), until they settle onto the substratum and germinate into male or female gametophytes. Ecklonia radiata can disperse via three modes; zoospores, sperm and detached fertile drift material. Population genetic studies on *E. radiata* using neutral microsatellite markers (Dolman & Coleman 2009, reported in Wernberg et al 2019) have identified that genetic structure around the Australian continent is weak, suggesting widespread gene flow that is mediated by the strength and direction of prevailing ocean boundary currents. Such strong connectivity should imbue considerable resilience on this species, however climate change is operating at such a large scale that warming temperatures are negatively affecting kelp across its entire range.** **Due to the depths associated with the activity action zone, with no discharge of the sound source at full power to occur in water depths less than 50 m, impacts on larger plants and nearshore planktonic phases arising from the activities associated with the Regia MSS are not anticipated. There is no scientific information on the potential for noise-induced effect in macroalgae and no functional cause-effect relationship has been established. Therefore, impacts from acoustic disturbance on macroalgae/ marine flora, or associated cultural values has not been considered further.** It is understood there is potential for kelp in shallower, more coastal areas to be impacted in the highly unlikely event of a marine oil spill, and a detailed description of kelp, its cultural and seaweed industry value, and risks to kelp associated with a spill are detailed in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages), 6.14 (Seaweed Industry), 6.17 (Protected Areas). ***References****:* *Bennett Scott, Wernberg Thomas, Connell Sean D., Hobday Alistair J., Johnson Craig R., Poloczanska Elvira S. (2015) The 'Great Southern Reef': social, ecological and economic value of Australia's neglected kelp forests. Marine and Freshwater Research 67, 47-56.* *Wernberg, T., Coleman, M.A, Babcock, R.C., BELL, S.Y., BOLTON, J.J., Connel, S.D., Hurd, C.L., Johnson, C.R., Marzinelli, E.M., Shears, N.T., Steinberg, P.D., Thomsen, M.S., Vanderklift, M.A., Vergés, A., Wright, J.T. (2019) Biology and ecology of the globally significant kelp Ecklonia Radiata. Oceanography and Marine Biology: An Annual Review, 2019, 57, 265-324.*
E10	**Matter**: Risks to seaweed **Claim:** Not only is it not described, risks have not been identified, and despite the region being home to some of the world's leading seaweed scientists, no comment has been sought.	CGG acknowledges claims regarding risks to seaweed and has reviewed the Environment Plan (EP) to ensure that marine flora were adequately described. A description of kelp, its cultural and seaweed industry value, and risks to kelp are detailed in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages), 6.14 (Seaweed Industry), 6.17 (Protected Areas). **Although there is no evidence to suggest that the Regia MSS will have any material effect on marine algae populations in the region, having considered these claims, additional information has been added to Appendix E2 (Impact Assessment – Underwater Sound: Plankton), as detailed in response to Matter E09, to ensure that this consideration is captured within the EP.**
E11	**Matter**: Impacts on planktonic seaweed **Claim:** Specifically in their report, they mention the impact upon zooplankton, but completely neglect to mention the impacts on marine flora (seaweed, microalgae and seagrasses) who have planktonic life stages. **Claim:** Specifically in their report, they mention the impact upon zooplankton, but completely neglect to mention the impacts on marine flora (seaweed, microalgae and seagrasses) who have planktonic life stages. These species, to reproduce, release into the water column planktonic reproductive materials that, if evidence upon other planktonic species is to be followed, can be decimated by sound waves. What sets them apart from zooplankton is that these are unable to "replenish" in the way outlined in some of the research listed in the EP.	CGG acknowledges claims regarding the awareness of marine flora and has reviewed the Environment Plan (EP) to ensure that marine flora were adequately described. A comprehensive description of kelp, including survey findings along the Otway shelf from Warrnambool to Portland, is provided in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages). **Although there is no evidence to suggest that the Regia MSS will have any material effect on planktonic life stages of marine algae populations in the region, having considered these claims, the research below will be added to Appendix E2 (Impact Assessment – Underwater Sound: Plankton) as detailed in response to Matter E09, to ensure that this consideration is captured within the EP.**
E12	**Matter**: Acknowledgement of ecological role of seaweed **Claim:** Warrnambool and the broader Otway Basin is home to the world's most diverse and abundant seaweed population of anywhere on the globe. Seaweed is the main habitat forming species in the region, provides food, shelter, temperature control, erosion protection, storm attenuation, water filtration and a range of other	CGG acknowledges claims regarding the ecological role of seaweed and has reviewed the Environment Plan (EP) to ensure that this was adequately described. A comprehensive description of the ecological significance of kelp, including survey findings along the Otway shelf from Warrnambool to Portland, is provided in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages). An excerpt of the information provide in the EP is reproduced below:

	THEME	ENVIRONMENTAL AND ECOLOGICAL INFORMATION AND EFFECTS (E)
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	ecosystem services that are KEY to the ongoing survival of every other species present in the region. Despite this being well known and well understood, and this point being raised by multiple parties during face-to-face consultation in Warnambool, the ecological role of seaweed remains almost completely absent within this EP.	"Bull kelp is a significant habitat. The holdfast can be inhabited by a diverse array of epifauna and infauna invertebrates. These burrow into the holdfast creating holes that can be used by a wide variety of animals. In addition, bull kelp grows in large groups or forests that can become important nursery areas and sanctuary areas for fish, crustaceans and other fauna. Bull kelp has a long history of use by First Nations in Australia, New Zealand, and Chile. In Australia this reportedly dates back 65,000 years (Thurstan et al. 2018). First Nation people in Tasmania used dried bull kelp to transport water and food. The species name came from this use: potatorum means 'to drink' in Latin (Govt of SA 2023)." Additional information is also provided on the Giant Kelp Forests of South East Australia threatened ecological community. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
E13	**Matter**: Failure of EP to address impacts on water quality **Claim**: Seaweed is greatly impacted by pollution and water quality, which is not noted in the EP as is related to waste and fuel release, other than a single mention regarding seaweed farming. This is particularly concerning as this company has previously been found responsible for extensive damage to both commercial and wild seaweed populations related to their activities, so there would be at least a cursory understanding on their point of the risk.	CGG acknowledges claims regarding impacts to seaweed from discharges and an accidental release of fuel and has reviewed the Environment Plan (EP) to ensure that this was adequately assessed. A description of kelp and risks to kelp, and associated cultural and industry values, from an accidental release of fuel are detailed in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages), 6.14 (Seaweed Industry), 6.17 (Protected Areas). The impacts associated with planned vessel discharges (including, for example, sewage, grey water and deck drainage,) were assessed in the Preliminary Environmental Impact and Risk Assessment (PEIRA). The impacts assessment found that routine vessel discharges would have a negligible impact on water quality and would not result in a change in the viability of populations or ecosystems. Therefore, as impacts from planned vessel discharges were not predicted, they were not evaluated further. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
E14	**Matter:** Failure of EP to address coastal erosion due to loss of seaweed. **Claim:** The broader impact of erosion upon the coast and worsening storm damage due to loss of seaweed is also not noted.	CGG acknowledges claims regarding impacts to seaweed from an accidental release of fuel and has reviewed the Environment Plan (EP) to ensure that this was adequately assessed. A description of kelp, and risks to kelp from an accidental release of fuel, are detailed in EP Appendix D4 (Accidental Release of Fuel), in Section 6.3 (Benthic Assemblages). The predicted level of consequence to benthic assemblages from a 250 m^3 MDO spill is assessed as moderate as the consequences could be longer lasting (> 30 days) if kelp and other macroalgal areas are exposure to oil above the low threshold level, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium. The predicted level of risk is below the pre-defined acceptable level, and mitigation and the management measures including for example, the marine assurance system and oil spill response plans, are in place provide reliable prevention to have confidence in the predicted likelihood levels. **EP Appendix D4 (Accidental Release of Fuel), Section 6.3 (Benthic Assemblages) has been updated in response to these claims to reflect that, due to the exposed nature of the coastal areas within the Environmental Planning Area and the nature of MDO, long-term effects in areas of moderate MDO exposure are not expected and natural weathering should result in rapid recovery of communities. MDO shoreline loading at the high threshold is not predicted due to the low spill volume. Consequently, impacts resulting in the loss of coastal seaweed to the extent that coastal erosion could be affected are not predicted.**

3. Consultation

	THEME	CONSULTATION (C)
#	***Comments received***	***Titleholder response***
C01	**Matter**: Inadequate or unclear information to support consultation **Claim**: Information provided to the community has lacked clarity, and sufficient information to allow meaningful and informed consultation for relevant persons and affected communities. **Claim**: A requirement of adequate consultation is that it be comprehensive and comprehensible in order that the community may properly assess the scope of the project and its impacts. However, this EP has overlooked a broad array of impacts on endangered and other potentially impacted species, despite its significant volume. **Claim**: The consultation process has been confusing and inadequate, failing to provide sufficient information and time for meaningful input. **Claim**: In conclusion, the seismic blasting proposal by CGG must be refused by NOPSEMA due to its adverse impacts on marine life, the inadequacy of the 3332 page Environment Plan, and the confusion surrounding the public consultation process. **Claim**: The process of public consultation has been flawed, with confusion and insufficient information provided to affected communities. This lack of transparency undermines the credibility of the consultation process. **Claim**: In light of the review taking place into the Offshore Petroleum Greenhouse Gas Storage Act (OPGGS) consultation process, for which submissions are due three days before the public comment period for this proposal ends, we consider this consultation and public process to have failed the basic needs of providing sufficient information and time for respondents to digest new information that has been presented in a convoluted format. **Claim**: Submitter maintains that 60 days is simply not sufficient to allow members of the public to understand the complex issue of risk assessment, let alone to decide that CGG's approach is fit for purpose, and is another example of a failure in consultation. Based on these issues, this EP should be rejected by NOPSEMA as the decisions on what are acceptable or unacceptable risks, and measures of ALARP, have not been sufficiently addressed.	CGG acknowledges claims regarding the supply of sufficient information for consultation in the preparation of the Regia MSS Environment Plan (EP) and has reviewed the consultation process undertaken. CGG has undertaken extensive consultation as required under Division 3 and section 25 of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023. Formal consultation commenced on 03 February 2023, over 330 days prior to first submission to NOPSEMA, with initial communications outlining the proposed approach to consultation, a consultation timeline and information on the activity. Simultaneous to this, CGG undertook a significant advertising campaign and created an online consultation hub to support the identification of potentially relevant persons, as well as in-community meetings and information sessions. Relevant Persons were invited to co-design engagement, requesting communication methods best suited to their needs, and encouraged to ask questions and request further information if needed, as detailed in Chapter C1, 3.2. CGG extended the original consultation period twice to ensure relevant persons had a reasonable period with sufficient information to engage in the consultation process, as detailed in Chapter C1, 3.3 (EVENT ID: 1182 & 3331). CGG also made draft EP chapters and technical supporting reports publicly available to relevant persons via the consultation hub, as follows: preparatory information uploaded 1 February and 31 March 2023, Establishing Context documents 31 March to 6 June 2023, Risk Assessments on the 11 September 2023, Impact Analyses on the 22 September 2023, and Impact and Risk Treatment on the 28 September 2023. Other documents created through the co-design consultation process, which allowed for potentially relevant persons to request information sharing in their preferred format, included information summaries, webinar recordings, presentation slides, maps, and decision-making documents, and were also made publicly available on the consultation hub. This availability and instructions on how to provide feedback was communicated via email to relevant persons through project update emails (EVENT ID: 535, 1182, 1830, 1916, 2849, 3331, 3811). The draft EP chapters also contained a cover sheet explaining the purpose of publishing the draft chapter, encouraging feedback, and offering assistance if required, for example the summarising of information. The currently available information and information coming soon was also communicated at the Community Information Sessions (EVENT ID 1469, 1481, 1501, 1731, 4112) EP Chapter C1 (Consultation) outlines in detail the methods, approaches and communication tools used to support consultation, with extensive evidence of consultation provided in EP Appendices C2, C3, C4 and C5 (please note C3 and C4 are not released to the public as they contain individuals/organisations sensitive information). This consultation has included providing substantive and fit-for-purpose information on the proposed activities in a variety of forms, providing accessibility of information and allowing for informed decision making. During consultation, CGG documented and responded to all received objections, claims, requests for information, statements, and items of feedback from relevant persons, as detailed in EP Appendix C4. CGG considers that sufficient clear information was provided to allow relevant persons and potentially relevant persons to make an informed assessment of the possible consequences of the activity on their functions, interests or activities, and that each relevant person and potentially relevant persons has been provided with a reasonable period for the consultation, with ample opportunity to provide information and feedback, in a form best suited to them, on the Regia MSS as detailed in EP Chapter C and Appendix C2, 3 and 4. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
C02	**Matter**: Lack of meaningful public/ community consultation **Claim**: Public consultation meetings were an exercise in box ticking, with a consultant, acting on behalf of the proponents, making the statement at a Port Fairy public consultation meeting that "there will never be a scientific or cultural reason that would halt the project". This statement left those attending the consultation event with the clear impression the two proponents - CGG and ConocoPhillips - considered these projects a done deal, and the consultation event was a box ticking exercise, and an exercise in (poor) public relations. **Claim**: The lack of meaningful consultation with affected communities and [Indigenous groups] raises serious concerns about the transparency and legitimacy of the approval process.	CGG acknowledges claims regarding community consultation in the preparation of the Regia MSS Environment Plan (EP) and has reviewed the consultation process undertaken. The statement 'that there would never be a scientific or cultural reason that would halt the project', has previously been discussed with the relevant person, explaining that CGG believes the survey can be designed, and measures put in place, to bring any impacts to an acceptable level. CGG undertook a broad capture approach to identifying relevant people and information, and ensuring the community were aware of the consultation process and proposed activity, which included holding 11 community information sessions (see 3.2.4 of Appendix C1), and the Environment Manager spending 44 days visiting the local communities to raise awareness and meet with potentially relevant persons (see Appendix C1, Table C1-7). As part of the co-design process community members were empowered to request additional sessions in their area, with CGG holding the additional sessions, utilising their feedback on advert placement and timing. The community sessions were not only incredibly valuable in identifying relevant persons, but they provided an open format to provide and

	THEME	CONSULTATION (C)
#	***Comments received***	***Titleholder response***
	Claim: Informed consultation and engagement has not been made for the social wellbeing of coastal communities. **Claim**: There has been a lack of community consultation by REGIA on their proposed seismic blasting plans and their Environment Plan. **Claim**: The Environment Plan is deeply flawed [from a scientific perspective] and has gone through a flawed community consultation process (many coastal communities including the Surf Coast were ignored by REGIA). **Claim**: Submitter critiques the lack of transparency and consultation in the decision-making process, and calls for refusal of the proposal by NOPSEMA. **Claim**: There hasn't been appropriate consultation with other local community members affected by this proposal such as [tour operators], or local sea-loving residents.	receive information. A total of 11 community sessions were held at strategic locations based on the EPA. Information exchange at, and following, these events allowed engagement to be co-designed. Initially, in a bid to mitigate consultation fatigue, events were held with another titleholder who had a proposal in the area. The sessions were advertised in 9 local print newspapers, 3 targeted social media adverts and 272 radio adverts over 6 local stations and their websites. In addition, the collaborative titleholder placed 4 print adverts and 142 radio spots within the EPA to advertise these sessions. Tools, such as an interactive map, were used to facilitate a two-way dialogue with both interested community members and relevant persons. Information was also made publicly available, and resources such as summaries and FAQs were produced to be accessible to a wider audience. 13 Social media adverts and posts were targeted to the local audience, advertising the information sessions and milestone updates. Community members and relevant persons were also encouraged to ask questions and request further information, including information formatted and shared in a manner appropriate to their needs, including one on one in person meetings. Community members were also encouraged to share the activities information within their networks. When contact details were passed on to CGG of potentially relevant persons, they were contacted with initial information and a request for engagement. Local radio, television and print stories were participated in, and advertisements placed, numbering a total of 299 local and national media spots to further assist with community consultation. Transparency was fundamental in the consultation process, with feedback being addressed, comments posted on the Regia website responded to, and EP documents, and resources such as presentation slides (see Matter C01 above) were uploaded into the public document library hosted on the activity website. Changes made to the EP through consultation were shared publicly through project updates and webinars, copies, and recordings of which were made available on the consultation hub. Consultation feedbacks and adopted measures are available in Appendix C2, 3. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: The scientific robustness of the EP is addressed in response to Matter: I15. NOTE: Consultation with Indigenous groups is addressed in response to Matter: FN02. NOTE: Consultation with tour operators is addressed in response to Matter: C07, below. NOTE: Consultation with all coastal communities is addressed in response to Matter: C08, below.
C03	**Matter**: Confusion over who was undertaking what activity. **Claim**: Meetings were held in which the consultant spoke to both projects interchangeably, suggesting to community members that, by combining the consultation meetings for the two respective projects, the consultant was acting in the interest of expediting the process. This had the result of confusing attendees as to the specifics of each project the consultant was consulting on, and what information pertained to each project. This may have impacted the ability for relevant persons and affected communities to make informed Public Comments on this proposal, and the ConocoPhillips public comment process that ran in December 2023. **Claim**: The process of public consultation for this project throughout 2023 has been confused and convoluted, both in the online briefings and community meetings hosted by consultants Klarite on behalf of the proponents. Specifically, the same Klarite consultant acting as the public face for both CGG in this seismic proposal and ConocoPhillips for a separate gas test drilling proposal with areas of overlap in the Otway Basin. **Claim**: The rushed and confusing public consultation efforts by the proponent further erode trust and confidence in the decision-making process. **Claim**: Consultants working on behalf of the proponents, acted as the public face for both CGG in this seismic proposal and ConocoPhillips for a separate gas test drilling proposal with areas of overlap in the Otway Basin. Meetings heard the consultant discuss both projects interchangeably to hasten the process. This had the result of confusing attendees as to the specifics of each project the consultant was talking about.	CGG acknowledges claims regarding community confusion about proponents during the consultation process. In a bid to reduce consultation fatigue and burden on the community and potentially relevant persons, CGG collaborated with another title holder in the region who was undertaking engagement for a non-seismic project. CGG structured these meetings in two parts, with a break between project presentations to avoid confusion. When feedback requested separate meetings be held, CGG implemented our consultation co-design methodology and held Regia MSS only meetings. In some instances, relevant persons required combined meetings, which were undertaken. This initial collaboration was to address concerns of multiple events to attend, not timing. Having collaborative public information sessions would not have shortened the consultation process for either project. All communication resources, such as newsletters, emails, letters, information sheets and social media, were Regia MSS only and branded as such (see Appendix C5). CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no further changes have been made to the EP in response to these claims. NOTE: Claims regarding a lack of meaningful public/ community consultation is addressed in response to Matter: C02.

	THEME	CONSULTATION (C)
#	***Comments received***	***Titleholder response***
	Claim: The public consultation process conducted throughout 2023 has been fraught with confusion, both in online briefings and community meetings hosted by consultants on behalf of the proponents. **Claim**: The dual role of a consultant representing both CGG in the seismic proposal and ConocoPhillips in a separate gas test drilling proposal has muddled the clarity of information presented to the community. By merging consultation meetings for both projects, attendees were left unsure about the specifics of each project, potentially hindering relevant persons and affected communities from making informed public comments. **Claim**: The consultation process for this proposal has been equally concerning. Community meetings have been confusing and poorly organized, leaving affected communities and stakeholders without sufficient information or time to provide meaningful input. This lack of transparency and meaningful engagement undermines the principles of democratic decision-making and fails to uphold the rights of communities to participate in decisions that affect their environment and well-being.	
C04	**Matter**: Volume of information required to be reviewed **Claim**: The lengthy (3322 page) seems designed to obfuscate regarding Such obfuscation an extension of the procedures applied the proponent to the so-called "Consultation" process described below. Indeed, it is arguable that the consultation process indicates an attitude of contempt on the proponent's part toward the Australian government and people, the Australian environment and arguably to their own children and grandchildren. **Claim**: The Regia MSS application is 3332 pages long. It is unreasonable to expect consultees to thoroughly review such huge documents in short periods of time with any thoroughness. Is this a deliberate attempt to make it difficult for consultees to respond within 30 days? **Claim**: It is our view that the 3,332 page Environment Plan (EP) under consideration for this project is obtuse and unnecessarily convoluted, creating a barrier to clear community understanding and informed public assessment. **Claim**: The consultation company employed by CGG to carry out community consultation for this proposal did not prepare us for this extensive document. Instead, the emphasis was on informing community groups of our rights as relevant person(s), with little information about the project details or the science. **Claim**: Unfortunately, the parameters of this consultation have made it difficult for us to prepare a comprehensive response; a time frame of 30 days to read a 3,300 plus page document, find and evaluate their references, and then prepare a response is unrealistic. Considering the complex nature of the topic, which requires considerable time to research and process information, it would be impossible to develop a response which addresses all the potential issues with this plan. **Claim**: The submitter is concerned that an application of some 3,332 pages which requires a response within 30 days is unreasonable, unfair, and unachievable to adequately assess the capacity required for basic review (let alone thorough review).	CGG does not concur with claims relating to the volume of information to be reviewed, for the reasons stated below. The EP has been uniquely structured to address feedback related to the digestion of large and complicated environmental approval documents presented by titleholders. Further, the content is slightly more educational than a typical EP because many of the consultations revealed a need to fully describe the regulatory requirements, share NOPSEMA guidance, and explain environmental management concepts such as reducing impacts and risks to as low as reasonably practicable (ALARP) and to an acceptable level. By having a concise, 56-page, EP document and extended, comprehensive appendices, CGG aims to simplify the assessment processes for NOPSEMA, the public, and relevant persons. For the public, this format is easier to digest, encouraging more readers, inviting more public comments, and potentially helping to identify more relevant persons. For relevant persons identified in preparation of this Environment Plan, the parts of the EP addressing their functions, interests or activities and subsequent objections, feedback and claims are located more quickly and easily through the specific appendices, and their bookmarks. The EP contains a document map on page 3, containing hyperlinks and bookmarks, so reviewers can easily access the information pertinent to them. In addition to this, a video was also produced and linked to on pages 2 and 3 of the EP, providing a visual tool on how to navigate the appendices via the hyperlinks and how to use the bookmarks within the appendices with both Chrome and Explorer browsers. The draft EP Chapters were made publicly available on the website, prior to Public Comment, for relevant persons to review and they were encouraged to provide feedback and ask further questions if required (see theme C01 for further detail on timing and communication of information availability). Public webinars, community sessions and meetings, both virtual and in-person, with individuals and groups as per relevant persons preference, were undertaken during the preparation of the EP to support greater understanding of technical information. This process also facilitated feedback that allowed CGG to identify topics and produce information summaries to further assist relevant and potentially relevant persons to make informed assessments. When stakeholders expressed concern and burden, due to other proposed activities with similar engagement timelines and internal resourcing (Event ID 3413 & 3384), the decision was made to cancel the consultation pause, moving intended Public Comment period to 2024, and keep engagement open (Event ID 3331).CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Information on the quality and timing of information is supplied under theme C01
C05	**Matter**: Failure to respond to questions **Claim**: Questions asked in person and in writing were frequently left unanswered or relevant persons asking the questions were informed the information was not available.	CGG does not concur with these claims and notes that responses to all objections, claims and questions received during consultation were provided to relevant persons, as summarised in the Environment Plan (EP) Appendix C2. Given that responses to all relevant person objections, claims and questions were provided, and that, having considered the claims, CGG has satisfied itself that the potential risks and impacts referred to have been adequately addressed in the EP, no changes have been made to the EP in response to these comments.
C06	**Matter**: Consultation fatigue	CGG acknowledges claims relating to consultation fatigue associated with the Regia MSS.

	THEME	CONSULTATION (C)
#	***Comments received***	***Titleholder response***
	Claim: The submitter expressed being overwhelmed by the ongoing consultation for polluting offshore oil and gas as their kids have to deal with the consequences of the continued opening up of these public resources to private multinationals, at the detriment of our natural resources and our childrens future.	In a bid to mitigate consultation fatigue, initial community information events were held in conjunction with another proponent who was also promoting an offshore activity in the Otway. Following these events, CGG received feedback from some attendees that this was confusing and requested standalone information sessions, which were then organised and undertaken. When stakeholders expressed concern and burden, due to other proposed activities with similar engagement timelines and internal resourcing (Event ID 3413 & 3384), the decision was made to cancel the consultation pause, moving intended Public Comment period to 2024, and keep engagement open (Event ID 3331). Other ways CGG reduced burden was through the use of the consultation hub, creating a space where multiple forms of information could be accessed and feedback provided. This included a survey, where potentially relevant persons could state their functions, interests or activities and request further information and/or consultation, and state preferred means of contact. The Regia project supplied multiple points of contact, including email, phone, postal, social media, online comment boxes, interactive maps, instant feedback, and surveys. Project newsletters were utilised as a tool to capture important information, within a single correspondence to limit consultation fatigue, and to provide information on changes made throughout the consultation process. CGG also offered a co-design consultation process, allowing interested community members and potentially relevant persons to request communications in their preferred method and format, further reducing burden on the stakeholder. CGG has also undertaken collaborative work with other Titleholders in the region on the Sea Country Protection Plan (SCPP) and Commercial Fisheries Adjustment Protocol, to further reduce fatigue while facilitating relevant persons engagement to co-design these programs. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
C07	**Matter**: Failure to consult with relevant persons **Claim**: Cape Bridgewater – About 2500-3000 Australian Fur Seals and Long-Nosed Fur Seals have a breeding colony here. Numbers have been recovering since federal protection. Southern Elephant Seals visit here each summer whilst they moult. Submitter raised concerns that local tour operators with expert knowledge have not been consulted by CGG. **Claim**: Those who rely on these animals, such as tour operators who may run whale watching tours, and local businesses relying on tourism income which is affected by events such as mass amounts of dead sea creatures littering beaches following seismic testing, do not appear to have been adequately considered or consulted. **Claim**: Submitter recommends ensuring consultation processes with locals are also thorough enough to capture local knowledge of significant features. **Claim**: Submitter recommends conducting thorough consultation with local residents and local businesses, including all tourism operators, who may be impacted by the proposed seismic testing to assess potential project impacts. **Claim**: Some tourism operators were not even consulted by CGG, for example the popular whale watching and seal tour operators, and potentially many more. **Claim**: The titleholder has not demonstrated it has carried out consultations or proposed measures, as is required by regulation 34(g) of the Regulations, in relation to social and recreational activities, such as surfing, due to activities with the Operational Area and the Environment Planning Area.	CGG acknowledges claims regarding failure to consult with relevant persons and has reviewed the consultation process undertaken. Regarding impacts to the Long-nosed (or New Zealand) Fur-Seal and the Australian Fur Seal, these species are otariid pinnipeds which are assessed in Section 6.4 (Otariid Pinnipeds) of EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). Impacts and mitigation measures relevant to otariid pinnipeds are addressed extensively in response to Matters: M27, M28, and M31. CGG has reviewed relevant literature and assessed potential impacts on Southern Elephant Seals, a subantarctic species, including the studies conducted by Harris et al (2001) documented in Appendix B8 (Seismic Studies Report) Section 7 (Marine Mammals). **EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) Section 4 (Description of the Existing Environment that may be Affected by the Activity) has been updated in response to these claims, as follows:** **CGG has reviewed relevant literature including Conservation Advice for this species, and has noted the Southern Elephant Seal (*Mirounga leonine*) listed as Vulnerable under the EPBC Act, is a subantarctic species and, although some individuals have been recorded in coastal habitats, this species was not identified in the PMST search for this area. This species has a nearly circumpolar distribution and visits subantarctic islands to breed and to moult. There are two main populations found in Australian waters and the principal breeding colonies for these populations are located on Heard and Macquarie Islands (Shaughnessy 1999; McMahon et al. 2005). Southern Elephant Seals concentrate on the northern beaches of Macquarie Island, although colonies are scattered around the island (DEH 2003). In the Australian Antarctic Territory, small numbers of pups have been reported from Browning Peninsula and Peterson Island, near Casey station (Murray 1981 cited in Shaughnessy 1999), and there has been a well-frequented haul-out area at Vestfold Hills (Burton 1985). Off the coast of mainland Australia, several pups have been born and many animals recorded on Maatsuyker Island (located at the most southern end, off the south-west coast of Tasmania) (Shaughnessy 1999).** **Given the likelihood of encountering this species during the Regia MSS is low, impacts to the species are not predicted and have not been assessed further.** Potentially relevant persons were identified through desktop research, direct communications, through government agencies, community outreach events, and various targeted media and advertising techniques. CGG's strategy included developing tailored identification methods for subject-centred groups. CGG acknowledged that despite best endeavours, there may still be some unidentified relevant persons. To combat these challenges a broad capture of people and information, including the opportunity to self-identify, was undertaken (see Appendix C1, 3). This included holding 11 community information sessions, the Environment Manager spending 44 days visiting the local communities, 13 geographically targeted social media adverts, 299 local media spots, and local radio, television and print media articles (see Appendix

	THEME	CONSULTATION (C)
#	***Comments received***	***Titleholder response***
		C1). Individuals who attended community sessions, left map comments, instant feedback or undertook a consultation survey, were written to and invited to engage. Community members and relevant persons were also encouraged to share the activities information within their networks. When contact details were passed on to CGG of potentially relevant persons, they were contacted with initial information and a request for co-design engagement and activity planning. Through this process relevant persons in the Tourism Operators, Commerce, Other Marine users (such as surf clubs) and Interested member of public, amongst other, subject-centered groups were identified and engaged with, allowing for two-way information sharing and activity co-design. Consultation feedbacks and adopted measures are available in Appendix C2, 3, and full text consultation copies in Appendix C4. In the process of consultation, 737 individuals and 172 organisations were contacted during the preparation of the EP. Of these individual points of contact, 458 relevant persons were identified (full details of these persons can be found in Appendix C3). CGG will continue to promote relevant persons' self-identification throughout the life cycle of the activity. This will occur through the public comment process and regular updates on the Regia website, and so the suggested tourism operators will be contacted by CGG under ongoing consultation in our implementation strategy (see Appendix C1, 3.7). CGG's implementation strategy includes change management procedures in the event of new or modified information being received (see Appendix B3, 12.1). In accordance with the applicable regulatory requirements, CGG has prepared an evidence-based case that the environmental impacts and risks arising from the Regia MSS can be managed to below an acceptable level, with effects of this activity being short-term, localised, and recoverable, as detailed in EP Appendix E (Environmental Impact Assessments). An activity that caused large scale mortal effects would not be undertaken. **<u>Having considered these claims, CGG will contact the named tourism operators with relevant information and update the consultation records (Appendix C2 and C4) accordingly. EP Appendix E7 will also be updated with the assessment of Southern Elephant Seals as detailed above.</u>** NOTE: Consultation with communities is addressed in response to Matter: C02, above. NOTE: Impacts on local livelihoods – Tourism is addressed in response to Matter: T03 ***References:*** *Burton, H.R. (1985). Tagging studies of male southern elephant seals (Mirounga leonina L.) in the Vestfold Hills area, Antarctica, and some aspects of their behaviour. In: Ling, J.K. & Bryden M.M., eds. Studies of sea mammals in south latitudes. Page(s) 19-30. Adelaide, South Australian Museum.* *Department of the Environment and Heritage (DEH) (2003g). Sub-Antarctic Fur Seal and Southern Elephant Seal Recovery Plan - Background Paper. Available from: http://www.environment.gov.au/biodiversity/threatened/publications/seals.html.* *McMahon, C.R., M.N. Bester, H.R. Burton, M. A. Hindell & C.J.A Bradshaw (2005). Population status, trends and a re-examination of the hypotheses explaining the recent declines of the southern elephant seal Mirounga leonina. Mammal Review. 35:82-100.* *Shaughnessy PD. 1999. The Action Plan for Australian Seals. CSIRO Wildlife and Ecology, Natural Heritage Trust, Environment Australia.*
C08	**Matter**: Failure to consult with all coastal communities **Claim**: REGIA have ignored the communities of Lorne, Aireys Inlet, Anglesea, Torquay, Jan Juc, Barwon Heads, Ocean Grove and Point Lonsdale who share a strong understanding and appreciation of their marine environments. **Claim**: The lack of consultation on by REGIA in my community was staggering. REGIA held multiple community information workshops in Apollo Bay (I had to drive from Torquay one night to attend such a workshop) but none in Lorne, Aireys Inlet, Anglesea, Torquay, Jan Juc, Barwon Heads. **Claim**: Local environmental groups had to spend their own money and time to hold community information nights in Torquay and Barwon Heads in 2023 as a result of the lack of consultation by REGIA. Why did Apollo Bay get multiple community workshops and Torquay NONE! The community voice must be an important part of this consultation process.	CGG does not concur with claims relating to a failure to consult with all coastal communities, for the reasons stated below. A total of 11 community sessions were held at strategic locations based on the Environmental Planning Area (EPA) for the Regia MSS. Information exchange at, and following, these events allowed engagement to be co-designed. Initially, in a bid to mitigate consultation fatigue, events were held with another titleholder who had a proposed activity in the area. When requests were made by individuals on behalf of local environmental groups to hold standalone events, in requested areas, these were organised (Event ID's 1005, 806). The sessions were advertised in 9 local print newspapers, 3 targeted social media adverts and 272 radio adverts over 6 local stations and their websites. In addition, the collaborative titleholder placed 4 print adverts and 142 radio spots within the EPA to advertise these sessions. As per the response to Matter C02, CGG's process facilitated a broad capture of people and information, allowing self-identification and consultation co-design. Through desktop research and consultation, CGG became aware of local community groups, who were written to at the commencement and throughout the consultation period, and invited to engage in a manner that suited their needs (Person ID 315 & Org ID 117). CGG has not updated the EP in response to these claims.

	THEME	**CONSULTATION (C)**
#	***Comments received***	***Titleholder response***
C09	**Matter**: Inadequate public comment period **Claim**: The submitter strongly objects to the limited time of 30 days that community has been given to respond to this extensive and technical document. It equates to reading more than 100 pages per day for 30 days straight, and these pages are replete with obfuscation, padding, and vaguely worded claims. This allows no time to compile a reasonable response. It seems to us the cards are stacked against time-poor volunteers, and that CCG's intention is to overwhelm the layperson. **Claim**: The Environment Plan submitted by CGG to NOPSEMA, spanning 3,332 pages, is excessively lengthy. Given the 30-day public comment period, it does not afford the general public adequate time to review and respond appropriately. With individuals required to digest over 110 pages daily, this poses a challenge, particularly for those fully occupied with work commitments. **Claim:** Relevant persons are given only 30 days to review and provide feedback on the Regia MSS Environmental Plan. However, this plan is excessively long and repetitive, spanning 3332 pages of information that must be reviewed. This timeframe and volume of material make it unrealistic to expect fair and thorough public consultation on the proposed activities. **Claim**: We argue that this EP fails the requirement of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 as they relate to consultations and that it is not practicable for relevant persons to adequately assess this proposal within the allocated thirty day timeframe – particularly considering that this EP was released on a national public holiday one day prior to a weekend. In practical terms this has resulted in many relevant persons who might have taken the long weekend away from their inboxes missing three crucial days to read over and absorb the density of information and consider it on its merits. **Claim**: The EP has shouldered relevant persons for the purposes of consultation on this project with an unwieldy, incomprehensible and uncomprehensive document which is inaccessible within the 30 day public comment window.	Claims regarding the duration of the prescribed public comment period do not relate to the Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of these claims, they have not been considered further in preparing the EP. The 30-day period for public comment is prescribed in the Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023, section 30. Regarding relevant persons consultation, CGG extended the original consultation period twice to ensure relevant persons had a reasonable period with sufficient information to engage in the consultation process, as detailed in Section 3.3 of EP Appendix C1 (EVENT ID: 1182 & 3331). CGG also made draft EP chapters and technical supporting reports publicly available to relevant persons and the general public via the consultation hub, as follows: preparatory information uploaded 1 February and 31 March 2023, Establishing Context documents 31 March to 6 June 2023, Risk Assessments on the 11 September 2023, Impact Analyses on the 22 September 2023, and Impact and Risk Treatment on the 28 September 2023. When the public comment period closed on 26th February 2024 the draft EP chapters and supporting reports had been available to the public for 151 days at the minimum. Consequently, CGG considers that the consultation process has allowed ample opportunity for relevant persons to make an informed assessment of the possible consequences of the activity on their functions, interests, or activities. As a result, no changes have been made to the EP. NOTE: Claims regarding the volume of information required to be reviewed are addressed in response to Matter: C04
C10	**Matter**: Omissions triggering resubmission and new consultation process. **Claim**: Recognise that any omissions will require significant reevaluation of the plan and a resubmission for approval, and will also trigger a new consultation process as the risks and management strategies will have changed.	CGG acknowledges that under section 39 of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Environment Regulation) a titleholder may, in certain circumstances, be required to submit a revised Environment Plan (EP) under section 26 of the Environment Regulation. CGG has not updated the EP in response to these claims.

4. First Nations Heritage

	THEME	FIRST NATIONS HERITAGE (FN)
#	***Comments received***	***Titleholder response***
FN01	**Matter**: Acknowledgement of cultural values **Claim**: The proposed seismic blasting project is situated in important Sea Country for the Gunditjmara people, who have enduring spiritual and cultural connections to the area and marine life that lives within it. Their whale ancestors and kin, Koontapool, the southern right whale, and Wuuloc, the pygmy blue whale, are sacred to the Gunditjmara and hold a significant place in their cultural practices. The island of Deen Maar is part of the homeland of the Gunditjmara and Eastern Maar peoples and contains important cultural sites and artefacts as well as spiritual significance.	CGG acknowledges the Sea Country cultural values, identified through our consultation process and broad capture of information, and has appropriate management procedures in place. Cultural Hertiage values are mentioned throughout the Environment Plan (EP), along with Appendix B10 (Cultural Heritage Assessment), Appendix G4 (Sea Country Protection Plan), and Appendix C3 (Sensitive Information Report). **The EP has also been reviewed to ensure values are in alignment with the recently released Gunditjmara Nyamat Mirring Plan 2023 – 2033, and reference to this plan has been included in EP Appendix F2.** CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above.
FN02	**Matter**: Consultation with First Nations peoples. **Claim**: The consultation process has not adequately engaged with local First Nations communities or their representatives in order to determine the impact of this proposal on areas, or species, of cultural significance. **Claim**: The lack of meaningful consultation with [affected communities] and Indigenous groups raises serious concerns about the transparency and legitimacy of the approval process. **Claim**: Submitter recommends conducting thorough consultation with all First Nations People who may be impacted by the proposed seismic testing and prioritising consultation with local First Nations People to determine species and sites of marine and land cultural significance. **Claim**: The cultural significance of various areas and species, whilst mentioned, has also not appeared to receive adequate consultation as detailed in the EP. Ignoring the impacts of this proposal on the region's First Nations People is completely unacceptable. **Claim**: The environmental plan advises that First Nations people have been consulted in relation to CGG's proposed activity by posting a newspaper advertisement in a First Nation's newspaper. This method of communication is insufficient, as it requires affected parties to read that edition of the newspaper. **Claim**: CGG should advise whether every First Nations group that has a stake/interest in the area where CGG proposes to conduct seismic testing, has been properly consulted. **Claim**: There are many lands and title holders in the areas affected by this environmental plan, however it doesn't detail whether there has been consultation with all of the First Nations People whose land backs onto this observation area. **Claim**: Submitter recommends requesting full disclosure of which First Nations People were consulted regarding the proposed seismic testing.	CGG acknowledges claims relating to consultation with First Nations peoples associated with the Regia MSS and has reviewed the Environment Plan (EP) and the consultation process undertaken to ensure that the engagement process was adequately detailed and described. In developing the EP, CGG recognised that in the vastly deep culture of Indigenous Australians, there are often different cultural and consultation requirements that exist in the governance frameworks for the different Indigenous representative bodies. To respond to this, CGG undertook a tailored approach to First Nations consultation, seeking a co-designed process, which is detailed in EP Appendix C1, 3.1.11. Desktop research, engagement with government agencies, Cultural Heritage assessment reports, and advertising in First Nation specific publication were undertaken, in addition to the extensive in-community print and radio advertising (see Appendix C1, 3.1.3), to ensure a broad capture approach. CGG sought input and feedback from the First Nations groups, on how they require consultation to be undertaken, including considerations to reduce burden and consultation fatigue. All available methods of communication were offered, including meetings on Country and in groups. Bespoke communications were offered, to assist in communicating technical information, potential impacts and devised measures, as well as reducing burden, as CGG's consultation logs demonstrate (Appendix C3, 2 & Appendix C4). As a result of consultation during the development of the EP, and in recognition of First Nations groups' stewardship of their heritage and Country, CGG has committed to establishing a Sea Country Protection Program (SCPP), designed to identify, preserve, and protect cultural heritage sites and values within areas of operations off the Otway coast. The SCPP process will also aim to find mutually beneficial outcomes between First Nations communities and the petroleum titleholders. The SCPP is described in EP Appendix G4. First Nations people and organisations have a right to privacy, so individual's names will not be provided publicly, however NOPSEMA will receive this information to aid in their decision making. Some organisations have requested they are kept confidential, as is their right through Clause 25(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023, which states that organisations may request that information provided to us not be published in the Environment Plan. Correspondence between CGG and all organisations will however be provided in full to NOPSEMA in a part of the Environment Plan which is marked as sensitive and will not be published. CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Affected communities are addressed in response to Matter: C02. NOTE: Threats to culturally importance marine species (general) is addressed in response to Matter: C04
FN03	**Matter**: Impacts to ecosystems protected by First Nations peoples. **Claim**: First Nations people have protected and nurtured the ecosystems of the lands, sea and air of this continent for tens of thousands of years and this whale songline Country is of no exception. To seek to exploit and profit off its destruction is antithesis to First Nations justice and respect and will tether all semblance of respect and dignity to the company. **Claim:** Seismic blasting does not have community licence. In the proposed operation area, it will impact: whale habitat, endangered marine life, Southern Sea Country, the Zeehan Marine Park,	CGG acknowledges claims relating to impacts to ecosystems protected by First Nations peoples and has reviewed the Environment Plan (EP) to ensure the matter has been adequately assessed. CGG acknowledges the cultural, spiritual, and caretaker connection to Country, of First Nations people. The Regia EP preparation process included the assessment of activity impacts and risks and the development of control measures that will reduce these to As Low as Reasonably Practicable (ALARP, see Appendix F2) and designed with the principles of Ecologically Sustainable Development (Appendix F4) underpinning decision making. This process consistently reflected a commitment to safeguarding the marine environment, reducing environmental impacts and risks, and preserving the interests of future generations (Appendix F3, Acceptable Levels of Impact and Risk). CGG has developed a Fauna Management Plan (FMP, Appendix G2) that governs the

	THEME	FIRST NATIONS HERITAGE (FN)
#	***Comments received***	***Titleholder response***
	the Budj Bim Eel conservation area, [and commercial fisheries]. The food chain will be severely affected, with carry-on effects from zooplankton to fish, to whales. **Claim**: The project threatens important cultural heritage sites and lacks consent from First Nations custodians. **Claim**: The proposal to conduct seismic blasting for oil and gas exploration in our oceans will cause irreparable harm to ocean ecosystems and sacred Nyamat Mirring. This area is the ancestral lands of Gunditjmara people and part of their cultural heritage. **Claim**: The CGG proposal should be rejected outright rather than threatening Koontapul, Yarramila, and other marine creatures.	protection of marine fauna interactions during the survey. The FMP has clear guidance for on-water actions to protect marine fauna, along with shoreside support, decision, and review mechanisms to improve the fauna management system over time. CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Lack of meaningful public/ community consultation is addressed in response to Matter: C02. NOTE: UN Declaration on the Rights of Indigenous Peoples and consent is addressed in response to Matter: FN08 NOTE: Consultation regarding, and impacts on eels are addressed in response to Matter: FN04. NOTE: Impacts to Whale and Whale songlines are addressed in response to Matter: FN05. NOTE: Impacts on seaweed and cultural practices are addressed in response to Matter: FN06 NOTE: Productivity, including the Bonney Upwelling, is addressed in Matters: P01-P11
FN04	**Matter**: Consultation regarding, and impacts on, eels **Claim**: We note that local First Nations People were not consulted about the likely effects of seismic blasts on larval eels. **Claim**: Regia must consult with the First Nations people at Budj Bim to honestly and explicitly explain the damage that will ensue from the seismic blasting of the ocean and the consequent destruction of the eel larvae and get the response from these traditional owners. First Nations People must have the right of veto on whether damaging activities are allowed to take place on their Sea Country. **Claim**: Specific information relating to the effects of seismic basting on short fin eels needs to be explored as the migration patterns of the eel are intricate. Eels are vulnerable throughout their life cycle and have a single opportunity to successfully reproduce (14). Larval eels return on ocean currents to southwest Victoria and there is every likelihood, they will die during seismic blasting activity. [14. Koster, W. et al (2021, Nov.) Fast tracking of the oceanic spawning migrations of Australasian short finned eels. Retrieved February 4th , 2024 from: https://www.nature.com/articles/s41598-021-02325-9] **Claim**: The killing of eel larvae in the ocean by seismic blasting would have a devastating effect on the work done by the Gunditjmra people in the present times to repair and recreate the eel system at Budj Bim. It was destroyed by the European settlers who knew no better, but the proponents of seismic testing do know that seismic blasting kills larval fish and larval eels. **Claim**: The Short-Finned Eel is of great cultural significance to the indigenous Gunditjmara people. No studies have been done on the effect of seismic blasting on the “near threatened” Short-finned Freshwater Eel.	CGG acknowledges claims relating to consultation with First Nations People regarding, and impacts on, eels (Kooyang) and has reviewed the Environment Plan (EP) to ensure to ensure the matter has been adequately assessed. As described in Matter FN02 above, CGG undertook a comprehensive and tailored approach to the identification of relevant First Nations people, groups, and information. During this process, guided by the cultural heritage assessment report (Appendix B10) and consultation with First Nations organisations, the First Nations connection to Kooyang (Eels), and the Budj Bim Cultural Landscape World Hertiage Area eel traps, was identified. EP Appendix E3, Underwater Sound (Fish), Section 4.1.9., assessed both the Short-finned and Long-finned Eel, and the First Nations Connection to Eel, with impacts to Eels described in Section 6.5 of the appendix. The paper listed in the adjacent claim was referenced in this assessment. From the detailed assessment undertaken it was identified that the Operational Area (area potentially impacted by underwater sound) does not overlap habitat associated with the Long-finned Eel, with no effect to World Heritage values of Budj Bim as the aquaculture systems are outside of the area that may be affected by underwater sound. As detailed in EP Appendix F3, Section 5.2.5, there is no evidence to support an expectation of significant and measurable cumulative impacts to short-finned eels as a result of the Regia MSS. **Having considered these claims, a Fact Sheet summarising CGG’s assessment of Glass Eels, previously provided to First Nations organisation during ongoing consultation, has now been made publicly available on the website. This is evidenced in Appendix C5 of the EP.**
FN05	**Matter**: Impacts on whales and whale songlines **Claim**: The Traditional owners, keepers of whale songlines, hold grave concerns about the impact on whale migration should this go ahead as it is within 61km of whale birthing areas. They say this project has no permission to proceed. **Claim**: The Southern Right Whale are of strong cultural significance for the Gunditjmara Traditional Owners. The EPBC Act requires that the significance of this marine area and species such as the Southern Right Whale to First Nations people must be properly considered. The EP does not adequately address this requirement of the or other requirements laid out in international First Nations covenants to which Australia is signatory. **Claim**: Any negative impacts from seismic blasting on whales contravene the cultural and spiritual stories of local, coastal First Nations peoples. **Claim**: We also acknowledge the continuing connection and cultural practices of the First Nations peoples who have been stewards of the Sea Country extending across the coastal areas now	CGG acknowledges claims relating to impacts on whales and whale songlines and has reviewed the Environment Plan (EP) to ensure these have been adequately considered. As discussed in response to Matter FN02 above, CGG undertook comprehensive desktop research and a consultation process with First Nations organisations, allowing a broad capture of information, such as the cultural and spiritual significance of whale’s, whale songlines, ceremony and whale dreaming (see Appendices C1 (Section 3.1.11), C2 and C3). Control measures designed to protect the marine environment, such as shut down zones, no discharge of the sound source at full power in water depths less than 50 m, a Fauna Management Plan (Appendix G2) and the Sea Country Protection Program (Appendix G4), will ensure Sea Country values and sensitivities are protected. EP Appendix F3 (Acceptable Levels of Impact and Risk) outlines CGG’s commitment to managing environmental impacts and risks to within acceptable levels and demonstrates how this will be achieved. In this document Southern Right Whales and Blue Whale are identified as key environmental values and sensitivities, with further assessments provided in Sections 5.2.1 and 5.5.5 respectively. **Having considered these claims, the identified potential impacts and their measures concerning First Nations cultural values regarding whales, will be added to Appendix G2, Fauna Management Plan.**

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#	***Comments received***	***Titleholder response***
	known as Victoria since time immemorial. We note that their ability to practice their culture is a human right protected by Australian and international human rights law. Accordingly, we do not support any disruption to cultural practices and songlines of those First Nations peoples related to whale migration pathways and breeding cycles which are at high risk due to the seismic survey. **Claim**: The whales are part of the song lines of First Nationsâ€™people past, present and future they are the archives. If we respect Country we stop seismic testing. For thousands of years First Nations people have recorded whale knowledge in stories, art, music creating an archives of previous human survival through climate and environmental change. Testing disrupts breeding and causes static and disturbances for the whales. **Claim**: Seismic testing is destroying the vibration of the ocean that the whales depend on for communicating and their life. This cannot and should not continue it is shameful to First Nations people and makes a mockery of Australiaâ€™s tourism based on protecting whales.	NOTE: Impacts to Southern Right Whales, including migration and biologically important areas, are addressed in response to Matters: M14-22. NOTE: Impacts to Blue Whale are addressed in response to Matters: M23-26. NOTE: The UN Declaration on the Rights of Indigenous Peoples is addressed in response to Matter: FN08, below
FN06	**Matter**: Impacts on seaweed and cultural practices. **Claim**: Avoiding the bonny upwelling to protect planktonic species is not adequate for protecting the reproductive life cycle of seaweed, as they breed much more openly and broadly throughout the proposed zone. Impacts upon these species, also greatly impacts the ability of Wathaurong and Eastern Maar peoples to continue their cultural practices, as seaweeds remain extremely important cultural species, especially for women (unpublished + unpublished research, Z Brittain Deakin Uni, R Thurstan Exeter Uni).	CGG acknowledges claims relating to impacts on seaweed and cultural practices and has reviewed the Environment Plan (EP) to ensure the matter has been appropriately considered. A comprehensive description of kelp, including survey findings along the Otway shelf from Warrnambool to Portland, is provided in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages). **Although there is no evidence to suggest that the Regia MSS will have any material effect on marine algae populations in the region, having considered these claims, the research below will be added to Appendix E2 (Impact Assessment – Underwater Sound: Plankton) to ensure that this consideration is captured within the EP.** **In Australia, shallow (<30 m) temperate reefs are defined largely by the distribution of *Ecklonia radiata* kelp forests, which span more than 8000 km of coastline from the subtropical waters of northern New South Wales down the east coast of mainland Australia, around Tasmania, along Australia's southern coastline and north as far as Kalbarri in Western Australia (Bennet et al 2015). Most of Australia's kelp-dominated temperate reefs lie within the 'coastal zone' under state jurisdiction (3 nautical miles or 5.5 km from shore) (Bennett et al 2015). On the south and west coasts of Australia, E. radiata forests typically occur in mosaics of mixed species with large canopy-forming fucoids (e.g. *Cystophora spp*., *Scytothalia dorycarpa*), covering most of the rocky reefs.** **Timing of reproduction is variable across its distribution range with seasonal peaks in Western Australia and more continuous reproduction of sori and zoospores in Tasmania. Water temperature is the key driver of reproductive timing but is also influenced by other variables such as wave action. Once E. radiata zoospores are released, they have the ability to swim for at least 24 h (although they often do so for only 1–2 h), until they settle onto the substratum and germinate into male or female gametophytes. Ecklonia radiata can disperse via three modes; zoospores, sperm and detached fertile drift material. Population genetic studies on E. radiata using neutral microsatellite markers (Dolman & Coleman 2009, reported in Wernberg et al 2019) have identified that genetic structure around the Australian continent is weak, suggesting widespread gene flow that is mediated by the strength and direction of prevailing ocean boundary currents. Such strong connectivity should imbue considerable resilience on this species, however climate change is operating at such a large scale that warming temperatures are negatively affecting kelp across its entire range.** **Due to the depths associated with the activity action zone, with no discharge of the sound source at full power to occur in water depths less than 50 m, impacts on larger plants and nearshore planktonic phases arising from the activities associated with the Regia MSS are not anticipated. There is no scientific information on the potential for noise-induced effect in macroalgae and no functional cause-effect relationship has been established. Therefore, impacts from acoustic disturbance on macroalgae/ marine flora, or associated cultural values has not been considered further.** **It is understood there is potential for kelp in shallower, more coastal areas to be impacted in the highly unlikely event of a marine oil spill, and a detailed description of kelp, its cultural and seaweed industry value, and risks to kelp associated with a spill are detailed in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages), 6.14 (Seaweed Industry) and 6.17 (Protected Areas).** ***References:***

	THEME	FIRST NATIONS HERITAGE (FN)
#	***Comments received***	***Titleholder response***
		Bennett Scott, Wernberg Thomas, Connell Sean D., Hobday Alistair J., Johnson Craig R., Poloczanska Elvira S. (2015) The 'Great Southern Reef': social, ecological and economic value of Australia's neglected kelp forests. Marine and Freshwater Research 67, 47-56. *Wernberg, T., Coleman, M.A, Babcock, R.C., BELL, S.Y., BOLTON, J.J., Connel, S.D., Hurd, C.L., Johnson, C.R., Marzinelli, E.M., Shears, N.T., Steinberg, P.D., Thomsen, M.S., Vanderklift, M.A., Vergés, A., Wright, J.T. (2019) Biology and ecology of the globally significant kelp Ecklonia Radiata. Oceanography and Marine Biology: An Annual Review, 2019, 57, 265-324.*
FN07	**Matter**: Inadequate/ inappropriate measures. **Claim**: The measures the titleholder proposes to adopt because of consultations are inappropriate, as is required by regulation 34(g)(i) of the Regulations, in relation to cultural rights. **Claim**: The EP fails to properly address cultural heritage concerns of Indigenous peoples.	CGG acknowledges claims relating to perceived inadequacy of measures in place to protect cultural heritage and has reviewed the Environment Plan (EP) and measures proposed in response to these claims. It is important to acknowledge the mistakes of the past in assuming knowledge about First Nations values and how they can be protected. This is why we have consulted with First Nations groups and individuals to the best of our ability and have proposed a Sea Country Protection Program (SCPP) that acknowledges the stewardship of Country (EP Appendix G4). The SCPP is proposed to be co-designed and co-implemented with First Nations peoples with Sea Country within or adjacent to operational areas. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
FN08	**Matter**: UN Declaration on the Rights of Indigenous Peoples. **Claim**: Submitter supports First Nations peoples and calls on NOPSEMA to recognise that under the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), the principle of Free, Prior, and Informed Consent (FPIC) is a specific right granted to Indigenous Peoples, which aligns with their universal right to self-determination. Furthermore, FPIC allows First Nations peoples to provide, withhold or withdraw consent at any point regarding projects impacting their territories. Submitter recommends that NOPSEMA refuse this EP given the objections raised by First Nations peoples regarding seismic blasting in their Sea Country and the potential impacts on culturally-significant wildlife and habitats. **Claim**: Gunditjmara Traditional Owners have the right to determine what happens to country. According to Article 32, Item 2 of the UN Declaration on the Rights of Indigenous Peoples: states shall consult and cooperate in good faith with the Indigenous peoples concerned through their own representative institutions in order to obtain their free and informed consent prior to the approval of any project affecting their lands. **Claim**: Submitter understands that First Nations peoples have repeatedly voiced their opposition to the CGG proposal and their concern for the risk of damage to their culturally significant Sea Country, wildlife and landscapes. Submitter supports First Nations peoples and calls on NOPSEMA to recognise that under the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), the principle of Free, Prior, and Informed Consent (FPIC) is a specific right granted to Indigenous Peoples, which aligns with their universal right to self-determination. **Claim**: Submitter supports First Nations peoples and calls on NOPSEMA to recognise that under the UN Declaration on the Rights of Indigenous Peoples (UNDRIP), the principle of Free, Prior, and Informed Consent (FPIC) is a specific right granted to Indigenous Peoples and their right to self-determination. 49) 49. https://humanrights.gov.au/our-work/un-declaration-rights-indigenous-peoples-1	CGG acknowledges claims relating to the UN Declaration on the Rights of Indigenous Peoples (UNDRIP) and has reviewed the Environment Plan (EP) to ensure these rights have been adequately reflected. Noting that whilst Australia supports UNDRIP, it has not been implemented into law, policy and practice and consent is not a requirement under current regulations. The UN Declaration on the Rights of Indigenous Peoples "addresses both individual and collective rights, cultural rights and identity, rights to education, health and employment, language, and others. It outlaws discrimination against indigenous people and promotes their full and effective participation in all matters that concern them. It also ensures their right to remain distinct and to pursue their own priorities in economic, social and cultural development". The Declaration "explicitly encourages harmonious and cooperative relations between States and indigenous peoples". With Article 18 stating "Indigenous peoples have the right to participate in decision-making in matters which would affect their rights, through representatives chosen by themselves in accordance with their own procedures, as well as to maintain and develop their own indigenous decision-making institutions" (United Nations, 2007). CGG's alignment with this statement is reflected in the EP, through the co-design methodology of both consultation and activity, consultation efforts, information capture, impact assessments and the implementation strategy and measures, such as the Sea Country Protection Plan (see Appendix G4). CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
FN09	**Matter**: Acknowledgement of objections. **Claim**: The Environmental Plan does not adequately consider the objections of Traditional Owners and their concerns regarding the risk to culturally significant Sea Country. **Claim**: I respectfully ask that NOPSEMA refuse this Environmental Plan given the objections raised by First Nations peoples regarding seismic surveying in their Sea Country and the potential impacts on culturally-significant wildlife and habitats.	CGG acknowledges the public objection and concerns regarding First Nations matters and has reviewed the Environment Plan (EP) to ensure these rights have been adequately reflected. CGG undertook a tailored consultation strategy to allow a broad capture of information and identification of relevant First Nations individuals and groups (see Matter FN02). Cultural Heritage values are mentioned throughout the EP, along with Appendix B10 (Cultural Heritage Assessment), Appendix G4 (Sea Country Protection Plan), and Appendix C3 (Sensitive Information Report). Consultation, including concerns and objections, are recorded in full in Appendix C4, with summaries and feedbacks available in Appendix C2.

	THEME	FIRST NATIONS HERITAGE (FN)
#	***Comments received***	***Titleholder response***
	Claim: For the purposes of this consultation we acknowledge the Gunditjmara community, some of whom have shown strong opposition to seismic blasting in their cultural sea country. **Claim**: In particular we cite the Citizen's Protection Declaration10 written by representatives from the Southern Ocean Protection Embassy Collective: WE REFUSE ANY FURTHER FOSSIL FUEL PROJECTS ON OUR LAND AND IN OUR WATERS. We condemn all new and existing seismic testing and gas mining exploration approvals across the south west Victorian coastal waters covering Gunditjmara Sea Country. We demand an absolute stop to mining, drilling and other forms of environmental assault on Gunditjmara country, specifically areas of highly regarded cultural significance. These include sacred Whale Songline and Birthing Country and Sacred Women's Country. We refuse permits allowing resource extraction industries to continue operations and commit further advances of a foreign destructive colonial legacy. Drilling must be included alongside seismic testing as risks to whale safety under the Conservation Management Plan for the Southern Right Whale: A Recovery Plan under the Environment Protection and Biodiversity Conservation Act. Greater regulatory provisions must be included under the Wildlife Act 1975 to include restrictions on ocean blasting and drilling. 10 https://drillwatch.org.au/	Through desktop research and engagement with other groups, CGG also learnt of objections from Southern Ocean Protection Embassy Collective (SOPEC) and its founder. First Nations persons were invited through multiple channels to participate in consultation during the development of the EP as evidenced in Appendix C4. Whilst some did not respond, their objections were researched and addressed. These efforts are documented in the Sensitive Information Report, Appendix C3. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
FN10	**Matter**: Compensation to First Nations Peoples. **Claim**: We also acknowledge the social impact on First Nations Communities of titleholders and project proponents offering financial compensation to Traditional Owners in return for their approval of projects. A startling demonstration of both the damaging impact on cultural areas and sea country as a whole, and the lack of natural social licence, Traditional Owner consent must be bought – it is clearly not given willingly. This leads to divisions within communities between those Traditional Owners who want to protect their cultural heritage at all costs and those who are willing to be bought off in order to overlook damage to their sea country. We consider this to be the most damning evidence of industry awareness of the damage caused by their operations, and their willingness to extend that damage into the social fabric of First Nations Communities.	CGG does not concur with claims relating to compensation to First Nations Peoples. CGG has not offered financial compensation to Traditional Owners in return for their approval of projects. CGG has committed to establishing a Sea Country Protection Program in consultation with First Nations Peoples with Sea Country within or adjacent to operational areas. This will be a partnership that supports the protection of Sea Country, and will align with the stated goal of the Gunditjmara Nyamat Mirring Plan 2023-2033 that seeks to "start a conversation and facilitate respectful, beneficial partnerships to help strengthen and heal Nyamat Mirring" (Introduction, 2023). CGG has considered these claims and is satisfied that the concerns raised have been appropriately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

5. Tourism, Recreation and Communities

	THEME	**TOURISM, RECREATION AND COMMUNITIES (T)**
#	***Comments received***	***Titleholder response***
T01	**Matter**: Impacts on coastal communities (general) **Claim**: This seismic blasting proposal by CGG should be refused by NOPSEMA due to the impacts on coastal communities, marine life and our oceans. **Claim**: This proposal is totally out of touch for what is best for the region and for the public. **Claim**: This region harbours immense cultural and economic worth that will live far beyond our changing dependence of fossil fuels. It is imperative that we consider at the lasting, irreparable impact this testing could do.	CGG acknowledges claims relating to impacts on coastal communities and has reviewed the Environment Plan (EP) to ensure potential impact were appropriately considered. When designing the activity, it was recognised that communities along the Otway Coast are deeply intertwined with this marine ecosystem. Their livelihoods, predominantly fishing and tourism, are directly linked to the health of the marine environment. There is a growing body of literature exploring the socio-economic dependence of these communities on the marine ecosystem, highlighting the need for sustainable management practices. Cumulative impacts on the areas' key environmental sensitivities and values have been assessed in EP Appendix E10 (Cumulative Impact Assessment). As shown in Annex 2 – CIA Scoping Tool, whilst a number of socio-economic components were identified, the only potential material impacts identified concerned commercial fishing. Further assessment was undertaken and a number of measures, including activity limitations and an adjustment protocol, were put in place. Environmental aspects were screened against the components of the environment, to identify potential impacts (EP Appendix F1 (Regia MSS Environment Plan), Table F1-3) allowing further assessment and refinement through consultation, prioritising, identifying and preventing irreversible environmental damage. EP Appendix F4 (ESD Assessment) underlines the adherence to Ecologically Sustainable Development (ESD) principles, highlighting the integration of economic, social, and environmental considerations in decision-making processes and illustrating how the activity design process aligns with key principles like the precautionary approach, intergenerational equity, and conservation of biological diversity. Consequently, there is no irreversible environmental damage predicted from the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to this claim. NOTE: Lack of meaningful public/ community consultation is addressed in response to Matter: C02.
T02	**Matter**: No return to community **Claim**: This proposal offers our community little long-term return for considerable community cost. **Claim**: Flow on impact to regional communities, businesses and livelihoods.	CGG does not concur with claims regarding no return to community from the Regia MSS, nor claims regarding considerable community cost. CGG has devised an Environment Plan (EP) that ensures any potential impacts are managed to levels that are as low as reasonably practicable and acceptable, aligning the project with the key principles of Ecologically Sustainable Development (Appendix F4). This includes consideration of the Integration Principle, whereby the decisions made do not compromise the ability of future generations to meet their needs and enjoy a healthy marine environment. The Regia MSS will provide valuable information about the subsurface geology of the ocean floor. This information can be used for a variety of purposes such as oil and gas exploration, environmental studies, and natural resource management. Australia is facing challenges to the security of its domestic gas supply, specifically in the east coast gas market and a domestic gas supply shortfall could have serious consequences for Australians (DISR, 2022). Australians rely on gas for residential heating and cooking. Australian industry and manufacturers rely on gas as feedstock and for energy. Insufficient gas supply could impact the stable operation of Australia's electricity network. CGG has considered these claims and is satisfied that the concerns raised have been appropriately considered, as outlined above. As a result, no changes have been made to the EP in response to this claim. ***References****:* *DISR, 2022. Securing Australia's domestic gas supply – Options to improve the Australian Domestic Gas Security Mechanism (1 August 2022), Australian Government Department of Industry, Science and Resources. https://consult.industry.gov.au/securing-australias-domestic-gas-supply*
T03	**Matter**: Impacts on local livelihoods – Tourism **Claim**: The whole ecosystem is incredibly important and any proposals that will impact on that should simply not occur The likelihood for people of seeing wildlife in the region, and in particular the now increasing presence of whale activity along the coast, is in itself a tourist attraction; and needs to be nurtured not detrimentally impacted. **Claim**: This area of the Otway Coast has a well earned reputation as the calving place for southern Right , Humpback whales , many tourists travel to this area solely for this reason , the seismic blasting will endanger this livelihood of local tourism industry. **Claim**: This area is worth so much to Australias tourism industry and this proposal places this industry at risk.	CGG acknowledges claims relating to impacts on local livelihoods including tourism and has reviewed the Environment Plan (EP) to ensure the matter has been adequately assessed. When designing the activity, it was recognised that communities along the Otway Coast are deeply intertwined with this marine ecosystem. Their livelihoods, predominantly fishing and tourism, are directly linked to the health of the marine environment. There is a growing body of literature exploring the socio-economic dependence of these communities on the marine ecosystem, highlighting the need for sustainable management practices. Environmental aspects were screened against the components of the environment, to identify potential impacts (EP Appendix F1 (Regia MSS Environment Plan), Table F1-3 allowing further assessment and refinement through consultation, prioritising identifying and preventing irreversible environmental damage. Appendix G1 (Environmental Performance) details the control measures and environmental performance required for the activity to reduce environmental impacts and risks to As Low As Reasonably Possible (ALARP) and acceptable levels. It includes consultation outcomes and was updated throughout the consultation process. It demonstrates compliance with applicable regulations (Regulation 21 (5)(c) & Regulation 21(7)) whilst Appendix F2 (ALARP Assessment) contains additional or alternative control measures considered. Activity co-design also reflects this, with the activity design being adapted over time, through consultation. For example, consultation resulted in an activity limitation extending the water depth for 'no seismic acquisition' from no shallower than 30 m to no shallower than 50 m to reduce impacts to commercial

	THEME	TOURISM, RECREATION AND COMMUNITIES (T)
#	***Comments received***	***Titleholder response***
	Claim: As a member of the public whos job often relies on the health of he ocean and presence of the Southern Right Whale and Humpback Whales during migration, I feel decision makers must truly consider how such seismic blasting practices will impact not just the natural environments themselves, but the impact on the tourism/ecotourism businesses along the south-west coast of Victoria. **Claim**: Submitter recommends assessing the impacts of proposed activity on tourism; whale watching cruises often include dolphin watching; assessing the impacts of proposed activity on tourism, such as whale watching. **Claim**: I live in Melbourne but I travel to SA to snorkel in the unique and beautiful marine environments. Thinking of seismic blasting interfering with marine life such as whales is very upsetting for me and definitely would reduce my likelihood of tourism to SA in the future. **Claim**: Both fishing and whale watching are massive tourist draw cards that contribute a large amount of money into the local economy. I cannot fathom why we would put this and other aspects of our marine environment at risk for a fossil fuel that is only going to contribute to fuelling the greenhouse effect. **Claim**: Not only is this harmful to the marine life around my hometown, it is also heartbreaking to the townspeople and the people who come to visit to see the whales every year. **Claim**: You can't tell me that seismic testing will have little, to on impact on the delicate ecosystem that we have. And if that ecosystem is damaged or destroyed, so could be the vital tourism that supports much of our population.	and recreational fishers, surfers, swimmers, and coastal users. Additionally, whale mitigation zones around survey vessels where activities are restricted to reduce the risk of disturbance to marine mammals were implemented, and acquisition within the Bonney Coast Upwelling Key Ecological Feature and the Southern Right Whale reproductive BIA were excluded. The survey timing has also been adapted, from one 6-month window to two 3-month windows, reflecting additional measures for Blue Whales and upwelling/increased biodiversity periods. EP Appendix F4 (ESD Assessment) outlines the adherence to Ecologically Sustainable Development (ESD) principles, highlighting the integration of economic, social, and environmental considerations in decision-making processes and illustrating how the activity design process aligns with key principles like the precautionary approach, intergenerational equity, and conservation of biological diversity. Consequently, there is no irreversible environmental damage predicted from the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Consideration of flow-on impacts is addressed in response to Matter: T07, below NOTE: Productivity, including the Bonney Upwelling, is addressed in Matters: P01-P12 NOTE: Impacts on coastal communities (general), is addressed in Matter: T01, above
T04	**Matter**: Impacts on volunteer marine rescue units **Claim**: The proposal furthermore does not consider potential impacts on volunteer marine rescue (VMR) units that maybe tasked to respond.	CGG acknowledges claims relating to impacts on volunteer marine rescue units and has reviewed the Environment Plan (EP) to ensure to ensure the matter has been adequately considered. The activity has been designed to be compliant with all on-water safety regulations, assessed in Appendix B2 (Legislative Requirements), with control measures adopted to ensure any potential impacts and risks are reduced to As Low As Reasonably Practicable (ALARP) and acceptable levels. As described in Section 7.4.1 of EP Appendix G1 (Regia MSS Environment Plan), the activity will include one support vessel and one chase vessel, accompanying the acquisition vessel. The support vessel will be responsible for equipment and crew transfers and, when safe, assist in the recovery of lost equipment or unintentional garbage discharges. Support and/or chase vessels will accompany the seismic vessel during surveying operations to patrol and maintain a clear zone ahead of the vessel. This includes scouting for and communicating with commercial, recreational, shipping, and other marine users to ensure their safety. Local water safety organisations were contacted during the consultation process, with full text copies of correspondence available in Appendix C4. CGG has considered these claims and is satisfied that the concerns raised have been appropriately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
T05	**Matter**: Importance of little penguins for tourism **Claim**: The Environment Plan fails to recognise the importance of Little Penguins for tourism on page 2821. **Claim**: The Warrnambool (Middle Island) breeding colonies have been omitted, which is of concern given they are in proximity to the Operational Area and are significant for regional tourism https://www.nature.com/articles/s41598-017-16569-x	CGG acknowledges claims relating to the importance of little penguins for tourism has reviewed the Environment Plan (EP) to ensure this has been appropriately considered. EP Appendix E1 (Physical Presence) Section 5.1.4 (Marine Tourism) confirms that no areas of marine tourism were identified within the operational area. This is also shown on map 'MAP-REG-EPM-064 Little Penguin Biologically Important Areas', in Appendix B12 (Regia MSS Maps). The Middle Island Little Penguins were identified in the Preliminary Environmental Impact and Risk Assessment (EP Appendix B4), and via the online interactive map comments. Further, engagement was undertaken with relevant specialists in this area. The potential impacts assessed, with measures adopted where required, are described in detail in EP Appendix E5 (Impact Assessment - Underwater Sound: Birds), namely in Sections 2, 4.5, 6 and 7. CGG has considered these claims and is satisfied that the concerns raised have been appropriately considered in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

	THEME	TOURISM, RECREATION AND COMMUNITIES (T)
#	***Comments received***	***Titleholder response***
T06	**Matter**: Changes to dolphin migration patterns affecting tourism **Claim**: If the dolphin migration patterns through the Operational Area are changed, this will have adverse impacts on tourism businesses, even if they are not in the Operational Area.	CGG acknowledges claims relating to impacts on dolphins affecting tourism and has reviewed the Environment Plan (EP) to ensure that these impacts were appropriately considered. Dolphins were identified as being present in the operational area in the Protected Matter Search Tool (PMST, Appendix B5), and potential impacts and thresholds were identified in the Underwater Sound Impact Assessment (Appendix E7). Six dolphin species were identified which are likely or may occur in the area, none of these species are threatened or have biologically important behaviour in the area. As detailed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), impacts to dolphins, which are classified as high-frequency (HF) cetaceans, are limited to avoidance behaviour out to 2.95 – 10.3 km from the sound source, depending on where in the Operational Area the survey is being undertaken. As HF cetaceans are not dependent on any specific area within the area affected, impacts may occur to individuals but not at a level to reduce fitness. Predicted impacts to dolphins are limited to temporary / reversible and small scale behavioural response and are not predicted to result in changes in migration patterns or impacts at a population level. CGG has considered these claims and is satisfied that the concerns raised have been appropriately considered and assessed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
T07	**Matter**: Consideration of flow-on impacts **Claim**: Consideration of the flow-on impacts needs to be provided, with identification and assessment of the risks, impacts and consequences for: a) The local region overall – communities, businesses, livelihoods, and jobs b) The social costs associated with such impacts and consequences c) Fishing and tourism in the short and long term need to be assessed.	CGG does not concur with claims regarding a lack of consideration of flow-on impacts associated with the Regia MSS, for the following reasons. EP Appendix F4 describes how the Regia MSS EP preparation process aligns with the principles of Ecologically sustainable Development (ESD). The assessment of the Regia MSS Environment Plan (EP) preparation process against the principles of ESD demonstrates CGG's strong commitment to responsible and sustainable offshore petroleum activities in Australian waters, ensuring that the cost of protecting natural and human capital is adequately considered. The adherence to ESD principles, as enshrined in the Regulations, underscores the importance of integrating economic, social, and environmental considerations into the decision-making processes surrounding petroleum operations. From the precautionary approach to intergenerational equity and the conservation of biological diversity, the EP process consistently reflects a commitment to safeguarding the marine environment, reducing environmental impacts and risks, and preserving the interests of future generations. CGG has considered these claims and is satisfied that the concerns raised have been appropriately considered and assessed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

6. Marine Mammals

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
M01	**Matter**: Impacts to marine mammals (general) **Claim:** There are various inadequacies in the proposal's Environment Plan (EP), emphasising potential irreparable harm to marine ecosystems, particularly endangered species such as southern right whales and Australian sea lions. **Claim:** I am particularly concerned about the impact on whales. **Claim:** The Environment Plan (EP) submitted by CGG to NOPSEMA lacks clarity and fails to adequately address the potential impacts of seismic blasting on marine life, particularly EPBC-listed species such as southern right whales and Australian fur seals. **Claim:** The Environment Plan (EP) submitted to NOPSEMA by CGG is a convoluted and incomprehensible 3,332 page document fails to provide sufficient detail on the impacts of seismic blasting on the endangered southern right whales and Australian sea lions. **Claim:** In particular, there is a lack of detail on the presence of numerous/ several EPBC-listed species, including Endangered marine mammals (including blue whales, southern right whales and Australian sea lions), and what enforceable measures will be taken to ensure that the key ecological features and threatened species in the proposed project areas will not be harmed. **Claim:** In particular, there is a lack of detail on the presence of several EPBC-listed species, including the endangered southern right whale, endangered Australian fur seals, vulnerable fin and sei whales and dwarf and pygmy sperm whales. **Claim**: It fails to demonstrate management practices that would guarantee the health and wellbeing of whales and other marine life. **Claim:** This seismic blasting proposal by CGG should be because of the extreme harm it poses to all other cetaceans, marine mammals and in fact the entire marine ecosystem in our southern ocean.	CGG acknowledges claims regarding impacts to marine mammals associated with the Regia MSS, particularly to endangered species such as Southern Right Whales (SRWs) and Australian Sea Lions and have reviewed the Environment Plan (EP) to ensure that impacts to these species have been adequately assessed. Impacts and risks to marine mammals, including SRWs and Australian Sea Lions, have been assessed in: • Appendix D1 (Risk Assessment – Accidental Release of Materials and Waste Overboard) • Appendix D2 (Risk Assessment – Collision with Marine Fauna) • Appendix D4 (Risk Assessment – Accidental Release of Fuel) • Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) • Appendix E10 (Impact Assessment – Otway Cumulative Impact Assessment Refer to responses M06, M08 and M09 for further explanation of how impacts to marine mammals, particularly whales, are assessed in the EP. Refer to responses M27, M28 and M29 for further explanation of how sea lions are assessed within the EP. CGG is confident that impacts and risks to marine mammals have been thoroughly assessed in the EP. The EP also includes identification of mitigation and management measures in each impact assessment section (see appendices listed above), including a Fauna Management Plan (Appendix G2) that outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. In accordance with the control measures set out in the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with all environmental regulatory requirements. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
Key Matter: Impact Assessment for Cetaceans		
M02	**Matter:** Timing and duration of impacts **Claim:** The proposed start date for this operation is April 2024, and CGG is proposing to conduct seismic blasting year round except for January, February and March. Seismic blasting in the remaining 9 months within the Operational Area (OA) would take place over Biologically Important Areas (BIA) for EPBC-listed whale species, threatening critical feeding, calving and migration routes. Specifically: • May to October is calving period for the EPBC-listed Endangered southern right whale in this region, and they will be migrating through the OA and the broader Environment Planning Area before and after this calving period. • October to June is the feeding period for the EPBC-listed Endangered pygmy blue whale, with the OA situated completely within the whales' designated foraging BIA. January through to April is the peak feeding time for this species.	CGG acknowledges claims regarding impacts to marine mammals over the duration of the Regia MSS and has reviewed the Environment Plan (EP) to ensure that the duration of the activity has been adequately described. Although the term of the EP is effectively four and a half years (earliest start date for operations is 1 April 2024, and latest finish date for operations is 31 October 2028), the activity will not occur continuously over that period. EP Appendix A2 (Description of Activity) Table A2-3 (Operating envelope parameters) provides details on the actual operational duration of the activity with the maximum number of operational days specified as 90 continuous days and the maximum number of acquisition days specified as 60 days. Consequently, the marine seismic survey will not be conducted 'year round' as stated in the claim. Information on the Environment Protection and Biodiversity Conservation Act 1999 listing and seasonal presence of Southern Right, Pygmy Blue, Sei, Fin and Pygmy Right Whales, as well as other species, is provided in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), with excerpts provided below: • The peak period for **Southern Right Whale** (SRW) mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. Calving females are known to have high site fidelity and a 3 to 4-year calving interval. Other population classes stay for shorter and variable periods undertaking coastal movements and departing the coast earlier than female-calf pairs (CoA 2012).The PMST Report identified that Southern Right Whale breeding is known to occur within area that may be affected by

	THEME	**MARINE MAMMALS (M)**
#	**Comments received**	***Titleholder response***
	• January to April is the foraging period for the pygmy right whale, Vulnerable fin whale and Vulnerable sei whale in the OA.	underwater sound, in addition the area where the noise effect criteria for SRW is reached is within the migration BIA and reproduction BIA (Appendix B12 MAP-REG-EPM-069). • **Pygmy Blue Whales** (PBW) Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015e). Pygmy Blue Whales then move southeast to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015e). The area that may be affected by underwater sound is within the Pygmy Blue Whale foraging (annual high use) BIA (Appendix B12 MAP-REG-EPM-068). Blue Whales predominately occur in this area between January to April (DoE 2015e) though they have been recorded in the Otway area as early as October and as late as June. • There are no BIAs for the **Fin Whale** within Australian waters. Fin Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April. • There are no BIAs for the **Sei Whale** within Australian waters. Sei Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately occur between January to April. • There are no BIAs for the **Pygmy Right Whale** within Australian waters. Pygmy Right Whale are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April. Impacts and risks to marine mammals, including impacts to biologically important behaviours (feeding, calving and migration) have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna), where relevant. Measures to mitigate impacts are also detailed in these Appendices and in the Fauna Management Plan, included in Appendix G, that includes whale detection and measures to minimise anthropogenic noise threats to whales, associated with the survey and, vessel strike for all species. EP Appendix F2 (ALARP Assessment) Section 6.1 includes additional measures to protect these species during biologically important behaviours, such as: • Minimising the duration of the survey to a maximum of 60 days of acquisition • Surveying shallower SRW BIAs between November and April when this species is not known to be present. • Not surveying during the months of January-March and managing potential interactions with PBWs, and other foraging species listed above, given the larger spatial distribution of the population through the shoulder seasons, i.e. through the implementation of the Fauna Management Plan. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including these species and identifies: • There will be no impact to SRWs within reproduction BIAs based on spatial and temporal exclusion zones, and the energetic costs of behavioural disturbance on migration would be extremely low, if avoidance behaviour occurred, and would not impact the recovery of the species. • As the Regia MSS will only occur during one season when blue whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). The Regia MSS will not impact on the recovery of the population. CGG has considered these claims and is satisfied that the potential impacts and risks have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
M03	**Matter**: Consideration of presence of cetaceans all year round **Claim:** The REGIA Environment Plan does not take into consideration the year round presence of different whale species whales in the Otway Basin. **Claim**: Submitter is of the view that seismic blasting within this area should be avoided entirely due to the evidence that shows vulnerable marine mammal species use this area year round.	CGG acknowledges claims regarding temporal presence of marine mammals in the Otway Basin and has reviewed the Environment Plan (EP) to ensure that the year round presence of different whale species has been adequately described. Information on the Environment Protection and Biodiversity Conservation Act 1999 listing and seasonal presence of Southern Right, Pygmy Blue, Sei, Fin and Pygmy Right Whales, as well as other species, is provided in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), with excerpts provided below: • The peak period for **Southern Right Whale** (SRW) mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. Calving females are known to have high site fidelity and a 3 to 4-year calving interval. Other population classes stay for shorter and variable periods undertaking coastal movements and departing the coast earlier than female-calf pairs (CoA 2012).The Protected Matters Search Tool (PMST) Report identified that Southern Right Whale breeding is known to occur within

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		area that may be affected by underwater sound, in addition the area where the noise effect criteria for SRW is reached is within the migration Biologically Important Area (BIA) and reproduction BIA (Appendix B12 MAP-REG-EPM-069). • **Pygmy Blue Whales** (PBW) Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015e). Pygmy Blue Whales then move southeast to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015e). The area that may be affected by underwater sound is within the Pygmy Blue Whale foraging (annual high use) BIA (Appendix B12 MAP-REG-EPM-068). Blue Whales predominately occur in this area between January to April (DoE 2015e) though they have been recorded in the Otway area as early as October and as late as June. • There are no BIAs for the **Fin Whale** within Australian waters. Fin Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April. • There are no BIAs for the **Sei Whale** within Australian waters. Sei Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately occur between January to April. • There are no BIAs for the **Pygmy Right Whale** within Australian waters. Pygmy Right Whale are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April. CGG undertook a presence/absence analysis of environmental receptors in the environment planning area to decide on the preferred timing of the activity. The outcome of the analysis can be found in EP Appendix F2 (ALARP Assessment) Section 6.1 (Survey Timing Constraints) and Annex 1 (Presence/ Absence Analysis for Species within the Environmental Planning Area). In acknowledgement of the varied timing of these species CGG has committed to a range of measures to mitigate and manage impacts to these species, including: • A change in timing preference to avoid the peak levels of biodiversity expected in the summer months (January/February/March). • Excluding the Southern Right Whale reproduction Biologically Important Area from the activity area. • Excluding activity from the Southern Right Whale reproduction Biologically Important Area (15 km) while Southern Right Whales are present. • No acquisition within 500 m of the Bonney Upwelling Key Ecological Feature (KEF), nor the West Tasmanian Canyons KEF. • The implementation of a comprehensive Fauna Management Plan (Appendix G2). CGG has considered these claims and is satisfied that the year round presence of different whale species has been adequately considered in the EP, as detailed above. As a result, the EP has not been updated in response to these claims.
M04	**Matter:** Overlap of the OA with the Australian Whale Sanctuary **Claim:** The Environment Plan states the operational area will overlap the Australian Whale Sanctuary and it being an offence to kill, injure or interfere with a cetacean. Seismic blasting is likely to contravene this legislation, leading us to ask 'why is seismic blasting allowed, when cetaceans will be interfered with?' Especially, as no safeguards can be sufficient to prevent this. **Claim:** The Environment Plan states the observation area will overlap the Australian Whale Sanctuary and it being an offence to kill, injure or interfere with a cetacean, the above impacts breach this act. These impacts should carry sufficient weight to put an immediate stop to this proposal.	CGG acknowledges claims regarding an overlap of the Operational Area (OA) with the Australian Whale Sanctuary and has reviewed the Environment Plan (EP) to ensure that the overlap was adequately considered. The Australian Whale Sanctuary includes all Commonwealth waters from the three nautical mile state waters limit out to the boundary of the Exclusive Economic Zone. Within the Sanctuary it is an offence to kill, injure or interfere with a cetacean. These restrictions are established to conserve all cetaceans in Australian waters under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). For species which are listed as threatened under the EPBC Act, which includes Blue Whale, Southern Right Whale, Sei Whale and Fin Whale, additional protections are afforded to these species through recovery plans prepared by the Australian Government (Department of Climate Change, Energy, the Environment and Water; DCEEW). Impacts and risks to marine mammals, including impacts to biologically important behaviours (feeding, calving and migration) have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna), where relevant. Measures to mitigate impacts are also detailed in these Appendices and in the Fauna Management Plan (Appendix G2), that includes whale detection and measures to minimise anthropogenic noise threats to whales, associated with the survey and, vessel strike for all species. Species-specific management plans, recovery plans and conservation advice have been taken into consideration when developing these control measures. Appendix F3 (Acceptability Assessment) of the EP demonstrates how the environmental impacts and risks of the Regia MSS will be of an acceptable level. Acceptability takes into account a broad framework of concepts in order to define acceptable levels, including Principles of ecologically sustainable development (ESD) and Legislative Context which both reference Section 3A of the EPBC Act. The principles of ESD in Section 3A of the EPBC Act refer to a set of guidelines aimed at promoting responsible environmental stewardship and sustainable use of natural resources. The six principles of ESD (as described in Appendix B1, Table B1-1) are designed to ensure that the EPBC Act can be adhered to,

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		including the protection requirements afforded to whales located within the Australian Whale Sanctuary (i.e., an offence to kill, injure or interfere with a cetacean within the defined area). The defined acceptable levels for the Regia MSS (Appendix B1, Section 5) relevant to marine mammals include: • The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage. • The impact and risk assessments are based on sufficient information to understand if: o Serious/irreversible environmental damage is predicted; or o The application of the precautionary principle is applied in the presence of scientific uncertainty. • Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans, and • Ecological Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem. In accordance with the control measures set out within the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to acceptable levels that are as low as reasonably practicable, in accordance with environmental regulatory requirements. CGG has considered these claims and is satisfied that the year round presence of different whale species has been adequately considered in the EP, as detailed above. As a result, the EP has not been updated in response to these claims.
M05	**Matter:** Animat modelling **Claim:** The EP states that, due to a lack of fine-scale behavioural data on southern right whales, CGG's animat modelling for southern right whales in the Otway Basin instead used data from North Atlantic right whales (EP p. 604, Appendix B7) and southern right whales in South America. This was the case for scenarios of southern right whale aggregation and migration. Of all the data used to inform the animat modelling for southern right whales, only the data on migration travel speed came from the south-east Australian population. Similarly for pygmy blue whales, the EP states that data on fine-scale foraging behaviour are not currently available for pygmy blue whales. Therefore, data from multi-sensor tags deployed on blue whales from the North Pacific were used to inform the feeding behaviours" (EP p.603, Appendix B7). Data from blue whales off the coast of California was also used. Only data on travel speed and surface interval were derived from studies on Australian pygmy blue whales. Given the independent expert advice regarding the importance of using species-specific and location-specific data to accurately model animal behaviour and associated potential impacts of seismic surveys, the submitter does not consider that CGG's animat modelling is fit for purpose. **Claim:** Northern hemisphere whale populations may be the closest analog to those in the Otway Basin, but there is considerable uncertainty about how these populations differ in their perception of, and physiological and behavioural reaction to, seismic surveys. Significantly, this knowledge gap is not acknowledged in the EP. These data sources and parameters demand scrutiny because the results of the animat modelling produced less conservative estimates of impacts to whales than did the sound propagation modelling in the EP" Animat modelling of impact thresholds for southern right whales show permanent threshold shifts (PTS) - permanent hearing loss - occurring at a maximum of 1.5 km from the seismic source, temporary threshold shifts (TTS) - temporary hearing loss - at 1.6 km, and behavioural impacts at 8.17 km. However, these modelled predicted maximum distances are smaller than those calculated by sound propagation modelling for baleen whales (4.89 km, 43.5 km, and 10.3 km, respectively).	CGG acknowledges claims regarding the analogues used for animat modelling and has reviewed the Environment Plan (EP) to ensure that the selection of modelling parameters and their applicability to the assessment has been adequately described. As described in Appendix B7 (Sound Modelling Report), the parameters used for forecasting realistic behaviours (e.g., diving and foraging depth, swim speed, surface times) by the JASMINE model are determined and interpreted from marine mammal studies (e.g., tagging studies) where available, or reasonably extrapolated from related or comparable species. In the case of this EP, animat modelling was undertaken to further understand potential behavioural changes resulting from underwater sound exposure. Acoustic modelling (Appendix B7) provides two main ways to describe the sound exposure from an underwater noise source – per pulse (i.e., exposure from each individual seismic pulse) and accumulated exposure (i.e., total exposure experienced over a time period of 24 hours). Although those parameters provide a good starting point for determining the nature and scale of potential impacts and for characterising received levels of sound at different distances, they do not provide a real-world understanding of how marine mammals will receive sound. Marine mammals are active individuals, with their movements and behaviours varying depending on complex biological factors. It is not credible that an individual would remain within constant distance of a sound source for 24-hours, primarily because the sound source will be moving (and hence the individual marine mammal would have to move at the exact same speed and trajectory to maintain exposure) but also because that does not align with what we know of marine mammal behaviours, based on published literature for specific and analogous species. Therefore, animat modelling has been used to provide a more realistic understanding of how marine mammal behaviour will affect potential exposure over extended periods of time. Animat modelling is just one tool used to understand the nature and scale of potential impacts to marine mammals from underwater sound emissions. Animat modelling offers a unique insight into how individual animals could behave in reaction to a sound source with the parameters of the planned Regia marine seismic survey, however the results from the modelling are used in conjunction with literature and other underwater sound modelling studies to fully describe the range of potential effects that could occur to sensitive marine mammal species. The methodology used to assess the overall level of identified impacts and risks acknowledges that uncertainty may exist within the assessment evaluation, with the uncertainty level highlighted in each impact evaluation section. In Section 6.3 of Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), the level of uncertainty in the assessment of impacts to LF cetaceans is assessed as high based on: • The sound effect criteria used in the impact assessment have been published in peer reviewed journals. • There is limited published data on noise studies specific to species. • The absence of direct hearing data for low frequency (LF) cetaceans continues to warrant substantial caution in attempting to predict their hearing capabilities and any potential susceptibility of their hearing to nose exposure (South et al. 2019). • An absence of long-term monitoring data of the effects of seismic on LF cetaceans in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region. This high level of uncertainty results in an overall impact level of high, and an application of the precautionary principle when selecting mitigation measures. Measures to mitigate impacts are also detailed in Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and in the Fauna Management Plan (Appendix G2), that includes whale detection and measures to minimise anthropogenic noise threats to whales, associated with the survey and, vessel strike for all species.

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	Despite the scientific uncertainty in the animat modelling - which was not accounted for or qualified - the results were nonetheless used to design mitigation measures that serve to ensure compliance with EPBC Policy Statement 2.1. "An 11.3 km buffer around southern right whale calving grounds has been presented as a sufficient treatment to prevent injury to southern right whales. The maximum distance for TTS for baleen whales is 43.5 km according to sound propagation modelling, making the 11.3 km buffer insufficient to mitigate harm to southern right whales in their calving grounds. By relying on the shorter distances generated by animat modelling (which is itself informed by data from different populations, introducing further uncertainty in the results), CGG could potentially expose EPBC-listed species to damaging levels of sound exposure. Based on this failure to qualify the results of the animat modelling in line with scientific best practice, adopt more conservative thresholds and design mitigation measures accordingly, the EP should be refused.	CGG has reviewed the discussion and reasoning around applying a >15 km activity limitation (M#01: Activity Limitation) buffer around a Southern Right Whale reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS. CGG is satisfied that the precautionary principle has been appropriately applied to the application of mitigation measures for baleen whales, and that animat modelling is suitably described in the EP. As a result, the EP has not been updated in response to these claims.
Key Matter: Impacts on Cetaceans		
M06	**Matter:** Underwater sound impacts on cetaceans (general) **Claim:** I am against seismic testing as it is very hazardous to sea life, in particular whales and dolphins. **Claim:** The noise from the seismic blasts will spread kilometres and be harmful to whales' hearing. **Claim:** Evidence that seismic blasting is extremely harmful to whales and other marine life is growing. (e.g. Ed Yong An Immense World London Bodley Head 2022). **Claim:** Not mentioned in the Regia application is the fact that seismic blasting has been connected to temporary and permanent hearing loss, habitat abandonment, mating and feeding disruption and possible death in marine mammals like whales. **Claim:** There is overwhelming scientific evidence that seismic blasting is extremely harmful and disruptive to whales and marine life. **Claim:** The Environment Plan is deeply flawed from a scientific perspective failing to acknowledge the science around the impacts seismic blasting has on whales and other marine life. **Claim:** Seismic blasting causes temporary and permanent hearing loss, abandonment of habitat, disruption to mating and feeding, beach strandings, and even death, to whales, dolphins and seals.2 The Otway Basin provides important habitat for such animals including protected sanctuaries for blue whales, southern right whales, and their calves. (2)RP Koper and S Plön, 'The Potential Impacts of Anthropogenic Noise on Marine Animals and Recommendations for Research in South Africa' (Endangered Wildlife Trust, 2012),https://biblioteca.biofund.org.mz/wp-content/uploads/2018/11/1542889906- 1727.Ewt%20Research%20&%20Technical%20Paper%201%20-%20Koper%20&%20Plon%20-20Ocean%20Noise%20Pollution.Pdf.	CGG acknowledges claims regarding impacts on cetaceans from underwater sound associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that impacts to these species were adequately assessed. CGG has provided a detailed discussion of the scientific literature outlining potential impacts to cetaceans from exploratory seismic surveys in EP Appendix B8 (Seismic Sound Studies Report, Section 7 Marine Mammals) and Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). CGG has reviewed the scientific literature provided in these claims and is satisfied that best available, peer reviewed literature has been used to inform impact assessment. Kavanagh et. al. (2019), cited in this claim, is included in Section 7 of the EP Seismic Sound Studies Report. Activity-specific underwater sound modelling (Appendix B7a and B7b Sound Modelling Reports) was commissioned to ensure that the extent of potential impacts to marine mammals were fully understood. In acknowledgement of the potential for the Regia MSS to impact cetaceans within the Otway Basin, CGG developed control measures in consultation with marine mammal experts, taking into consideration relevant Conservation Management Plans and all environmental regulatory requirements. Control measures to reduce impacts on cetaceans are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). Control measure M#03: Fauna Management System (Appendix G2) outlines whale and dolphin detection techniques and measures to minimise anthropogenic noise threats and the risk of vessel strike associated with the survey. The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. Mortal and potential mortal injury impacts are not predicted to occur as received sound levels are not of sufficient magnitude and injury (including permanent and temporary threshold shift) of cetaceans is not predicted as a result of the Regia MSS, as described in detail in EP Appendix F7 (Impact Assessment – Underwater Sound: Marine Mammals) and Appendix F3 (Acceptable Levels of Impact and Risk). Refer to the following responses for further details on potential impacts to cetaceans: • Impacts to cetaceans are predicted to be limited to behavioural responses as described in response to Matter: M05. • Impacts associated with strandings are addressed in response to Matter: M13. CGG has assessed the claims pertaining to underwater sound impacts to cetaceans and considers the detailed control measures included in the Fauna Management Plan will reduce the impacts associated with underwater sound to as low as reasonably practicable and acceptable levels. Consequently, no changes have been made to the EP in response to these claims.

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	Claim: Seismic blasting does not have community licence. In the proposed operation area, it will impact: whale habitat, endangered marine life, Southern Sea Country, the Zeehan Marine Park, the Budj Bim Eel conservation area, and commercial fisheries. The food chain will be severely affected, with carry-on effects from zooplankton to fish, to whales. **Claim**: Seismic blasting has been found to result in permanent damage and death for a diversity of species within marine ecosystems... larger species such as whales have been deafened or killed outright. **Claim:** I'm a coast and marine scientist myself and find it hard to ignore scientific evidence of the impact of seismic blasting on cetaceans and other marine life. https://www.nature.com/articles/s41***-***-****0-4 . **Claim:** Additionally, the sound waves generated by seismic blasting can have detrimental effects on marine mammals, such as deafening. **Claim**: It is well known these blasts damage, deafen, and kill aquatic mammals. **Claim:** Recommendations: Request studies into the effects of seismic blasts on whale populations.	
M07	**Matter:** Underwater sound and juvenile marine mammals **Claim:** Marine mammals don't have the hairs in their inner ears, and their ears are blocked off when underwater, but I wonder are infant marine mammals taken into account when safe distances from seismic blasting for different marine mammals are calculated? If not, it is a consideration that may impact whether the calculations are inclusive for young of seals, dolphins or whales. If they are based only on adults, they may not be appropriate or inclusive and therefore be void. **Claim:** NOPSEMA should reject the use of seismic blasting as proposed by CGG because safe sound level limits of seismic blasting for marine mammals do not take into account the significantly smaller size of juveniles and their consequent likely greater sensitivity and potential for harm. **Claim:** If calculations for safe sound levels for marine mammals are based on adult male measurements and the hearing and anatomy of young/smaller marine mammals is more sensitive and prone to harm from loud sound than adults, then the precautionary safe distances and sound levels to avoid harm for marine mammals will need to be adjusted before the project can be approved and undertaken.	CGG acknowledges claims regarding impacts of underwater sound on juvenile marine mammals and has reviewed the Environment Plan (EP) to ensure that this was appropriately considered. The behaviour of whale mother/calf pairs can be dramatically different from other demographics, particularly in regard to the amount of time spent resting at the surface (Cusano et al. 2019, Nielsen et al. 2019). Therefore, modelling conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences, for the EP (Appendix B7a and 7b - Sound Modelling Report) created separate behavioural profiles for differing species demographics. EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) Section 6.3 (Low Frequency Cetaceans) presents the result of Animat modelling conducted for whales undertaking biologically important behaviours such as Southern Right Whale mother and calf pairs and foraging differences between male and female Pygmy Blue Whales. In addition, the Animat modelling considers the vessel and whale movements and provides a more realistic prediction of the area that may be affect by underwater sound. Modelling results show that exposure ranges are, on average, slightly longer for TTS and PTS for mother and calf pair versus no calf Southern Right Whale scenarios as well. This is primarily due to the inclusion of nursing behaviour, where animals spend time stationary at the surface (Thomas et al. 1984), and the long duration of resting periods with slow travel speeds for mother/calf pairs (Hain et al. 2013). As a result, they accumulate more sound energy and are exposed for a longer time. Modelling also showed female Pygmy Blue Whale scenarios resulted in slightly larger exposure ranges than the corresponding male Pygmy Blue Whale scenarios. These detailed modelling results provide for extensive consideration whale sensitivities, and have informed the impact assessment, see Table E7-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Marine Mammals. CGG has considered these claims and is satisfied that the potential impacts to various species demographics have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims. ***References***: *Cusano, D.A., L.A. Conger, S.M. Van Parijs, and S.E. Parks. 2019. Implementing conservation measures for the North Atlantic right whale: Considering the behavioral ontogeny of mother-calf pairs. Animal Conservation 22(3): 228-237. https://doi.org/10.1111/acv.12457.* *Hain et al. 2013 - James H. W. Hain ,Joy D. Hampp,Sheila A. McKenney,Julie A. Albert,Robert D. Kenney. Swim Speed, Behavior, and Movement of North Atlantic Right Whales (Eubalaena glacialis) in Coastal Waters of Northeastern Florida, USA. Published: January 10, 2013. https://doi.org/10.1371/journal.pone.0054340* *Nielsen, M.L., L. Bejder, S.K. Videsen, F. Christiansen, and P.T. Madsen. 2019. Acoustic crypsis in southern right whale mother–calf pairs: infrequent, low-output calls to avoid predation? Journal of Experimental Biology 222(13): jeb190728.* *Thomas et al. 1984*

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M08	**Matter**: Underwater sound affecting biologically important areas **Claim:** This initiative poses an imminent threat to the delicate marine ecosystem, particularly endangering the critical habitats of the southern right whales and other marine life in the region. **Claim:** I am opposed to seismic blasting so close to an environmentally sensitive area. It does not align to the environmental plan of protecting the marine environment. **Claim:** This is the last regular calving ground for the 300 remaining southern right whales and inside crucial feeding areas of endangered blue Pygmy whales. The risk is too great. **Claim**: All marine life ONLY have the ocean for their homeâ€¦ for them to suffer by becoming deaf, and unable to communicate is beyond harrowing! I hope there is an urgent review, followed by action, to cease seismic blasting and prioritise the welfare of our beautiful water creatures! **Claim:** Seismic blasts can damage the hearing of whales and keep them away from key feeding and breeding grounds. Other large animals like dolphins, sea turtles, and sea lions could suffer similar effects. We can only imagine how distressing seismic blasts must be for marine animals, like whales and dolphins, that rely on sound to navigate and for communicating over vast distances. **Claim:** Seismic blasting is a cruel treatment to impose on sea creatures of all kinds. Some will have little choice but to remain in the vicinity either because they can\'t move or because it\'s their habitual grounds, such as whales calving. **Claim**: This EP is inadequate and must be refused due to know impacts to our oceans and marine life. It ignores that there are no safe blasting in the breading grounds of whales, for example. **Claim:** Whales are such an iconic species to our coastline and project will force whales out of crucial breeding grounds. **Claim:** This initiative poses an imminent threat to the delicate marine ecosystem, particularly endangering the critical habitats of the southern right whales and other marine life in the region.	CGG acknowledges claims regarding impacts on cetaceans within biologically important areas (BIAs), and has reviewed the Environment Plan (EP) to ensure that impacts to these areas and the species that utilised them were adequately assessed. The impact of underwater sound on cetaceans within biologically important areas has been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). Measures to mitigate impacts are also detailed in this Appendix and in the Fauna Management Plan, included in Appendix G2. The Fauna Management Plan provides for whale detection and measures to minimise anthropogenic noise threats to whales associated with the survey. EP Appendix F2 (ALARP Assessment) Section 6.1 includes additional measures to protect these species within biologically important areas, such as: • Minimising the duration of the survey to a maximum of 60 days of acquisition. • Surveying shallower Southern Right Whale BIAs between November and April when this species is not known to be present. • Not surveying during the months of January-March, which is the peak period for Pygmy Blue Whale presence and managing potential interactions with this species and other foraging species, given the larger spatial distribution of the population through the shoulder seasons, through the implementation of the Fauna Management Plan. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including BIAs for these species and identifies: • There will be no impact to Southern Right Whales within reproduction BIAs based on spatial and temporal exclusion zones, and the energetic costs of behavioural disturbance on migration within the migration BIA would be extremely low if avoidance behaviour occurred and would not impact the recovery of the species. • The Regia MSS will only occur during one season when Pygmy Blue Whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). Consequently, the Regia MSS is not predicted to impact on the recovery of the population. CGG has considered these claims and is satisfied that the potential impacts to these species within their BIAs have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
M09	**Matter:** Impacts on biologically important behaviours (foraging/ feeding, calving and migrating) and masking **Claim:** Seismic testing is the same thing to marine animals only much much worse and it doesn\'t stop day or night!!! It disrupts communication, hearing, navigation, reproduction and breeding of whales and all marine creatures. **Claim:** The marine life of our south-east oceans is unique and under increasing threat from the expansion of the offshore oil and gas industry. Evidence has shown that seismic blasting harms marine life and can deafen whales, impacting their feeding and migration patterns. **Claim:** Just stop this idea immediately. As you know it will damage whales and their breeding groups. **Claim:** It will devastate the marine environment and particularly damage the already threatened pygmy blue whales and southern right whales that breed and feed there**.** **Claim**: Seismic testing is destroying the vibration of the ocean that the whales depend on for communicating and their life. This cannot and should not continue	CGG acknowledges claims regarding impacts on biologically important behaviours and masking and has reviewed the Environment Plan (EP) to ensure that these impacts were adequately assessed. Impacts and risks to marine mammals, including impacts to biologically important behaviours (feeding, calving and migration) have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). Measures to mitigate impacts are also detailed in this Appendix and in the Fauna Management Plan, included in Appendix G. The Fauna Management Plan provides for whale detection and measures to minimise anthropogenic noise threats to whales associated with the survey. EP Appendix F2 (ALARP Assessment) Section 6.1 includes additional measures to protect these species during biologically important behaviours, such as: • Minimising the duration of the survey to a maximum of 60 days of acquisition • Surveying shallower Southern Right Whales Biologically Important Areas (BIAs) between November and April when this species is not known to be present. • Not surveying during the months of January-March, which is the peak period for Pygmy Blue Whale presence, and managing potential interactions with this species and other foraging species, given the larger spatial distribution of the population through the shoulder seasons, through the implementation of the Fauna Management Plan (Appendix G2). EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including BIAs for these species and identifies:

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	it is shameful to First Nations people and makes a mockery of Australiaâ€™s tourism based on protecting whales. **Claim:** Seismic blasting during known periods of presence for these identified species will inevitably lead to harm, hearing loss and disruption in navigation, feeding and breeding activities of cetaceans in the area. **Claim:** Science tells us that seismic blasting has a negative impact on whales and other marine (In marine mammals, the blasts — which reach more than 250 decibels and be heard for miles — can cause hearing loss, disturb essential behaviours like feeding and breeding, and mask communications between individual whales and dolphins. The blasts also reduce catch rates of commercial fish). **Claim:** Whales rely on echolocation for communication with each other, finding food and navigation. Seismic blasting can damage whale hearing, prevent echolocation and kill or displace their food supply. **Claim:** I am very concerned about the new seismic blasting proposal to find methane gas because it will endanger whales. The planned blast is only a few kilometres from the whale\'s calving grounds off the coast of Victoria. **Claim:** Seismic blasting has been linked to significant harm to marine life, including deafening whales, disrupting their feeding and migration, and causing mortality in various species. The proposed operation threatens critical feeding, calving, and migration routes of endangered whale species in this region. **Claim:** Impacts on Whales: The proposed start date is dangerously close for this operation to begin this April 2024 putting at risk feeding, calving and migration routes. Some endangered species are foraging for food in these same areas and puts their survival at risk. **Claim:** Regarding whales, the proposed operational schedule threatens critical feeding, calving, and migration routes of EPBC-listed whale species. Seismic blasting during these periods poses significant harm to vulnerable whale populations. **Claim:** The literature (2) (3) has indicated that marine mammals rely heavily upon acoustics as a primary means of communicating, navigating and foraging for food as well as avoiding danger. Past research has indicated that any changes to their acoustic environments impact upon their behavioural patterns. (4). (2)George Frisk (2012) Noiseonomics: the relationship between ambient noise levels in the sea and global economic trends. Nature Article No. 437, Retrieved Dec. 4th, 2923 from <u>https://www.nature.com/articles/srepoo437</u> (3)Tom Mustil (2022). How to speak whale: Voyage into the Future of Animal Communication. William Collins; (4) Christine Erbe, Michael Dähne, Jonathan Gordon, Heike Herata, Dorian Houser, Sven Koschinski, Russell Leaper, Robert McCauley, Brian Miller, Mirjam Müller, Anita Murray, Julie Oswald, Amy Scholik-Schlomer, Max Schuster, Ilse van Opzeeland, Vincent M. Janik (2019, Nov) Managing the effects from ship traffic, seismic surveying and construction on marine mammals in the Antarctic. Retrieved Dec. 4th , 2023 from https://research-portal.standrews.ac.uk/en/publications/managing-the-effects-of-noise-from-ship-traffic-seismicsurveying. **Claim:** Seismic blasting threatens critical feeding, calving, and migration routes of numerous (~29) cetacean species. Claim: all seismic blasting proponents including Regia should explain to the community, independent scientists, and First Nation’s People how noise from	• There will be no impact to Southern Right Whales within reproduction BIAs based on spatial and temporal exclusion zones, and the energetic costs of behavioural disturbance on migration within the migration BIA would be extremely low if avoidance behaviour occurred and would not impact the recovery of the species. • The Regia MSS will only occur during one season when Pygmy Blue Whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). Consequently, the Regia MSS is not predicted to impact on the recovery of the population. **<u>EP Appendix B8 (Seismic Study Report), provides an overview of current published, peer-reviewed literature available on acoustic masking. In response to these claims CGG has updated the information provided in EP Appendix E7 (Underwater Sound (Marine Mammals), in Section 6.3 to include the following:</u>** **<u>The sound generated by seismic surveys comprises low frequency pulses in the order of tens of milliseconds, occurring several seconds apart. At great distances from the seismic source, sound levels will be quieter, but transmission of the sound via multiple pathways (water, seabed) and reverberation mean that the pulse duration increases with distance. The sound frequencies that are emitted by seismic acoustic sources are broadband; however, most of the energy is concentrated between 0.1 kHz and 0.25 kHz. Consequently, the lowest frequency cetaceans are particularly affected since they have the most overlap with the frequencies of the seismic survey acoustic sources. As detailed in EP Appendix F3 (Acceptable Levels of Impact and Risk), Blue Whale calls last up to 18 s and generally consist of three segments: a 9-s-long, 27-Hz tone, followed by a 1-s downsweep to 19 Hz and another, longer-lasting downsweep to 18 Hz (Širović et al 2004, Rankin et al 2005); and Antarctic Blue Whale source levels have been estimated to be between 188-191 decibels (Miller et al 2021). Given the short seismic pulse duration relative to the duration of marine mammal vocalisations (several seconds to several minutes or longer), marine mammals are likely to be able to detect calls in between seismic pulses (Wood et al., 2012).</u>** **<u>Further, several studies have documented compensation responses (anti-masking strategies) to anthropogenic underwater noise, including changes in vocalisation strength, frequency, and timing (Erbe et al., 2016). For example, Blue Whales increased their calls (emitted during social encounters and feeding) when a seismic survey was operational in the area (Di lorio and Clark, 2010). Such adaptations have also been reported for Humpback Whales (McCauley et al., 1998; 2003b), Right Whales (Parks et al., 2007, 2011), Killer Whales (Holt et al., 2008), and Bottlenose Dolphins (van Ginkel et al., 2017). It is thought that increased calling enhances the probability that communication signals will be successfully received by conspecifics by reducing the effects of auditory masking.</u>** **<u>It is likely that marine mammals in the vicinity of the OA during the Regia MSS, particularly baleen whales, may be subject to some masking effects. The proposed survey timing, i.e., avoiding the peak productivity period for foraging Blue Whale and other species in the area will reduce the potential for behavioural impacts, including interference with communication.</u>** **<u>Masking levels are difficult to predict, and no auditory thresholds exist for predicting masking effects on marine mammals (Erbe et al., 2016); however, as outlined above masking responses (e.g., changes in calling rates) have been documented to occur at relatively low exposure levels (i.e., lower than would elicit any behavioural response). Any masking effects will however cease at the completion of the survey and are highly unlikely to have detectable population level effects.</u>** **<u>EP Appendix E7 (Underwater Sound (Marine Mammals), Sections 6.1 and 6.2 were also updated to include the following:</u>** **<u>Auditory masking of high-frequency and very high-frequency cetacean vocalisations is less likely as these species generally operate at higher frequencies than those generated by a seismic survey.</u>** Regarding claims of impacts to echolocation, baleen whales do not use echolocation, but rather communicate using a series of sounds. Toothed whales (e.g. Sperm Whales) and dolphins use echolocation for hunting and navigating. As stated in EP Appendix B8 (Seismic Study Report), Sperm Whales did not show any statistically significant changes in horizontal movement, diving and echolocation behaviour at received levels of approximately 118–131 dB re 1μPa^2·s (SELM-weighted) (Miller et al. 2009); further, the hearing of dolphins (HF cetaceans) is less sensitive in the low frequency range of air gun impulses (<500 Hz) and seismic operators sometimes report dolphins and other small toothed whales near operating seismic source arrays. However, there is a component of seismic pulses in the higher spectrum and in general most toothed whales do show some limited avoidance of operating seismic vessels. Note: Claims regarding injury of cetaceans are addressed in response to Matter: M07. Claims regarding impacts to prey species/ food supplies are addressed in response to Matter: M11. ***References:*** *Di Iorio L and Clark CW. 2010. Exposure to seismic survey alters blue whale acoustic communication. Biology letters 6:51-54.*

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	their seismic blasts will not affect the hearing, auditory group communication, and behaviour of whales and dolphins both in the range of a few kilometres and up to thousands of kilometres away. **Claim:** Marine animals cannot live peacefully and humanely with seismic blasting. Whales and other marine animals cannot live as deaf creatures. They rely on hearing to feed and navigate. Stop this now! **Claim:** Potential impacts of noise, such as that resulting from seismic testing, include interruption of essential behaviours, masking signals of interest (e.g., the sounds of predators, conspecifics or prey), displacement from crucial habitat, dir ect physical injury including temporary or permanent hearing loss, and in extreme cases, death. **Claim:** The Environment Plan does not provide sufficient detailed evidence on specific potential impacts on hearing, navigation, calving and feeding. **Claim:** The submitter also notes that there is a lack of evidence of the behaviors and impacts on several marine mammals in the proposed seismic blast area. **Claim**: The scientific evidence overwhelmingly demonstrates the detrimental effects of seismic blasting on marine life, including whales, dolphins, and plankton. These species face disruption to their feeding, migration, and reproductive behaviors, posing a grave to survival. operational schedule, which coincides with critical periods further exacerbates the potential harm to these already vulnerable populations.	*Erbe C, Reichmuth C, Cunningham K, Lucke, K and Dooling R. 2016. Communication masking in marine mammals: A review and research strategy. Marine pollution bulletin, 103(1-2), pp.15-38.* *Holt M M, Veirs V, & Veirs S. 2008. Noise Effects on the Call Amplitude of Southern Resident Killer Whales (Orcinus Orca). Bioacoustics, 17(1–3), 164–166. https://doi.org/10.1080/09524622.2008.9753802* *McCauley RD, Jenner MN, Jenner C, McCabe KA and Murdoch J. 1998. "The Response of Humpback Whales (Megaptera Novaeangliae) to Offshore Seismic Survey Noise: Preliminary Results of Observations About a Working Seismic vessel and Experimental Exposures" - refereed paper. The APPEA Journal 1998 - Delivering National Prosperity, 38(1), Technical and Commercial Papers - APPEA Conference, Canberra, March 1998.* *McCauley R, Cato DH, Dunlop R, Noad M. 2023. Measurements of a 20, 440, and 3130 cubic inch air gun or array off Peregian Beach Queensland and Dongara Western Australia highlight small and large scale inhomogeneous sound propagation environments. The Journal of the Acoustical Society of America, 2023* *Miller PJ, Johnson MP, Madsen PT, Biassoni N, Quero M & Tyack PL. 2009. Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico. DeepSea Research I, 56, 1168-1181. http://dx.doi.org/10.1016/j.dsr.2009.02.008.* *Miller BS, The IWC-SORP/SOOS Acoustic Trends Working Group, Balcazar N, Nieukirk S, Leroy EC, Aulich M, Shabangu FW, Dziak RP, Lee WS, Hong JK. 2021. An open access dataset for developing automated detectors of Antarctic baleen whale sounds and performance evaluation of two commonly used detectors. Sci Rep 11:806.* *Parks SE, Ketten DR, O'Malley JT and Arruda J. 2007. Anatomical predictions of hearing in the North Atlantic right whale. The Anatomical Record 290(6): 734-744. https://doi.org/10.1002/ar.20527.* *Rankin S, Ljungblad D, Clark C, Kato H. 2005. Vocalisations of Antarctic blue whales, Balaenoptera musculus intermedia, recorded during the 2001/2002 and 2002/2003 IWC/SOWER circumpolar cruises, Area V, Antarctica. Journal of Cetacean Research and Management. 7. 13-20. 10.47536/jcrm.v7i1.752.* *Širović A, Hildebrand JA, Wiggins SM, McDonald MA, Moore SE, Thiele D. 2004. Seasonality of Blue and Fin Whale Calls and the Influence of Sea Ice in the Western Antarctic Peninsula. Deep Sea Res. (II Top. Stud. Oceanogr.) 51 (17-19), 2327–2344. doi: 10.1016/j.dsr2.2004.08.005* *van Ginkel C, Becker DM, Gowans S, & Simard P. 2017. Whistling in a noisy ocean: Bottlenose dolphins adjust whistle frequencies in response to real-time ambient noise levels. Bioacoustics, 27(4), 391–405.* *Wood J, Southall BL, and Tollit DJ. 2012. PG&E offshore 3-D Seismic Survey Project Environmental Impact Report–Marine Mammal Technical Draft Report. SMRU Ltd. 121 pp. https://www.coastal.ca.gov/energy/seismic/mm-technical-report-EIR.pdf.*
M10	**Matter:** Impacts to whales food source **Claim:** Whales are only one of many species that are affected by these regular incredibly loud blasts, even the krlll that whales need for food are disoriented and later die. **Claim**: The adverse effects of seismic blasting extend beyond the immediate vicinity of the operation. Studies have shown a direct correlation between seismic activity and increased mortality rates in shellfish and marine mammals, as well as significant disruptions to the marine food chain.	CGG acknowledges claims regarding impacts of underwater sound on food sources for whales and has reviewed the Environment Plan (EP) to ensure that this was appropriately considered. Impacts to whales are extensively addressed in response to Matters: M02-M09 above. Regarding impacts to prey species such as krill, EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) – Section 4.1 includes acknowledgement of krill's importance to PBWs. EP Appendix F3 (Acceptable Levels of Impact and Risk), Section 5.2.2. provides for further assessment of key environmental values and concludes that, as the Regia MSS will only occur during one season when blue whales are present in Australia waters, potential impacts to individual blue whales will not impact on the recovery of the population. EP Appendix F3, Section 5.2.7 (Plankton Communities and the Bonney Upwelling System) provides a detailed assessment of the predicted level of impact to prey species for blue and other whale species in the region and concludes that impacts on population dynamics of these communities, as a result of the Regia MSS are insignificant relative to the scales of change that operate normally, and while effects of seismic will be felt by plankton assemblages at localised scales the highly dynamic nature of populations in space and time will ensure there are no population level effects hence the magnitude of any effects will be minor. **CGG has undertaken further investigation and provided an additional response related to this matter in EP Appendix F3, Section 5.2.10.1 which states:** **Krill is a key component of the plankton communities of the region. Because of its primary role in the regional food chains many species long term sustainability is closely linked to the annual upwelling events that drive the krill blooms upon which animals converge to feed. Because upwelling is the key driver of krill population dynamics, it follows that the huge shifts in temporal and areal extent of the GSU both within and between years will cause krill populations to shrink and expand in a similar way. Such changes, as previously noted, can be as much as 50%. The animals that rely on this system (e.g. whales) for their survival must therefore have evolved to survive and thrive within a system that changes markedly in scale and extent. When put into this context the scale of any potential impacts to plankton**

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		communities from the proposed Regia MSS will have no measurable effect on the population health of plankton communities. By extension the risk associated with reduced krill biomass available to feeding animals as a result of the proposed Regia MSS is immeasurably low.
M11	**Matter:** Research on impacts of anthropogenic noise on marine mammals. **Claim:** The review team is referred to the article: 'Underwater noise pollution is risking the lives of whales and dolphins.' https://www.nhm.ac.uk/discover/news/2022/july/underwater-noise-pollution-risking-lives-whales-dolphins.html#:~:text=Anthropogenic%20noise%20can%20change%20a,and%20poor%20immune%20system%20functionls This article although not written specifically about SRWs, comments on a study undertaken on narwhals (also a cetacean) and demonstrates that highly unusual and dangerous physiological conditions occur when they flee. **Claim:** A further article pertaining to the same study clarifies what the scientists observed. Namely, there was a lack of correlation between the whales' heart rates and the level of exertion they were undertaking. https://www.bbc.com/news/science-environment-42259289 Dr Terry Williams (University of California) is quoted in the article as saying, "" ...two opposite things happening at exactly the same time, heart rate is really low, and that is superimposed on an exercise response. It was crazy."" This reduction in heart rate, the scientists suggest, could help explain some whale strandings. If animals are moving quickly to escape a threat, but their heart rate is very low, this could deprive their brain of oxygen and leave them disorientated. Long periods of this low blood flow and reduced oxygen supply to the brain might even cause permanent damage." "I think we've identified a real physiological challenge here and we're going to pursue the details of that to see if we can figure out what's going on".	CGG acknowledges claims regarding research on the impacts of anthropogenic noise on marine mammals and has reviewed the Regia MSS Environment Plan (EP) to ensure appropriate peer reviewed published literature was references to support conclusion. The articles cited in the relevant claims pertain to a study on the physiological response of Narwhals to anthropogenic noise (Williams *et. al.* 2022), which found individuals had marked cardiovascular, respiratory and locomotor reactions in response to seismic pulses. The study assessed the effect of seismic pulses and associated ship noise on 13 Narwhals over a 5-year period. **Updates have been made to EP Appendix B8 (Seismic Studies Report) Section 6 in response to these claims as follows:** **A study on the physiological response of Arctic Narwhals to anthropogenic noise found individuals had marked cardiovascular, respiratory and locomotor reactions in response to seismic pulses. Noise exposed Narwhals experienced a 2-2.2-fold increase in the energetic cost of diving, whilst paradoxically heart rate reduced (bradycardia). Williams *et. al.* 2022 compared these results to studies on trained harbour porpoises (*Phocoena phocoena*, Elmegaard et al., 2021) and a closely related species, the Beluga Whale (*Delphinapterus leucas*, Lyamin et al., 2011). In the harbour porpoise study, the cetaceans initially had intensified levels of bradycardia, however this response diminished as they habituated to the noise. In the Beluga Whale study, the continued noise exposure resulted in eventual bradycardia. These studies are impacted by variation in environmental conditions and type of fear stimuli (Williams *et. al.* 2022).** **Updates have been made to EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) Section 6.5 in response to these claims as follows:** **While there has been considerable conjecture that the displacement of cetaceans from seismic surveys (as a consequence of avoidance) could result in stranding events, no solid evidence has yet been forthcoming to support this link. The most recent assessment of whale stranding patterns in Victoria (Foord et al., 2019) makes no reference to seismic surveys, and found no seasonal stranding pattern. While Foord et al (2019) didn't specifically investigate the relationship between strandings and seismic surveys, seismic surveys typically occur over the summer months off the south coast of Australia; hence if causal links were present, some evidence of seasonal patterns would be expected.** **Further to this, NOPSEMA (2019) states that "Evidence of mass whale stranding exists from six to seven million years ago, long before anthropogenic sound became a factor, and it is likely that any observable increase in occurrence [of stranding events] is due to greater visibility of previously inaccessible coastline."** ***References***: *Elmegaard, S. L., McDonald, B. I., Teilmann, J., & Madsen, P. T., 2021. 'Heart rate and startle responses in diving, captive harbour porpoises (Phocoena phocoena) exposed to transient noise and sonar'. The Journal of Experimental Biology, 10. https://doi.org/10.1242/bio.058679.* *Foord, C.S., Rowe, K.M.C,, Robb K , 2019. 'Cetacean biodiversity, spatial and temporal trends based on stranding records (1920-2016), Victoria, Australia'. PLoS ONE 14(10): e0223712. https://doi.org/10.1371/journal.pone.0223712.* *Lyamin, O. I., Korneva, S. M., Rozhnov, V. V., & Mukhametov, L. M., 2011. 'Cardiorespiratory changes in beluga in response to acoustic noise'. Doklady Akademii Nauk, 440, 704–707. https://doi.org/10.1134/S0012496611050218.* *NOPSEMA, 2019. Environment and Communications References Committee. Inquiry into the impact of seismic testing on fisheries and the marine environment. Submission 66 from the National Offshore Petroleum Safety and Environmental Management Authority. December 2019. pp. 103. Available online at: https://www.nopsema.gov.au/sites/default/files/documents/2021-06/A706091.pdf* *Williams, T. M., Blackwell, S. B., Tervo, O., Garde, E., Sinding, M-H., Richter, B., & Heide-Jørgensen, M. P., 2022. 'Physiological responses of narwhals to anthropogenic noise: A case study with seismic airguns and vessel traffic in the Arctic'. Functional Ecology, 36, 2251–2266. https://doi.org/10.1111/1365-2435.14119.*
M12	**Matter:** Cumulative effects of seismic activity in the area **Claim:** The EP fails to address the cumulative impact of seismic blasting and marine noise on marine life. It fails to provide specific impacts on the array of Baleen whales and the other 34 species that have been identified as being present by the EPBC Act Protected Matters Report.	CGG acknowledges claims regarding cumulative impacts and has reviewed the Environment Plan (EP) to ensure that cumulative impacts have been appropriately considered for cetacean species. Appendix E10 (Cumulative Impact Assessment) presents a detailed assessment of potential cumulative impacts. The effects of past projects and activities, and currently operating projects, are included in the description of existing condition of, and any pressure or threats affecting, the environment, i.e., any impacts to marine life from current previous activities and projects is inherent within the description of the baseline. The

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		cumulative impact assessment considers the impacts of the proposed activity on key environmental values and sensitivities in conjunction with the impacts from other reasonably foreseeable future projects. Potential for cumulative impacts to whale species, including baleen whales, has been scoped in Appendix E10 (Cumulative Impact Assessment). During the assessment process, components of the environment and aspects of the ongoing and reasonably foreseeable projects and activities were identified where there was the potential for successive, additive, or synergistic impacts to reasonably accumulate over temporal and spatial scales, when considered in the context of ongoing and reasonably foreseeable future projects or activities in the Otway Basin. The CIA Scoping Tool (Annex 2 – CIA Scoping Tool) details the assessment undertaken of the components of the environment and aspects of the Otway Exploration Drilling Program to identify where a potential cumulative cause-effect pathway with the other reasonably foreseeable future projects (identified in Table E10-31-) may occur and, if it may occur, was likely to have a material impact. For underwater sound, impacts on noise-sensitive whale species with biologically important behaviours, such as the Blue Whale and Southern Right Whale, within relevant BIAs that overlap underwater sound EMBAs were identified through this process. Where a potential cumulative cause-effect pathway and material impact was identified further assessment was undertaken as detailed in • EP Appendix E10 Section 5.4: Effects of Elevated Levels of Sound to Blue Whales, and • EP Appendix E10 Section 5.5: Effects of Elevated Levels of Sound to Southern Right Whales. In both assessments, it is concluded that, without appropriate detection and actions in place there is the potential that blue whales could be exposed to underwater sound from two sources (seismic and drilling) within the foraging BIA that could result in them expending more energy to move away from the sound source to forage or restrict the area of foraging. This could also occur for consecutive years whilst drilling activities are undertaken within the Otway Basin. However, cumulative impacts resulting in an increase in the likelihood of PTS and TTS for foraging blue whales is not predicted due to the small distances to the PTS and TTS noise criteria for activities. Consequently, as each titleholder will be required to undertake their activity in a manner that will not be inconsistent with the relevant recovery / management plans, such that blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area and that actions within and adjacent to SRW BIAs should demonstrate that they do not prevent any SRW from utilising the area or cause injury (TTS and PTS) and/or disturbance, cumulative impacts are not predicted. CGG considers the assessment of cumulative impacts to be a full and complete assessment, undertaken in line with NOPSEMA guidelines and industry best practice. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M13	**Matter**: Mass strandings **Claim:** Seismic testing causes hearing loss and navigation loss in whales and they get stranded en masse and die as a result. Other marine animals die instantly in test areas.	CGG acknowledges claims regarding impacts on marine mammals associated with underwater sound and has reviewed the Environment Plan (EP) to ensure that this was appropriately considered. **As stated in response to Matter M11 above, updates have been made to EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), Section 6 .5 of the EP in response to these claims as follows:** **While there has been considerable conjecture that the displacement of cetaceans from seismic surveys (as a consequence of avoidance) could result in stranding events, no solid evidence has yet been forthcoming to support this link. The most recent assessment of whale stranding patterns in Victoria (Foord et al., 2019) makes no reference to seismic surveys, and found no seasonal stranding pattern. While Foord et al (2019) didn't specifically investigate the relationship between strandings and seismic surveys, seismic surveys typically occur over the summer months off the south coast of Australia; hence if causal links were present, some evidence of seasonal patterns would be expected.** **Further to this, NOPSEMA (2019) states that "Evidence of mass whale stranding exists from six to seven million years ago, long before anthropogenic sound became a factor, and it is likely that any observable increase in occurrence [of stranding events] is due to greater visibility of previously inaccessible coastline."** ***References***: *Foord, C.S., Rowe, K.M.C,, Robb K , 2019. 'Cetacean biodiversity, spatial and temporal trends based on stranding records (1920-2016), Victoria, Australia'. PLoS ONE 14(10): e0223712. https://doi.org/10.1371/journal.pone.0223712* *NOPSEMA, 2019. Environment and Communications References Committee. Inquiry into the impact of seismic testing on fisheries and the marine environment. Submission 66 from the National Offshore Petroleum Safety and Environmental Management Authority. December 2019. pp. 103. Available online at: https://www.nopsema.gov.au/sites/default/files/documents/2021-06/A706091.pdf*
Key Matter: Southern Right Whale (SRW)		

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M14	**Matter:** Southern Right Whale is not mentioned in the Environment Plan **Claim:** It is concerning that the Southern Right whale is not mentioned in the CGG plan , which also does not include any enforceable measures to protect this endangered species.	CGG acknowledges claims regarding the consideration of Southern Right Whales (SRW) and measures to protect this species within the Environment Plan (EP) and has reviewed the EP to ensure this species was adequately considered and appropriate mitigation measures were identified. Presence of the SRW within the Regia MSS Operational Area was identified in the Protected Matters Search Tool (PMST) report (Appendix B5) as 'breeding known to occur within area'. Biologically Important Areas (BIAs) for the SRW are identified in relevant impact and risk assessment sections. Description of SRW spatial and temporal presence, and potential impacts and risks to SRW associated with the Regia MSS, have been described and assessed in: • Appendix D1 (Risk Assessment – Accidental Release of Materials and Waste Overboard) • Appendix D2 (Risk Assessment – Collision with Marine Fauna) • Appendix D4 (Risk Assessment – Accidental Release of Fuel) • Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) • Appendix E10 (Impact Assessment – Otway Cumulative Impact Assessment These appendices include identification of mitigation and management measures to ensure potential impacts and risks have been reduced to As Low As Reasonably Practicable (ALARP). Measure M#03: Fauna Management System and, more specifically the Fauna Management Plan in Appendix G2, outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. EP Appendix F2 (ALARP Assessment) Section 6.1 includes additional measures to protect SRWs during biologically important behaviours, such as: • Minimising the duration of the survey to a maximum of 60 days of acquisition • Surveying shallower SRW BIAs between November and April when this species is not known to be present. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including SRWs and identifies: • There will be no impact to SRWs within reproduction BIAs based on spatial and temporal exclusion zones, and the energetic costs of behavioural disturbance on migration would be extremely low, if avoidance behaviour occurred, and would not impact the recovery of the species. CGG has reviewed the EP in response to this claim and is satisfied that potential impacts and risks to SRWs associated with the Regia MSS, as well as mitigation and management measures, have been adequately addressed. As a result, no changes have been made to the EP in response to this claim.
M15	**Matter:** Impacts to Southern Right Whales **Claim:** The Southern Right Whale is just beginning to recover from whaling, over one hundred years ago. This fresh assault cannot be allowed. Please NOPSEMA refuse CCG\'s proposal. **Claim:** Recommendation: Request CGG to undertake studies on the effect of their project on the health and wellbeing of Southern Right whales. **Claim:** This seismic blasting proposal by CGG should be refused due to the devastating impact it will have, firstly on the remnant eastern endangered SRW population, secondly, on the greater population of Australian SRWs, a significant number of which access their primary breeding grounds at Head of Bight via the species' main east-west migratory route, part of which falls within the area of CGG's proposal and thirdly, because of the extreme harm it poses to all other cetaceans, marine mammals and in fact the entire marine ecosystem in our southern ocean. **Claim**: This seismic blasting proposal must not be approved, a multinational company.? Their only interest is monetary profits, blowing up the ocean would be catastrophic for the southern right whales.	CGG acknowledges claims regarding impacts to Southern Right Whales (SRWs) associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that these were adequately described and mitigated. Potential impacts and risks to SRW associated with the Regia MSS have been assessed in: • Appendix D1 (Risk Assessment – Accidental Release of Materials and Waste Overboard) • Appendix D2 (Risk Assessment – Collision with Marine Fauna) • Appendix D4 (Risk Assessment – Accidental Release of Fuel) • Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) • Appendix E10 (Impact Assessment – Cumulative Impact Assessment SRW habitat and potential presence in relation to the Regia MSS has been described throughout these appendices and informs impact and risk assessments. Excerpts are provided below: 'Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012). The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by Southern Right Whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and

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		sporadically occupied areas include Encounter Bay in SA. Southern Right Whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al. 2017). A number of additional areas for Southern Right Whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (CoA 2012). These emerging areas off Victoria align with the Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) which provides an update to BIAs and emerging aggregation areas (Figure D1-51-). The proposed changes are: • Reproductive areas - Areas where mating, calving, nursing and/or presence of neonates are known, or likely, to occur. For Victoria this is the nearshore area between Portland and Port Campbell. • Migration areas - Areas where Southern Right Whales are known, or likely, to use for movement between regions that support biologically important behaviour (e.g., coastal movement between reproductive areas). The EP also describes any overlap between areas of potential impact and SRW BIAs: • The Operational Area overlaps the Southern Right Whale Migration BIA where the whales are present between April and October (NCVA 2023) (Appendix B12 MAP-REG-EPM-069; Appendix D1; Appendix D2). • The Environmental Planning Area overlaps the Southern Right Whale reproduction and migration BIAs (Appendix B12 MAP-REG-EPM-069; Appendix D4) • The PMST Report identified that Southern Right Whale breeding is known to occur within area that may be affected by underwater sound, in addition the area where the noise effect criteria for SRW is reached is within the migration BIA and reproduction BIA (Appendix B12 MAP-REG-EPM-069; Appendix E7). Peer reviewed literature and sound modelling has been used to inform the impact assessment sections listed above. CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a: Initial Sound Modelling Report and B7: Secondary Sound Modelling Report) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including SRWs. Acoustic modelling was used in conjunction with animat modelling for SRWs to provide a more realistic prediction of the area that may be affected by underwater sound (as opposed to acoustic modelling alone). Estimates of sound exposure distribution were determined by moving large numbers of simulated animals (animats) through a modelled time-evolving sound field, computed using acoustic models. As described in Section 6.3 (Low-frequency Cetaceans) of Appendix E7 (Impact Assessment: Underwater Sound Marine Mammals), the predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whales is 1.4km, 14.2 km and 9.51km, respectively. This modelling has been used to ensure that the action from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) of “Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance” will be met. This includes implementation of activity limitations where the sound source will not be operated within 15 km (based on modelling which produced a TTS effect distance of 14.2 km) of the Southern Right Whale reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the reproduction BIA and HCTS, and surveying shallower areas between November and April when this species is not known to be present. Therefore, due to the spatial and temporal exclusion zones, there will be no impact to Southern Right Whales within reproduction BIAs. (EP Appendix E7- Impact Assessment Underwater Sound: Marine Mammals). CGG have also provided a summary of available literature and descriptions of the potential impacts of anthropogenic noise on marine mammals (EP Appendix B8- Seismic Studies Report, Section 7 Marine Mammals). CGG has used current best available science and modelling to assess impacts and risks on species listed under the Environment Protection and Biodiversity Conservation Act 1999, with application of conservative distances within which species may be impacted. The EP fully acknowledges and describes SRW biologically important behaviours and spatial and temporal overlap with the Regia MSS. The EP includes identification of mitigation and management measures in each impact assessment section (see appendices listed above), including a Fauna Management Plan (Appendix G2) that outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. In accordance with the control measures set out in the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with all environmental regulatory requirements. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
M16	**Matter:** Impacts to Southern Right Whale Biologically Important Areas **Claim**: Of particular concern is the proximity of the proposed blasting site to the most important calving grounds for south-east Australia\'s 300 remaining southern right whales. These majestic creatures, already facing numerous threats to their survival, would be subjected to intolerable levels of noise pollution and disturbance, putting their very existence at risk. **Claim:** Allowing any seismic blasting to species-sensitive areas such as the Otway Basin just kilometres off the coast of the Great Ocean Road and in the calving grounds of the endangered southern right whale should not be allowed. **Claim**: Under no circumstances should the seismic blasting be allowed near endangered whale\'s calving grounds. There is no way to mitigate the effects of the seismic blasting. **Claim**: The EP states that blasting will not occur within the reproduction BIA or within 12km of the reproduction BIA while whales are present. However, southern right whales migrate to their calving grounds from April to November using the migration BIA, which stretches from the Victorian coast, south to Tasmania, and west to the southern coast of Western Australia. It is therefore not possible that the CGG project could operate in those months without exposing southern right whales to seismic blasting in their migration BIA. Further, the proposal to conduct seismic blasting in critical habitat for this Endangered species is incompatible with the Australian Government's efforts to protect the species and support its recovery. **Claim:** This EP is inadequate and must be refused due to know impacts to our oceans and marine life. It ignores that there are no safe blasting in the breading grounds of whales, for example **Claim:** The plan does not outline how the sound is not going to impact the Southern Right Whale breeding area when the seismic zone surrounds the area **Claim:** There are so many plans in the pipeline for massive marine-based industrial developments along the southern coast of Australia right now. Most of these will include seismic blasting, increased vessel noise and potential vessel strike, drilling, pile-driving and/ or other acute and/or chronic noise and chemical spill hazards. Each of them, will negatively impact critical breeding and/or migratory SRW habitat and will increase the accumulate stresses impacting our already struggling SRW population. **Claim:** It could also impact Southern Wright whales which use this area as a nursery and other cetacean species that are endemic or transit through this area as part of their migration. **Claim:** Southern right whales are listed as Endangered under the EPBC Act and the EP does not adequately demonstrate that risks and impacts to designated migration and reproduction BIAs, both of which lie within CGG's Environment Planning Area, will be reduced to an acceptable level.	CGG acknowledges claims regarding impacts to Southern Right Whales (SRWs) Biologically Important Areas (BIAs) associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that these are adequately described and mitigated. CGG acknowledges the importance of protecting SRWs within the reproduction and migration BIAs. SRW habitat and potential presence in relation to the Regia MSS has been described throughout the EP (as outlined in response M15). The Operational Area overlaps the SRW migration BIA where the whales are present between April and October (NCVA 2023) (Appendix B12 MAP-REG-EPM-069; Appendix D1; Appendix D2). The Operational Area does not overlap the reproduction BIA for the SRW and as such no seismic testing will be conducted within the reproduction BIA. As described in EP Appendix E7 (Impact Assessment Underwater Sound: Marine Mammals), the area where noise effect criteria for SRWs is reached is within the migration BIA and reproduction BIA (Appendix B12 MAP-REG-EPM-069; Appendix E7). As detailed in EP Appendix F7 (Impact Assessment – Underwater sound: Marine Mammals), animat modelling was undertaken for whales undertaking biologically important behaviours, including Southern Right Whales (breeding), that considers the vessel and whale movements and provides a more realistic prediction of the area that may be affect by underwater sound. The predicted maximum distances to the Permanent Threshold Shift (PTS) 24hr cumulative effect criteria, Temporary Threshold Shift (TTS) 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whales is 1.4km, 14.2 km and 9.51km, respectively, respectively. To meet the action from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) of "Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance", CGG adopted specific control measures to mitigate potential impacts to SRWs including: • Use of a reduced acoustic source size. • Measure M#01: which stipulates the sound source will not be discharged in the Southern Right Whale reproduction BIA at any time. • Measure M#01: which stipulates that CGG will implement an activity limitation where there will be no discharge of the sound source within >15 km of the SRW reproduction BIA or Habitat Critical to Survival (HCTS) while SRWs are present in the BIA and HCTS. 15 km is based on initial modelling which produced a TTS effect distance of up to 14.2 km, from a more conservative BIA (based on the initial NCVA update) as the furthest distance to sound effect criteria for aggregating Southern Right Whale without a calf. • Measure M#03: Fauna Management System and, more specifically the Fauna Management Plan in Appendix G2, which outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey within the migration BIA. • Minimising the duration of the survey to a maximum of 60 days of acquisition, and • Surveying shallower parts of the SRW migration BIAs between November and April when this species is not known to be present. The response to Matter: M18 describes how impacts to SRWs within the migration BIA have been assessed and mitigated in the EP. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including SRWs and identifies: • Permanent or temporary hearing loss to SRWs is not predicted based on the distance of the spatial and temporal exclusion zones to SRW reproduction BIAs. • While SRWs are migrating to and from the coastal reproduction BIAs, they are moving at speeds between 3 – 3.3. km/hr (Charlton 2017) and hence are unlikely to be within the area of cumulative sound exposure for a long enough period to receive cumulative sound levels above the effect criteria. • As the Regia MSS will only occur during one season when SRWs are present in Australia waters, potential behavioural impacts to individual SRW will not impact on the recovery of the population. The Acceptability Assessment (Appendix F3) also describes how CGG has ensured that regulatory requirements relevant to the Regia MSS and SRWs will be met. As stated in Section 5.2.1.5 of Appendix F3, the updated draft National Recovery Plan for SRW (DCCEEW 2023) has significant weight in CGG's assessment due to the involvement of Commonwealth and State regulatory agencies, threatened species managers, and scientific experts in the development of the recovery plan. As such, recommended actions from the plan relevant to the Regia MSS have been implemented as detailed above and within Section 5.2.1.6 of Appendix F3. CGG acknowledges the importance of assessing cumulative impacts to species including SRWs. Cumulative impacts have been thoroughly assessed in EP Appendix E10 (Cumulative Impact Assessment)/ This assessment concluded that as each titleholder will be required to undertake their activity in a manner that will not be inconsistent with the relevant recovery / management plans, such that actions within and adjacent to SRW BIAs should demonstrate that they do not prevent any SRW from utilising the area or cause injury (TTS and PTS) and/or disturbance, cumulative impacts are not predicted. CGG has reviewed the EP in response to these claims and is satisfied that potential impacts and risks to SRWs, within their reproduction and migration BIAs, have been adequately assessed. Appropriate mitigation and control measures ensure that potential impacts associated with the

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#	**Comments received**	***Titleholder response***
		Regia MSS are reduced to As Low As Reasonably Practicable (ALARP). As a result, no changes have been made to the EP in response to this claim.

M17	**Matter**: Impacts to remnant eastern population of Southern Right Whales
	Claim: Given the scientific research* observing an 88% drop in whale / cetacean sightings caused by these seismic tests, it's more than concerning to see the map with Logan's Beach (Whale nursery, tourist icon) directly labelled adjacent to the proposed operating and testing field. It should be more than clear that the value of this marine environment and the marine animals that inhabit this area far outweighs any short term financial gain from seismic testing and any subsequent oil and gas drilling it facilitates. * Kavanagh, A.S., Nykänen, M., Hunt, W. et al. Seismic surveys reduce cetacean sightings across a large marine ecosystem. Sci Rep 9, 19164 (2019).
	Claim: If this proposal is allowed to progress, not only will the major east-west SRW migratory corridor to Head of Bight be negatively impacted, but Logan's Beach, the only habitat used by the small remnant population of the eastern SRW (thought to be a genetically different to the western SRW population) will be rendered unsuitable as crucial calving and nursing habitat.
	Claim: Seismic blasting next to their only Victorian calving ground will undoubtedly drive calving / nursing Southern Right Whale cows away from this historically important habitat. It could even spell the end for this small remnant, genetically unique population - only about 300 individuals remain. If we want this tiny population to survive, then we must preserve the integrity of its only breeding habitat.
	Claim: This seismic blasting proposal by CGG should be refused due to the devastating impact it will have, firstly on the remnant eastern endangered SRW population, secondly, on the greater population of Australian SRWs, a significant number of which access their primary breeding grounds at Head of Bight via the species' main east-west migratory route, part of which falls within the area of CGG's proposal and thirdly, because of the extreme harm it poses to all other cetaceans, marine mammals and in fact the entire marine ecosystem in our southern ocean.
		CGG acknowledges claims regarding impacts to the south-eastern Southern Right Whale (SRW) population and has reviewed the EP to ensure impacts and risks to this population were appropriately considered.
		CGG acknowledges the importance of the reproduction Biologically Important Area (BIA), including Logan's Beach, throughout the EP. Important areas for the south-eastern SRW population are described in the EP:
		• 'Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012).
		• The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by Southern Right Whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA. Southern Right Whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al. 2017). A number of additional areas for Southern Right Whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (CoA 2012). These emerging areas off Victoria align with the Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) which provides an update to BIAs and emerging aggregation areas (Figure D1-51-). The proposed changes are:
		  ○ Reproduction areas - Areas where mating, calving, nursing and/or presence of neonates are known, or likely, to occur. For Victoria this is the nearshore area between Portland and Port Campbell.
		  ○ Migration areas - Areas where Southern Right Whales are known, or likely, to use for movement between regions that support biologically important behaviour (e.g., coastal movement between reproductive areas).'
		The EP also describes any overlap between areas of potential impact and SRW BIAs:
		• The Operational Area overlaps the Southern Right Whale migration BIA where the whales are present between April and October (NCVA 2023) (Appendix B12 MAP-REG-EPM-069; Appendix D1; Appendix D2).
		• The Environmental Planning Area overlaps the Southern Right Whale reproduction and migration BIAs (Appendix B12 MAP-REG-EPM-069; Appendix D4)
		• The PMST Report identified that Southern Right Whale breeding is known to occur within that area that may be affected by underwater sound, in addition the area where the noise effect criteria for SRW is reached is within the migration BIA and reproduction BIA (Appendix B12 MAP-REG-EPM-069; Appendix E7).
		• The acquisition area does not overlap the reproduction BIA.
		Appendix E7 of the EP comprehensively assesses potential impacts to marine mammals, including SRWs, from anthropogenic noise associated with the Regia MSS. The response to Matter: M15 describes how peer reviewed literature and sound modelling have been used to inform the impact assessment for the SRW, and details mitigation and management measures that will be implemented to ensure impacts will be reduced to As Low As Reasonably Practicable (ALARP).
		To meet the action from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) of "Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance", CCG adopted specific control measures to mitigate potential impacts to SRWs including:
		• Use of a reduced acoustic source size.
		• Measure M#01: which stipulates the sound source will not be discharged in the Southern Right Whale reproduction BIA at any time.
		• Measure M#01: which stipulates that CGG will implement an activity limitation where there will be no discharge of the sound source within 15 km of the SRW reproduction BIA or Habitat Critical to Survival (HCTS) while SRWs are present in the BIA and HCTS. 15 km is based on initial modelling which produced a TTS effect distance of up to 14.2 km as the furthest distance to sound effect criteria for aggregating Southern Right Whale without a calf. .

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#	**Comments received**	***Titleholder response***
		• Measure M#03: Fauna Management System and, more specifically the Fauna Management Plan in Appendix G2, which outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey within the migration BIA. • Minimising the duration of the survey to a maximum of 60 days of acquisition, and • Surveying shallower parts of the SRW migration BIAs between November and April when this species is not known to be present. • In accordance with the control measures set out in the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with all environmental regulatory requirements. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including SRWs and identifies: • Permanent or temporary hearing loss to SRWs is not predicted based on the distance of the spatial and temporal exclusion zones to SRW reproduction BIAs. • While SRWs are migrating to and from the coastal reproduction BIAs, they are moving at speeds between 3 – 3.3. km/hr (Charlton 2017) and hence are unlikely to be within the area of cumulative sound exposure for a long enough period to receive cumulative sound levels above the effect criteria. • Thus, effects are limited to behaviour responses to migrating SRW which may range from short term orientation to moving away from the sound source. Disturbance of migrating mothers could increase their energy expenditure which could result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51 km, the energetic costs would be extremely low if avoidance behaviour occurred. • In addition, SRWs whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (CoA 2012). Along the Australian coast, individual SRWs use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (CoA 2012). Thus, if a SRW avoided the area above the behavioural effect criteria of 9.51 km it is unlikely to prevent them from undertaking their seasonal migrations. • As the Regia MSS will only occur during one season when SRWs are present in Australia waters, potential behavioural impacts to individual SRW will not impact on the recovery of the population. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
M18	**Matter:** Impacts to migrating Southern Right Whales **Claim**: Given that this operation is proposed to occur between the months of April - December, there is significant risk of harm to the Southern Right Whale during their calving period (May - October), when they will be migrating through the operational area. **Claim**: Plan states that blasting will not occur within the reproduction area, or within 12km of the reproduction area, while whales are present. However, southern right whales migrate to their calving grounds from April to November, an area which stretches from the Victorian coast, south to Tasmania, and west to the southern coast of Western Australia. It is therefore not possible that the CGG project could operate in those months without exposing southern right whales to seismic blasting during their migration to their birthing area. (46). 46 https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0021/90750/Southern-RightWhale.pdf. **Claim:** The Environmental Plan states that surveying will not take place within 12km of the whale's reproductive 'Biologically Important Area' (BIA) whilst the whales are present. However, given that the Southern Right Whale migrates through the BIA between April and November it is not possible that the project could operate in these months without exposing these whales to seismic surveying.	CGG acknowledges claims regarding the impacts to migrating Southern Right Whales (SRW) and has reviewed the Environment Plan (EP) to ensure these impacts were adequately described and mitigated. As detailed in EP Appendix F7 (Impact Assessment – Underwater sound: Marine Mammals), animate modelling was undertaken for whales undertaking biologically important behaviours, such as Southern Right Whales (breeding), that considers the vessel and whale movements and provides a more realistic prediction of the area that may be affect by underwater sound. The predicted maximum distances to the Permanent Threshold Shift (PTS) 24hr cumulative effect criteria, Temporary Threshold Shift (TTS) 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whales is 1.4km, 14.2 km and 9.51km, respectively. To meet the action from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) of "Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance" CCG adopted specific control measures to mitigate potential impacts to SRWs including: • Use of a reduced acoustic source size. • Measure M#01: which stipulates the sound source will not be discharged in the Southern Right Whale reproduction BIA at any time. • Measure M#01: which stipulates that CGG will implement an activity limitation where there will be no discharge of the sound source within 15 km of the SRW reproduction BIA or Habitat Critical to Survival (HCTS) while SRWs are present in the BIA and HCTS. 15 km is based on initial modelling which produced a TTS effect distance of up to 14.2 km as the furthest distance to sound effect criteria for aggregating Southern Right Whale without a calf. • Measure M#03: Fauna Management System and, more specifically the Fauna Management Plan in Appendix G2, which outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey within the migration BIA. • Minimising the duration of the survey to a maximum of 60 days of acquisition, and • Surveying shallower parts of the SRW migration BIAs between November and April when this species is not known to be present.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
	Claim: The endangered southern right whale returns to the beaches around Warrnambool for calving in the winter months, between May to October. They travel through the operating area in the lead up to and during this calving period. Noting that the operating area is just 16.22km from Warrnambool, we hold grave concerns about the ability of Southern Right Whales to return to these beaches for their calving season. **Claim:** There are some claims within the submission that seismic blasting will not occur at birthing times , however this is an unrealistic as southern right whales migrate to their calving grounds from April to November using the migration BIA, which stretches from the Victorian coast, south to Tasmania, and west to the southern coast of Western Australia. It is therefore not possible that the CGG project could operate in those months without exposing southern right whales to seismic blasting in their migration BIA.	EP Appendix E10 (Cumulative Impact Assessment) concluded that, without appropriate detection and actions in place there is the potential that SRWs could be exposed to underwater sound from two sources (seismic and drilling) within the migration BIA that could result in them expending more energy to move away from the sound source when migrating to and from coastal breeding areas. This could also occur for consecutive years whilst drilling activities are undertaken within the Otway Basin. However, as fauna management-type plans including detection and mitigation measures are considered standard within the industry, the potential for behavioural disturbance is significantly mitigated. Cumulative impacts resulting in an increase in the likelihood of PTS and TTS for a migrating SRW are not predicted due to the small distances to the PTS and TTS noise criteria for drilling activities. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including SRWs and identifies: • Effects are limited to behaviour responses to migrating SRW which may range from short term orientation to moving away from the sound source. Disturbance of migrating mothers could increase their energy expenditure which could result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51km, the energetic costs would be extremely low if avoidance behaviour occurred. • In addition, SRWs whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (CoA 2012). Along the Australian coast, individual SRWs use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (CoA 2012). Thus, if a SRW avoided the area above the behavioural effect criteria of 9.51km it is unlikely to prevent them from undertaking their seasonal migrations. • As the Regia MSS will only occur during one season when SRWs are present in Australia waters, potential behavioural impacts to individual SRW will not impact on the recovery of the population. CGG has reviewed the EP in response to this claim and is satisfied that potential impacts SRWs on migration associated with the Regia MSS have been appropriately assessed and are mitigated to as low as reasonably practicable and acceptable levels. As a result, no changes have been made to the EP in response to this claim.
M19	**Matter:** Impacts to Southern Right Whale energy reserves during migration **Claim:** SRW's do not eat while overwintering on the Australian coast. They rely solely on their stored energy reserves to sustain themselves and their calves until they return to their summer feeding grounds. In their research paper 'Behavioural Development in southern right whale calves', Mia L. K. Nielsen, Kate R. Sprog, Lars Bejder, Peter T. Madsen and Fredrik Christiansen provide the following critical details as they relate to this: https://www.int-res.com/abstracts/meps/v629/p219-234/ "Most baleen whales migrate to low-latitude breeding grounds during winter to give birth and nurse their calves during the early stages of growth and development. While mothers invest a large amount of energy into the early development of their calves, the time allocated to important behaviours associated with maternal care (e.g., nursing) as well as the energetics related to the rapid growth of calves are important to quantify and understand to inform conservation measures. To investigate this, we conducted behavioural focal follows of southern right whale Eubalaena australis mother- calf pairs on a breeding ground in South Australia using unmanned aerial vehicles. Over the breeding season, we conducted behavioural focal follows of 51 mother calf pairs for a total of 58 h across 75 d. Our observations showed that the proportion of time calves spent in nursing position and the duration of potential nursing bouts increased with increasing calf size throughout the breeding season, suggesting that calves seek to maximise energy acquisition. With increasing body size, the absolute metabolic expenditure of calves increased, underlining the importance of mothers being able to maintain low energy expenditure to ensure sufficient energy available for their calves during the nursing season. Our findings from this	CGG acknowledges claims regarding the impacts to Southern Right Whale (SRW) energy reserves during migration and has reviewed the Environment Plan (EP) to ensure this has been adequately assessed. CGG acknowledges the importance of protecting SRWs within the Biologically Important Areas (BIA) from disturbances which could disrupt the crucial maternal care, energy transfer and rapid early development of calves. This acknowledgement resulted in the adoption of specific control measures to mitigate potential impacts including: • Measure M#01: which stipulates the sound source will not be discharged in the Southern Right Whale reproduction BIA at any time. • Measure M#01: which stipulates that CGG will implement an activity limitation where there will be no discharge of the sound source within 15 km of the SRW reproduction BIA or Habitat Critical to Survival (HCTS) while SRWs are present in the BIA and HCTS. 15 km is based on initial modelling which produced a TTS effect distance of up to 14.2 km as the furthest distance to sound effect criteria for aggregating Southern Right Whale without a calf. • Measure M#03: Fauna Management System and, more specifically the Fauna Management Plan in Appendix G2, which outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey within the migration BIA. • Minimising the duration of the survey to a maximum of 60 days of acquisition, and • Surveying shallower parts of the SRW migration BIAs between November and April when this species is not known to be present. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including SRWs and identifies: • Effects are limited to behaviour responses to migrating SRW which may range from short term orientation to moving away from the sound source. Disturbance of migrating mothers could increase their energy expenditure which could result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51 km, the energetic costs would be extremely low if avoidance behaviour occurred. • In addition, SRWs whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (CoA 2012). Along the Australian coast, individual SRWs use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
	undisturbed population (1) demonstrate the considerable changes that calves undergo during the -3 months they spend on the breeding ground and (2) highlight the importance of these areas to be protected from anthropogenic disturbances that could disrupt the crucial maternal care, energy transfer and rapid early development of calves.” They go on to note in their conclusion that, “Despite the limited time that SRWs spend on their breeding ground, fasting, lactating females transfer an enormous amount of energy to their calves (Christiansen et al. 2018). To facilitate the high energy transfer, a substantial part of the daily time budget of mothers is devoted to milk delivery. Here, we show that SRW calves are in nursing position -10 % of the time and that this proportion increased with calf size. Increased time spent nursing may reflect an increased energy expenditure of calves as they grow larger. The high proportion of time spent nursing emphasises the vulnerability of SRW mother-calf pairs to disturbances in the environment that could either disrupt crucial energy transfer between a mother and calf or increase the daily energy expenditure for either of them. A way for calves to decrease their energy expenditure is by remaining close to the mother. We show that calves are within an adult body length (<14 m) to its mother for >90% of the time. However, the estimated fixed rate of volume loss by the lactating females are mis-matched by an increasing rate of FMR of the growing calf. Thus, to maintain the documented calf growth rates, lactating females may reduce their maintenance metabolism. This notion is supported by the decreased ventilation rate of mothers during the breeding season. The apparent necessity of a lactating female to maintain low energy expenditure during the breeding season highlights the importance of protecting the breeding habitats to minimise human disturbance e.g. boat-based whale-watching, shipping, fishing and oil and gas development. A similar result of maintaining a low energy expenditure was documented for lactating humpback whales on a breeding ground in Western Australia (Bejder et al. 2019). Such disturbances would potentially increase the energy expenditure of both mother and calves and/or decrease the amount of time nursing can occur and hence the amount of energy available to allocate to calf growth, which may ultimately lead to a lower chance of survival (Christiansen el al. 2014). Nursing areas are therefore important for the healthy growth not only of the calves but also for the population”.	whales have also been recorded at locations up to 700 km apart within a single season (CoA 2012). Thus, if a SRW avoided the area above the behavioural effect criteria of 9.51 km it is unlikely to prevent them from undertaking their seasonal migrations. • As the Regia MSS will only occur during one season when SRWs are present in Australia waters, potential behavioural impacts to individual SRW will not impact on the recovery of the population. CGG has reviewed the EP in response to this claim and is satisfied that potential impacts SRWs energy reserves associated with the Regia MSS have been appropriately assessed and are mitigated to as low as reasonably practicable and acceptable levels. As a result, no changes have been made to the EP in response to this claim.
M20	**Matter:** Impacts to Southern Right Whale food source **Claim:** There are only about 300 endangered Southern Right Whales that visit our waters. Their breeding has not been going well in recent years. Being close to a seismic blasting regime will reduce their food supply of krill, make them less likely to be comfortable to visit our area and give birth and may also be harmful to the more sensitive young whales.	CGG acknowledges claims regarding the impacts to food sources for the Southern Right Whale (SRW) and has reviewed the Environment Plan (EP) to ensure this was appropriately considered. EP Appendix E7 (Impact Assessment: Underwater Sound: Marine Mammals) provides information on the distribution of SRWs in the Southern Hemisphere, with a circumpolar distribution between latitudes of 16°S and at least 65°S, migrating from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). Further information provided in draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) elaborates that, while feeding whales have been observed in the region of the Subtropical Front (41 – 44°S) in January and December, feeding has not been observed in coastal Australian waters, although other parts of the Australian Exclusive Economic Zone (EEZ) may be utilised for feeding, and three likely foraging grounds have been identified; south-west of WA, waters associated with the Subtropical Front, and Antarctic waters. Consequently, impacts to SRW food sources are not predicted given the significant distances from the Regia MSS to likely foraging grounds. Impacts to food sources for other species known to forage in the Otway Basin are assessed in response to Matter M10. CGG has reviewed the EP in response to this claim and is satisfied that potential impacts SRWs energy reserves associated with the Regia MSS have been appropriately assessed. As a result, no changes have been made to the EP in response to this claim.
M21	**Matter:** Impacts to Southern Right Whale calving and cow-calf pairs	CGG acknowledges claims regarding impacts on SRW calving and cow-calf pairs and has reviewed the Environment Plan (EP) to ensure that these impacts are adequately assessed.

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#	**Comments received**	***Titleholder response***
	Claim: I am appalled that this is allowed to happen both for risks to whales calving and because we need to stop new fossil fuel exploration. **Claim:** There are a broad range of consequences likely to negatively impact SRWs as a result of exposure to seismic blasting. Among them the following behavioural and physiological impacts should be of concern to the Nosema review team in regard to pregnant SRW cows and cow-calf pairs. **Claim:** Scientific research and observational data on the 'fight-flight' response shows how cetaceans, when faced with physically uncomfortable and/or threatening anthropogenic noise, will flee in order to escape the perceived danger. Consequences of the fight-flight response can be incredibly serious, both in the immediate and in the longer term. The stress of a pregnant female fleeing an excessive noise impact could have serious physiological implications for both the mother and her unborn calf. No less so, the stress to a cow fleeing the area to protect her new-born. **Claim:** SRW mothers are fiercely protective of their young and waste no time escaping perceived danger - an instinctive antipredator strategy. Capable of short bursts of fast swimming, SRWs either choose to fight or flee. If fleeing is the only option available, this response can have devastating ramifications for the calf. Unable to keep up with its mother, the calf will likely succumb to exhaustion, separation and/or predator attack. **Claim:** Should temporary hearing loss have affected one or both of the pair, things get a lot worse. Temporary deafness can last anywhere from minutes to hours. Apart from reducing the chances of the pair being reunited, a distressed calf calling for its mother is essentially a location beacon for predators.	Impacts and risks to marine mammals, including SRW and cow-calf pairs have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals), EP Appendix B7a and B7b – (Sound Modelling Reports) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996; DCCEEW 2022). The peak period for Southern Right Whale mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. Calving females are known to have high site fidelity and a 3 to 4-year calving interval. Other population classes stay for shorter and variable periods undertaking coastal movements and departing the coast earlier than female-calf pairs (CoA 2012). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Reports) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including SRW calving and cow-calf pairs. The predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whale mother and calf pairs is 1.4km, 14.2 km and 9.51km, respectively (see tables 24 and 25 in EP Appendix B7 – Sound Modelling Reports). Control measures to reduce impacts to SRW calving and cow-calf pairs are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). M#01: Activity Limitations stipulates the sound source will not be discharged in the Southern Right Whale reproductive BIA at any time. M#01: Activity Limitations also stipulates that CGG will implement an activity limitation where there will be no discharge of the sound source within 15 km of a Southern Right Whale BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS. 15 km is based on modelling which produced a TTS effect distance of up to 14.2 km as the furthest distance to sound effect criteria for aggregating Southern Right Whale without a calf. Control measure M#03: Fauna Management System, namely the Fauna Management Plan (EP Appendix G2) provide details on whale detection techniques and measures to minimise anthropogenic noise threats and the risk of vessel strike associated with the survey. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including these species and identifies: • Permanent or temporary hearing loss to SRWs is not predicted based on the distance of the spatial and temporal exclusion zones to SRW reproduction BIAs. In addition, while SRWs are migrating to and from the coastal reproduction BIAs, they are moving at speeds between 3 – 3.3. km/hr (Charlton 2017) and hence are unlikely to be within the area of cumulative sound exposure for a long enough period to receive cumulative sound levels above the effect criteria. • Effects are limited to behavioural responses to migrating SRW which may range from short term orientation to moving away from the sound source. Disturbance of migrating mothers could increase their energy expenditure which could result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51 km, the energetic costs would be extremely low if avoidance behaviour occurred. • SRWs whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (CoA 2012). Along the Australian coast, individual SRWs use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (CoA 2012). Thus, if a SRW avoided the area above the behavioural effect criteria of 9.51 km it is unlikely to prevent them from undertaking their seasonal migrations. CGG will establish an expert panel of independent and qualified experts in SRW and BW. The aim of the expert panel is to provide advice and recommendations on the FMP Implementation Plan. The Fauna Management Plan (EP Appendix G2, table G2.2) provides further details on the expert panel. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. CGG has assessed the claims pertaining to underwater sound impacts and considers the detailed control measures included in the Fauna Management Plan will reduce the impacts associated with underwater sound to as low as reasonably practicable and acceptable levels. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
		References: *Bannister JL, Kemper CM & Warneke RM. 1996. The Action Plan for Australian Cetaceans. Canberra: Australian Nature Conservation Agency.* *DCCEEW. 2022. Draft National Recovery Plan for the Southern Right Whale, Department of Climate Change, Energy, the Environment and Water, Canberra.* *Christiansen, F., Víkingsson, G.A., Rasmussen, M.H. and Lusseau, D., 2014. Female body condition affects foetal growth in a capital breeding mysticete. Functional Ecology, 28(3), pp.579-588.* *CoA. 2012. Conservation Management Plan for the Southern Right Whale. Commonwealth of Australia.* *Charlton, C.M. (2017). Population demographics of southern right whales (Eubalaena australis) in southern Australia. Ph.D. thesis. Curtin University, Centre for Marine Science and Technology, Perth, Australia, pp. 171.*
M22	**Matter:** Cumulative impacts to Southern Right Whales **Claim:** Before whaling in Victoria, Southern Right Whales used to give birth in Port Fairy Bay, with up to 30 whales visible in the bay at a time (Honan, 2009). I am hopeful that one day the species may recover and this may happen once again. Every extra project that happens in our ocean that has a harmful impact on our whales, makes it harder and less likely for them to recover. Each one, such as yours, that intends to blast when whales are in the vicinity, adds to the cumulative impact that they have to endure and somehow cope with.	CGG acknowledges claims regarding cumulative impacts on SRW and CGG has reviewed the Environment Plan (EP) to ensure that these impacts are adequately assessed. EP Appendix E10 (Cumulative Impact Assessment) presents a detailed assessment of potential cumulative impacts. The effects of past projects and activities, and currently operating projects, are included in the description of existing condition of, and any pressure or threats affecting, the environment, i.e., any impacts to marine life from current previous activities and projects is inherent within the description of the baseline. The focus of this Cumulative Impact Assessment (CIA) is to further build on these assessments by considering the impacts of the proposed activity on key environmental values and sensitivities in conjunction with the impacts from other reasonably foreseeable future projects. Table E10-3-1 in Appendix E10 of the EP details ongoing and future projects in the Otway offshore region. Potential for cumulative impacts to Southern Right Whales have been specifically addressed in: • Effects of Elevated Levels of Sound to Southern Right Whales (Appendix E10 Section 5.5). With the current uncertainty on the timing of some other projects and the distance of underwater sound affected areas, there is the potential for cumulative impact if the following occur within the migration BIA during the biologically relevant periods (nominally April and October): • Overlap between one seismic survey and one drilling activity for one season. • Consecutive drilling/P&A activities over several seasons. Without appropriate detection and actions in place there is the potential that SRWs could be exposed to underwater sound from two sources (seismic and drilling) within the migration BIA that could result in them expending more energy to move away from the sound source when migrating to and from coastal breeding areas. This could also occur for consecutive years whilst drilling activities are undertaken within the Otway Basin. Detection methodologies and mitigation measures for Southern Right Whales are addressed in EP Appendix G2 (Fauna Management Plan). The assessment concluded that cumulative impacts are not predicted as all draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) such that actions within and adjacent to SRW BIAs should demonstrate that it does not prevent any SRW from utilising the area or cause injury (TTS and PTS) and/or disturbance. Table E10-5-7 – of EP Appendix E10 contains the full cumulative impacts assessment for Southern Right Whale. Cumulative impacts resulting in an increase in the likelihood of PTS and TTS for a migrating SRW is not predicted due to the small distances to the PTS and TTS noise criteria for drilling activities. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. CGG has assessed the claims pertaining to underwater sound impacts and considers the detailed control measures included in the Fauna Management Plan will reduce the impacts associated with underwater sound to as low as reasonably practicable and acceptable levels. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
Key Matter: Blue Whale		
M23	**Matter:** Impacts to Blue Whales	CGG acknowledges claims regarding underwater noise impacts on Blue Whales/Pygmy Blue Whales (BW) and has reviewed the Environment Plan (EP) to ensure that these impacts are adequately assessed.

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	Claim: This destruction must not be allowed, for so many reasons, largely for the safety and future of the blue whales.	Impacts and risks to marine mammals, including Blue Whales have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) describes the distribution of Blue/Pygmy Blue Whales in and around the operational areas, noting that Pygmy Blue Whales not only occur on the Continental Shelf, but also in deeper waters, and that it is likely that whales occurring throughout this region are taking advantage of the highly productive waters associated with both the Bonney Upwelling and the subtropical convergence as foraging habitat, with peak foraging season occurring from January to April. CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Report) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including Blue Whales. The predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Blue Whales is 1.98 m, 22.5 km and 9.83 km, respectively. Control measures to reduce impacts to Blue Whales are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). M#01: Activity Limitations stipulates the seismic source will not be discharged in January, February and March. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March. M#01: Activity Limitations also stipulates the sound source will only be discharged in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA. Control measure M#03: Fauna Management System outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. The Fauna Management Plan (FMP) (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. CGG will establish an expert panel of independent and qualified experts in Southern Right Whales and BW. The aim of the expert panel is to provide advice and recommendations on the FMP Implementation Plan. The Fauna Management Plan (EP Appendix G2, Table G2.2) provides further details on the expert panel. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including these species and identifies: • As the Regia MSS will only occur during one season when Blue Whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of Blue Whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). The Regia MSS will not impact on the recovery of the population. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. CGG has assessed the claims pertaining to underwater sound impacts and considers the detailed control measures included in the Fauna Management Plan will reduce the impacts associated with underwater sound to as low as reasonably practicable and acceptable levels. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
M24	**Matter:** Impacts to migrating Blue Whales **Claim:** Of particular concern the proposal\'s impact on endangered whale species. The operational schedule outlined by CGG would coincide with critical periods for pygmy blue whales, including calving and feeding seasons. These whales, already facing significant threats due to historical whaling and habitat degradation, cannot afford further disturbances to their essential habitats and migration routes. Seismic blasting during these sensitive periods would not only disrupt their natural behaviours but also jeopardize their chances of survival and recovery.	CGG acknowledges claims regarding underwater noise impacts on migrating Blue Whales and has reviewed the Environment Plan (EP) to ensure that these impacts are adequately assessed. Refer to the following responses: • Migratory patterns of Blue Whales to the Otway are extensively addressed in response to Matter: M03. • Underwater sound impacts to blue whales and control measures are extensively addressed in response to Matter: M23. The area that may be affected by underwater sound is within the Pygmy Blue Whale foraging (annual high use) BIA (Appendix B12 MAP-REG-EPM-068). Blue Whales predominately occur in this area between January to April (DoE 2015e) though they have been recorded in the Otway area as early as October and as late as June. Control measures to reduce impacts to Blue Whales are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). #01: Activity Limitations stipulates the seismic source will not

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		be discharged in January, February and March. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March. M#01: Activity Limitations also stipulates the sound source will only be discharged in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. Control measure M#03: Fauna Management System (Appendix G2) outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. CGG will establish an expert panel of independent and qualified experts in SRW and BW. The aim of the expert panel is to provide advice and recommendations on the FMP Implementation Plan. The Fauna Management Plan (EP Appendix G2, table G2.2) provides further details on the expert panel. CGG has assessed the claims pertaining to underwater sound impacts and considers the detailed control measures included in the Fauna Management Plan (Appendix G2) will reduce the impacts associated with underwater sound to as low as reasonably practicable and acceptable levels. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims.
M25	**Matter:** Overlap of the operational area with Blue Whale Biologically Important Area **Claim:** The proposed survey area is a critical feeding habitat for endangered blue whale species and southern right whale (as well as other baleen whales), which very seldom vocalise in the feeding grounds. Seiche Environmental (2020) Marine Mammal Monitoring Report - Seabird 2D Seismic Survey, Otway Basin, Australia. Obtained under Freedom of Information, July 2023". **Claim:** Table 37 (page 235) in the EP shows seismic activity taking place in the OA directly over Baleen Whale habitat and Biologically Important Areas (BIA) including the Bonney Upwelling, threatening EPBC listed species. **Claim:** The endangered pygmy blue whale comes to the Southern Ocean to feed from October to June, directly within the operating area for this project. **Claim:** The submitter recommends CGG amends the impact assessment and mitigation actions to address their concerns and ensure all blue whales can continue to use the BIA without injury. **Claim:** There is evidence that blue whales feed year round (Moller et al., 2020). It is therefore essential that no seismic acquisition occurs within the BIA at any time of year. **Claim**: Pygmy blue whales must be able to use BIAs free of threat, harm or injury from seismic blasting exploration activities, according to EPBC Policy Statement 2.1. Based on the growing evidence of year round habitation of the OA by pygmy blue whales, seismic exploration in this area poses unacceptable risk.	CGG acknowledges claims regarding the overlap of the operational area with Blue Whale BIA and has reviewed the Environment Plan (EP) to ensure that these impacts are adequately assessed. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. CGG acknowledges that the area that may be affected by underwater sound is within the Pygmy Blue Whale foraging (annual high use) BIA (Appendix B12 MAP-REG-EPM-068). Blue Whales predominately occur in this area between January to April (DoE 2015e) though they have been recorded in the Otway area as early as October and as late as June. Impacts and risks to marine mammals, including Blue Whales, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). Measures adopted to ensure environmental impacts will be of an acceptable level and as low as reasonably practicable (ALARP) are detailed in these appendices. Control measures to minimise impacts to blue whales are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). #01: Activity Limitations stipulates the seismic source will not be discharged in January, February and March. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March. During this time permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (EP Appendix G2). Furthermore, it has been suggested that Blue Whales may continue to forage within 2.5 km of an operating seismic survey if resources are abundant enough to outweigh the physical and energetic costs of acoustic disturbance (Burton *et al* 2023). M#01: Activity Limitations also stipulates the sound source will only be discharged in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. Control measure M#03: Fauna Management System (Appendix G2) outlines whale detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
		CGG will establish an expert panel of independent and qualified experts in SRW and BW. The aim of the expert panel is to provide advice and recommendations on the FMP Implementation Plan. The Fauna Management Plan (EP Appendix G2, table G2.2) provides further details on the expert panel. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including these species and identifies: • As the Regia MSS will only occur during one season when Blue Whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of Blue Whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). The Regia MSS will not impact on the recovery of the population. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP along with the Fauna Management Plan will ensure anthropogenic threats to Blue Whales inside the BIA are minimised. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References:*** *Burton, C., Bouchet, P.J., Gill, P. and Marley, S.A., 2023. Evidence of likely foraging by pygmy blue whales in the Timor Trough during the late austral winter and early austral spring. Marine Ecology Progress Series, 718, pp.99-117.*
M26	**Matter:** The Environment Plan is inconsistent with the Blue Whale Management Plan. **Claim**: The submitter and their many community members and supporters contend that the EP is inconsistent with the Blue Whale Conservation Management Plan. **Claim:** The proposed management procedures are inconsistent with the Blue Whale Conservation Management Plan. Action Area A.2 of the Management Plan states "Anthropogenic noise in biologically important areas will be managed such that any blue whale con6nues to utilise the area without injury, and is not displaced from a foraging area." This quote stipulates that any and all blue whales, at any time of year, can use the BIA without injury or displacement.	CGG acknowledges claims regarding requirements for titleholders to undertake their activity in a manner that is not inconsistent with the Blue Whale Conservation Management Plan and has reviewed the Environment Plan (EP) to ensure this is adequately addressed. To reduce impacts to Blue Whales within the BIA, CGG established Control measure M#01: Activity Limitations (EP Appendix G2). M#01: Activity Limitations stipulates the seismic source will not be discharged in January, February and March. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March. M#01: Activity Limitations also stipulates the sound source will only be discharged in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. Control measure M#03: Fauna Management System (Appendix G2) outlines whale and dolphin detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. CGG will establish an expert panel of independent and qualified experts in SRW and BW. The aim of the expert panel is to provide advice and recommendations on the FMP Implementation Plan. The Fauna Management Plan (EP Appendix G2, table G2.2) provides further details on the expert panel. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP along with the Fauna Management Plan will ensure the EP is consistent with the Blue Whale Management Plan. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
Key Matter: Pinnipeds		
M27	**Matter:** Underwater sound impacts to seals	CGG acknowledges claims regarding underwater sound impacts to seals from the Regia MSS and have reviewed the Environment Plan (EP) to ensure that impacts to these species are adequately assessed.

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#	**Comments received**	***Titleholder response***
	Claim: Problems that I foresee include: Harming the seals directly with blasts. (I have heard of seal death accounts from other seismic blasting projects). **Claim:** Problems that I foresee include: Creating more difficult conditions in which to communicate and hunt that rely on use of hearing and sound detection. **Claim:** Causing stress to seals with the incessant loud blasts day and night, especially as they don't usually go back to land overnight and stay at sea to forage for a number of days. **Claim:** Problems that I foresee include: Providing another layer of more challenging conditions in which to survive and try to recover as a species. **Claim:** The Australian Fur Seals of Deen Maar are already under significant threat and having difficulty recovering as a population due a number of different threats they already face. Having another environmentally destructive activity added to the list of threats they already face in a highly used area upon which they heavily rely for their survival is a problem for them, as it will ADD to the difficulties they will face in trying to locate sufficient food to be healthy and raise a healthy generation of pups. **Claim:** There is an absence of knowledge regarding the impact of seismic blasts on marine seals and we request that CGG conduct further studies into the impact of seismic blasts on seals, before conducting any seismic blasts. **Claim:** Recommendations: Request studies into the effects of seismic blasts on seal health, behaviours and populations. **Claim:** Some potential effects of seismic blasting to local species of significance are: There are 4 seal species known to most frequently inhabit the ocean off the coast of Western Victoria; Australian Fur Seals, Long-Nosed Fur Seals, Southern Elephant Seals and Sub-Antarctic Fur Seals. **Claim:** In general, seismic blasting is a concern for seals because: It can damage the seals' hearing or even kill at close range. **Claim:** It may interfere with the seals being able to locate food in ways in which rely on hearing. **Claim:** It may interfere with communication between seals that rely on sound detection. **Claim:** It may well prevent seals from foraging in specific locations upon which they rely for their food, where they visit in their greatest densities. **Claim:** So how can CGG conduct its seismic blasting project in such a way that individual seals (as they are ALL protected, not just the species as a whole) will not be harmed directly or indirectly? **Claim:** Australian Fur Seals are PROTECTED BY LAW and not to be harmed, either directly or indirectly. CGG would be irresponsible and negligent to not consider the effects that their seismic blasting will have on the seals and to take action that is constructive in ensuring that they don't cause further challenges for this seal colony. **Claim:** Endangered Australian sea lions, Australian fur seals, and little penguins are at risk from seismic blasting.	Impacts and risks to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). CGG carried out a Protected Matters Search Tool (PMST) search and found three species of seal with the potential to occur within the Active Source Area, as detailed in Environment Plan (EP) (Appendix B5 PMST Reports). The Australian Fur-seal (*Arctocephalus pusillus*) was listed as breeding known to occur within area, the New Zealand Fur-seal (*Arctocephalus forsteri*) and the Australian Sea-lion (*Neophoca cinerea*) were listed as species that may occur within the Active Source Area. The Australian Sea-lion (*Neophoca cinerea*) is listed as 'endangered' under the Environment Protection and Biodiversity Conservation Act 1999. In Victorian waters Australian Fur-seal breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland. In Tasmanian waters they breed on Reid Rocks. There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. Their preferred breeding habitat is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges. Lady Julia Percy Island is within the area that may be affected by underwater sound. The Australian Sea Lion is a specialised benthic forager, primarily feeding on the sea floor (DSEWPaC 2013). The Australian Sea Lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy 1999). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Report) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including seals. The effect criteria for PTS and TTS for these species was not reached. The effect criteria for TTS for these species was not reached for the per pulse criteria and was only reached at 60 m from the sound source for the 24 hr cumulative effect criteria. It is highly unlikely that a seal or sea lion would stay within 60 m of the sound source for up to 24 hr, thus TTS impacts are not predicted. Impacts to seals or sea lions are limited to avoidance behaviour within an area between 2.91 – 11.8 km depending on where in the Operational Area the survey is being undertaken. As seals and sea lions are not dependent on any specific area within the area affected impacts may occur to individuals but not at a level to reduce fitness. Control measures to reduce impacts to Australian Fur-seal and the Australian Sea Lion are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). #01: Activity Limitations stipulates the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. 11.8 km is the furthest distance to sound effect criteria for pinnipeds (seals and sea lions). The increased protections afforded through the 17 km buffer are considered highly conservative to minimise disturbance of breeding seals in recognition that this is the largest Australian Fur Seal breeding colony in Australia. CGG will also implement soft starts, where prior to acquisition commencing the sound source power is ramped up over 30 minutes. This measure reduces the risk that seals or sea lions are within distances that PTS or TTS could occur. CGG has reviewed relevant literature and has noted the Southern Elephant Seals and Sub-Antarctic Fur Seals are subantarctic species. The Southern Elephant Seal has a nearly circumpolar distribution and visits subantarctic islands to breed and to moult. There are two main populations found in Australian waters and the principal breeding colonies for these populations are located on Heard and Macquarie Islands (Shaughnessy 1999; McMahon et al. 2005). Southern Elephant Seals concentrate on the northern beaches of Macquarie Island, although colonies are scattered around the island (DEH 2003). In the Australian Antarctic Territory, small numbers of pups have been reported from Browning Peninsula and Peterson Island, near Casey station (Murray 1981 cited in Shaughnessy 1999), and there has been a well-frequented haul-out area at Vestfold Hills (Burton 1985). Off the coast of mainland Australia, several pups have been born and many animals recorded on Maatsuyker Island (located at the most southern end, off the south-west coast of Tasmania) (Shaughnessy 1999). The subantarctic fur seal is a small, carnivorous marine mammal. In Australian waters, the subantarctic fur seal breeds, moults and hauls out mainly on Macquarie Island, but individuals range widely and occasionally reach the beaches of Tasmania and mainland Australia (DEH 2003g). Breeding colonies are only found at Macquarie Island (Shaughnessy et al. 1988; Goldsworthy 1999). Subantarctic fur seal individuals haulout at Heard Island, and one pup was born in each of 1987, 2000 and 2003 (Woinarski et al. 2014). Very few immigrants from large breeding colonies in the western Indian Ocean visit Australia (Woinarski et al. 2014). The Southern Elephant and the Seal Sub-Antarctic Fur Seals did not come up in the PMST search (see EP Appendix B5 PMST Reports), thus the likelihood of encountering the species during the Regia MSS is low and impacts to these species is not predicted. The Long-Nosed-Fur-Seal is a an Otariid pinniped and impacts to Otariid pinnipeds are assessed in Section 6.4 (Otariid Pinnipeds) of Appendix E7 of the EP (Impact Assessment – Underwater Sound: Marine Mammals). Impacts to this species are not predicted.

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		The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP will ensure anthropogenic threats to seals are minimised. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References***: *Burton, H.R. (1985). Tagging studies of male southern elephant seals (Mirounga leonina L.) in the Vestfold Hills area, Antarctica, and some aspects of their behaviour.* ***In:*** *Ling, J.K. & Bryden M.M., eds. Studies of sea mammals in south latitudes. Page(s) 19-30. Adelaide, South Australian Museum.* *Department of the Environment and Heritage (DEH) (2003g). Sub-Antarctic Fur Seal and Southern Elephant Seal Recovery Plan - Background Paper. Available from:* http://www.environment.gov.au/biodiversity/threatened/publications/seals.html. *DSEWPaC. 2013. Recovery Plan for the Australian Sea Lion (Neophoca cinerea). Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia.* *Goldsworthy, S. (1999). Maternal attendance behaviour of sympatrically breeding Antarctic and subantarctic fur seals, Arctocephalus spp., at Macquarie Island. Polar Biology. 21:316-325.* *McMahon, C.R., M.N. Bester, H.R. Burton, M. A. Hindell & C.J.A Bradshaw (2005). Population status, trends and a re-examination of the hypotheses explaining the recent declines of the southern elephant seal Mirounga leonina. Mammal Review. 35:82-100.* *Shaughnessy, P.D., G.L. Shaughnessy & L. Fletcher (1988a). Recovery of the fur seal population at Macquarie Island. Papers and Proceedings of the Royal Society of Tasmania. 122:177-187.* *Shaughnessy PD. 1999. The Action Plan for Australian Seals. CSIRO Wildlife and Ecology, Natural Heritage Trust, Environment Australia.* Woinarski, J., A. Burbidge & P. Harrison (2014). *The Action Plan for Australian Mammals 2012*. CSIRO Publishing, Victoria, Australia.
M28	**Matter**: Underwater sound impacts to Australian Sea Lions **Claim**: CGG will argue that the sea lions will choose to avoid the seismic blasted area when they experience discomfort from the sound source, but why should they have to when they are ENDANGERED and we are supposed to be protecting them? They may be restricted from locations that they actually need to feed to find enough food to be healthy. **Claim**: The Australian Sea Lion is listed as Endangered under the EPBC Act and its current estimated population size makes it the rarest pinniped in the world. Foraging by this species is known to occur from coastal waters (20-100m depth) to continental shelf areas within the CGG Environment Planning Area. **Claim:** Endangered Australian sea lions, Australian fur seals, and little penguins are at risk from seismic blasting. **Claim:** I am particularly concerned about the impact endangered endangered lions along with the other unique life.	CGG acknowledges claims regarding impacts to Australian Sea Lions from the Regia MSS and have reviewed the Environment Plan (EP) to ensure that impacts to these species are adequately assessed. Refer to the following responses: • Impacts associated with underwater noise and Australian Sea Lions are extensively addressed in response to Matter: M03. • Impacts associated with underwater noise and Little Penguins are extensively addressed in response to Matter: B01. Impacts and risks to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). The Australian Sea Lion is a specialised benthic forager, primarily feeding on the sea floor (DSEWPaC 2013). The Australian Sea Lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy 1999). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Reports) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including Australian Sea Lion. The effect criteria for PTS for these species was not reached. The effect criteria for TTS for these species was not reached for the per pulse criteria and was only reached at 60 m from the sound source for the 24 hr cumulative effect criteria. It is highly unlikely sea lions would stay within 60 m of the sound source for up to 24 hr, thus TTS impacts are not predicted. Impacts to sea lions are limited to avoidance behaviour within an area between 2.91 – 11.8 km depending on where in the Operational Area the survey is being undertaken. As seals and sea lions are not dependent on any specific area within the area affected impacts may occur to individuals but not at a level to reduce fitness. CGG will implement soft starts, where prior to acquisition commencing the sound source power is ramped up over 30 minutes. This measure reduces the risk that seals or sea lions are within distances that PTS or TTS could occur. The control measures outlined in the EP will ensure anthropogenic threats to sea lions are minimised. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

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		References: *DSEWPaC. 2013. Recovery Plan for the Australian Sea Lion (Neophoca cinerea). Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia.* *Shaughnessy PD. 1999. The Action Plan for Australian Seals. CSIRO Wildlife and Ecology, Natural Heritage Trust, Environment Australia.*
M29	**Mater:** Impacts to pinniped food sources **Claim:** Problems that I foresee include: Interfering with the seal's food supply directly, such as scaring off fish (Davis, 2020). **Claim:** Problems that I foresee include: Killing off future food supply of fish larvae in the zooplankton (McCauley et.al, 2017). **Claim:** It is also unknown how the seismic blasting will affect next generations of their food supplies and whether this will result in insufficient prey in following seasons to feed this already struggling colony of significance. **Claim**: Also, like the seals, sea lions food supply may well be scared off, reduced or killed, making their chance of survival and recovery as a species harder and less likely. **Claim:** It may well be a concern because of the seal's food supply being killed directly or indirectly from zooplankton being killed (McCauley et.al., 2017) and the flow on effect up the food chain.	CGG acknowledges claims regarding impacts to pinniped food sources from the Regia MSS and has reviewed the Environment Plan (EP) to ensure that impacts to these species are adequately assessed. Research being undertaken at Lady Julia Percy Island indicates that adult females Australian Fur-Seals feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al. 2008, Hume et al. 2004, Arnould & Kirkwood 2007). Studies have shown Australian Fur-Seal females to be almost exclusively benthic foragers, feeding on a wide range of prey including bony fish cephalopods and elasmobranchs (Arnould & Hindell 2001, Kirkwood et al. 2008, Deagle et al. 2009). The Australian Sea Lion is a specialised benthic forager, primarily feeding on the sea floor (DSEWPaC 2013). The Australian Sea Lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy 1999). Impacts to pinniped food sources including impacts to invertebrates, fish and elasmobranchs are assessed in Matter F01, F04, and F07. Impacts to pinniped food sources including penguin are assessed in Matter B01 and impacts to zooplankton are assessed in Matter P05. Impacts to zooplankton as a food source is assessed in Matter P07. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References:*** *Arnould, J.P.Y.A., Boyd, I., Rawlins, D. and Hindell, M., 2001. Variation in maternal provisioning by lactating Antarctic fur seals (Arctocephalus gazella): response to experimental manipulation in pup demand. Behavioral ecology and sociobiology, 50, pp.461-466.* *Arnould, J.P. and Kirkwood, R., 2007. Habitat selection by female Australian fur seals (Arctocephalus pusillus doriferus). Aquatic Conservation: Marine and Freshwater Ecosystems, 17(S1), pp.S53-S67.* *DSEWPaC. 2013. Recovery Plan for the Australian Sea Lion (Neophoca cinerea). Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia.* *Deagle, B.E., Kirkwood, R. and Jarman, S.N., 2009. Analysis of Australian fur seal diet by pyrosequencing prey DNA in faeces. Molecular ecology, 18(9), pp.2022-2038.* *Hume F, Hindell MA, Pemberton D & Gales R. 2004. Spatial and temporal variation in the diet of a high trophic level predator, the Australian fur seal (Arctocephalus pusillus doriferus). Marine biology. Vol. 144, no. 3, pp. 407-415.* *Kirkwood, R., Hume, F. and Hindell, M., 2008. Sea temperature variations mediate annual changes in the diet of Australian fur seals in Bass Strait. Marine Ecology Progress Series, 369, pp.297-309.* *Robinson S, Gales R, Terauds A & Greenwood M. 2008. Movements of fur seals following relocation from fish farms. Aquatic Conservation: Marine and Freshwater Ecosystems. Vol. 18, no. 7, pp. 1189-1199.* *Shaughnessy PD. 1999. The Action Plan for Australian Seals. CSIRO Wildlife and Ecology, Natural Heritage Trust, Environment Australia.*
M30	**Matter:** Impacts to juvenile seals **Claim:** CGG has not investigated whether the ears and hearing ability of seal pups are more sensitive to seismic blasting compared to adults. This must be investigated given the proposed activities will take place in close proximity to pupping grounds.	CGG acknowledges claims regarding underwater sound impacts to juvenile seals from the Regia MSS and has reviewed the Environment Plan (EP) to ensure that impacts to seal pups are adequately assessed. Impacts to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). CGG carried out a Protected Matters Search Tool (PMST) search and found three species of seal with the potential to occur within the Active Source Area, as detailed in Environment Plan (EP) (Appendix B5 PMST Reports), including the Australian Fur-Seal (*Arctocephalus pusillus*), with breeding known to occur within area. In Victorian waters Australian Fur-Seal breed at a number of offshore islands. In Tasmanian

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	Claim: Causing some harm, such as killing some of the seals, or preventing them from foraging from their hot spots, or impacting their food supply to a level that affects them negatively for that season or any future seasons or damaging the young seals' hearing, is not acceptable. **Claim:** Problems that I foresee include: Especially when closer to Deen Maar, potentially causing harm to the hearing of juvenile seals that are learning to forage or foraging within a smaller range from Deen Maar. Due to their smaller size, their ears may be more sensitive and more susceptible to harm from loud noise. **Claim:** Investigate whether the ears and hearing ability of seal pups are more sensitive to seismic blasting compared to adults.	waters they breed at Reid Rocks. Twenty-five percent of the population occurs on Lady Julia Percy Island/ Deen Maar and Seal Rocks, with only Lady Julia Percy Island /Deen Maar being within the area that may be affected by underwater sound. Fur-seals are present in the region all year, with breeding taking place during November and December. Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al. 2008, Hume et al. 2004, Arnould & Kirkwood 2007). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7: Sound Modelling Report) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including seals. The effect criteria for Permanent Threshold Shift (PTS) for these species was not reached. The effect criteria for Temporary Threshold Shift (TTS) for these species was also not reached for the per pulse criteria and was only reached within 60 m from the sound source for the 24 hr cumulative effect criteria. Given it is highly unlikely that a seal (adult or juvenile) would stay within 60 m of the moving sound source for up to 24 hr, TTS impacts are not predicted. Consequently, impacts to seals are limited to avoidance behaviour out to 2.91 – 11.8 km distance from the acoustic source, depending on where in the Operational Area the survey is being undertaken, affecting individuals but not at a level to reduce fitness. Control measures to reduce impacts to seals are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). **<u>Information in the EP Appendix E7 (Impact Assessment – Underwater Sound Marine Mammals) has been updated as follows:</u>** • **<u>M#01: Activity Limitations, has been updated to reflect that the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals to ALARP and an Acceptable level. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix B7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. The secondary modelling was undertaken in response to consultation with commercial divers mainly to address constraining the sound source operation to water depths of no shallower than 50 m. Results from this work show that behavioural sound effect criteria for pinnipeds is now reached at a maximum of 11.8 km from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted.</u>** • **<u>CGG has committed to not conducting the survey in the high productivity months of January-March which represents an important period when lactating females are alternating between feeding trips at sea and periods ashore to suckle their pups.</u>** **<u>EP Appendix F1 (Environmental Plan) has also been updated to amend the buffer to Deen Maar to 17km.</u>** Further, CGG will also implement soft starts where, prior to acquisition commencing, the sound source power is ramped up over 30 minutes, to reduce the risk of startle response (as identified in EP Appendix B8 (Seismic Studies Report)) and ensure no seals (adults or pups) are within effect distances whereby the onset of PTS or TTS could occur. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to levels that are as low as reasonably practicable and acceptable in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP will ensure anthropogenic threats to both adult and juvenile seals are minimised. Further, CGG has extended the buffer around Lady Julia Percy /Deen Maar Island such that behavioural impacts to breeding Australian fur-seals will be reduced.
M31	**Matter:** Displacement of Deen Maar and Portland seal colonies **Claim:** I am especially concerned about the impact of seismic on the Australian Fur Seal colony on Dean Maar, in particular disruption to feeding practices due to displacement as a result of seismic blasting within the area proposed by CGG, which overlaps this colony\'s year-round continental shelf foraging grounds to a significant extent. See research conducted by Arnould & Kirkwood (2008/2011). **Claim:** Prey directly around the colony site is typically reduced in a halo effect in colonies with high populations (Kirkwood & Arnould, 2011). So even though CGG	CGG acknowledges claims regarding impacts to seals associated with the Regia MSS and have reviewed the EP to ensure impacts to seals are adequately assessed. Impacts to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). CGG carried out a Protected Matters Search Tool (PMST) search and found three species of seal with the potential to occur within the Active Source Area, as detailed in Environment Plan (EP) (Appendix B5 PMST Reports), including the Australian Fur-seal (*Arctocephalus pusillus*), with breeding known to occur within area. The presence of Australian fur seals is described in EP Appendix E7 Section 4.1:

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	is providing a seismic blasting buffer of 10.3km from Deen Maar, this area is likely to have a low amount of food for the seals to persist on, and so the seals generally forage much further afield. **Claim:** Portland is home to a seal colony as is Deen Marr Indigenous Protected Area and in previous studies they have shown avoidance of their preferred feeding areas during seismic activities, leading to increased effort for their overall foraging. The impact of this on the health and longevity of seals is unknown. Longer-term repercussions on hearing cannot be ruled out (9) (9) https://www.cbd.int/doc/meetings/mar/mcbem-2014-01/other/mcbem-2014-01-su bmission-seismic-airgun-en.pdf. **Claim:** Interestingly, when overlaid with the CGG map, there is a very strong match up of the required foraging hot spot for the seal mothers of Deen Maar and the area that is proposed to be seismic blasted by CGG. Here is an approximate sketch that I drew up showing seal colony locations of Western Victoria, the continental shelf boundary, the CGG area and the foraging zone (not including density levels) of the female mother seals: Ref Kirkwood & Arnould, 2011. **Claim:** This Australian Fur Seal colony is significant for the species, the balance of the local marine ecosystem and for community in our local area. It needs serious consideration to ensure this project does not negatively impact it.	• In Victorian waters they [Australian Fur-seals] breed on offshore islands, including Lady Julia Percy Island (Deen Maar), Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland. In Tasmanian waters they breed on Reid Rocks. • There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. • Australian Fur-seals are present in the region all year, with breeding taking place during November and December. • Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. • Lady Julia Percy Island is within the area that may be affected by underwater sound. Control measures to reduce impacts to seals are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). **Information in the EP Appendix E7 (Impact Assessment – Underwater Sound Marine Mammals) has been updated as follows:** • **M#01: Activity Limitations, has been updated to reflect that the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals to ALARP and an Acceptable level. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix B7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. The secondary modelling was undertaken in response to consultation with commercial divers mainly to address constraining the sound source operation to water depths of no shallower than 50 m. Results from this work show that behavioural sound effect criteria for pinnipeds is now reached at a maximum of 11.8 km from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted.** • **CGG has committed to not conducting the survey in the high productivity months of January-March which represents an important period when lactating females are alternating between feeding trips at sea and periods ashore to suckle their pups.** **EP Appendix F1 (Environmental Plan) has also been updated to amend the buffer to Deen Maar to 17km.** Further, CGG will also implement soft starts where, prior to acquisition commencing, the sound source power is ramped up over 30 minutes, to reduce the risk of startle response (as identified in EP Appendix B8 (Seismic Studies Report)) and ensure no seals are within effect distances whereby the onset of Permanent Threshold Shift (PTS) or Temporary Threshold Shift (TTS) could occur. The EP recognises the important foraging area between Portland and Cape Otway as detailed by Kirkwood and Arnold (2011), 'Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour' (EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals)). The map referenced in this matter focuses on this foraging area, which is a 20 km strip out to 120 km. Kirkwood and Arnold (2011) note that seals from Lady Julia Percy Island tend to forage south-east of the colony between 60-200 m depth. The foraging area overlaps the Regia MSS. Modelling was conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences, for the EP (Appendix B7 - Sound Modelling Report) to assist in understanding the potential acoustic impacts on key regional receptors including pinnipeds. The effect criteria for PTS for these species was not reached. The effect criteria for TTS for these species was also not reached for the per pulse criteria and was only reached within 60 m from the sound source for the 24 hr cumulative effect criteria. Given it is highly unlikely that a seal would stay within 60 m of the moving sound source for up to 24 hr, TTS impacts are not predicted. Consequently, impacts to seals are limited to avoidance behaviour out to 2.91 – 11.8 km distance from the moving acoustic source, depending on where in the Operational Area the survey is being undertaken, affecting individuals but not at a level to reduce fitness. **In response to Matter: M31, the following changes have been made to the EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals):** **Section 4.1 has been updated to add the following:** **A study on the foraging behaviour of seals from the colony at Lady Julia Percy Island found that lactating Australian Fur-seals tended to search for prey south-east of their colony at 60- 200 m depth (Kirkwood and Arnould, 2011). The Regia MSS Operational Area may overlap foraging areas for the Australian Fur-seal.** **Section 6.4 has been amended to revise a bullet point as follows:** **Impacts to seals or sea lions are limited to avoidance behaviour within an area between 2.91 – 11.8 km depending on where in the Operational Area the survey is being undertaken. The Regia MSS Operational Area may overlap foraging areas for the Australian Fur-seal.** **EP Appendix F1 (Environmental Plan) has also been updated to amend the buffer to Deen Maar to 17km.**

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#	**Comments received**	***Titleholder response***
		<u>No changes to the overall assessment of impacts or the selection of mitigation measures is required as a result of these changes.</u> The literature referenced in this claim highlights impacts to foraging behaviours of Gray Seals and Harbour Seals based on a 1998 study (Thompson et. al. 1998 cited in Weilgart, 2013). Appendix B8 (Seismic Studies Report) includes references to several studies on the impacts of seismic on Grey Seals, Harbour Seals and phocid seals (Gotz et. al. 2009; Harris et al. 2001). Gotz et. al. (2009) recorded immediate, but short-term startle responses in two seals, with behaviour returning to normal soon after each trial. Harris et. al. undertook monitoring studies on phocid seals s (more sensitive to sound than otariid pinnipeds) and observed: • During daylight hours seals were seen at nearly identical rates during periods where there were no air guns firing, one air gun firing and the full array operational. • Seals tended to be further away during full array seismic. Swimming away was more common during full array operation than no air gun periods, but relative behaviours (looked, approached, swam parallel to boat's track, dive or swam away when full array was firing) did not differ significantly among the distance categories. • Approximately 79% of seal sightings were within 250 m of the seismic vessel. There was partial avoidance of the zone less than 150 m from the vessel during full array seismic, but seals did not move much beyond 250 m at any time. • Received levels of noise pulses from the full array were ≥180 dB SPL out to a radius of 1 km. Despite this, many seals showed little or no obvious avoidance and no obvious tendency to avoid diving (Appendix B8 Seismic Studies Report). As described above, mitigation measures have been implemented to reduce potential impacts to seals from noise associated with the Regia MSS. Reputable literature and acoustic modelling has been used to inform impact assessment and mitigation measures. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to levels that are as low as reasonably practicable and of an acceptable level in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. Appendix F3 (Acceptability Assessment) of the EP demonstrates how the environmental impacts and risks of the Regia MSS will be of an acceptable level. Acceptability takes into account a broad framework of concepts in order to define acceptable levels, including Principles of ecologically sustainable development (ESD) and Legislative Context which both reference Section 3A of the EPBC Act. The principles of ESD in Section 3A of the EPBC Act refer to a set of guidelines aimed at promoting responsible environmental stewardship and sustainable use of natural resources. Application of the principles of ESD ensures that impact at a population or ecosystem level are avoided. The control measures outlined in the EP will ensure anthropogenic threats to Australian Fur-seals are minimised. Further, CGG has extended the buffer around Lady Julia Percy /Deen Maar Island such that behavioural impacts to Australian Fur-Seals will be reduced. Refer to the response to Matter: M27 regarding the impact of underwater sound on Australian Fur -seals and Matter M:32 regarding impacts to foraging female fur seals. *References* *Arnould, J. & Kirkwood, R., 2011. 'Foraging trip strategies and habitat use during late pup rearing by lactating Australian fur seals'. Australian Journal of Zoology, 2011, 59, 216–226. ttp://dx.doi.org/10.1071/ZO11080.* *Gotz T, Hastie G, Hatch L, Raustein O, Southall B, Tasker M and Thomsen F. 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment. OSPAR Commission. London.* *Harris RE, Miller GW and Richardson WJ. 2001. Seal Response to Air gun Sounds During Summer Seismic Surveys in the Alaskan Beaufort Sea. Marine Mammal Science. 17(4):795-812.* *Weilgart, L., 2013. 'A review of the impacts of seismic airgun surveys on marine life'. Submitted to the CBD Expert Workshop on Underwater Noise and its Impacts on Marine and Coastal Biodiversity, 25-27 February 2014, London, UK. Available at: http://www.cbd.int/doc/?meeting=MCBEM-2014-01.*
M32	**Matter:** Operational Buffer around Deen Maar **Claim:** Female seals migrate out to the continental shelf to feed, a journey that involves passing through the OA where the seismic source is operating. Although CGG has placed an operational buffer around Deen Maar/Lady Julia Percy Island to protect seals and cultural heritage from seismic blasting, it has not recognised or taken measures to protect the seal migration pathway and reduce the risk of harm to migrating seals posed by blasting activities. Nor has CGG investigated whether the ear anatomy and hearing abilities of seal pups are more sensitive to	CGG acknowledges claims regarding underwater sound impacts to foraging female seals from the Regia MSS and has reviewed the Environment Plan (EP) to ensure that impacts to foraging female seals are adequately assessed. Impacts to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). CGG carried out a Protected Matters Search Tool (PMST) search and found three species of seal with the potential to occur within the Active Source Area, as detailed in Environment Plan (EP) (Appendix B5 PMST Reports), including the Australian Fur-Seal (*Arctocephalus pusillus*), with breeding known to occur within area. In Victorian waters Australian Fur-seal breed at a number of offshore islands. In Tasmanian waters they breed at Reid Rocks. Twenty-five percent of the population occurs on Lady Julia Percy Island/ Deen Maar and Seal Rocks, with only Lady Julia Percy Island /Deen Maar being within the area that may be affected by underwater sound.

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	seismic blasting than those of adult seals. This must be investigated given the proposed activities will take place in close proximity to pupping grounds.	Fur-seals are present in the region all year, with breeding taking place during November and December. Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al. 2008, Hume et al. 2004, Arnould & Kirkwood 2007). EP Appendix B8 (Seismic Studies Report) provided a review monitoring studies (Harris et al. 2001) undertaken on the behaviour of phocid seals (which are more sensitive to sound than otariid pinnipeds such as the Australian Fur-Seal) during a nearshore seismic program in Alaska observed that: • During daylight hours seals were seen at nearly identical rates during periods where there were no air guns firing, one air gun firing and the full array operational. • Seals tended to be further away during full array seismic. Swimming away was more common during full array operation than no air gun periods, but relative behaviours (looked, approached, swam parallel to boat's track, dive or swam away when full array was firing) did not differ significantly among the distance categories. • Approximately 79% of seal sightings were within 250 m of the seismic vessel. There was partial avoidance of the zone less than 150 m from the vessel during full array seismic, but seals did not move much beyond 250 m at any time. • Received levels of noise pulses from the full array were ≥180 dB SPL out to a radius of 1 km. Despite this, many seals showed little or no obvious avoidance and no obvious tendency to avoid diving. CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Reports, results from B7b are used here) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including seals. The effect criteria for Permanent Threshold Shift (PTS) for these species was not reached. The effect criteria for Temporary Threshold Shift (TTS) for these species was also not reached for the per pulse criteria and was only reached within 60 m from the sound source for the 24 hr cumulative effect criteria. Given it is highly unlikely that a seal would stay within 60 m of the moving sound source for up to 24 hr, TTS impacts are not predicted. Consequently, impacts to seals are limited to avoidance behaviour out to 2.91 – 11.8 km distance from the moving acoustic source, depending on where in the Operational Area the survey is being undertaken, affecting individuals but not at a level to reduce fitness. Control measures to reduce impacts to seals are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). **Information in the EP has been updated as follows:** • **M#01: Activity Limitations, has been updated to reflect that the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals to ALARP and an Acceptable level. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix B7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. The secondary modelling was undertaken in response to consultation with commercial divers mainly to address constraining the sound source operation to water depths of no shallower than 50 m. Results from this work show that behavioural sound effect criteria for pinnipeds is now reached at a maximum of 11.8 km from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted.** • **CGG has committed to not conducting the survey in the high productivity months of January-March which represents an important period when lactating females are alternating between feeding trips at sea and periods ashore to suckle their pups.** **EP Appendix F1 (Environmental Plan) has also been updated to amend the buffer to Deen Maar to 17km.** Further, CGG will also implement soft starts where, prior to acquisition commencing, the sound source power is ramped up over 30 minutes, to reduce the risk of startle response (as identified in EP Appendix B8 (Seismic Studies Report)) and ensure no seals are within effect distances whereby the onset of PTS or TTS could occur. The Regia MSS will be managed so that the potential impacts and risks will be mitigated to levels that are as low as reasonably practicable and acceptable in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP will ensure anthropogenic threats to foraging female seals are minimised. Further, CGG has extended the buffer around Lady Julia Percy /Deen Maar Island such that behavioural impacts to breeding Australian Fur-Seals will be reduced.

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		Note: Impacts to juvenile seals addressed in response to Matter: M30 above.
M33	**Matter:** Insufficient mitigation measures for seals and sea lions **Claim:** In the Plan it is stated that CGG has placed an operational buffer around Deen Maar Indigenous Protected Area to protect seals from seismic blasting, however it has not recognised, or taken measures, to protect seal migration through the Operational Area to their breeding grounds. **Claim:** Recommendation: Increase the exclusion zone from known colonies from seismic blasts to 100km. **Claim:** Recommendation: Formulate a plan for risk mitigation and management of the risks that seismic blasting has on seal behaviour and populations. **Claim:** NOPSEMA should reject the Environment Plan by CGG if a safe plan for the Australian Fur Seal colony at Deen Maar, as well as the others is not formed. This should be in conjunction with knowledgeable seal scientists from Victoria that are familiar with the colony. **Claim:** The EP lacks clarity and fails to adequately address the potential marine life, particularly EPBC-listed such as fur seals. The document, spanning over 3,000 pages, is convoluted and lacks essential details on mitigation measures to protect these vulnerable species. **Claim:** The EP shows that sea lion behavioural effects from seismic blasting can occur up to 10km from the seismic source, yet there are no mitigation measures in place to detect, measure or reduce the harm from seismic blasting to foraging sea lions as they pass through or near the OA. **Claim:** On page 2, 979 of their plan, CGG mentions impacts on seals and sea lions will be limited to 2.95 - 10.3km and there will be a sound exclusion zone within 10.3km of the breeding ground. However, according to the Department of Climate Change, Energy, Water and Environment due to mobility and foraging requirements fur seals may occur in areas 500km from the colony making the exclusion zone of 10.3 km that CGG recommends severely inadequate. (45) 45. https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21. **Claim:** In addition to the impacts on marine mammals, the proposal neglects to adequately address the potential consequences for other marine species, such as pinnipeds and penguins. Endangered species like Australian sea lions and little penguins are at risk of significant harm from seismic activities in their habitats, yet the EP fails to implement adequate measures to protect these vulnerable populations. **Claim:** The EP acknowledges that there is limited published data on seismic effects on sea lions, yet asserts that the disturbance will be "minimal". Based on this failure to explicitly acknowledge and consider the implications of sea lion foraging near the OA and to accordingly implement appropriate mitigation measures to protect the world's rarest pinniped from harm, the EP should be refused. **Claim:** When Australian Sea Lions are in the vicinity of the seismic blasting, it is unlikely that Marine Mammal Observers will spot these creatures, diving for up to 12 minutes at a time. And they certainly wouldn't be detected by sight during night time blasting periods.	CGG acknowledges claims regarding mitigation measure for underwater sound impacts to seals and sea lions and has reviewed the Environment Plan (EP) to ensure that mitigation measures were appropriately considered. Impacts to marine mammals, including seals, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). CGG carried out a Protected Matters Search Tool (PMST) search and found three species of otariid pinnipeds with the potential to occur within the Active Source Area, as detailed in Environment Plan (EP) (Appendix B5 PMST Reports), including the Australian Fur-Seal (breeding known to occur in the area), New Zealand Fur-Seal (may occur in the area,) and the Australian Sea Lion (known to occur in the area). There are no biologically important areas (BIAs) in the area for these species. The Australian Sea Lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC 2013). They typically forage up to 60 km from their colony, with the closest colonies occurring in South Australia, but can travel up to 190 km when over shelf waters (Shaughnessy 1999). Australian Sea Lions, forage at all times of day and dive continuously while at sea (Costa & Gales 2003). Individual dives rarely exceed eight minutes in duration (Kirkwood & Goldsworthy 2013). EP Appendix B8 (Seismic Studies Report) provided a review monitoring studies (Harris et al. 2001) undertaken on the behaviour of phocid seals (which are more sensitive to sound than otariid pinnipeds) during a nearshore seismic program in Alaska observed that: • During daylight hours seals were seen at nearly identical rates during periods where there were no air guns firing, one air gun firing and the full array operational. • Seals tended to be further away during full array seismic. Swimming away was more common during full array operation than no air gun periods, but relative behaviours (looked, approached, swam parallel to boat's track, dive or swam away when full array was firing) did not differ significantly among the distance categories. • Approximately 79% of seal sightings were within 250 m of the seismic vessel. There was partial avoidance of the zone less than 150 m from the vessel during full array seismic, but seals did not move much beyond 250 m at any time. • Received levels of noise pulses from the full array were ≥180 dB SPL out to a radius of 1 km. Despite this, many seals showed little or no obvious avoidance and no obvious tendency to avoid diving. Regarding recommendations for a 100 km exclusion zone from Deen Maar, CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7: Sound Modelling Report) to assess distances from activities where underwater sound reached exposure criteria corresponding to various levels of potential impact to marine fauna including seals and sea lions. The effect criteria for Permanent Threshold Shift (PTS) for these species was not reached. The effect criteria for Temporary Threshold Shift (TTS) for these species was also not reached for the per pulse criteria and was only reached within 60 m from the sound source for the 24 hr cumulative effect criteria. Given it is highly unlikely that a seal would stay within 60 m of the moving sound source for up to 24 hr, TTS impacts are not predicted. Consequently, impacts to seals and sea lions are limited to avoidance behaviour out to 2.91 – 11.8 km distance from the moving acoustic source, depending on where in the Operational Area the survey is being undertaken, affecting individuals but not at a level to reduce fitness based on the Seismic Studies Report information in Appendix B8. Control measures to reduce impacts to seals and sea lions are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). **Information in the EP has been updated as follows:** • **M#01: Activity Limitations, has been updated to reflect that the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals to ALARP and an Acceptable level. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix B7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. The secondary modelling was undertaken in response to consultation with commercial divers mainly to address constraining the sound source operation to water depths of no shallower than 50 m. Results from this work show that behavioural sound effect criteria for pinnipeds is now reached at a maximum of 11.8 km from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted.** • **CGG has committed to not conducting the survey in the high productivity months of January-March which represents an important period when lactating females are alternating between feeding trips at sea and periods ashore to suckle their pups.** • **EP Appendix F1 (Environmental Plan) has also been updated to amend the buffer to Deen Maar to 17km.**

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		Further, CGG will also implement soft starts where, prior to acquisition commencing, the sound source power is ramped up over 30 minutes, to reduce the risk of startle response (as identified in EP Appendix B8 (Seismic Studies Report)) and ensure no seals or sea lions are within effect distances whereby the onset of PTS or TTS could occur. The Regia MSS will be managed so that the potential impacts to seal and sea lions will be mitigated to levels that are as low as reasonably practicable and acceptable in accordance with environmental regulatory requirements. The control measures outlined in the EP will ensure anthropogenic threats to seals and sea lions are minimised. Further, CGG has extended the buffer around Lady Julia Percy /Deen Maar Island such that behavioural impacts to breeding Australian Fur-Seals will be reduced.
Key Matter: Impacts to Other Marine Mammals		
M34	**Matter:** Impacts on dolphins **Claim:** Dolphins– These come and go at all times of the year in the Moyne region. They are affected by seismic blasting in similar sorts of ways as whales, as they also rely heavily on echolocation to survive in an underwater world. They are expected to leave the area when seismic blasting regimes are conducted. It hardly seems fair, given the ocean is their habitat. **Claim:** Gordon et al., (2003) and Gray and van Waerebeek (2011) reported a single pantropical spotted dolphin showing severe behavioural distress followed by ataxia near a seismic array. Mann et al. (2010) reported several incidences of permanent hearing loss in stranded odontocetes where exposure to high levels of anthropogenic noise cannot be dismissed. There is very limited research on the impact of seismic blasts on dolphins. **Claim:** Request studies into the effects of seismic blasts on dolphin populations.	CGG acknowledges claims regarding impacts to dolphins over the duration of the Regia MSS and has reviewed the Environment Plan (EP) to ensure that the assessment of potential impacts to dolphin species has been adequately described. Sound exposure criteria thresholds and impacts to marine mammals were identified using extensive peer review, published literature (referenced throughout the EP). In addition, modelling was conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences, for the EP (Appendix B7a and B7b- Sound Modelling Report) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals. Table E7-5-1 in EP Appendix E7 (Impact Assessment - Underwater Sound: Marine Mammals) states the sound exposure guidelines for the onset of Permeant Threshold Shift (PTS), Temporary Threshold Shift (TTS) and the current interim criterion for impulsive sound sources for marine mammal' behavioural threshold. Table E7-5-1 shows that the noise effect criteria for PTS for high-frequency cetaceans (such as dolphins) was not reached during any modelled scenario. Table E7-5-1 also shows that the noise effect criteria for TTS per pulse effect criteria is not reached but the TTS 24hr cumulative effect criteria is reached up to 50 m. However, it is not feasible that a dolphin would be within that distance of the moving vessel for 24 hrs, thus impacts are not predicted. **<u>EP Appendix E7, Section 6.2 has been updated to provide clarity to the statements within this section and now states:</u>** • **<u>The TTS per pulse effect criteria is not reached. The TTS 24hr cumulative effect criteria is reached up to 50 m, however it is not feasible that a cetacean would be within that distance of the moving vessel for 24 hrs, thus impacts are not predicted.</u>** Impacts to high-frequency cetaceans are limited to avoidance behaviour out to between 2.91 – 11.8 km depending on where in the Operational Area the survey is being undertaken. As high-frequency cetaceans are not dependent on any specific area within the area affected impacts through avoidance behaviour may occur to individuals but not at a level to reduce fitness. The Protected Matters Search Tool (PMST) Report (Appendix B5 – PMST Reports) identified that six dolphin species, which are classed as high-frequency cetaceans, potentially occur within the area that may be affected by underwater sound. The predicted level of impact based on the effect (minor) and uncertainty (medium) levels is assessed as medium. For HF cetaceans the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7 of Appendix E7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels. Gordon et al. (2003) reviews of the effects of seismic surveys on marine mammals and discusses a number of sources including underwater explosions and military applications. Gordon et al. (2003) does state that underwater explosions cause tissue damage and can be lethal, but such activities are not part of the Regia MSS. Gordon et al. (2003) continues by stating pressure pulses from air guns have longer rise times and are therefore less likely to cause damage than pressure waves from high explosives and to date there is no evidence that seismic pulses cause acute physical damage to marine mammals. Gordon et al. (2003) does not refer to behavioural distress or ataxia in dolphins near a seismic array as per the claim. It should be noted that further reviews have been conducted since Gordon et al. (2003) which have been used as part of the impact assessment used in the EP. Gray and van Waerebeek (2011) reported on a single pantropical spotted dolphin relative to a vessel towing a seismic array with significant differences in the specifications of the towed source, with Gray and van Waerebeek (2011) reporting a towed array of 2 x 3400 cui compared to the maximum total volume to be utilised during the Regia MSS of 2,820 cui. They also implemented a reduced soft start period (20 minutes) compared to 30 minutes for the Regia MSS. Modelling, as previously detailed, shows that PTS and TTS per pulse effect criteria for high-frequency cetaceans is not reached, with TTS 24hr cumulative effect criteria only reached within 50 m of the sound source, with impacts therefore limited to avoidance behaviour only. The control measures detailed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and the Fauna Management Plan (Appendix G2) demonstrate that impacts have been reduced to as low as reasonably practicable (ALARP) and are of an acceptable level. Whilst Mann et al. (2010) discusses a number of contributing factors to hearing loss in marine mammals, it also states that the noise exposure history of any of dolphins studied is not known. Regarding strandings, Mann et al. (2010) states that based on the locations of stranding, it is

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		possible that some of them have been exposed to chronic noise from boating and shipping, while for others this is unlikely. There is no mention in Mann et al. (2010) of seismic activities. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. **<u>CGG has updated the EP to provide additional clarity on the underwater sound modelling results as described above, however no material changes have been made to the EP in response to these claims.</u>** ***References***: *Gordon, J., Gillespie, D., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., Thompson, D., 2003. 'A Review of the Effects of Seismic Surveys on Marine Mammals' . Marine Technology Society Journal, 37(4):16-34.* *Gray, H., van Waerebeek, K., 2011. 'Postural instability and akinesia in a panspotted tropical dolphin Stenella attenuata, in proximity to operating airguns of a geophysical seismic vessel'. Journal for Nature Conservation 19(6): 363– 367.* *Mann D, Hill-Cook M, Manire C, Greenhow D, Montie E, et al. (2010) Hearing Loss in Stranded Odontocete Dolphins and Whales. PLoS ONE 5(11): e13824. doi:10.1371/journal.pone.0013824*
M35	**Matter**: Impacts on dwarf and pygmy sperm whales **Claim**: Dwarf and pygmy sperm whales have been recorded in the deep water areas of the OA off the west coast of Tasmania, with the greatest number of sightings occurring in October and November. Very little information exists on how these species are affected by seismic blasting, and there is limited data on the distribution and habitat use of these species, which are found in oceanic waters far from shore. Allowing seismic blasting in these periods fails to protect these species from the proven harm inflicted by this activity to whales over hundreds of kilometres in range. **Claim:** The submitter recommend that CGG fund research on these species, with NOPSEMA overseeing the efficacy of this research to ensure the adequate protection of these species.	CGG acknowledges claims regarding the presence of Dwarf and Pygmy Sperm Whales off the west coast of Tasmania and have reviewed the Environment Plan (EP) to ensure that the assessment of potential impacts to Sperm Whales has been an appropriate. Dwarf Sperm Whales are found in open ocean habitats in temperate to tropical waters around the world with no recorded sightings or strandings off Victoria (DCCEEW 2023a). Pygmy Sperm Whales are found in ocean habitats in temperate to tropical waters around the world and have been recorded in all states except NT, though as strandings (DCCEEW 2023b). There is limited information on both Pygmy and Sperm Whales as they are difficult to observe in the wild. These animals are usually found offshore in deeper waters (Best, 2007), and data from stomach analysis from stranded individuals suggests Pygmy Sperm Whales feed in waters beyond the edge of the continental self, while Dwarf Sperm Whales feed mainly over the continental shelf and slope (Ross, 1979, Plön et al., 1999, Plön and Baird, 2022, Plön, 2023). These studies also indicate both species feed predominately on n squid, with few fish and crustaceans in the diet (Ross, 1979, Sekiguchi et al., 1992, McAlpine and Murison, 1997, Plön et al., 1999, Santos et al., 2006, Beatson, 2007, West et al., 2009, Staudinger et al., 2014, Matsuda et al., 2023). Recent research has shown that there there has been at least some historical gene flow between these distant populations of Dwarf Sperm Whales between Chile and South Africa, and Australia. (Plön et al. 2023). Both the Dwarf and Pygmy Sperm Whales have an identified presence as "species or species habitat may occur" within the Active Source Area by the Protected Matters Search Tool (PMST), however, numbers are predicted to be low and as there are no BIAs these species are likely to be transient in the area. EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) assess impacts to very-high frequency (VHF) cetaceans such as Sperm Whale, with detailed noise modelling provided in EP Appendix B7a and B7b (Sound Modelling Report, results from B7b are used here). CGG also provided an extensive literature study on the effects of seismic activity on marine mammals including Sperm Whales in Appendix B8 (Seismic Sound Studies Report, Section 7-Marine Mammals). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Reports) to assess distances from the sound source within which sound effect criteria are predicted to be exceeded. This was tested for several survey layouts that were iteratively refined based on feedback and insights from interested persons. For VHF functional hearing group species such as Dwarf and Pygmy Sperm Whales, the distance from the sound source within which the Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) <u>per pulse</u> effect criteria was exceeded was between 410m and 820 m for all survey layout scenarios tested. Through iterative testing of survey layouts, the PTS 24hr cumulative effect criteria was able to be constrained to within 70 m of the sound source. An exceedance of the TTS 24hr cumulative effect criteria was also iteratively reduced to within 350 m of the sound source, down from max 550 m that was initially predicted for earlier survey layout scenarios. The potential for a PTS or TTS response impact has thereby been spatially constrained and is only credible if an individual remains within the predicted distance of the moving sound source continuously for a period of 24 hours. Considering the limited distance range from the sound source within which these sound effect criteria are exceeded (max 820 m) as well as the range of controls adopted for implementation of the survey, the risk to Dwarf and Pygmy Sperm Whales is considered to be addressed comprehensively through survey pre-planning efforts. Control measures to minimise impacts to very high frequency cetaceans are outlined in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). M#03: Fauna Management System (Appendix G2) outlines whale and dolphin detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey.

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		The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. CGG acknowledges the recommendation to fund research on Dwarf and Pygmy Sperm Whales, and also acknowledges that NOPSEMA's Research Strategy 2024-2027 identifies threatened and migratory species as a relevant research topic for decision-making. With their research strategy, NOPSEMA promotes a collaborative approach to addressing knowledge gaps. Relevant research topics include: • Better understanding, and where possible quantifying, behavioural responses to underwater noise and implications for foraging, feeding, fitness and breeding success in the context of EPBC Act species recovery requirements (e.g. Actions relevant to underwater noise management set out in in-force EPBC Act species conservation management documentation). CGG commissioned Klarite to undertake a review of seismic studies and extensive research undertaken (available in Appendix B8), demonstrating that core impact pathways for cetaceans from underwater noise is well established. This fundamental understanding of impact pathways has been brought into the EP to inform the impact assessment for marine mammals. To continue to inform knowledge gaps, CGG will submit all sightings and acoustic observations as reports to the Australian Antarctic Division via the National Marine mammal Data Portal and hosted by the Australian Marine Mammal Centre (AMMC) for the collation of national sightings. The AMMC has developed database applications to support marine mammal conservation and policy initiatives. These applications: • provide the public with summarised information on the biology of Australian marine mammals; • facilitate data-driven management and conservation decisions; • collate, protect and archive data; • assisting with reporting obligations to the International Whaling Commission and under the Environment Protection and Biodiversity Conservation Act encouraging and facilitating collaboration, analysis and reporting. The observational data hosted by the AMMC is available to research community. CGG will, further, review any new relevant research that is available in the public domain, or otherwise made available. To continue to manage the Regia MSS to ALARP and Acceptable levels, collection and review of new relevant research, if any, will be completed within one month of the commencement of the Regia MSS. A risk assessment and management of change process will be instigated if outcomes of relevant research suggest that there has been a significant change to the context of the Regia MSS that may lead to an update to the Fauna Management Plan (EP Appendix G2). The Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. See EP Appendix F2 (ALARP Assessment) for a detailed explanation of the ALARP status determination used for the Regia MSS. The control measures outlined in the EP will ensure anthropogenic threats to of Dwarf and Pygmy Sperm Whales are minimised. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References****:* *Beatson, E., 2007. The diet of pygmy sperm whales, Kogia breviceps, stranded in New Zealand: implications for conservation. Rev. Fish. Biol. Fish. 17, 295–303.* *Best, P.B., 2007. Whales and Dolphins of the Southern African Subregion. Cambridge University Press, Cape Town, pp. 338.* *Matsuda, T.A., Matsuishi, T.F., Tajima, Y., Yamada, T. K., 2023. Notes on stomach contents of pygmy and dwarf sperm whales (Kogia spp.) from around Japan. Advances in Marine Biology, 96, pp.1-24.* *McAlpine, D.F., Murison, L.D., 1997. New records for the pygmy sperm whale, Kogia breviceps (Physeteridae) from Atlantic Canada with notes on diet and parasites. Mar.Mamm. Sci. 13 (4), 701–704.* *Plön, S.E.E., Bernard, R.T.F., Klages, N.T.K. and Cockcroft, V.G., 1999. Stomach content analysis of pygmy and dwarf sperm whales and its ecological implications: is there niche partitioning. European Research on Cetaceans, 13, pp.336-339.* *Plön, S., Baird, R., 2022. Kogia sima. In: Hackländer, K., Zachos, F.E. (Eds.), Handbook of the Mammals of Europe. Springer* *Plön, S., 2023. Kogia breviceps. In: Hackländer, K., Zachos, F.E. (Eds.), Handbook of the Mammals of Europe. Springer*

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#	**Comments received**	***Titleholder response***
		Plön, S., Best, P.B., Duignan, P., Lavery, S.D., Bernard, R.T., Van Waerebeek, K. and Baker, C.S., 2023. Population structure of pygmy (Kogia breviceps) and dwarf (Kogia sima) sperm whales in the Southern Hemisphere may reflect foraging ecology and dispersal patterns. Advances in Marine Biology, 96, pp.85-114 *Ross, G.J.B., 1979. Records of pygmy and dwarf sperm whales, genus Kogia, from southern Africa, with biological notes and some comparisons. Ann. Cape Prov. Mus. (nat. Hist.)11 (14), 259–327.* *Santos, M.B., Pierce, G.J., López, A., Reid, R.J., Ridoux, V., 2006. Pygmy sperm whales Kogia breviceps in the Northeast Atlantic: new information on stomach contents and strandings. Mar. Mamm. Sci. 22, 600–616.* *Sekiguchi, K., Klages, N.T.W., Best, P.B., 1992. Comparative analysis of the diets of smaller odontocete cetaceans along the coast of Southern Africa. S. Afr. J. Mar. Sci. 12,843–861.* *Staudinger, M.D., McAlarney, R.J., McLellan, W.A., Pabst, D.A., 2014. Foraging ecology and niche overlap in pygmy (Kogia breviceps) and dwarf (Kogia sima) sperm whales from waters of the U.S. mid-Atlantic coast. Mar. Mamm. Sci. 30, 626–655.* *West, K.L., Walker, W.A., Baird, R.W., White, W., Levine, G., Brown, E., et al., 2009. Diet of pygmy sperm whales (Kogia breviceps) in the Hawaiian Archipelago. Mar. Mamm. Sci. 25, 931–943.*
M36	**Matter**: Impacts on fin and sei whales **Claim**: Fin and sei whales are listed as Vulnerable under the EPBC Act. These species are known to feed in the OA from January to April, though there is limited information available concerning the lifecycle and habitat use of these species. Submitter recommends that the precautionary principle be applied in recognition of the lack of understanding of how these species will be affected, both immediately and cumulatively, by the proposed seismic blasting surveys in their important habitats areas. **Claim:** The submitter recommend that CGG fund research on these species, with NOPSEMA overseeing the efficacy of this research to ensure the adequate protection of these species.	CGG acknowledges claims regarding impacts to Fin and Sei Whales from the Regia MSS and have reviewed the Environment Plan (EP) to ensure that impacts to these species are adequately assessed. Impacts and risks to marine mammals, including Fin and Sei Whales, have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna). Both the Fin and Sei Whales have an identified presence as "foraging, feeding or related behaviour known to occur within the area" within the Active Source Area by the Protected Matters Search Tool (PMST), included in EP Appendix B5 (PMST Reports). There are no BIAs for the Fin and Sei Whales within Australian waters. The conservation advice for both species (TSSC 2015ba, TSSC 2015b) identify anthropogenic noise and acoustic disturbance as a minor consequence rating. There is no information on foraging areas for Fin, Pygmy Right Whale or Sei whales off Victoria. The Fin Whale is listed as vulnerable and migratory under the EPBC Act. As described in EP Appendix E7 Section 4.4 (Fin Whale), while Australian Antarctic waters are important feeding grounds for Fin Whales, the species also feeds in the Bonney Upwelling during summer/autumn sometimes in the company of Blue and Sei Whales (DCCEEW 2023). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat with the species feeding on planktonic crustacea, krill, some fish and cephalopods (DCCEEW 2023). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed. The Sei Whale is listed as vulnerable under the EPBC Act. As described in EP Appendix E7 Section 4.7, Sei Whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. In Australia, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978; Bannister et al. 1996; Thiele et al. 2000; Chatto and Warneke 2000; Bannister 2008). Sightings of Sei Whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al. 2012), where opportunistic feeding has been observed between November and May (Gill et al. 2015). CGG commissioned international experts to undertake underwater sound modelling (EP Appendix B7a and B7b: Sound Modelling Reports) to assess distances from the sound source within which noise effect criteria are predicted to be exceeded. This was tested based on several survey layouts that were iteratively refined based on feedback and insights from interested persons. For low frequency (LF) functional hearing group species such as Fin and Sei whales, the distance from the sound source within which the Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) per pulse effect criteria was exceeded remained at 30 - 90 m for all survey layout scenarios tested. The distance from the sound source within which cumulative effect criteria were exceeded, however, was predicted to reduce significantly once the survey layout was refined and constrained to deeper than 50 m. The PTS 24hr cumulative effect criteria was able to be limited to within 5.08 km (min 1 km) – which was out to 4.89 km from the sound source in earlier survey layout scenarios. Although this was number did not reduce, CGG is confident that these individuals could be observed through visual and acoustic detection mechanisms already built in as controls for the survey and, if observed, triggering requirements to moderate operation of the sound source. The TTS 24hr cumulative effect criteria was also able to be limited to within 41.9 km (min 20.5 km) – which was out to 43.5 km from the sound source in earlier survey layout scenarios. The potential for a TTS response impact has thereby been spatially constrained and is only credible if an individual remains within the predicted distance of the moving sound source continuously for a period of 24 hours. Considering the range of

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		controls adopted for implementation of the survey, the risk to Sei and Fin Whales is considered to be addressed comprehensively through survey pre-planning efforts. Control measures to minimise impacts during the survey to low frequency cetaceans are outlined in in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals). M#03: Fauna Management Plan (EP Appendix G2) outlines whale and dolphin detection techniques and measures to minimise anthropogenic noise threats and risk of vessel strike associated with the survey. The Fauna Management Plan (EP Appendix G2) also outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. Although the Fauna Management Plan outlines mitigation measures for low frequency cetaceans, it does not specifically mention Fin and Sei Whales. **<u>EP Appendix G2 (Fauna Management Plan) has been updated to include Fin and Sei Whales.</u>** CGG acknowledges the recommendation to fund research on Fin and Sei Whales, and also acknowledges that NOPSEMA's Research Strategy 2024-2027 identifies threatened and migratory species as a relevant research topic for decision-making. With their research strategy, NOPSEMA promotes a collaborative approach to addressing knowledge gaps. Relevant research topics include: • Better understanding, and where possible quantifying, behavioural responses to underwater noise and implications for foraging, feeding, fitness and breeding success in the context of EPBC Act species recovery requirements (e.g. Actions relevant to underwater noise management set out in in-force EPBC Act species conservation management documentation). CGG commissioned Klarite to undertake a review of seismic studies and extensive research undertaken (available in Appendix B8), demonstrating that core impact pathways for cetaceans from underwater noise is well established. This fundamental understanding of impact pathways has been brought into the EP to inform the impact assessment for marine mammals. To continue to inform knowledge gaps, CGG will submit all sightings and acoustic observations as reports to the Australian Antarctic Division via the National Marine mammal Data Portal and hosted by the Australian Marine Mammal Centre (AMMC) for the collation of national sightings. The AMMC has developed database applications to support marine mammal conservation and policy initiatives. These applications: • provide the public with summarised information on the biology of Australian marine mammals; • facilitate data-driven management and conservation decisions; • collate, protect and archive data; • assisting with reporting obligations to the International Whaling Commission and under the Environment Protection and Biodiversity Conservation Act encouraging and facilitating collaboration, analysis and reporting. The observational data hosted by the AMMC is available to research community. CGG will, further, review any new relevant research that is available in the public domain, or otherwise made available. To continue to manage the Regia MSS to ALARP and Acceptable levels, collection and review of new relevant research, if any, will be completed within one month of the commencement of the Regia MSS. A risk assessment and management of change process will be instigated if outcomes of relevant research suggest that there has been a significant change to the context of the Regia MSS that may lead to an update to the Fauna Management Plan (EP Appendix G2). The Regia MSS will be managed so that the potential impacts and risks will be mitigated to levels that are as low as reasonably practicable (ALARP) and acceptable in accordance with environmental regulatory requirements. Additional information on the determination of ALARP is provided in EP Appendix F2 (ALARP Assessment). CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. **<u>CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan) to include Fin and Sei Whales.</u>** ***References:*** *Bannister JL, Kemper CM & Warneke RM. 1996. The Action Plan for Australian Cetaceans. Canberra: Australian Nature Conservation Agency* *Baker. 1985. Pygmy right whale Caperea marginata (Gray, 1846). In: Ridgway SH & Harrison R, eds. Handbook of Marine Mammals Vol. 3: The Sirenians and Baleen Whales. Page(s) 345-354. Academic Press, London.* *Chatto R & Warneke RM. 2000. Records of cetacean strandings in the Northern Territory of Australia. The Beagle, Records of the Museums and Art Galleries of the Northern Territory. 16:163-175.* *DCCEEW 2023. Balaenoptera physalus — Fin Whale. Species Profile and Threats Database. Department of Climate Change, Energy, the Environment and Water.*

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#	**Comments received**	***Titleholder response***
		Gill PC, Pirzl R, Morrice MG & Lawton K. 2015. Cetacean diversity of the continental shelf and slope off southern Australia. The Journal of Wildlife Management. *Miller BS, Kelly N, Double MC, Childerhouse SJ, Laverick S & Gales N. 2012. Cruise report on SORP 2012 blue whale voyages: development of acoustic methods. Paper SC/64/SH1 1 presented to the IWC Scientific Committee.* *Parker DAA. 1978. Observations of Whales on Australian National Antarctic Research Expeditions (ANARE) Voyages between Australia and Antarctica. Australian Wildlife Research. 5:25-36.* *Thiele D. 2002. International Whaling Commission - Southern Ocean GLOBEC collaboration. Update from the Western Antarctic Peninsula. GLOBEC International Newsletter. 8(2):7-9.* *TSSCa, 2015. Threatened Species Scientific Committee. Established under the Environment Protection and Biodiversity Conservation Act 1999. Conservation Advice Balaenoptera physalus- Fin whale.* *TSSCb, 2015. Threatened Species Scientific Committee. Established under the Environment Protection and Biodiversity Conservation Act 1999. Conservation Advice Balaenoptera borealis - Sei whale*
Key Matter: Mitigation Measures for Marine Mammals		
M37	**Matter:** Insufficient mitigation measures (general) **Claim:** The plan lacks in sufficient detail, data and effective mitigation methods that would ensure endangered and vulnerable marine species who are known to frequently feed, calve and migrate through this area are protected. **Claim:** There are also no safe measures when decibels exceed sound that whales can endure. Safety measures, evidence already tells us, are largely breached with seismic blasting. (see for example, https://www.thesaturdaypaper.com.au/news/environment/2023/06/10/seismic-blasting-whistleblower-speaks#hrd). **Claim:** Under no circumstances should the seismic blasting be allowed near endangered whales calving grounds. There is no way to mitigate the effects of the seismic blasting.	CGG acknowledges claims regarding insufficient mitigation measures for marine mammals and has reviewed the Regia MSS Environment Plan (EP) to ensure that appropriate mitigation measures for marine mammals have been identified and were adequately described. Impacts and risks to marine mammals, including impacts to biologically important behaviours (feeding, calving and migration) have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna), where relevant. Measures to mitigate impacts are also detailed in these Appendices and in the Fauna Management Plan, included in Appendix G, that includes whale detection and measures to minimise anthropogenic noise threats to whales, associated with the survey and, vessel strike for all species. The NOPSEMA Environment plan content requirement Guidance Note (2020) and Environment Plan decision making Guideline (2024) describe the purpose of mitigation measures and the process for determining whether effective measures have been identified for implementation. These NOPSEMA documents provided the basis of the robust framework provided in EP Appendix F2 (ALARP Assessment), which systematically identifies and evaluates control measures and strategies that can reasonably and effectively reduce risks to the lowest practicable level. Appendix F3 (Acceptability Assessment) of the EP demonstrates how the environmental impacts and risks of the Regia MSS will be of an acceptable level, taking into account the mitigation measures and strategies identified, and applying additional mitigation measures where relevant to ensure that risks are effectively reduced to acceptable levels. The mitigation measures outlined in the EP will reduce all risks to ALARP and acceptable levels. CGG has reviewed the methodology and application of mitigation measures throughout the EP and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M38	**Matter:** Shut down zones for whales **Claim:** The decision to implement a 2km shut down zone for all whales (apart from pygmy blue and southern right whales) is not supported by evidence. In contrast, the EP states that CGG will implement a 14km shut down zone for pygmy blue whales and a 12km shut down zone for southern right whales "to provide another level of protection to whales." This inconsistency in the shut down distance must be explained in the context of CGG's obligations to protect all whale species from seismic blasting, as detailed in Policy Statement 2.1 of the EPBC Act. **Claim:** The decision to implement a 2km shut down zone for all whales (apart from pygmy blue and southern right whales) is not supported by evidence. That is, the EP used modelling to calculate specific shut down distances for southern right and blue whales, but simply stated a 2km shut down for other whale species without justifying this distance with evidence. **Claim:** The EP outlines a mitigation plan to have a 3 km shut down zone for all whales (apart from pygmy blue and southern right whales) which is ineffective and	CGG acknowledges claims regarding the adequacy of a 2 km shut down zone for whales (excluding the pygmy blue whale and southern right whale) and has reviewed the Environment Plan (EP) to ensure that the 2 km spatial extent is adequate. Sound exposure criteria thresholds and impacts to marine mammals were identified using extensive peer review, published literature (referenced throughout the EP). In addition, modelling was conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences for the EP (B7a and B7b - Sound Modelling Report) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals. Table E7-5-1 in Section E7 - Underwater Sound (Marine Mammals) of the EP states the sound exposure guidelines for the onset of Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and the current interim criterion for impulsive sound sources for marine mammal' behavioural threshold. The EP has utilised the most current, globally recognised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing PTS and TTS thresholds which are from NMFS (2018) and Southall et al. (2019). Further, CGG has developed a Fauna Management Plan (Appendix G2) which details the procedure and actions that will be implemented such as shut down zones, pre-acquisition surveys and soft starts. Appendix B7a and B7b (Sound modelling) was conducted to identify potential impacts to species per pulse and over a cumulative 24h period. The maximum distance where per pulse effect criteria was reached was for very high frequency cetaceans at 820 m. In line with Policy Statement 2.1 of the EPBC Act CGG has implemented soft starts, where prior to acquisition commencing, the sound source power is ramped up

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	not underpinned by evidence. The EP used modeling to calculate shut down distances for southern right whales and pygmy blue whales, but have self determined a 3 km shut down zone for other whale species without justifying this decision with evidence. **Claim:** The rationale behind implementing a 2km shutdown zone for all species except the Southern right whale and Pygmy blue whale lacks sufficient evidence to support its claim of non-adverse impacts on threatened whale species' hearing. **Claim:** CGG must substantiate its reasoning behind the inconsistent shutdown zone distances, particularly as stipulated by policy statement 2.1 of the EPBC Act, which requires CGG to ensure the protection for all whale species from seismic blasting. **Claim:** The shut down envelope of 2km if a whale is sighted is woefully inadequate. Whales communicate over tens or even hundreds of kilometres and blue whales have been found to stop singing for days after exposure to seismic airgun blasts 10km away. Changes in whale behaviour have been observed up to 54–73 km from seismic surveys at received levels that could be as low as <125 dB (Weitgart, L 20136). The measures proposed under the EP appear to favour the proponent's convenience over actually minimising likely impacts on cetacean species. **Claim:** CGG has identified that they will shutdown operations for all whales within 2,000 metres (2km) of the seismic testing activities. We believe that 2km is inadequate as within 2km whales could still be well within the seismic blasting area and greatly affected by the sound blasts. **Claim:** Whales can dive frequently, or they can be underwater for up to 15 minutes, which would result in the whales potentially travelling vast distances during this time. They can initially dive from outside of the 2 km visual search radius and travel underwater to within the radius where the seismic blasting is being conducted, without being observed. In order to ensure that no whales are injured or killed during the blast, CGG must create a plan which includes thorough and accurate monitoring of what is happening out of sight, in the ocean.	over 30 minutes. This will ensure no cetaceans are within distances that PTS or TTS could instantly occur. Therefore, a 2 km shut down zone for whales is considered to be an adequate distance which will ensure that whales are protected from injury from the per pulse effect criteria. The maximum distance where cumulative 24h period effect criteria was reached for low-frequency cetaceans at 41.9 km, based on secondary modelling (EP Appendix B7b). It is not realistic that a whale will be stationary for a 24-hour period unless there is potential for them to be undertaking behaviours such as reproduction or foraging. Animat modelling was undertaken for particularly sensitive species with national conservation/recovery management plans which identify anthropogenic noise as a threat to the species recovery and was intended to afford additional protection to threatened species that by limiting the potential for disturbance. The Pygmy Blue Whale and the Southern Right Whale both have Conservation Management Plans that identify anthropogenic noise as a threat to the species recovery as well as spatially identified biologically important areas (BIAs) within the area that may be affected by underwater sound impacts. Therefore, these species have been further assessed with Animat modelling which considers vessel and whale movements and resulted in extended shutdown distances of 23 km and 15 km. The 2 km shutdown zone is based on the low power zone for whales as detailed in the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (Policy Statement 2.1). This is based on the likelihood of encountering other whales to be low, for which Policy Statement 2.1 details if the likelihood of encountering whales is low, the chance of a seismic survey having a significant impact on a whale species should be minimal, provided that the proponent and the operator of the seismic survey adopt the measures outlined in Part A Standard Management Procedures. No other foraging or reproduction BIAs occur within the area that may be affected by underwater sound, however 3 other whale species have been identified to potentially participate in foraging behaviours such as the Fin Whale, Sei Whale and the Pygmy Right Whale. The Pygmy Right Whale does not have a recovery plan or conservation advice. Conservation advice for the Fin Whale and the Sei Whale identify anthropogenic noise and acoustic disturbance as a threat, however it is assessed to have a minor consequence. Therefore, a 2 km shut down zone for whales is considered to be an adequate distance. The shut down procedure and associated spatial extents detailed in the Fauna Management Plan (Appendix G2) are considered to be adequate to protect whale species from injury from sound emissions associated with the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M39	**Matter:** Shut down zones for pygmy blue and southern right whales **Claim:** The EP states a 14 km shut down zone for pygmy blue whales and a 12 km shut down zone for southern right whales. Considering that research shows that seismic blast noise travels over 100 kms, we believe that 14 km and 12 km shut down zones are inefficient in adequately protecting these endangered species. This inconsistency in the shut down distance must be explained in the context of CGG's obligations to protect all whale species from seismic blasting, as detailed in Policy Statement 2.1 of the EPBC Act. **Claim**: Scientific research demonstrates that seismic blast noise travels over 100 km's in the oceans. The impact to marine life is well beyond the described zone in this EP. **Claim:** The proposed 14km shutdown zone and 12km shutdown zone for the PBW and SRW, respectively, are impractical, as monitoring from such distances is completely unrealistic, even under optimal conditions. This raises concerns regarding the Environmental Plan's feasibility and adherence to regulatory requirements, and therefore should be refused by NOPSEMA. **Claim:** Whales live below the ocean and below the field of view of a person standing on a boat. Research shows that many whale species are able to hold their breath, and some species can swim at 35 km/h which renders the 3 km,	CGG acknowledges claims regarding the adequacy of a proposed 14 km shutdown zone for Pygmy Blue and the initial 12 km shutdown zone Southern Right whales and has reviewed the Environment Plan (EP) to ensure that the spatial extent of each shutdown zone is adequate. Sound exposure criteria thresholds and impacts to marine mammals were identified using extensive peer review, published literature (referenced throughout the EP). In addition, modelling was conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences for the EP (B7 - Sound Modelling Report) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals. Table E7-5-1 in Section E7 - Underwater Sound (Marine Mammals) of the EP states the sound exposure guidelines for the onset of Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and the current interim criterion for impulsive sound sources for marine mammal' behavioural threshold. Further, CGG has developed a Fauna Management Plan (Appendix G2) which details the procedure and actions that will be implemented such as shut down zones, pre-acquisition surveys and soft starts. Appendix B7 (Sound Modelling) was conducted to identify potential impacts to species per pulse and over a cumulative 24h period. The maximum distance where cumulative 24h period effect criteria was reached for low-frequency cetaceans was initially modelled at 43.5 km (maximum TTS 24hr cumulative effect criteria for low frequency (LF) cetaceans). This was reduced to 41.9 km based on secondary modelling (EP Appendix B7b) In any case, it is considered not realistic that a whale will be stationary for a 24-hour period unless there is potential for them to be undertaking behaviours such as reproduction or foraging. Animat modelling considers vessel and whale movements and Animat modelling was undertaken for particularly sensitive species with national conservation/recovery management plans which identify anthropogenic noise as a threat to the species recovery and was intended to afford additional protection to threatened species that by limiting the potential for disturbance. The Pygmy Blue Whale and the Southern Right Whale both have Conservation Management Plans that identify anthropogenic noise as a threat to the species recovery as well as spatially identified biologically important areas (BIAs) within the area that may be affected by underwater sound impacts.

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	14km and 12km shutdown zones ineffective in ensuring that whales are not in the area through MFO's the submitter supports the recommendations for sufficient mitigation measures. However, we also recommend that whale exclusion zones be rezoned to over 35 km.	The predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whales is 1.4 km, 14.2 km and 9.83 km, respectively. The predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Pygmy Blue Whales is 1.98 km, 22.5 km and 9.51 km, respectively. A 15 km shut down zone for Southern Right Whales, updated on the basis of revised modeling in Appendix B7b, and the 23km shut down zones for Blue Whales is based on the Animat modelling results where 14.2 km and 22.5km were the furthest distance to sound effect. Therefore, the revised 15 km shut down zone for Southern Right Whales and 23 km shutdown zone for Pygmy Blue Whales is considered to be an adequate distance. The EP does provide a justification for the shut down zones for both the Pygmy Blue Whale and the Southern Right Whales in Section 9.1 (Shut Down Zone) of Appendix G2 of the EP (Fauna Management Plan). The EP details the shut down distances are based on the underwater modelling and the distances are used as the activity must be conducted in a manner to meet the actions from the: • Conservation Management Plan for the Blue Whale of "Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area". • Draft National Recovery Plan for the Southern Right Whale of "Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance". The shut down procedure and associated spatial extents detailed in the Fauna Management Plan (Appendix G2) are considered to be adequate to protect whale species from injury from sound emissions associated with the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M40	**Matter:** Additional shut down and exclusion distances for dolphins **Claim:** Implement shut down within 100 km (extended from 100m as per plan) of dolphin sightings. **Claim:** Increase the exclusion zone from known seal colonies from seismic blasts to 100km. **Claim:** A proposed control method for the management of acoustic disturbance was a shutdown zone for whales of 2000 metres (2km) within the seismic activity. The submitter believes this control measure is necessary and would like this control measure to be extended to dolphins and increased to 100km. **Claim:** the EP would require a substantial increase in mitigation methods that are backed by strong evidence, and the shutdown zones should be significantly increased to ensure these species [dolphins] are protected. **Claim**: Scientific research demonstrates that seismic blast noise travels over 100 km's in the oceans. The impact to marine life is well beyond the described zone in this EP.	CGG acknowledges claims regarding impacts to dolphins and seals over the duration of the Regia MSS and has reviewed the Environment Plan (EP) to ensure that the assessment of potential impacts to dolphin species have been adequately described and assessed. Sound exposure criteria thresholds and impacts to marine mammals were identified using extensive peer review, published literature (referenced throughout the EP). In addition, modelling was conducted by internationally renowned underwater noise specialist, Jasco Applied Sciences, for the EP (B7a and B7b - Sound Modelling Reports) to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals. Table E7-5-1 in Section E7 - Underwater Sound (Marine Mammals) of the EP states the sound exposure guidelines for the onset of Permanent Threshold Shift (PTS), Temporary Threshold Shift (TTS) and the current interim criterion for impulsive sound sources for marine mammal' behavioural threshold. Table E7-5-1 of EP Appendix E7 shows that the noise effect criteria for PTS for high-frequency cetaceans (such as dolphins) was not reached during any modelled scenario. Table E7-5-1 also shows that the noise effect criteria for TTS per pulse effect criteria is not reached but the TTS 24hr cumulative effect criteria is reached up to 50 m. However, it is not feasible that a dolphin would remain within that distance of the moving vessel for 24 hrs, thus TTS is not predicted. Table E7-5-1 of the EP shows that the noise effect criteria for PTS for otariid pinnipeds (such as sea lions and fur seals) was not reached during any modelled scenario. Table E7-5-1 also shows that the noise effect criteria for TTS per pulse effect criteria is not reached but the TTS 24hr cumulative effect criteria is reached up to 60 m. Again, it is not feasible that a seal would remain within that distance of the moving vessel for 24 hrs, thus TTS is not predicted. Sections 6.2 and 6.4 (of EP Appendix E7), state that impacts to high-frequency cetaceans and otariid pinnipeds are limited to avoidance behaviour within an area out to 2.1 – 11.8 km depending on where in the Operational Area the survey is being undertaken. As high-frequency cetaceans and otariid pinnipeds are not dependent on any specific area, impacts are predicted to be limited to avoidance behaviour affecting individuals but not at a level to reduce fitness. The PMST Report (Appendix B5 – PMST Reports) identified that 6 dolphin species, which are classed as high-frequency cetaceans, and 3 otariid pinnipeds species potentially occur within the area that may be affected by underwater sound. For both dolphin and otariid pinnipeds, the predicted level of impact based on the effect (minor) and uncertainty (medium) levels is assessed as medium within the EP. The predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7 of EP Appendix E7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels and therefore the increase in exclusion ones is not required. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
M41	**Matter**: Temporal seismic exclusion periods **Claim:** Seismic blasting may be avoided at certain times of the year to minimise the chance of harming the whales or interfering with their feeding, but no matter what time of the year activity is conducted, whales of some species will be visiting. **Claim:** The submitters believe that the decision to stop seismic blasting during the months of January, February and March, as outlined in the EP is insufficient. There is clear evidence that many marine mammal species are frequenting this area in other months for feeding, calving and migration.	CGG acknowledges claims regarding seasonal exclusions relevant to the timing of the Regia MSS and has reviewed the Environment Plan (EP) to ensure that these have been adequately described. As detailed in response to Matter M10 above, impacts and risks to marine mammals, including impacts to seasonal biologically important behaviours (feeding, calving and migration) have been assessed in EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) and EP Appendix D2 (Risk Assessment – Collision with Marine Fauna), where relevant. Measures to mitigate impacts are also detailed in these Appendices and in the Fauna Management Plan, included in Appendix G. The Fauna Management Plan includes whale detection and measures to minimise anthropogenic noise threats to whales, associated with the survey and, vessel strike for all species. EP Appendix F2 (ALARP Assessment) Section 6.1 describes the process that CGG undertook to establish timing constraints for the activity and the additional measures identified to protect species during biologically important behaviours, such as: • Minimising the duration of the survey to a maximum of 60 days of acquisition • Surveying shallower Southern Right Whale (SRW) Biologically important Areas (BIAs) between November and April when this species is not known to be present. • Not surveying during the months of January-March and managing potential interactions with Pygmy Blue Whales (PBW), and other foraging species, given the larger spatial distribution of the population through the shoulder seasons, i.e., through the implementation of the Fauna Management Plan. EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2 provides for further assessment of key environmental values and sensitives including these species and identifies: • There will be no impact to SRWs within reproduction BIAs based on spatial and temporal exclusion zones, and the energetic costs of behavioural disturbance on migration would be extremely low, if avoidance behaviour occurred, and would not impact the recovery of the species. • As the Regia MSS will only occur during one season when blue whales are present in Australia waters, and permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). The Regia MSS will not impact on the recovery of the population. In accordance with the control measures set out within the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and acceptable levels in accordance with environmental regulatory requirements. CGG has considered these claims and on the basis of the strong suite of control measures already proposed, is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M42	**Matter**: The use of MFOs/MMOs is inadequate for marine mammal detection **Claim:** The measures described of having a Marine Fauna Observer (MFO) on a boat to spot whales, and reduce the scale of seismic blasting frequency if they are spotted, is ineffective. Whales live below the ocean and below the field of view of a person standing on a boat. Many of the affected species can dive for prolonged periods of time, and will not be sighted from above the water. Seismic blasting during known periods of presence for these identified species will inevitably lead to harm, hearing loss and disruption in navigation, feeding and breeding activities of cetaceans in the area. **Claim:** The method of protection and detection having a having a Marine Fauna Observer (MFO) on a boat to spot whales, and reduce the scale of seismic blasting frequency if they are spotted, is ineffective. I have personally spoken to a retired marine spotter and they claim it was almost impossible to watch the water at all times and detect animals below the surface. Any attempt to create corridor in the sea and blasting exclusion zones and shut down distances is likewise unfeasible as currents and all oceans creatures travels as they wish and are hard to monitor. **Claim:** Given the potential damage to whales' hearing and communication systems, it is vitally important that they are detected during a seismic operation:	CGG acknowledges claims regarding the ability of Marine Fauna Observers (MFOs) to detect cetaceans and has reviewed the Environment Plan (EP) to ensure that limitations and supplemental methods have been adequately considered and described. Measure M#03: Fauna Management System, which includes the Fauna Management Plan (EP Appendix G2), outlines specific measures to minimise anthropogenic noise threats to relevant species as required by EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales. Further, an activity limitation (M#01) has been applied to reduce the acoustic source size used for the survey. As described in EP Appendix G1 (Control Measures and Environmental Performance), the Fauna Management System is designed to safeguard marine mammals, with a primary focus on Southern Right Whales (SRWs) and Blue Whales (BW), during the Regia MSS. This control measure employs various surveillance methods to detect marine mammal presence, assess their classification, monitor behaviour, and ensure the adaptation of the acquisition plan to minimise the impact of sound on these mammals. The Fauna Management System and Fauna Management Plan, describe multiple methods for detecting fauna, including Marine Fauna Observers (MFO) and Passive Acoustic Monitoring (PAM) from the vessel, and Acoustic Detection Monitoring (ADM) within the broader area. Acoustic monitoring provides for the detection of vocalising whales, including submerged whales. Further, an expert panel of independent and qualified cetacean experts will assist in responding to the dynamic situations that are likely to arise during the survey, to ensure that appropriate action Is taken. This panel will coordinate aerial surveys to detect the movement of SWs into and out of the coastal reproduction BIA, and the movement of BWs into and out of the Otway area, complementing vessel-based observations and acoustic monitoring, In addition to the use of PAM and ADM, in recognition that whales will not be visually detectable when they are submerged, pre-acquisition detection criteria have been established that require that no SRW or BW are detected within 24-48 hours prior to acquisition commencing, as detailed in the Fauna Management Plan (Appendix G2), Figure G2-6.

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#	**Comments received**	***Titleholder response***
	The method of detecting whales by using an observer based on the ship conducting the seismic survey is not valid. **Claim:** Vulnerable species, the fin whale and the sei whale feed in the operating area during the southern summer period and are still found in the area in the month of April. Additionally, the pygmy right whale can also be found foraging in the operating area during this time. Given the failures highlighted with the spotting program used to detect whales as described in the EP, we urge NOPSEMA to refuse approval for this project.	CGG has not proposed to 'reduce the scale of seismic blasting frequency' in response to the detection of a whale, as stated in claims by interested persons. Rather, the Fauna Management Plan details specific actions that could be taken including to shut-down the acoustic source, move away, etc in the event that cetaceans are detected within relevant shut down zones determined through expert sound modelling. Further, based on previous seismic surveys, CGG has chosen to only implement a shut down and not a low power zone to provide another level of protection to whales. The proposed measures adopt the best national and international approaches to minimise impacts on marine mammals, including the use of a reduced acoustic source size, spatial and temporal measures to prohibit acquisition in and around BIAs during relevant seasons, MFOs, PAM, ADM, shut-down zones, soft-starts, delayed starts, limitations on night-time and low visibility operations and adaptive management procedures involving an expert panel. In particular, the Regia MSS has adopted the EPBC Act Policy Statement 2.1 and additional measures that exceed the requirements of this policy statement to ensure that the risks to marine mammals are reduced to the lowest possible level. Additionally, several alternative management and mitigation measures were assessed in EP Appendix F2 (ALARP Assessment) and were rejected as explained in Annex 4. CGG considers that the management and mitigation measures proposed are sufficient to ensure impacts are reduced to levels that are as low as reasonably practicable and acceptable, in accordance with regulatory requirements. Consequently, no changes have been made to the EP in response to these claims.
M43	**Matter:** Limitations of MFOs/MMOs when detecting marine mammals **Claim:** Additionally, high sea states commonly experienced in the region can lead to seasickness among MFOs, particularly during shifts and high swell events, potentially impairing their ability to observe marine fauna. In such cases, off-duty MFOs may need to cover shifts, resulting in fatigue and reduced effectiveness in monitoring. Furthermore, MFOs on duty are not relieved for bathroom breaks, leaving periods of time without any mitigation methods in place.	CGG acknowledges claims regarding MFO duties and fatigue management and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. **CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan), EP Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Outcomes) to include an additional MFO/ PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage.** Refer to M46 below for response to fatigue management for PAM operators.
M44	**Matter:** MFOs/MMO's only effective in daylight hours and optimum conditions **Claim:** An additional concern is the fact that the surveys are proposed to be conducted during both the day and night. Certainly, whales in the vicinity would not be detected by an observer at night. 24-hour seismic operations cannot be justified and should not take place. **Claim:** The effectiveness of management procedures during daylight hours heavily relies on visibility of the marine environment. MFOs can only observe surface marine fauna during daylight, and their observations are contingent upon good visibility. However, visibility in offshore operations varies significantly based on environmental conditions such as wind, sea state, precipitation, fog, and glare, with visibility decreasing as these factors worsen. **Claim:** Moreover, the challenging ocean conditions in the Otway Basin pose significant threats to MFO visibility and increase the risk of equipment damage and environmental emergencies. These conditions, along with the direct experience of poor environmental conditions during the 2020 Otway Basin Seismic Survey, led MFOs to recommend additional mitigation measures for future seismic surveys in the region, such as restricting operations to daylight hours and periods of good visibility (Seiche Environmental, 2020). **Claim:** Deck top spotters for whales are only able to view whales in the direction within which they look and only within limited scope during daylight hours, even under optimal conditions. There are no guarantees therefore that threatened, endangered or critically endangered species present within the 10.3km behavioural response impact zone defined under the EP (p. 582) will be detected under the spotting methods described.	CGG acknowledges claims regarding the effectiveness of Marine Fauna Observers (MFOs) being limited to daylight hours with reasonably sighting conditions, and has reviewed the Environment Plan (EP) to ensure that these limitations were adequately considered in the EP. In the context of the Regia MSS, it is acknowledged that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection. CGG acknowledge that visual detection of marine fauna is restricted to daylight hours and reasonable sightings conditions. Consequently, several management measures have been considered in the Fauna Management Plan (Appendix G2) such as pre-acquisition detection criterion which must be met which counter these limitations. Further, CGG has committed to utilising Passive Acoustic Monitoring (PAM) and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. Aerial surveys will complement vessel-based observations and acoustic monitoring techniques and will be overseen by the Southern Right Whale (SRW) and Blue Whale (BW) expert panel. This panel will be in charge of determining when aerial surveys are required and will develop the objectives and flight path for the survey. Aerial surveys will be used to identify if SRWs are moving between the reproduction BIA and if BWs are moving within the Otway area. As listed in Appendix G2 details of when aerial surveys will be employed are listed below: • Directed by the BW/SRW expert panel • Required to obtain information to inform decision making • Detection of a BW outside of 23 km of the seismic source • Detection of a SRW occurs outside of 15 km of the seismic source • 3 BW/SRW shut downs occur within 24 hours • The seismic source has not been able to restart within the past 12 hours due to an ongoing presence of BW/SRW.

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#	**Comments received**	***Titleholder response***
	Claim: Further we contend that it is impossible to accurately observe whales in poor weather and at night. **Claim:** Marine observers are on board blasting vessels, that operates day and night (blasts every 10 seconds or so for months on end) cannot see whales and dolphins (cetaceans) at night and cannot see below the see surface. A high risk process that offers few guarantees that whales and dolphins will be adequately protected. **Claim:** I don't see how it can even be considered that seismic blasting is allowed to happen at night or at other times when visibility is not optimum. And even when it IS the best visibility possible, who is to say that the whales aren't travelling underwater for tens of minutes at a time, which would make them difficult to spot.	CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M45	**Matter:** MFOs/MMO's do not have a 360-degree view, the use of one MFO/MMO is inadequate. **Claim:** Marine fauna observers (MFO) are inadequate to mitigate any impacts to whales. They are positioned on board their vessel to look for whales, however their view is insufficient as it does not cover a full 360 degree view, which is imperative to ensure there is no harm to whales. There is no place on the ship from which an MFO can monitor all sides of the vessel or even under the sea water; this becomes much harder at night when visibility diminishes further with low light. **Claim:** MFOs have a maximum visibility of 180 degrees at any given time, and their field of vision is further hindered by the structures and layout of their work environment, even on the vessel bridge where visibility is presumed to be highest. **Claim:** Marine observers are on board the blasting vessels, which operates day and night (blasts every 10 seconds or so for months on end) but they cannot see whales and dolphins (cetaceans) at night and they cannot see below the see surface. There are no vantage points on the vessels from which they have a 360 degree view of the surrounding ocean. **Claim:** Especially because it is impossible for the MMOs to have simultaneous 360 degree vision, as well as full concentration, for hours on end. **Claim:** The Fauna Management Plan states that there must be at least one Marine Fauna Observer (MFO) on duty at all times on the seismic vessel during daylight hours. However, having only one MFO on watch is inadequate for maintaining a comprehensive 360-degree watch over the sea surface for marine fauna. **Claim:** The submitter recommends a minimum of two MFOs are on duty at all times from the Seismic Vessel (totalling 4 MFOs onboard). **Claim:** The Environment Plan specifies the use of Marine Fauna Observers (MFO) to watch for marine fauna during the course of the survey. It is believed that having one observer on board a vessel is inadequate, as their ability to monitor the water around the entire vessel is impeded. There is no way for the observer to see behind the vessel and the observer's view is diminished in the dark, making it almost impossible to see dolphins and whales.	CGG acknowledges claims regarding the ability of Marine Fauna Observers (MFOs) to survey relevant zones, and has reviewed the Environment Plan (EP) to ensure this was adequately considered in the EP. In the context of the Regia MSS, it is acknowledged that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection. CGG acknowledge that visual detection of marine fauna is restricted to daylight hours and reasonable sightings conditions. Consequently, several management measures have been considered in the Fauna Management Plan (Appendix G2) such as pre-acquisition detection criterion which must be met which counter these limitations and CGG has committed to utilising Passive Acoustic Monitoring (PAM) and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). EPBC Act Policy Statement 2.1(Interaction between offshore seismic exploration and whales) considers that Part A Standard Management Procedures may be sufficient in locations where the likelihood of encounters with whales is low, and trained crew can perform observation duties. However, proponents need to consider additional avoidance and mitigation measures for areas and/or seasons where the likelihood of encountering whales is moderate to high. In these circumstances, proponents should not only apply Part A Standard Management Procedures, but should also consider measures like those outlined in Part B Additional Management Procedures. In situations involving biologically important habitats, such as those encountered in the Regia MSS, it is necessary to implement more extensive measures, such as greater precaution zones and additional marine mammal observer coverage. Requirements for Marine Mammal Observers are specified in Section B.1 of the policy statement which states, 'as the likelihood of encountering whales increases, the proponent should engage MMOs. MMOs should be trained and experienced in whale identification and behaviour, distance estimation, and be capable of making accurate identifications and observations of whales in Australian waters. The MMOs should assist other observers (e.g. trained crew) and be available to provide advice, should whales be encountered.'. The Fauna Management Plan includes requirements for Vessel Crew to be trained in the implementation of the FMP, and to communicate whale sighting immediately, supported by relevant information where available (e.g. latitude and longitude, time of sighting, no. of whales). **CGG has considered these claims and has determined that additional MFO coverage is appropriate to further mitigate the potential for whales to go undetected within the 3 km observation zone. Consequently, CGG has updated EP Appendix G2 (Fauna Management Plan), EP Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Performance) to include an additional MFO/ PAM operator will be present on the vessel to support fatigue management. In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be onboard a dedicated spotter vessel at all times. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals.**
M46	**Matter:** Passive Acoustic Monitoring (PAM) is inadequate for marine mammal detection **Claim:** An industry report from a similar region concluded that PAM is ineffective during periods of darkness or poor visibility and that detecting certain vocalizations using standard equipment is nearly impossible (Seiche	CGG acknowledges claims regarding the inadequacy of Passive Acoustic Monitoring (PAM) for marine mammal detection, and has reviewed the Environment Plan (EP) to ensure this was adequately considered in the EP. CGG acknowledges there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection.

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#	**Comments received**	***Titleholder response***
	Environmental, 2020). Given that PAM is primarily relied upon to mitigate impacts on whales during these conditions, this finding raises concerns, especially in an area known for its significance to blue whales and southern right whales. **Claim**: The submitter supports professional PAM operator opinions that PAM is an ineffective mitigation method to mitigate impacts to marine mammals in the proposed survey area, and should be excluded from the Regia Marine Seismic Survey. **Claim:** Omission of the decision criteria that must be met before PAM can be validated as suitable for estimating distances for low frequency cetaceans during the application of the 14 km shut down for blue whales, and a 12 km shut down for southern right whales.	CGG commissioned a desktop assessment of available whale detection technologies for marine seismic surveys (Appendix F5 Marine Mammals Detection Technology Assessment) which acknowledges the limitation of PAM's ability to detect marine life acoustic signals in amongst the large impulse noise of seismic airgun arrays being discharged during seismic surveys. Dependent on the water depth and subsurface geology, the subsurface acoustic reflections from each seismic source impulse can still be returning to the sea surface whilst the next airgun array impulse is generated. This means that the actual "quiet" period where lower amplitude marine fauna noise source levels can be monitored, without background seismic signal data present, is either minimal or non-existent during active survey periods. Therefore, PAM systems need to be able to filter out, or differentiate between seismic energy returns. The best times for detection of marine mammal vocalisations are the short periods of lower noise levels between seismic airgun pulses and during transits between seismic survey transect lines (line changes). Appendix F5 details a number of PAM systems, including the advantages and disadvantages of each. CGG will utilise this report along with the most up to date scientific research prior to acoustic detection system confirmation. EP Appendix F5 Marine Mammals Detection Technology Assessment notes "the use of PAM is just one aspect of a comprehensive environmental monitoring and management plan that operators implement during seismic surveys. Other measures, such as visual monitoring, pre-survey assessments, and adherence to mitigation zones, also play significant roles in safeguarding marine life during seismic operations." To maximize marine mammal detection, CGG has committed to utilising Fixed Buoy Acoustic Monitoring along with PAM technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. CGG acknowledges that visual detection of marine fauna is restricted to daylight hours and reasonable sightings conditions. Several management measures have been considered in the Fauna Management Plan (Appendix G2) such as pre-acquisition detection criterion which must be met which counter these limitations. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M47	**Matter:** PAM is only effective when marine mammals are communicating **Claim:** The Plan also states CGG will use Passive Acoustic Monitoring (PAM) with the aim of detecting dolphins in real time, particularly at night or during poor visibility. PAM only works when dolphins are communicating, and is ineffective at determining the range and bearing of animals. As dolphins often go for over 10 minutes without calling (41), PAM can fail to realise that dolphins are in the area, as they can enter the seismic blasting zone during a period when they are not communicating. 41. https://seamor.org/how-long-can-a-bottlenose-dolphin-hold-its-breath/#:~:text=Dolphins. **Claim:** CGG plans to use Passive Acoustic Monitoring (PAM) with the aim to detect whales in real time, particularly at night or during poor visibility operations. These only work when whales are communicating, and are ineffective at determining the range and bearing of animals. As whales often go for over 20 minutes without calling, PAM can miss that whales are in the area, as a whale can enter the seismic blasting zone during a period when they are not communicating. The irony is that seismic blasts themselves can silence whales. (32). The seismic blasts can also interfere with PAM as they are ineffective in noisy environments, as the seismic blasts can mask the sound of the whales.(38) 32. https://www.fisheries.noaa.gov/feature-story/10-wonderful-whale-facts 38. https://www.wwf.org.uk/sites/default/files/2019-04/Acousticmonitoring-WWF-guide lines.pdf.	CGG acknowledges claims regarding the effectiveness of Passive Acoustic Monitoring (PAMs) and has reviewed the citations referenced in the development of the Environment Plan (EP) to ensure that the use of PAMs for the Regia MSS represents a suitable mitigation measure. CCG notes the following supplied websites provided with corresponding claims, which do not represent published peer reviewed literature and are therefore not discussed further: • https://seamor.org/how-long-can-a-bottlenose-dolphin-hold-its-breath/#:~:text=Dolphins. • https://www.fisheries.noaa.gov/feature-story/10-wonderful-whale-facts • https://www.wwf.org.uk/sites/default/files/2019-04/Acousticmonitoring-WWF-guide lines.pdf. The ALARP assessment for underwater sound during the Regia MSS evaluates the impact of elevated underwater sound levels resulting from seismic, vessel and helicopter operations during the survey. These activities have the potential to disturb marine fauna due to underwater sound, presenting an effect that is both unusual in its nature and of higher order in terms of potential impact. The sustainable management of the Regia MSS activity relies on multiple categories of controls including both standard and novel measures for planning the survey, management of sound source emissions, and visual and acoustic detection of marine fauna. The strength of the management approach for underwater noise of the Regia MSS lies in the multiple and complementary controls adopted, recognising and mitigating that each have its technical or practical limitations. Pre-survey planning and assessment is the most effective step in eliminating unnecessary risks and impacts, and reducing residual risks and impacts to ALARP and Acceptable levels. The pre-survey planning and assessment step for Regia MSS is comprehensive and includes iterative testing of planned sound emissions of survey layouts that have been refined following considerations of insights gained from interested persons. For cetaceans in the low frequency hearing group (baleen), the maximum distance for the per pulse Permanent Threshold Shift (PTS) criterion to be triggered is 30 m from the sound source and up to 90 m for the Temporary Threshold Shift (TTS) criterion. Cumulative sounds exposure criteria have been assessed and used conservatively, as they assume that an individual remains within the moving sound source for 24 hrs during operations. The cumulative PTS sound exposure criterion may be exceeded if an individual remains within 5.07 km of the moving sound source for 24 hrs. Similarly, the cumulative TTS criterion is exceeded if a cetacean remains within 41.9 km of the moving sound source for 24 hrs. For

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#	**Comments received**	***Titleholder response***
	Claim: Secondly, some whale species, including blue whales, vocalize less frequently in their feeding areas (Oleson et al., 2007). Lastly, many species of concern either do not produce vocalizations or do so infrequently. Consequently, even if whales pass close to a PAM system, they may remain undetected. This ineffectiveness of PAM was evident in a recent seismic survey where no baleen whales were detected despite visual sightings of blue whales during the day (Seiche Environmental, 2020). Additionally, when baleen whales are detected, there is low confidence in determining their location and direction using standard PAM equipment (Seiche Environmental, 2020).. This inability to accurately locate whales hampers the ability of operators to establish safety zones.	cetaceans in higher frequency hearing groups, such as toothed whales, the distances from the sound sources to where sound effect criteria may be exceeded is much reduced and well within visual and acoustic observation ranges of controls adopted. The Fauna Management Plan (EP Appendix G2) outlines the implementation of marine fauna observers, acoustic detection technologies, aerial surveys, activity action zones for vessels and helicopters to reduce vessel collisions and disturbance, shut down zones and pre-acquisition and acquisition processes and actions. Marine Fauna Observers (MFOs) are deployed to monitor fauna before and during survey activities. Mitigation and buffer zones, and sound source limitations are established to ensure compliance with noise levels and to protect marine fauna. Spatial and temporal restrictions on survey activities are enforced during sensitive times and locations. Additionally, communication protocols and adaptive management strategies are in place, based on marine fauna observations and noise monitoring data. EP Appendix F2 (ALARP Assessment) provides information on the technical, economic, and practical feasibility of these measures, which is high as they rely on established technologies and equipment, are cost-effective, and are practical to implement within the standard operating procedures of the Regia MSS. They also align with regulatory expectations for minimising underwater sound impacts. To enhance the management of underwater sound, the ALARP assessment recommends the adoption of additional measures such as real-time underwater sound monitoring and advanced marine fauna observation technologies, including passive acoustic monitoring on the vessel and on tethered buoys. These technologies are in various stages of development and integration with existing vessel systems. They are deemed expensive but reasonable and recommended to improve the detection and monitoring of marine fauna in relation to underwater sound sources, despite some uncertainty in their effectiveness. EP Appendix F5 (Marine Mammal Detection Technology Assessment) provides an assessment of the level of technical and commercial development of systems to support marine fauna observations. This report was used to inform the assessments in Annex 2 and Annex 4. Overall, passive acoustic monitoring has become an essential tool in marine mammal research and mitigation, offering a non-invasive and effective means of detecting vocalising marine mammals. Ongoing advancements in technology continue to improve the accuracy, efficiency, and scope of PAM use in a broad range of applications. However, it is considered best practice as an additional management procedure beyond the standard management procedure requirements of the EPBC Act, Policy Statement 2.1. The Fauna Management Plan (Appendix G2) outlines specific measures to minimise anthropogenic noise threats to relevant species, including the implementation of increased safe operating distances between vessels and whales, pre-acquisition surveys and a variety of detection systems. CGG acknowledges that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method, including PAM, can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection. CGG has committed to utilising PAMs and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M48	**Matter:** PAM is ineffective in noisy marine environments **Claim:** The irony is that seismic blasts themselves can silence dolphins. (32). The seismic blasts can also interfere with PAM as they are ineffective in noisy environments, as the seismic blasts can mask the sound of the dolphins.(38) 32. https://www.fisheries.noaa.gov/feature-story/10-wonderful-whale-facts 38. https://www.wwf.org.uk/sites/default/files/2019-04/Acousticmonitoring-WWF-guide lines.pdf. **Claim:** Passive Acoustic Monitoring (PAM) is proposed as a method to detect whales during surveys, particularly in conditions of low visibility such as night time. This is especially crucial because seismic operations are proposed to occur during darkness when visual detection methods utilised by Marine Fauna	CGG acknowledges claims regarding the effectiveness of PAM in noisy marine environments and has reviewed the citations provided alongside the Environment Plan (EP) to ensure that the use of PAM for the Regia MSS is a suitable mitigation measure. CGG has committed to utilising Passive Acoustic Monitoring (PAM) and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. CGG commissioned a desktop assessment of available whale detection technologies for marine seismic surveys (Appendix F5) which acknowledges the limitation of PAM's ability to detect marine life acoustic signals in amongst the large impulse noise of seismic airgun arrays being discharged during seismic surveys. Dependent on the water depth and subsurface geology, the subsurface acoustic reflections from each seismic source impulse can still be returning to the sea surface whilst the next airgun array impulse is generated. This means that the actual

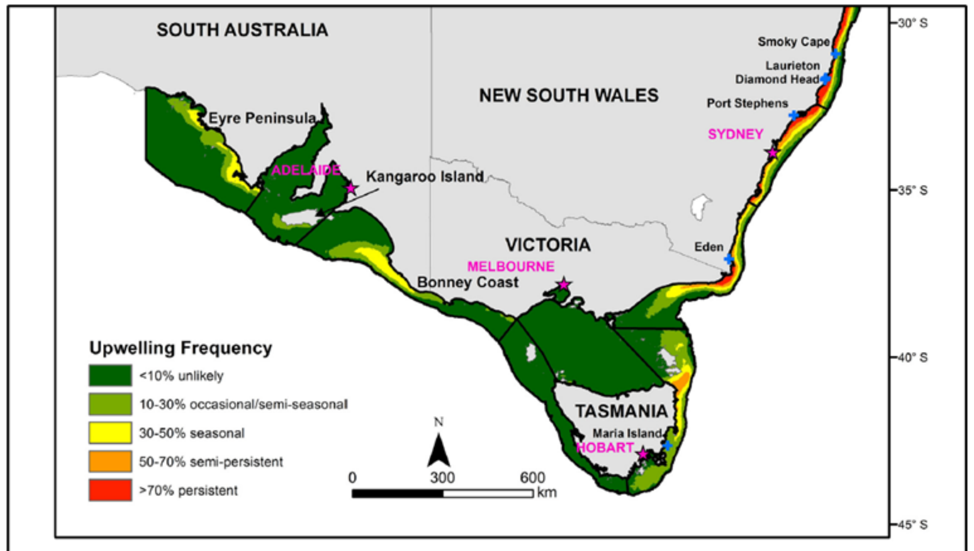
	THEME	**MARINE MAMMALS (M)**
#	**Comments received**	***Titleholder response***
	Observers (MFOs) are ineffective, and in areas important for blue whales and southern right whales. However, PAM faces challenges in effectively detecting whales due to several reasons. Firstly, the constant noise generated by the seismic vessel interferes with the detection process. **Claim:** Moreover, PAM equipment is typically placed behind the seismic vessel, exposing it to various sources of noise such as engine and propeller noise, as well as the low-frequency sound produced by airguns. For example, the vocalisation frequencies of blue whales are between 10 and 40 Hz (Cummings & Thompson, 1971; Richardson et al., 1995) and seismic vessel engine frequencies are in a similar range starting from 11.0 Hz. This proximity to such noises masks the low-frequency biological sounds emitted by whales, further reducing detection capabilities (Seiche Environmental, 2020). **Claims:** There may well be whale detection systems in place, however whales can't be seen at night, and baleen whale vocalisations are difficult to detect against the similar frequency levels of boat propellers and seismic airgun blasts.	"quiet" period where lower amplitude marine fauna noise source levels can be monitored, without background seismic signal data present, is either minimal or non-existent during active survey periods. Therefore, PAM systems need to be able to filter out, or differentiate between seismic energy returns. The best times for detection of marine mammal vocalisations are the short periods of lower noise levels between seismic airgun pulses and during transits between seismic survey transect lines (line changes). Appendix F5 lists several PAM systems and details the advantages and disadvantages of each. CGG will utilise this report along with the most up to date scientific research prior to the Regia MSS commencing and acoustic detection system confirmation. The Fauna Management Plan (Appendix G2) outlines specific measures to minimise anthropogenic noise threats to relevant species, including the implementation of increased safe operating distances between vessels and whales, pre-acquisition surveys and a variety of detection systems. CGG acknowledges that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method, including PAM, can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection. CGG considers the approach detailed in the Fauna Management Plan (Appendix G2) to be adequate in improving the detection of marine mammals during the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M49	**Matter:** The use of two PAM operators is inadequate **Claim:** Implementing a 24-hour roster with only two PAM operators is likely to lead to fatigue and gaps in observations due to necessary breaks for meals and rest. For instance, dividing the 24-hour period between just two operators could mean either a 12-hour shift, which raises concerns about fatigue and adequate meal breaks, or a 4-hour rotation repeated six times, which doesn't allow for sufficient sleep. To ensure effective monitoring, more than two PAM operators are needed for continuous 24-hour operations. **Claim:** If PAM is used during the seismic survey (and operations are 24 hours), the submitter recommends more than two PAM operators are rostered on. This will 1) manage fatigue, and 2) allow for continuous 24 hour PAM observations to be maintained.	CGG acknowledges claims regarding the number of PAM operators allowed and has reviewed the Environment Plan (EP) to ensure that the proposed mitigation measure is sufficient. As described in the Fauna Management Plan (Appendix G2), CGG's whale detection strategy includes the integration of acoustic detection systems, recognising the dynamic nature of whale behaviour and the crucial factor that whales must vocalise to be detected. Acoustic detection systems will consist of passive acoustic monitoring (PAM) and the use of fixed buoy acoustic detection monitoring. **CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan), EP Appendix F3 (Acceptability Assessment), and EP Appendix G1 (Environmental Outcomes) and Appendix G2 (Acceptability Assessment) Section 6 to include an additional MFO/ PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage.**
M50	**Matter:** The use of reliable marine mammal detection technology **Claim:** Whales may not be detected before they are in the area of operation. No information has been given in the application on reliable detection of whales during both day and the night. **Claim:** PAM has been determined as an ineffective detection mechanism for Baleen whales [NOPSEMA, RMS ID: A701545]. In response, CGG has included ADMs (tethered buoys), MFOs and aerial surveys to their detection regime. Yet, adding additional methods, each with admitted weaknesses in various environmental conditions, does not necessarily constitute a reliable method for improving the detection regime for whales and other marine mammals. **Claim:** It is quite possible that the addition of other visual and/or acoustic methods of detection will not increase detection rates for PAM under conditions of poor visibility or in the absence of whale vocalisations. **Claim:** If one single protected whale comes within range of the area, without question it should confidently be able to be detected to ensure zero harm or stress is caused to it, otherwise the activity should not be allowed to be conducted. It is not acceptable or worth the risk to be adding non-essential human caused pressures to the remaining individuals of these protected species.	CGG acknowledges claims regarding the reliability of marine mammal detection technology and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. In the context of the Regia MSS, it is acknowledged that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection. No single method can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection. CGG acknowledge that visual detection of marine fauna is restricted to daylight hours and reasonable sightings conditions. Several management measures have been considered in the Fauna Management Plan (Appendix G2) such as pre-acquisition detection criterion which must be met which counter these limitations. Further, CGG has committed to utilising Passive Acoustic Monitoring (PAM) and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. Aerial surveys will complement vessel-based observations and acoustic monitoring techniques and will be overseen by the SRW and BW expert panel. This panel will be in charge of determining when aerial surveys are required and will develop the objectives and flight path for the survey. Aerial surveys will be used to identify if SRWs are moving between the reproduction BIA and if BWs are moving within the Otway area. As listed in Appendix G2 details of when aerial surveys will be employed are listed below:

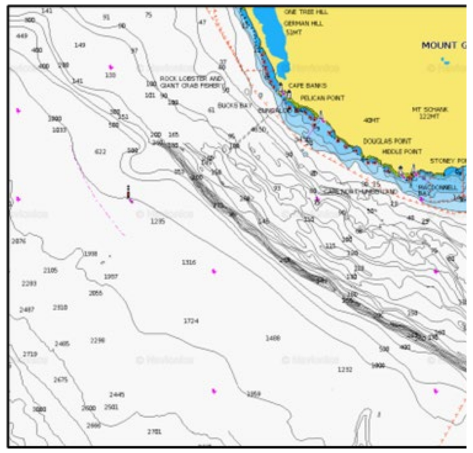
	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
		• Directed by the BW/SRW expert panel • Required to obtain information to inform decision making • Detection of a BW outside of 23 km of the seismic source • Detection of a SRW occurs outside of 15 km of the seismic source • 3 BW/SRW shut downs occur within 24 hours • The seismic source has not been able to restart within the past 12 hours due to an ongoing presence of BW/SRW. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M51	**Matter:** Restrict seismic operations to daylight hours periods of good visibility periods **Claim:** Considering the limitations of PAM in protecting marine fauna, especially during darkness or poor visibility, additional mitigation measures are necessary. It is recommended to restrict seismic operations to daylight hours or periods of good visibility to ensure the protection of listed species under the Environment Protection and Biodiversity Conservation (EPBC) Act. **Claim:** The submitter recommends seismic operations are not conducted during darkness and/or periods of poor visibility to mitigate impacts to EPBC listed species during these times. **Claim:** The submitter recommends mitigation methods appropriate for the region and expected environmental conditions and include restricting seismic operations to daylight hours and/or periods of good visibility only.	CGG acknowledges claims regarding the restriction of the Regia MSS to daylight hours during periods of good visibility and has reviewed the Environment Plan (EP) to ensure that mitigation measures are adequately considered within the EP. CGG acknowledge that visual detection of marine fauna is restricted to daylight hours and reasonable sightings conditions. Several management measures have been considered in the Fauna Management Plan (Appendix G2) such as pre-acquisition detection criterion which must be met which counter these limitations. Further, CGG has committed to utilising Passive Acoustic Monitoring (PAM) and Fixed Buoy Acoustic Monitoring technologies to detect whale vocalisations in the marine environment. Prior to deploying these acoustic detection systems, they will be subjected to rigorous testing to validate reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. The deployment of acoustic monitoring technologies to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations (Appendix F5). The use of acoustic detection technologies will allow CGG to detect whales 24/7 while the survey is occurring and will not require operations to be restricted to daylight hours. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in Appendix G2 of the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M52	**Matter:** The use of aerial surveys **Claim:** At a minimum, CGG must be required to have a spotter plane surveying for cetaceans every day that seismic blasting occurs in order to provide a 10km sighting zone. **Claim:** Given the site-specific and species-specific data and recommendations of the Seiche Environmental report, it is essential additional mitigation procedures are employed throughout the current survey area to compensate for the lack of detection probability of baleen whales, particularly during poor environmental conditions. Additional mitigation procedures include aerial surveys, or where aerial surveys are not possible (during darkness or during high wind conditions), a complete cessation of acquisition. **Claim:** It is recommended aerial surveys are undertaken immediately prior to, and during, seismic swathes to ensure aerial surveys are more effectively providing a “clearance search” of the footprint of the seismic vessel. **Claim:** The submitter recommends aerial surveys are conducted immediately prior to, and during, acquisition within any BIA. **Claim:** The submitter recommends seismic surveys are not undertaken during poor visibility during daylight hours without a concurrent aerial survey. **Claim:** During poor environmental conditions, aerial surveys can assist in the maintenance of the Shut Down Zone, given MFOs positioned on the seismic vessel have significantly reduced visibility. It is recommended seismic surveys are not undertaken during poor visibility without a concurrent aerial survey.	CGG acknowledges claims regarding the use of aerial surveys for assisting with marine mammal detection during the Regia MSS and has reviewed the Environment Plan (EP) to ensure that this mitigation measure was adequately considered. The Fauna Management Plan (Appendix G2) outlines the details on how the Regia MSS will minimise anthropogenic noise threats and the risk of collision to fauna to relevant species. A number of different techniques will be utilised by Regia MSS to assist in the detection of marine mammals. No single method can guarantee the detection of all whales, but by combining several complementary techniques across various platforms, it maximises the likelihood of accurate and early detection both above and below the water surface. The Chapter 9 of the Fauna Management Plan provides a detailed procedure, including actions to be implemented during the seismic acquisition such as soft starts, shut down zone distances and pre-acquisition and acquisition processes and actions. Aerial surveys will complement vessel-based observations and acoustic monitoring techniques and will be overseen by the SRW and BW expert panel. This panel will be in charge of determining when aerial surveys are required and will develop the objectives and flight path for the survey. Aerial surveys will be used to identify if SRWs are moving between the reproduction BIA and if BWs are moving within the Otway area. As listed in Appendix G2 details of when aerial surveys will be employed are listed below: • Directed by the BW/SRW expert panel • Required to obtain information to inform decision making • Detection of a BW outside of 23 km of the seismic source • Detection of a SRW occurs outside of 15 km of the seismic source • 3 BW/SRW shut downs occur within 24 hours • The seismic source has not been able to restart within the past 12 hours due to an ongoing presence of BW/SRW. CGG acknowledge that visual detection of whales is restricted to daylight hours and reasonable sightings conditions and that animal behaviour has the ability to further affect detection probability. Several management procedures such as pre-acquisition detection criterion which must be met will help to counter these limitations. Daily use of aerial surveys, including while Regia MSS is within BIAs, is not considered appropriate nor practicable on account of weather constraints, aviation safety and aircraft availability. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in Appendix G2 of the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
	Claim: Aerial surveys increase the observation area, however continue to limit observation to the sea surface only. The EP does not stipulate when an aerial survey will be conducted prior to commencement of acquisition. **Claim:** Similarly, aerial detection to scan an area of up to 10km from the survey vessel will only locate whales in optimal conditions, during daylight hours. The public is not informed whether operations will cease when spotting is unavailable due to insufficient light or poor weather. **Claim:** Having spotter planes to look out for them on occasion will certainly not be sufficient to monitor for the presence of marine mammals either.	
M53	**Matter:** EP fails to address if there is a process to ensure there is no seismic discharge in the Southern Right Whale reproduction Biologically Important Area **Claim:** Based on the information inspected, it is not clear that there is a real-time verification process in place to ensure that there is no discharge of the seismic array inside the BIA. There are no roles and responsibilities for this critical verification step specified in the EP. **Claim:** The submitter recommends a real-time verification process be put in place to ensure there is no discharge of the seismic array inside the BIA. Roles and responsibilities for this critical verification step need to be specified in the EP.	CGG acknowledges claims regarding the potential for discharge of seismic sources in the southern right whale BIA and has reviewed the Environment Plan (EP) to ensure that this was adequately considered. The peak period for Southern Right Whale (SRW) mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. The PMST Report identified that Southern Right Whale breeding is known to occur within an area that may be affected by underwater sound, in addition the area where the noise effect criteria for SRW is reached overlaps the reproduction BIA (Appendix B12 MAP-REG-EPM-069). Consequently, CGG has included additional measures to protect the SRW within this BIA by surveying shallower areas between November and April when this species is not known to be present. Therefore, due to the spatial and temporal exclusion zones, there will be no impact to SRWs within reproduction BIAs. EP Section 6.4.3 (Details of Control Measures) includes “M#05: Sail Line Plan: Procedural control for contractor activities, including technical and spatial data to comply with CGG specifications”; and Section 6.5 (Environmental Performance Outcomes and Standards) includes “EPO 7. To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment’. Additional details on the M#05: Sail Line Plan, including an evaluation of effectiveness, are included in EP Appendix G1 (Control Measures and Environmental Performance), which shows that the sail line plan supports onboard real-time monitoring of survey performance to ensure that the seismic acquisition activity adheres to the specified boundaries and achieves the specific geophysical objectives, ensuring there can no seismic discharge outside of the permitted areas. As shown in Table G1-2 (Measurement Criteria for the Regia MSS), this control measure is the responsibility of the Quality Control Representative and is included in the daily report. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in Appendix G2 of the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
M54	**Matter:** Additional mitigation measures for marine mammal detection **Claim**: CGG should also be required to utilise new technology that detects whales in low visibility conditions (i.e. WhalePOD and Seiche Smart Visual Detection Systems (SSVDOs)) - technologies which were developed using funding from NOPSEMA specifically to address the known limitations of MFOs. **Claim**: Given the legal responsibility for CGG to reduce harm to whales and cetaceans during seismic surveys under EPBC Policy Statement 2.1, CGG’s refusal to transparently consider the costs associated with technology that addresses a limitation with MFOs is a problematic weakness of this EP. **Claim:** The SSVDOs are now commercially available, but CGG in its EP did not conduct a cost-benefit analysis regarding the implementation of the device during seismic surveys. The reason for this was not explained. **Claim:** Similarly, the WhalePOD system was deemed “likely to be cost prohibitive for the potential benefits of system deployment” according to the EP (p.3232), though no cost projection was provided. **Claim:** Support vessels with MFOs should be utilised to facilitate execution of an extended Shut Down Zone for blue whales and southern right whales to 14 kms and 12 kms, respectively.	CGG acknowledges claims regarding alternative/ additional mitigation measures for whale detection and has reviewed the Environment Plan (EP) to ensure that these were adequately considered. CGG recognise the complexities and uncertainties inherent in this task and acknowledge that no single detection method is perfect. Therefore, they have strategically leveraged the strengths of multiple alternative methods to enhance confidence in detection capabilities. Consequently, the use of multiple detection methods, including visual and aerial observations and acoustic detections systems, enhances overall confidence in detecting whales, both above and below the water surface. Regarding the consideration of alternative technologies, CGG commissioned an independent assessment of available whale detection technologies as additional management procedures for the Regia 3D Marine Seismic Survey, as included in EP Appendix F5 (Marine Mammals Detection Technology Assessment). This detailed assessment collated all available information on the status and suitability of alternative detection technologies, such as the Seiche Marine Technology | Thermal Imaging and High Definition Camera and WhalePOD (thaum.io) camera based systems. The information provided is from relevant equipment vendors and publicly available sources. Both systems are in stages of commercialisation and the costs associated with trailing all of these technologies would be unreasonable, considering the uncertainty in effectiveness to mitigate impacts. Consequently, these technologies are not currently suitable for application and alternative detection methods are considered more suitable. Up to 10 aerial surveys have been included as part of Control Measure M#03 Fauna Management System, as stated in EP Section 6.4.3 (Details of the control measures) and as evaluated in the EP Appendix F2 (ALARP Assessment – Annex 4).

	THEME	MARINE MAMMALS (M)
#	**Comments received**	***Titleholder response***
	Claim: Additional mitigation procedures are required for the Regia Marine Seismic Survey to compensate for the lack of detection probability of baleen whales during poor environmental conditions. Additional mitigation procedures appropriate for the region (given its significance and provision of critical habitat for protected species) include support vessels, aerial surveys and a cessation of acquisition during poor environmental conditions. The submitter recommends additional mitigation procedures, including a Support Vessel, to compensate for the lack of detection probability of baleen whales during poor environmental conditions. Additional mitigation procedures include support vessels with MFOs, aerial surveys, and a cessation of acquisition during poor environmental conditions. **Claim:** Implement radars that search for whales under the ocean water that are monitored 24/7 or whilst the seismic blasts are being conducted. **Claim:** Implement radars that search for dolphins under the ocean water that are monitored 24/7 whilst the seismic blasts are being conducted. **Claim:** It is quite possible that the addition of other visual and/or acoustic methods of detection will not increase detection rates for PAM under conditions of poor visibility or in the absence of whale vocalisations. **Claim:** Furthermore, the proposed mitigation measures, such as the presence of Marine Fauna Observers on board, are woefully inadequate to protect marine life effectively. The limitations of these measures, combined with the lack of consideration for new technologies that could enhance whale detection in low visibility conditions, highlight the shortcomings of CGG\'s approach to mitigating environmental impacts. **Claim:** Given the critical nature of detection of SRW due to the Operating Area intersecting known migration paths of SRWs and given that the survey will be active during months of migration and calving and Logan's Beach whale nursery, Submitter requests that cumulative effectiveness of multiple detection strategies be explicitly assessed for the expected combinations of conditions during the acquisition period. **Claim:** Request studies into the probability of a whale being within the testing zone undetected, giving due consideration to the proposed exclusion zone, the diving and travelling distances of whales and the limitations of human observers. Use this information to reassess the risk mitigation proposal. **Claim**: Saying that no blasts occur if whales are sighted does not account for the waves traveling many miles and disrupting the whales' perception and navigation further out than within visible range of vessels or helicopters.	The use of a spotter vessel with MMOs was also evaluated in EP Appendix F2 (ALARP Assessment – Annex 4), which identified a significant cost element for a limited benefit of an extra 3 km radius of observation. Further, the addition of more vessels in an area would increase overall risks more than the offset of impacts considering the other measures adopted (i.e. tethered buoys). Conventional radar is not considered an appropriate detection technology given it is designed to reflect off dense objects like metal, which means that it is unlikely to detect whales or dolphins. Radio detection and ranging (also known as RADAR), has been tested and found to be a poor performer in real world conditions for a range of reasons (Verfuss et al 2018). CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References**:* *Ursula K. Verfuss, Douglas Gillespie, Jonathan Gordon, Tiago A. Marques, Brianne Miller, Rachael Plunkett, James A. Theriault, Dominic J. Tollit, Daniel P. Zitterbart, Philippe Hubert, Len Thomas, Comparing methods suitable for monitoring marine mammals in low visibility conditions during seismic surveys, Marine Pollution Bulletin, Volume 126, 2018, Pages 1-18, ISSN 0025-326X, https://doi.org/10.1016/j.marpolbul.2017.10.034. (https://www.sciencedirect.com/science/article/pii/S0025326X17308809)*

7. Productivity

	THEME	PRODUCTIVITY
#	***Comments received***	***Titleholder response***
Key Matter: The Bonney Coast Upwelling		
P01	**Matter:** Misrepresentation of the Bonney Coast Upwelling **Claim:** The EP inaccurately characterises the Bonney Upwelling as being smaller, less extensive, and further from the boundary of the OA than it actually is . In reality, the upwelling overlaps with the OA and provides the nutrient-dense water that is critical for primary production and zooplankton growth. **Claim:** The full expanse of the Bonney Upwelling has been misrepresented in the Environmental Plan. **Claim**: The Environment Plan misrepresents the full expanse of the biologically important area, the Bonney Upwelling. **Claim**: Both the size of the area that will be affected and the true extent of the Bonny Upwelling have been misrepresented by the industry.	CGG acknowledges claims regarding representation of the Bonney Upwelling and has reviewed the Environment Plan (EP) to ensure that the representation described in the EP is an accurate assessment based on available scientific literature. CGG recognises the fundamental role of the upwelling systems to the ecology of the area. Earlier consultation with conservation groups and relevant persons revealed that the change in timing of the survey did not adequately address concerns associated with effects to zooplankton communities, particularly during upwelling events and the values associated with Key Ecological Features (KEFs) in the region. CGG subsequently endorsed an activity limitation of no acquisition within 500m of the Bonney Coast Upwelling KEF, nor the West Tasmanian Canyons KEF (Appendix F3: page 24 Regia EP). The upwelling systems in the region are collectively known as the Great Southern Upwelling which is not a continuous system but rather 3 distinct systems (the Bonney Coast Upwelling, Kangaroo Island Upwelling and the Eyre Peninsula Upwelling) that ebb and flow in strength and extent within and between years, subject to wind conditions. The Bonney Coast Upwelling extends NW from Cape Nelson, Portland with its epicentre running NW from Mount Gambier. Summarising over 10 years of data Huang and Wang (2019) were able to clearly show where upwelling activity is highest and conversely where it is minimal. The area within which the Regia MSS is being proposed is not within any of the core upwelling zones (Appendix F3: page 30-31, Regia EP)  Fig. 14. The upwelling frequency map, generated by combining the 126 monthly upwelling maps. **Figure 1:** Map showing upwelling frequency. Examination of nautical charts from the region further clarifies why the core of the Bonney Coast Upwelling is centred adjacent to Mt Gambier. The bathymetry indicates a steep drop off from 200 to 400m which provides a geological ramp for concentrating and intensifying upwelling dynamics, with the steep ridge line providing a mechanism for intense and concentrated upwelling of nutrients and associated plankton communities, as shown below.

	THEME	**PRODUCTIVITY**
#	***Comments received***	***Titleholder response***
		 **Figure 2:** Map showing bathymetry off the coast of Mount Gambier. Further, mapping of the Bonney Coast Upwelling, as shown in Figure MAP-REG-EPM-003b (Bonney Coast Upwelling Key Ecological Feature), is based on spatial data from the Australian Government's National Conservation Values Atlas (NCVA). The spatial boundary of this KEF, as defined in the NCVA, was derived through a review of enhanced chlorophyll occurrence for summer seasonal data (1998-2010) provided by CSIRO. CGG has considered these claims and is satisfied that the extent of the Bonney Coast Upwelling has been appropriately described and mapped using Australian Government spatial data in the EP, as described outlined above. As a result, the EP has not been updated in response to these claims. ***References:*** *Huang, Z. and Wang, X.H., (2019) Mapping the spatial and temporal variability of the upwelling systems of the Australian south-eastern coast using 14-year of MODIS data. Remote sensing of environment, 227, pp.90-109.*
P02	**Matter:** Overlap of the Operational Area with the Bonney Coast Upwelling **Claim**: Blue whales and pygmy blue whales feed on these zooplankton in the waters of the Bonney Upwelling and the OA, thus an accurate characterisation of the Bonney Upwelling is crucial to understanding the connection between the physical environment and the food webs and species present in the OA and Environment Planning Area. These inaccuracies in the EP in detailing the BIA and the Key Ecological Feature of the Bonney Upwelling is another reason this EP and all seismic activity in the area should be refused. **Claim**: The Bonney Upwelling is a Key Ecological Feature that overlaps with the Environment Planning Area and abuts the OA. The upwelling provides the nutrient-dense water that is critical for primary production and zooplankton growth. Blue whales and pygmy blue whales feed on these zooplankton in the waters of the Bonney Upwelling and the OA. **Claim**: The EP misrepresents the environmentally significant Bonney Upwelling. It fails to acknowledge it's much larger geospatial range that sees it enter into the Operating Area. This indicates an increased likelihood of Baleen Whale species, such as the Pygmy Blue Whale being within the OA. Further, it indicates that plankton, a keystone species, would be at higher risk of seismic blasting. **Claim:** The Bonney Upwelling in fact enters into the operational area, as the distribution and productivity of its nutrient rich waters has an impact across a significant geospatial area. Given the close relationship of much of marine life with these waters there is an increased likelihood that key species will be found in the operational area.	CGG acknowledges claims regarding overlap with the Bonney Coast Upwelling Key Ecological Feature (KEF) and has reviewed the Environment Plan (EP) to ensure that the overlap and significance of this KEF was appropriately described in the EP. As stated in the response to Matter P01, the upwelling systems in the region are collectively known as the Great Southern Upwelling which is not a continuous system but rather 3 distinct systems (the Bonney Coast Upwelling, Kangaroo Island Upwelling and the Eyre Peninsula Upwelling) that ebb and flow in strength and extent within and between years, subject to wind conditions. Mapping of this area is appropriate based on the Australian Government's National Conservation Values Atlas. The importance of the Bonney Coast Upwelling KEF is described in detail in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) Section 4.3 (Bonney Coast Upwelling Key Ecological Feature), with predicted impacts detailed in Section 6 (Predicted Levels of Impact), on page13. CGG has committed to M#01: Activity Limitations, whereby there will be no discharge of the sound source within the Bonney Coast Upwelling KEF, based on NCVA mapping as described in response the Matter: P01, and no discharge of the sound source in January, February and March to protect the associated increase in biodiversity during this period. It is important to note that the upwelling systems are extremely variable, with their extent and strength varying considerably both within and between years. Such variability provides a mechanism and evolutionary driver for those animals reliant on the upwelling, to be mobile and willing to move. By utilising the geostationary Himawari-8 satellite, Leplastrier & Huang (2017), were able to map the BCU on a daily basis from Nov 2016-March 2017 and showed that the upwelling was actually made up of 3 distinct events each approximately 2 weeks in duration and covering a total area that ranged from 9460 to 12923 km^2. This is a 27% change in potential feeding ground extent within a single season. As noted in EP Appendix F3 (Acceptability Assessment) Section 5.2.7.1 (Species-specific Sensitivity), the areal and temporal extent of the upwelling can vary by over 50% from year to year (Huang & Wang 2019); however, the core of the system remains adjacent to Mt Gambier for the reasons previously outlined.

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	Claim: The proximity of the OA to the Bonney Upwelling which produces a significant volume of zooplankton presents a real danger to the foraging opportunities for all marine species within and beyond the OA.	CGG has considered these claims and is satisfied that the overlap and importance of the Bonney Coast Upwelling KEF has been appropriately characterised in the EP, as outlined above and response to Matter P01. As a result, the EP has not been updated in response to these claims. *References:* *Huang, Z. and Wang, X.H., (2019) Mapping the spatial and temporal variability of the upwelling systems of the Australian south-eastern coast using 14-year of MODIS data. Remote sensing of environment, 227, pp.90-109.* *Leplastrier, Aero and Huang, Zhi (2017) Dynamics and connectivity of the Bonney Coast Upwelling on a daily scale using the Himawari-8 dataset. AMSA 2017 Conference Proceedings, Darwin NT.*
P03	**Matter**: Implementation of mitigation measures to avoid the Bonney Coast Upwelling Key Ecological Feature (KEF) **Claim:** CGG indicated in an email to the submitter (November 2023) that it "will implement an activity limitation for there to be no acquisition within 300m of the Bonney Coast Upwelling KEF." However, there is no indication in the EP of how CGG plans to implement this mitigation measure, given the timing and spatial extent of the Bonney Upwelling varies each season and is detected principally by satellite imagery analysis of chlorophyll-a prevalence, or aerial surveys to detect fronts and plankton blooms. The boundaries of the upwelling also change rapidly (i.e. timescale of days) in response to changes in oceanographic variables, such as wind speed and direction and temperature. Given the lack of clarity detailing how CGG plans to detect the spatial extent of the Bonney Upwelling and adjust acquisition accordingly within short timeframes**,** the submitter does not consider that CGG will be able to mitigate the impacts of seismic surveys on this KEF, and strongly recommends that the EP be refused. **Claim:** If this project were to go ahead the operating area would require a significant redfininition of the area to exclude [marine parks and] the Bonney Upwelling, the EP would require a substantial increase in mitigation methods that are backed by strong evidence, and the shutdown zones should be significantly increased to ensure these species are protected.	CGG acknowledges claims regarding implementation of mitigation measures to avoid the Bonney Coast Upwelling Key Ecological Feature (KEF), and has reviewed the Environment Plan (EP) to ensure that the Regia MSS area proposed takes into account the presence of the KEF and has established boundaries sufficiently distant from this system. As stated in the response to Matters P01 and P02 this KEF is a highly dynamic system that will vary in spatial and temporal extent every year. There are no hard boundaries to these systems hence an appropriate response is to locate a survey outside the upwelling areas as defined through examination of long-term satellite records, as was done by Huang & Wang (2019), and as established under the Australian Government's National Conservation Values Atlas (NCVA). Their data clearly shows the BCU to be located west of Cape Nelson. This does not preclude the existence and prevalence of smaller and/or more transient upwelling events in other areas as there is evidence of upwelling at a lower level across the greater shelf region and blue whales are known to aggregate for feeding along the Otway coast SE of Cape Nelson (Gill et al 2011). As detailed in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) CGG has committed to M#01: Activity Limitations, whereby there will be no discharge of the sound source within the Bonney Coast Upwelling KEF, based on mapping as described in response the Matter: P01, and no discharge of the sound source in January, February and March to protect the associated increase in biodiversity during this period. Appropriate timing of the MSS will also mitigate any potential effects by avoiding periods when upwelling is most prevalent. CGG has considered these claims and is satisfied that measures to mitigate impacts to the Bonney Coast Upwelling KEF have been appropriately considered and adopted in the EP, as outlined above and response to Matters P01 and P03. As a result, the EP has not been updated in response to these claims. ***References****:* *Gill PC, Morrice MG, Page B, Pirzl R, Levings AH, Coyne M. (2011) Blue whale habitat selection and within-season distribution in a regional upwelling system off southern Australia. Marine Ecology Progress Series 421:243-63.*
Key Matter: Impacts on Plankton, including krill		
P04	**Matter** No modelling of impacts to zooplankton **Claim:** The studies mention permanent sub- lethal effects on rock lobster and mortal injury to zoo plankton. The Environmental plan accepts these as non-critical risks however there seems to be no independent modelling of the impact of underwater sound as recommended by the preliminary environmental statement. **Claim:** CGG claims that larvae mortality is negligent when compared with natural mortality, based upon a study by DNV Energy (2007) and Hawkins & Popper (2012). The more recent study by Lara and Vasconcelos (2021) investigated zebra fish larvae (a reference model species in biology) and their physiological and behavioural response to sound. Lara and Vasconcelos (2021) found larvae exposed to 150dB increased 1) mortality by approximately 33%, 2) heart rate, 3) yolk consumption and 4) cortisol levels. In summary, exposure to loud noises resulted in negative physiological responses within larvae. **Claim:** GG has failed to incorporate highly relevant research to accurately inform an assessment on mortality impacts of seismic activity on larval fish.	CGG acknowledges the claims regarding modelling of seismic impacts and has reviewed the Environment Plan (EP) to check that all available and relevant modelling studies on seismic effects have been included in the knowledge base used to develop the EP. There have been a number of modelling studies that have investigated the effects of sound in the marine environment and its impact across numerous taxa, although there remains a bias towards adults/juveniles rather than planktonic communities. As part of this EP, modelling was commissioned to understand the likely seismic propagation profiles within the proposed MSS area and this output matched to known levels of Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) impairment as described in the scientific literature (EP Appendix B7a and B7b – Sound Modelling Report, Jasco 2023 and 2024). From this modelling, effect distances were established for all identified groups including for fish eggs and larvae, and this has informed the EP. The largest targeted modelling study looking specifically at seismic effects on zooplankton was done by Richardson et al (2017) as a direct response to an experiment by McCauley et al. (2017) which found seismic caused significant mortality in zooplankton out to 1.2km from the source. Richardson et al (2017) also found significant declines of up to 22% of plankton biomass within their survey area of 86km x 30km, reducing with distance thereafter, but remaining within natural mortality rates. The outcomes of the McCauley et al (2017) work have not been repeated elsewhere hence, while clearly significant and relevant to the question of impacts, there remain multiple inconsistencies in this work that need to be tested and verified through repeated experiments.

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	Claim: CGG has failed to identify cause and effect pathways from the impacts of anthropogenic noise on important behavioural mechanisms and has not modelled potential mortality or injury through these pathways (such as settlement cues). **Claim:** Sources referenced such as Sætre and Ona (1996) are outdated and CGG fails to incorporate more recent literature when completing the risk analysis on larvae. We therefore recommend the risk assessment and mitigation procedures are revised based on recent literature relevant to the seismic location.	**EP Appendix F3, Section 5.2.10 (formerly 5.2.7) has been updated to include results from a very recent, major research program (ZoopSeis - https://www.hi.no/hi/nettrapporter/toktrapport-en-2022-9) commissioned by the Institute of Marine Research in Norway, to specifically test the general validity of the outcomes of the McCauley et al (2017) experiment. This program used a combination of modelling and laboratory work to address what forces can induce injury and mortality in zooplankton, and at what ranges from a seismic survey such forces could be strong enough to have a lasting impact. Results to date support the model of declining impacts with increasing distance from the seismic source.** In totality, there is a significant body of work - as outlined in the EP - that illustrates a consistent pattern of harmful but variable effects close to seismic sources but attenuating with distance. To date there has been no evidence found of population-level effects on plankton communities nor any subsequent trophic cascading as a direct result of any MSS. While the evidence is clear that MSS will cause injury and/or mortality to plankton in close proximity to seismic signals these impacts are substantially less than natural mortality rates. EP Appendix F3 (Acceptability Levels of Impact and Risk) Section 5.2.7 (Plankton Communities and the Bonney Upwelling System) further discusses the risks associated with seismic surveys and plankton communities. Mitigating effects, no matter what their size, is still the preferred outcome under the principals of ALARP and hence the motivation to avoid any MSS surveys within central upwelling areas and during periods of peak upwelling intensity. Consequently, CGG has committed to M#01: Activity Limitations, whereby there will be no discharge of the sound source within the Bonney Coast Upwelling KEF, based on NCVA mapping as described in response the Matter: P01, and no discharge of the sound source in January, February and March to protect the associated increase in biodiversity during this period. **CGG has considered these claims and is satisfied that all available and relevant modelling studies on seismic effects have been included in the knowledge base used to develop the EP, as outlined above, and the EP has been updated to include reference to recent publications.** ***References:*** *McCauley RD, Day RD, Swadling KM, Fitzgibbon QP, Watson RA, Semmens JM (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7):0195.* *Richardson AJ, Matear RJ, Lenton A (2017) Potential impacts on zooplankton of seismic survey.CSIRO, Australia 34 pp.* *Vereide EH and Kuhn S (2024) Effects of Anthropogenic Noise on Marine Zooplankton in Popper, Arthur N. et al. (Ed.) The effects of noise on aquatic life. Springer Cham. 500 pp.* *Vereide EH, Khodabandeloo B, de Jong K (2024) The copepod Acartia sp. is more sensitive to a rapid pressure drop associated with seismic airguns than Calanus sp. Marine Ecology Progress Series 730:15-30.*
P05	**Matter:** Impacts to plankton (and marine life in general) from seismic survey **Claim**: Research has shown that seismic blasting results in serious harm to a variety of marine life, deafening whales and disrupting their feeding and migration, damaging the ability of southern rock lobsters to function and navigate, and causing mortality in small fish and zooplankton. **Claim:** Evidence suggests that seismic blasting harms marine life, including deafening whales, disrupting their feeding and migration, and causing mortality in small fish and zooplankton. **Claim:** Research suggests seismic blasting can cause harm to various marine whales, rock lobsters, fish, and zooplankton. It can disrupt their feeding patterns, migration routes, and even lead to mortality in some cases. **Claim:** Research demonstrates its adverse impact on various marine species, including the deafening of whales, disruption of their feeding and migration patterns, impairment of southern rock lobsters' functioning and navigation abilities, and mortality among small fish and zooplankton. As such, repercussions extend to industries such as commercial fishing and tourism. Given that this project benefits a select few at the expense of the wider community, including residents along the South-west Victorian coastline, it needs to be refused by NOPSEMA. **Claim:** CGG claims that larvae mortality is negligent when compared with natural mortality, based upon a study by DNV Energy (2007) and Hawkins & Popper (2012). The more recent study by Lara	CGG acknowledges the claims regarding impacts to a variety of marine life from seismic discharges, including plankton, and has reviewed the Environment Plan (EP) to ensure these were appropriately assessed. There is sufficient science available to demonstrate that seismic discharges can cause impairment and/or mortality to marine animals at various stages in their life-cycles. However, the scale of such impacts varies widely and is dependent on a multitude of factors that influence the dynamics at any given location and time period. Populations (of fish and invertebrates) and processes (Upwelling events, water temperatures, wind strength) within the southern Australian marine environment vary greatly, both within and between years, and between locations. This variability is well-documented and of much greater magnitude than hitherto reported effect sizes for MSS impacts. The EP provides an extensive assessment of the literature on underwater sound effects to Plankton, Fish, Invertebrates, Birds, Turtles, Marine Mammals and People, as documented in Appendix E (Environmental Impact Assessments). Based on community consultation these broad groupings are further split into species, or taxa specific sections that enable a more detailed assessment of the potential effects of seismic. Further to this a specific assessment was done to first define and then address acceptable levels of environmental impact and risk, as documented in EP Appendix F3 (Acceptability Assessment), which provides further assessment of key environmental values and sensitivities in recognition of their significance to the community. Specifically, more details have been provided on impacts and risks from seismic surveys on Southern Right Whales, Blue Whales, Southern Rock Lobsters, Giant Crab, Glass Eels (incl. adults), Gould's Squid, Plankton Communities and the Bonney Coast Upwelling, Snapper, Black Lip Abalone, Pale Octopus

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	and Vasconcelos (2021) investigated zebra fish larvae (a reference model species in biology) and their physiological and behavioural response to sound. Lara and Vasconcelos (2021) found larvae exposed to 150dB increased 1) mortality by approximately 33%, 2) heart rate, 3) yolk consumption and 4) cortisol levels. In summary, exposure to loud noises resulted in negative physiological responses within larvae. **Claim:** GG has failed to incorporate highly relevant research to accurately inform an assessment on mortality impacts of seismic activity on larval fish. **Claim:** CGG has failed to identify cause and effect pathways from the impacts of anthropogenic noise on important behavioural mechanisms and has not modelled potential mortality or injury through these pathways (such as settlement cues).	and King George Whiting. These assessments also include investigations of commercial fishing catches and correlations with seismic activity across the region, all of which found zero relationship. There is no evidence to support the premise that a 60 day MSS in the location outlined in the Regia MSS is likely to cause critical impacts to populations of fish species, invertebrate species and any associated commercial fisheries of these organisms. This is not to deny impacts from the Regia MSS will occur but rather that all likely or potential impacts will be immeasurably small relative to the variability that populations and processes display on multiple scales of space and time. CGG have utilised all available published and peer reviewed scientific information to provide the appropriate context for any potential seismic effects on key organisms and to draw conclusions. Nevertheless, we remain open to further analysis should new and compelling information be forthcoming. CGG has considered these claims and is satisfied that impacts to plankton (and marine life in general) have been appropriately considered in the EP, as outlined above and as detailed extensively in responses to Matters within the Themes of Fish, Sharks, Invertebrates and Fisheries and Marine Mammals. As a result, the EP has not been updated in response to these claims.
P06	**Matter**: Extent of impacts to zooplankton **Claim**: Research shows that zooplankton experience death 1.2 km away from seismic blasting sources (and potentially further), but the maximum distance used by CGG to evaluate risk is 230m - vastly underestimating the impacts to zooplankton. The EP must be rejected due to its errors in estimating zooplankton mortality, including the percentage of the population affected, recovery time, and the degree of wider ecosystem impacts such as food source availability for foraging whales. **Claim**: After seismic blasts, many zooplankton are found dead , as far away as 1.2 kilometres from the blast site. (Reference: McCauley, R., Day, R., Swadling, K. et al. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nat Ecol Evol 1, 0195 (2017). https://doi.org/10.1038/s41***-***-****, https://www.nature.com/articles/s41***-***-****) **Claim**: Seismic blasting kills zooplankton (the foundation of biodiversity & life in the ocean) within a radius of 1.2 kilometres. Studies show that seismic blasting has the following impacts; Death of zooplankton. **Claim:** Evidence that seismic blasting harms marine life is growing. The sound travels under water faster than it does through air, and can travel for hundreds to thousands of kilometres. It can kill or injure marine animals close by – even tiny zooplankton more than a kilometre away. **Claim:** Investigations conducted in Australia in conjunction with a full scale marine seismic survey suggested decreases in zooplankton abundance extending as far as 15km from the seismic source. Richardson AJ, Matear RJ and Lenton A. 2017. Potential impacts on zooplankton of seismic surveys. CSIRO, Australia. **Claim:** The pelagic fauna in the water do not maintain positions based on the substrate, but rather move with the water. This is the nature of pelagic environments. The outcome of this irrefutable natural law may be likened to a conveyor-belt impact providing a continual source of fresh zooplankton to the impact zone thus creating vast areas down stream depleted of life. The Pygmy blue whale and the Southern Right Whales are currently listed as Endangered under the Australian Environment Protection and Biodiversity Conservation (EPBC) Act. These species frequent the area of the CGG proposal AND feed almost exclusively on krill. NOPSEMA is entrusted with safeguarding species listed under the EPBC Act and must consider the 'conveyor belt' impact as having a direct and detrimental impact on the diet of these protected and endangered species. **Claim:** As the width and depth of the seismic blasts from a small single air gun kills krill at 1.2 km distance, the survey with its wide array of large guns would kill the plankton and krill across the whole area as it went backwards and forwards in a manner comparable to mowing a lawn. The much larger array that will be used in the proposed survey will certainly cause large-scale kills of fish, plankton, and the larval forms of eels and shellfish over a much longer distance.	CGG acknowledges the claims regarding impacts of mortality of zooplankton from seismic surveys and has reviewed the Environment Plan (Ep) to ensure these were appropriately assessed. To ensure that a thorough assessment of seismic effects to zooplankton has been completed CGG has utilised all available scientific peer-reviewed literature and reporting from government agencies such as Fisheries Authorities, which are considered authoritative and credible sources of information. EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) provides 50 references that were key to assessing the impact of underwater sound/seismic on plankton. EP Appendix F3 (Acceptability Assessment) further interrogates available information to define what is an acceptable level of impact for plankton communities of the region (Section 5.2.7). A key piece of work that is being cited to inform claims of extensive mortality is that of *McCauley et al. (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7): 0195*. This work presents an outcome more extreme than other published studies investigating seismic effects on zooplankton, concluding that seismic caused uniform mortality of larval krill species up to 1.2km away from the source. There have been other studies since that experiment and none of them have found an extended mortality range as described by McCauley et al (2017). The extensive mortality reported by McCauley et al (2017) was of larvae of Australian Krill, *Nyctiphanes australis*, while other studies have focussed on copepods. There has been multiple feedback from this work as to the effectiveness and thoroughness of the experimental design because of the unparalleled outcome relative to other studies. This has included multiple studies to check the general validity of McCauley et al (2017) with none being able to find a similar result either through modelling (Richardson et al 2017) or further experimental work (Fields et al 2019). The Norwegian Institute of Marine Science, which is one of the largest marine research institutes in Europe, has just completed a dedicated 3-year program of research called Zoopseis (https://app.cristin.no/projects/show.jsf?id=2517155) which was designed to look at the effects of seismic sound on zooplankton. It was largely motivated by the contradictory results of McCauley et al (2017) and a subsequent study by Field et al (2019) which suggested that seismic effects are highly variable and dependent on multiple factors. The project has combined modelling and experimental work to gain further insights, and some results are already available with the final report due within the next 12 months. **The EP has incorporated relevant information from all peer-reviewed scientific papers produced from this work so far. (Vereide et al. (2023) and Vereide et al. (2024a)) assessed seismic effects on copepods, and found there was significant damage at close quarters to seismic discharges but no evidence to support extensive and unattenuated mortality out to 1km + as reported in McCauley et al (2017). Mortality levels reported were also lower than natural mortality rates and hence are predicted to be difficult to separate from background mortality levels. Both papers also note that effects are highly variable according to many factors such as size and power of the seismic array, what species are being looked at and what stage of their life cycle is present. A review paper by Vereide et al (2024b) highlighted the vexed issue of extrapolating experimental results to real-life situations. They noted that although a seismic survey may cover up to 3000 km² and shoot continuously for many weeks the animals will not be constantly exposed throughout that period. The duration of exposure in the reviewed studies lasted for a maximum of 3–4 days, which could be considered too long to be transferred into a real-life setting, considering advection and migration processes that typically occur in the plankton.** Weight of scientific evidence shows that the effects of seismic on zooplankton are clearly not ubiquitous nor unrelenting through the entire signal range. Weight of scientific evidence also indicates that mortality rates linked to seismic remain substantially

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	Claim: Krill, a critical food source for many larger species, have been found dead up to 1.5km from seismic blasting operations, zooplankton are liquified and larger species such as whales have been deafened or killed outright. **Claim:** In a peer-reviewed paper published in the prestigious journal Nature, Ecology and Evolution, McCauley et al. (2017) showed that all krill larvae suffer complete (100%) mortality out to at least 1.2 km from a seismic survey blast discharge. Regia (and others) use a modelling exercise to try to negate a real physical world experiment – this is an abuse of the scientific process. **Claim:** Tasmanian research found seismic blasting also triggers extensive death in plankton and krill, two crucial foundations of marine food webs, from more than a kilometre away. **Claim**: Recent Australian studies have shown that seismic blasts kill shellfish and zooplankton more than a kilometre away and "there is a significant and unacknowledged potential for ocean ecosystem function and productivity to be negatively impacted by present seismic technology."[1]. 1 Robert D. McCauley et al., 'Widely Used Marine Seismic Survey Air Gun Operations Negatively Impact Zooplankton', Nature Ecology & Evolution 1, no. 7 (22 June 2017): 1–8, https://doi.org/10.1038/s41559-017-0195. **Claim:** Invertebrates make up 92% of marine species and play a critical role in providing food for larger species. There is a wealth of evidence of impacts on invertebrates by seismic blasting operations. **Claim:** Problems that I foresee include: Killing off zooplankton that is a food supply for their prey of fish, squid and octopus (McCauley et.al. 2017). **Claim:** Seismic blasting causes significant death of zooplankton, with research showing this effect out to a distance and depth of 1.2km from the seismic source. (McCauley et.al, 2017). With the extent of passes to be conducted through the Operating Area, there would be significant mortality to the zooplankton, which contains not only next generation larvae of many marine species, but is a food supply for small fish, filter feeding shellfish such as scallops, jellyfish, baleen whales and certain seabirds such as the Short-Tailed Shearwater. **Claim:** The EP on page 33 states there may be permanent mortal injury and mortality to zooplankton within 200m from the sound blasts. If zooplankton is affected so are other species that rely upon the zooplankton as a food source. **Claim:** If the zooplankton suffer mortal injury will this impact the animals in this zone as they may not have access to the same volume of food (zooplankton)? **Claim:** As a result of the seismic blasting, the whole area would end up devoid of the plankton and krill that form the basis of the food chain for everything from fish to whales. **Claim:** Considering that even the geographical range that needs to be considered is still not adequately defined, it becomes even more difficult to compile an exhaustive list of potentially affected species. Additionally, as these species interact with other species which may be outside the buffer zone (for example plankton as a food source for other animals) the impact zone needs to be considered as reaching far beyond the impact zone of seismic blasting that may be initially and incorrectly narrowly defined as where the sound waves reach. **Claim:** The blast destruction of krill will result in a cascade of possibly irreversible, catastrophic consequences to the ecosystem. This process has been widely demonstrated in studies of keystone species across the world. We presume that Regia are aware of these facts since they were raised during public consultation processes and they state that they are working closely on them. This is not the case. The term "keystone" does not appear anywhere in Regia's application, despite being informed of their critical importance. **Claim:** I am conscious that seismic testing is known to harm everything from zooplankton right up the food chain to charismatic mammals.	lower than natural mortality rates and not distinguishable from background mortality levels. The McCauley et al (2017) study remains highly germane to the issue of seismic effects on zooplankton but there remains much work to be done before its outcomes could be extrapolated. Relative to the whole scientific literature base it has provided an 'outlier point' which needs further validation through repeated experiments that also improve on the original study design. Time and space are equally important to consider when assessing the potential impacts of a MSS survey on marine life. Plankton dynamics are extremely variable or 'patchy' in both time and space (as articulated in the Regia MSS EP, Appendix F3 Section 5.2.7.2) and this ensures there are no uniform outcomes from a disturbance such as a MSS. Short-lived organisms such as zooplankton have extremely high population turnover rates as they are reproducing continuously. This provides a mechanism for population growth and resilience to local scale disturbances. The relative importance of the Regia MSS area to keystone fish and invertebrate species in the region and the importance of this region to the planktonic stages of these species has been assessed in the EP. There is no scientific evidence to support the premise that the area encapsulated by the Regia MSS is critical to the population health of these species and this is articulated in the Regia EP for each species. Further, annual fisheries catches and recruitment data for a number of commercial species have been compared with annual seismic activity, with no evidence of a relationship found. To further decrease any potential risks, CGG has committed to M#01: Activity Limitations, whereby there will be no discharge of the sound source within the Bonney Coast Upwelling KEF, based on NCVA mapping as described in response the Matter: P01, and no discharge of the sound source in January, February and March with the timing of the Regia MSS aligned to a period of the year when recruitment and larval dynamics are at their lowest for the greatest number of species. Historical outcomes can also provide insights into potential impacts from seismic activity across the greater region. This assessment found no evidence for changes in population levels of any key fisheries species that can be correlated to seismic activity. Rather, annual variation in commercial catches or counts of recruits have been linked to historical levels of fishing effort and changes in large-scale climate variables. From the exhaustive investigation of the literature and historical fishing records it is concluded that, while there will be negative effects to plankton within close proximity to the seismic source, there is no evidence that the level of any impacts will create population level effects to plankton communities nor precipitate trophic cascades. Regarding claims that the Regia MSS covers an area of 7.7 million hectares, as stated in Section 6.4.1.4 of the Regia MSS EP (Part 2: Contents of the Plan), the Regia MSS active source area is only approximately 304,100 hectares in size (3,401 km^2). **CGG has considered these claims and is satisfied that the extent of seismic effects on zooplankton have been appropriately assessed, as outlined above, and the EP has been updated to include reference to recent publications.** ***References:*** *Fields DM, Handegard NO, Dalen J, Eichner C, Malde K, Karlsen Ø, Skiftesvik AB, Durif CM, Browman HI (2019) Airgun blasts used in marine seismic surveys have limited effects on mortality, and no sublethal effects on behaviour or gene expression, in the copepod Calanus finmarchicus. ICES Journal of Marine Science 76(7):2033-44.* *McCauley RD, Day RD, Swadling KM, Fitzgibbon QP, Watson RA, Semmens JM (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7):0195.* *Richardson AJ, Matear RJ, Lenton A (2017) Potential impacts on zooplankton of seismic survey.CSIRO, Australia 34 pp.* *Vereide EH and Kuhn S (2024) Effects of Anthropogenic Noise on Marine Zooplankton in Popper, Arthur N. et al. (Ed.) The effects of noise on aquatic life. Springer Cham. 500 pp.* *Vereide EH, Khodabandeloo B, de Jong K (2024) The copepod Acartia sp. is more sensitive to a rapid pressure drop associated with seismic airguns than Calanus sp. Marine Ecology Progress Series 730:15-30.*

	THEME	PRODUCTIVITY
#	***Comments received***	***Titleholder response***
	Claim: Plankton communities, essential for marine food webs, face significant harm from seismic blasting. **Claim:** Furthermore, the seismic blasting project poses an undeniable threat to zooplankton, a keystone species and the building block for all marine ecosystems. **Claim:** The seismic blasts harm all levels of the food chain from marine plankton (phytoplankton and zooplankton) and krill through to whales. As plankton are main sources of food for many larger animals and birds harm to the bottom of the food chain would cause a catastrophic chain reaction that would affect the entire marine ecosystem. **Claim:** Plankton communities, foundational to marine food webs, are also at risk from seismic blasting. The EP\'s assessment of zooplankton mortality underestimates the true impact, and mitigation measures are insufficient to protect these vital ecosystems. **Claim:** Seismic blasting does not have community licence. In the proposed operation area, it will impact: whale habitat, endangered marine life, Southern Sea Country, the Zeehan Marine Park, the Budj Bim Eel conservation area, and commercial fisheries. The food chain will be severely affected, with carry-on effects from zooplankton to fish, to whales. **Claim:** We are aware that the proposed seismic blasting survey would be the largest such operation ever conducted: 7.7 million hectares. The impact on the food base and ecosystem would be immense and devastating. **Claim:** Furthermore, the adverse effects of seismic blasting extend beyond the immediate vicinity of the operation. Studies have shown a direct correlation between seismic activity and increased mortality rates in shellfish and marine mammals, as well as significant disruptions to the marine food chain. **Claim**: The EP\'s failure to accurately assess the impacts on plankton communities and their role in marine food webs a glaring oversight that further underscores the inadequacy of the proposal. **Claim**: Research has shown that sonar activity, seismic blasting and well drilling are invasive and result in serious harm to marine ecosystems. They have been implicated in destruction of baseline food sources, disrupting feeding and migration patterns from southern rock lobsters through to whales, penguins, seals, and coastal birds. **Claim:** There are thousands of different marine animal species in the proposed CGG survey area. All of the marine animals will be affected either directly or indirectly through the food chains, as a result of physical harm or mortality, or through behavioural changes in trying to avoid the harmful effects of the seismic blasting, or by a flow-on food chain effect from relying on another species to survive. **Claim:** At the level of intensity at which seismic blasting operates, there may be significant impact upon marine life, which in turn will have a flow-on effect to other species through the food chains, including humans with our local fisheries. **Claim:** CGG claims that larvae mortality is negligent when compared with natural mortality, based upon a study by DNV Energy (2007) and Hawkins & Popper (2012). The more recent study by Lara and Vasconcelos (2021) investigated zebra fish larvae (a reference model species in biology) and their physiological and behavioural response to sound. Lara and Vasconcelos (2021) found larvae exposed to 150dB increased 1) mortality by approximately 33%, 2) heart rate, 3) yolk consumption and 4) cortisol levels. In summary, exposure to loud noises resulted in negative physiological responses within larvae. **Claim:** CGG has failed to investigate prolonged exposure impacts, an impact highly relevant to larval fish, higher order consumers, and fisheries in the operational area (and surrounds). CGG has also failed to identify potential cause and effect pathways that could increase mortality rates. **Claim:** GG has failed to incorporate highly relevant research to accurately inform an assessment on mortality impacts of seismic activity on larval fish.	

	THEME	PRODUCTIVITY
#	***Comments received***	***Titleholder response***
	Claim: CGG has failed to identify cause and effect pathways from the impacts of anthropogenic noise on important behavioural mechanisms and has not modelled potential mortality or injury through these pathways (such as settlement cues). **Claim:** Sources referenced such as Sætre and Ona (1996) are outdated and CGG fails to incorporate more recent literature when completing the risk analysis on larvae. We therefore recommend the risk assessment and mitigation procedures are revised based on recent literature relevant to the seismic location.	
P07	**Matter**: Life cycle and recoverability of krill **Claim:** The issue of krill has been raised by Regia , without their mentioning that krill is the keystone species. Their arguments are essentially identical, that is, krill form part of the zooplankton community, zooplankton are ubiquitous and zooplankton will recover in a matter of weeks. This conflates the life cycles of short-lived zooplankton, such as copepods, with those that have annual life cycles, such as krill. All three companies use work on short-lived copepods and not on longer-lived krill to justify their applications. **Claim:** The industry must be aware that krill are a vital part of the food chain for fish, birds, and whales. If the immature generation is killed over the huge area proposed, and krill are wiped out for around a year, then this would inevitably affect the krill-dependent species' survival. Despite this, Regia states that krill grow fast which is not relevant, as elimination of the immature forms across the huge area proposed would not leave any alive to reach maturity. **Claim:** Regia's statement that krill killed by seismic blasts will recover in four weeks is ludicrous. This is despite scientific and community awareness that the lifecycle of krill is totally different from short-lived copepods. The evidence from different environments, different ocean ecosystems and highly active ocean areas cannot be used as a base for modelling the ecosystem of the Bonny Upwelling. **Claim**: The sheer size of the survey area would preclude the possibility of plankton and krill from further afield replenishing the field of operation within the ludicrously short time of four weeks that is quoted by another titleholder. **Claim:** While it has been suggested in the CGG EP that zooplankton will recover within four days, this assumption is based upon the lifecycle of small copepods living in a high current and there is a misunderstanding of the life cycle of krill. **Claim:** Another instance of misrepresentation is the dismissive statement by the proponents that the phytoplankton and zooplankton will recover in four days. That statement is based on studies of krill in high energy areas of ocean. Conditions in and around the Bonny Upwelling are quite different. Zooplankton killed by the seismic blasting would not be replaced in the relatively lower energy area in and around the Bonny Upwelling for a considerable time. **Claim:** Krill has a breeding season of about 5 months. Once the eggs are fertilised, they sink to depths between 100-2000m. When the eggs hatch, they move towards the surface growing through four developmental stages. The adults spawn multiple times across the breeding season and reach maturity after 2 years (8) (9). Therefore, as the time that the krill spend in the areas of seismic blasting covers the whole year, entire classes of larvae would potentially be killed and would not recover in 4 days as mentioned in the EP (10). (8) Department of Climate Change, Energy, the Environment and Water. Australian Antarctica Program. Retrieved February 10th, 2024 from https://www.antarctica gov.au/about-antarctica/animals/krill (9) Kawaguchu, S. et al (2023 Dec) Australian Antarctic Program. Retrieved February 10th, 2024 from https://www.antarctica.gov.au/news/2023/antctic-krill-south/ (10) Laurenson, L. (2023). Associate Professor Marine Science. Personal Communication.	CGG acknowledges claims regarding the life cycle and recoverability of krill, and has reviewed the Environment Plan (EP) to ensure these were appropriately assessed. As stated in the response to Matters P02, P04 and P06, CGG has utilised all available scientific peer-reviewed literature and reporting from government agencies to inform the assessment of potential seismic effects to zooplankton, including krill. The main krill species in southern Australia is *Nyctiphanes australis* which is recognised as a keystone species in the trophic chains of the region, serving as a primary food source for Pygmy Blue Whales, Jack Mackerel, Short-tailed Shearwater, Fairy Prion, Australian Salmon, Skipjack Tuna and Tiger Flathead, amongst others as is described in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton). Significant fluctuations in *N. australis* abundance patterns can therefore affect the abundance and distribution of dependent predators. As described in the EP Appendix E2, Section 4.1 (Krill - Nyctiphanes australis), life-history characteristics of *N. australis* include one of the highest production-to-biomass ratios among all krill genera which is ~10 times higher than for the more well known Antarctic krill *Euphausia superba*. This species has the fastest growth rate of all Nyctiphanes species at 40 days to max size with a maximum age of ~ 1year. This species also has the highest fecundity of the genus capable of carrying more eggs than the other species. Females reproduce continuously throughout the year with highest abundances during late spring/early summer when primary productivity from upwelling is at its highest in the region. There are up to 3 generations produced each year. These characteristics are what enable krill to form extremely dense swarms that facilitate feeding by predators and support extensive food chains. These same characteristics also enable rapid rebuilding of locally depleted populations when environmental conditions are favourable. The Bonney Coast Upwelling and Great Southern Upwelling system in general provides the mechanism for krill to thrive and grow in predictable locations and time periods each year, as they feast on the phytoplankton blooms. The relative consistency of the upwelling systems both in time and place provides the driver for migrating whales, birds and other predators to congregate at these zones each year to take advantage of the extraordinary abundance of food. The core upwelling zones have been identified as located outside the proposed Regia MSS survey area as stated in response to Matter P01 and P02. Nevertheless, Blue Whales have been noted as feeding along a narrow depth range from Robe in South Australia down to Port Cambell in Victoria (Gill 2002) which does include part of the proposed Regia MSS area. Hence moving the timing of the survey to the part of the year when upwelling is not at peak will be a highly effective mitigation response in keeping with an ALARP approach to risk management. Avoiding peak upwelling season will avoid any interaction between seismic and krill populations when they are at their most abundant, along with those animals that aggregate to take advantage of this system. Nevertheless, there will be zooplankton, including krill, present in local waters all year around and a small percentage of regional stocks are expected to be present in the proposed Regia MSS area. The science is clear that there will be lethal and sub-lethal effects to zooplankton within close proximity to the seismic source, as stated in response to Matter P05. However, there is no evidence to suggest that this area will be holding a critical mass of zooplankton such that seismic effects could cascade into population-level changes. Weight-of-evidence suggests a range of effects will occur that will be patchy in scope. Mortality levels from seismic as measured across multiple studies and multiple species have all indicated levels less than occurs within zooplankton populations normally. As stated in response to Matter P06 links to population-level changes in populations of fish and invertebrates and occurrence of seismic have not been found, going back over many years. CGG has considered these claims and is satisfied that the life cycle and recoverability of krill have been appropriately characterised in the EP using scientific peer-reviewed literature and reporting from government agencies, as outlined above. As a result, the EP has not been updated in response to these claims. ***References:***

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#	***Comments received***	***Titleholder response***
		Gill PC, Morrice MG, Page B, Pirzl R, Levings AH, Coyne M. Blue whale habitat selection and within-season distribution in a regional upwelling system off southern Australia. Marine ecology progress series. 2011 Jan 17;421:243-63.
P08	**Matter**: Compounded and cumulative impacts on plankton **Claim**: There is no acknowledgment in the EP that seismic-induced mortality of zooplankton will compound natural mortality levels and thus have a greater impact on plankton reproduction than natural mortality alone. The continuous nature of the blasting (i.e. every 10 to 15 seconds for 60 days in a row) will affect the ability of zooplankton communities to recover beyond what is presented in the EP, which considers seismic-induced mortality as separate (but within the parameters of) natural mortality. **Claim**: The EP should be refused for its failure to consider the cumulative and additive impacts of continuous seismic surveys on plankton communities, and therefore its failure to fully and comprehensively assess the effects of these surveys on a trophic level that is integral to broader ecosystem health and function. **Claim:** In their plan, CGG argues that Zooplankton are abundant and will only be affected over a small area. This reasoning ignores the fact that there will be multiple companies seismic blasting in the area, and each will have an effect on the population of marine species such as the Zooplankton. **Claim:** Recommendation: Request studies of the effect of multiple companies seismic testing in the same area and plankton populations. **Claim**: Furthermore, in addition to ignoring the keystone species, Regia state that krill will recover from disturbances because they are part of the zooplankton and the seismic blasts will impact only 0.2% of the bioregion per day. This day value is meaningless as the impacted area is the cumulative area of impact not only from Regia surveys, but for all those that preceded them and those that will subsequently occur (see Figures 1 and 2 below), covering most of the region west of Bass Strait. **Claim**: Whilst CGG addresses the issue of mortality to fish larvae, no cumulative impacts are assessed despite the large body of literature indicating sound pollution has the ability to alter many important behaviours that are paramount to fish larvae survival, such as settlement and orientation cues, predator response and the ability to find food (Jung and Swearer, 2011; Anderson et al., 2021).	CGG acknowledges claims relating to cumulative effects of seismic on zooplankton populations and has reviewed the supporting scientific peer-reviewed literature and reporting within the Regia MSS Environment Plan (EP). Following this review, CGG remains confident that the Regia MSS will not be a source of measurable impact, and that the outcomes described within the claims are not consistent with what is known about plankton life-histories and population dynamics in the region. As reported in EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2.7 (Plankton Communities and the Bonney Upwelling System), zooplankton populations in the region are dominated by copepods and cladocerans (herbivorous zooplankters commonly called 'water fleas') all year, although community composition is significantly different over spring-summer as upwelling provides conditions for krill (*N. australis*) biomass to expand exponentially. The key dynamic with plankton communities in the region is the Great Southern Upwelling System where plankton productivity becomes turbocharged because of concentrated upwelling of nutrient-rich deep waters during spring/summer months. As reported in EP Appendix F3 Section 5.2.7, the areal extent and length of the upwelling season varies enormously both within and between seasons. These differences can be as high as 50%, indicating there are huge reductions in the total biomass of plankton that is available to those animals targeting these systems. In 2008-09 the Bonney Coast Upwelling was restricted to the month of February only, while the geographic extent of this system has ranged between 5000km^2 and 13000 km^2 from year to year. The zooplankton community is therefore capable of responding positively, even after 50% reductions in its total population size from one year to the next. These dynamics indicate there is little cumulative effect of negative years being 'stored' in the population. Rather, the system is being moderated by large-scale climate forcing which is responsible for prevailing wind patterns and water temperatures, both of which are the key drivers of plankton dynamics in the region. Because krill population dynamics in the region are heavily influenced by the strength of the upwelling events which themselves can be highly variable, krill have evolved reproductive behaviours and modes to respond rapidly to improved conditions yet survive and thrive when conditions are less favourable. Any effects to zooplankton from the proposed Regia MSS must be measured against this background variability and hence why we have concluded that there is no evidence to support cumulative impacts to plankton communities from the proposed Regia MSS. The potential for cumulative impacts is also described in EP Appendix F3 Section 5.2.7.3 (Cumulative Impacts). CGG has considered these claims and is satisfied that the life cycle and recoverability of krill have been appropriately characterised in the EP using scientific peer-reviewed literature and reporting from government agencies, as outlined above. As a result, the EP has not been updated in response to these claims.
P09	**Matter**: Application of the precautionary principle for plankton **Claim**: While the EP acknowledges there is a high degree of plankton community diversity within the proposed OA and Environment Planning Area, its statement that comprehensive data for the area is not available should trigger application of the precautionary principle, given the critical role that plankton communities play in wider ecosystem function. **Claim**: When this concern was raised with CGG via email in November 2024, CGG's response indicated that their assessment of plankton communities in the OA was based on assumptions made in reference to knowledge of plankton communities in other oceanographic regions. Submitter does not consider that CGG has adequately described the vital plankton communities within the OA, and as such has not accurately assessed the potential impacts of seismic activity. **Claim:** Sources referenced such as Sætre and Ona (1996) are outdated and CGG fails to incorporate more recent literature when completing the risk analysis on larvae. We therefore recommend the risk assessment and mitigation procedures are revised based on recent literature relevant to the seismic location.	CGG acknowledges claims regarding the application of the 'precautionary principle' in respect of plankton communities in the proposed Regia MSS area and has undertaken to review the environment Plan (EP) to confirm appropriate consideration was given to this principle. Section 3A of the Environment Protection and Biodiversity Conservation Act 1999 defines the precautionary principle as: *If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* The Regia EP has provided a thorough review of all existing literature pertinent to understanding the marine environment within the proposed Regia MSS and greater surrounds. This includes over 50 references relating to plankton communities and the impacts of seismic on these communities, as detailed in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton). The annual upwelling events are the most important systems in the region with respect to plankton dynamics, as this is where phytoplankton and zooplankton are able to take advantage of upwelled deep-water nutrients to undergo exceptional growth and productivity, which in turn underpins a significant proportion of the regional food chains. Because of the importance of this system there have been multiple studies that have quantified the composition of plankton communities across the region and described the primary drivers of these systems. As stated in response to Matters P01 to P08, all evidence available indicates firstly that natural variability in plankton dynamics is vastly greater than localised impacts on plankton communities, and secondly that plankton communities resident in the Regia

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#	***Comments received***	***Titleholder response***
		MSS area are not exceptional in either biomass or extent. While there will be impacts to this community if seismic testing is undertaken, they will be immeasurably small relative to the natural fluctuations that are happening at far greater scales on a month-by-month and year-by-year basis. The available evidence, as presented in the EP, demonstrates that there is no evidence to support an outcome of serious and irreversible damage to plankton communities from the proposed Regia MSS. Further, through the implementation of M#01 as described above, the Regia MSS can also be scheduled to run outside peak upwelling periods and outside relevant upwelling Key Ecological Features which are effective measure to further reduce the levels of any possible seismic-related impacts. CGG has considered these claims and is satisfied that the Regia MSS will not result in serious or irreversible damage to plankton communities, as outlined above. As a result, the EP has not been updated in response to these claims.
P10	**Matter:** Inaccurate/ Inappropriate literature for plankton/ krill **Claim:** The three companies are conflating the issue of individual growth rate of krill and the increase in numbers of individuals from reproduction. Despite the fact that Bass Strait krill are fastest growing species in size of all the krill species, this is not the issue. The issue is the high mortality rate of individuals as a result of seismic blasts and the slow annual recovery of numbers. **Claim**: The industry is wilfully repeating the same misleading science despite our efforts to correct it. Just because these three companies use the same misleading science doesn't mean that it is correct. Equally, repeatedly ignoring the critical aspects of the ecosystems, such as the importance of the keystone species, is flawed. We use the word wilful because the industry has access to the best marine scientists in the world but chooses not to use them, or to use them to discredit research when it is convenient to them. **Claim: "**Furthermore, Regia has presented the findings of Fields et al. (2019) to negate the findings of McCauley et al. (2017). Major limitations of the relevance and comparability of the Fields et al. (2019) study include: 1. Fields et al. (2019) assess the mortality of copepods when exposed to seismic activity. Copepods are not a species of zooplankton present in the proposed survey area. 2. McCauley et al. (2017) highlight the substantial issue of krill mortality when exposed to seismic activity. Krill was not included in the study by Fields et al. (2019). **3.** Fields et al. (2019) examined copepods five times larger than copepods assessed in the McCauley et al. (2017) study, with McCauley et al. (2017) stating smaller copepods were more susceptible to damage. Vereide et al. (2023) observed similarly higher mortality as McCauley et al. (2017) when they examined the impacts of seismic on smaller copepods. **Claim:** I note that Regia relies on gas industry funded work by Richardson et al (2019) that is not peer-reviewed or published. Modelling exercises using copepods are used to suggest that krill population numbers would be quickly replenished. Firstly, krill are different species from the copepods cited as examples in the work of Richardson et al. Unlike copepods, their numbers would not be quickly replenished, as their life cycle from larval to adult forms takes around a year. **Claim**: The application gives disinformation about the purported renewal of zooplankton populations and krill, using the idea/model that zooplankton populations reproduce uniformly in the ocean around Australia. That model is simplistic and not based on reality. **Claim**: The companies quote the work industry-funded of Richardson et al. (2019) that is neither published nor peer reviewed in the scientifically accepted use of the terms. It is just an 5 opinion piece that used a series of modelling exercises (using short-lived species such as copepods and not krill) to suggest that there is little to be concerned about. **Claim**: CGG offers a biased and inaccurate assessment of the threat to plankton and inadequate recognition of the effect on the entire marine ecosystem in their environmental plan. **Claim**: Submitter recommends CGG amends the impact assessment and mitigation actions to address our concerns and ensure the risk assessment reflects site-specific and species-specific	CGG acknowledges claims regarding the use of literature to inform decisions and has reviewed the Environment Plan (EP) to ensure the literature cited is appropriate. As stated in response to Matter P06, to ensure that a thorough and complete assessment of seismic effects to zooplankton has been completed CGG has utilised all available peer-reviewed, published scientific literature and reporting from government agencies such as Fisheries Authorities, which are considered authoritative and credible sources of information. We have continued to source updated literature since the Regia EP was submitted, which includes communicating with and accessing the very latest research on seismic effects on zooplankton from a major European Research Agency, as can be seen in the response to Matter P06. Further, CGG has accessed over 50 references relating to plankton communities and the impacts of seismic on these communities to form our conclusions. Decisions have been based on an assessment of the entirety of the literature base available and have used a weight-of-evidence approach to draw conclusions. As stated in responses to all key matters above, while there is a high probability of lethal and sub-lethal damage to plankton communities within cited ranges of a seismic program, the weight-of-evidence indicates that there is low probability of serious or irreversible damage to plankton populations from a 60-day seismic survey in the location proposed by Regia. This probability will be further reduced by ensuring scheduling of the survey to avoid the peak upwelling season. Regarding claims associated with literature on copepods, zooplankton populations in the region are dominated by copepods and cladocerans (herbivorous zooplankters commonly called 'water fleas') all year (van Ruth and Ward 2009). Regarding claims associated with impacts on krill, as stated in response to Matter P08 and as described in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) Section 4.1, life-history characteristics of *N. australis* include one of the highest production-to-biomass ratios among all krill genera which is ~10 times higher than for the more well known Antarctic krill *Euphausia superba*. This species has the fastest growth rate of all Nyctiphanes species at 40 days to max size with a maximum age of ~ 1year. This species also has the highest fecundity of the genus capable of carrying more eggs than the other species. Females reproduce continuously throughout the year with highest abundances during late spring/early summer when primary productivity from upwelling is at its highest in the region. There are up to 3 generations produced each year. CGG has considered these claims and is satisfied that the Regia MSS EP refers to relevant peer-reviewed, published scientific literature, as outlined above. As a result, the EP has not been updated in response to these claims. ***References:*** *Van Ruth, P., and Ward, T.M., 2009, Meso-zooplankton abundance, distribution and community composition in the eastern Great Australian Bight. Transactions of the Royal Society of South Australia · November 2009. DOI: 10.1080/03721426.2009.10887124*

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#	***Comments received***	***Titleholder response***
	scientific literature, rather than cherry picking papers to support the incorrect conclusion that seismic has minor impacts to zooplankton. **Claim**: The scientific literature provided in the EP attempts to refute the findings of McCauley et al. (2017), and presents research that is 1) inappropriately interpreted and 2) incomparable. For example, CGG has presented the work of Richardson et al. (2017) to negate the important and highly relevant findings of McCauley et al. (2017). Major limitations include: 1. McCauley et al. (2017) presents real-world, direct observations from site-relevant Tasmanian waters, whereas Richardson et al. (2017) presents modelled findings. Models cannot negate direct observations, with any inconsistencies between the two highlighting a fundamental omission in data used to inform the model. 2. Richardson et al. (2017) focus on zooplankton from the North West Shelf, a tropical region, with vastly faster zooplankton recovery times in comparison to the proposed survey area (and McCauley et al. (2017)). 3. Krill was omitted from the simulation run by Richardson et al. (2017), resulting in significant omissions and irrelevance to the survey area (and the Bonney Upwelling, by extension). 4. McCauley et al. (2017) has undergone peer review and scrutiny from the scientific community. Richardson et al. (2017) is a study funded by the oil and gas lobby group, the Australian Petroleum Production and Exploration Association (APPEA). **Claim**: Misleading information has been given by Regia in trying to refute the real threat to krill, the ocean food chain, and krill-dependent species.	
P11	**Matter:** Recommendations for further research **Claim:** Given the importance of plankton, in particular krill, there should be further independent long termed scientific studies, prior to and following seismic testing, in the area(s) surveyed. **Claim:** Recommendation: Request studies into the effects of seismic blasts on plankton populations. **Claim:** Recommendation: Request studies into impacts of a reduction in plankton populations in the Operational Area on ocean health, biodiversity and environment. **Claim:** Recommendation: Request studies into impacts of a reduction in plankton populations in the Operational Area on other marine animals and birds for whom they are an important food source. **Claim**: Submitter request that Regia demonstrate that no lasting harm will occur to all the species dependent upon plankton and krill in subsequent years after seismic testing.	CGG acknowledges claims regarding research into the effects of seismic on marine communities and has reviewed the Environment Plan (EP) to ensure that adequate consideration was given to identifying areas for further research. Research into the effects of seismic on plankton communities is ongoing and responsive to environment-industry-government needs. This is exemplified by the work of the Norwegian Institute of Marine Science which commissioned a three-year research program to further investigate the outcomes of work by McCauley et al. 2017 and Field et al 2019, as stated in response to Matter P06. This program has just concluded, and reporting is pending. By using a weight-of-evidence approach, as has been demonstrated in EP Appendix E2 (Impact Assessment – Underwater Sound: Plankton) based on the significant evidence presented in EP Appendix B8 (Seismic Study Report), it is possible to make informed decisions that have a high level of certainty with respect to the likelihood of significant or irreversible damage happening to the plankton communities within the proposed Regia MSS area. The weight-of-evidence, as detailed in EP Appendix F3 (Acceptable Levels of Impact and Risk) Section 5.2.7 (Plankton Communities and the Bonney Upwelling System), clearly demonstrates that significant impacts to zooplankton (including krill, and the Bonney Coast Upwelling and the role they both play in ecosystem function and productivity) are not predicted as a result of the proposed Regia MSS. CGG has considered these claims and is satisfied that concerns raised have been adequately addressed in the EP, as outlined above. As a result, the EP has not been updated in response to these claims. ***References:*** *Fields DM, Handegard NO, Dalen J, Eichner C, Malde K, Karlsen Ø, Skiftesvik AB, Durif CM, Browman HI (2019) Airgun blasts used in marine seismic surveys have limited effects on mortality, and no sublethal effects on behaviour or gene expression, in the copepod Calanus finmarchicus. ICES Journal of Marine Science 76(7):2033-44.* *McCauley RD, Day RD, Swadling KM, Fitzgibbon QP, Watson RA, Semmens JM (2017) Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1(7):0195.*

8. Fish, Sharks, Invertebrates and Fisheries

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
Key Matter: Underwater sound impacts on fish, sharks and invertebrates		
F01	**Matter**: Impacts of underwater sound (general) **Claim:** Research has shown that seismic blasting results in serious harm to a variety of marine life, deafening whales and disrupting their feeding and migration, damaging the ability of southern rock lobsters to function and navigate, and causing mortality in small fish and zooplankton. **Claim**: Seismic testing is deadly for marine life and decimates seafood populations. It is well known that seismic blasting changes the behaviour of fish, can disorientate and destroy them; kill scallops and impact upon the immune systems of southern rock lobsters. (12)(13). (12) Davis, R. (2020 Aug.). Seismic surveying reduces whiting catch rate by 99.5 percent, research finds Retrieved November 11, 2923 from Seismic surveying reduces whiting catch rate by 99.5 per cent, research finds - ABC News. (13) University of Tasmania (2023, Sept). Whales stop singing, Rock Lobsters lose their balance: How seismic testing can harm marine life. Retrieved Dec. 8th 2023 from Whales stop singing and rock lobsters lose their balance: how seismic surveys can harm marine life - Institute for Marine and Antarctic Studies | University of Tasmania (utas.edu.au) **Claim:** Seismic blasting does not have community licence. In the proposed operation area, it will impact: [whale habitat, endangered marine life, Southern Sea Country, the Zeehan Marine Park, the Budj Bim Eel conservation area], and commercial fisheries. The food chain will be severely affected, with carry-on effects from [zooplankton to] fish, [to whales]. **Claim:** Approval of this application will have disastrous impacts on marine species, the local fishing industry and, ultimately, the climate. [**Claim:** At the level of intensity at which seismic blasting operates, there may be significant impact upon marine life, which in turn will have a flow-on effect to other species through the food chains, including humans with our local fisheries **Claim**: NO TO SONIC BLASTING! IT KILLS THE KRILL, AND OTHER FISH AND SEA CREATURES.	CGG acknowledges claims regarding seismic effects on fish (incl. Sharks/rays) and invertebrates associated with the Regia MSS and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. Potential impacts and risks to fish, sharks and invertebrates from underwater sound are described in the following sections: • Seismic Studies Summary (Appendix B8) provides a comprehensive review of the best available scientific, peer-reviewed literature, reports from government agencies (such as Fisheries Authorities) and other data sources to describe how seismic surveys can affect ecological receptors, including zooplankton, invertebrates, fish, birds, marine reptiles and marine mammals. • Impact Assessment Underwater Sound: Fish (Appendix E3) describes and assesses potential impacts and risks to fish from underwater sound generated by the Regia MSS • Impact Assessment Underwater Sound: Invertebrates (Appendix E4) describes and assesses potential impacts and risks to invertebrates from underwater sound generated by the Regia MSS In addition to these assessments further interrogation of the literature was undertaken for a number of species and groups that were highlighted, through community consultations, as being of particular importance. For these groups we defined acceptable levels of impact and risk to provide a clear framework for understanding what effects seismic might have on individual health and population-level health. These assessments can be found in Regia EP: Appendix F3 and include Southern Rock Lobster, Giant Crab, Glass Eels, Gould's Squid, Plankton Communities (including krill) and the Bonney Upwelling System, Octopus, Snapper, Abalone and King George Whiting. In summary CGG noted that seismic can cause lethal and sub-lethal effects to animals within close proximity to the seismic pulses, however these types of responses attenuate with distance from the seismic source and are not uniformly manifest. Secondly, the scale of lethal or sub-lethal effects measured across multiple scientific studies and species indicates seismic effects are significantly lower than natural rates of mortality (~variation) to be found in regional populations of fish and invertebrates and will be immeasurable in this context. Thirdly, we have found no evidence to support the proposed Regia MSS area being a "critical" area for populations of fishes and invertebrates, whereby population-level stability would be at risk from any potential damage sustained by fish or invertebrates within the Regia MSS area. There are clearly many important species that inhabit the proposed Regia MSS area, however when assessed from a population sustainability level this location is only a small part of much greater population ranges for these species. There are nevertheless parts of the Regia MSS area that will contain significant numbers of key species, such as whales at certain times of the year. Mitigation measures will be implemented to significantly reduce the risk to individuals in these locations during sensitive periods, as outlined in the Fauna Management Plan (Appendix G2). M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection). M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Where data was available, such as annual estimates of recruitment of key fish/invertebrate species, CGG also investigated whether there was any link to be seen with levels of seismic activity across the Victorian South Coast greater region. CGG found zero correlation between recruitment and seismic activities with large increases in recruitment during this period often coinciding with high levels of seismic activity. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims
F02	**Matter**: Impacts associated with particle motion are not addressed **Claim**: CGG has concluded throughout the EP that a range of species (including bivalves, sharks, crustaceans, fish, and invertebrates) are sensitive to particle motion, and have mentioned in multiple cases that the impact of partial motion on marine fauna could be greater than the impacts of sound. Despite acknowledging the known impacts of particle motion on marine fauna within the survey area, CGG have failed to make any attempt to understand or mitigate these impacts.	CGG acknowledges claims that the particle motion aspect of seismic surveys has not been described and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of seismic effects to fish and invertebrates has been completed (as described in Appendix B8; Seismic Studies Summary). Particle motion has been far less studied than sound pressure as a source of impacts on species from marine seismic surveys. This is because measuring pressure, particle motion, and ground motion energy levels from a seismic survey source is logistically and technically complex. CGG has endeavoured to include all relevant literature on particle motion as part of its review and continues to monitor international databases to stay abreast of new studies as they become published.

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	Claim: There are currently no threshold guidelines established for particle motion for marine animals, despite acknowledgement that particle motion can negatively impact various marine species. The onus should fall upon the proponent (CGG) to sufficiently address the threat particle motion presents to marine fauna. **Claim**: Submitter requests CGG to engage the Institute of Marine and Antarctic Studies (with established site-specific knowledge) to establish particle motion guidelines relevant to this application, ensuring both scientific literature and professional knowledge is used to inform these guidelines. **Claim**: Submitter recommends CGG conduct a literature review and establish threshold guidelines for particle motion relevant to threatened and protected species, as well as all fauna known to inhabit the area.	Recent research by McCauley et al (2021), has concluded that at distances of hundreds of metres or greater, measurements of Sound Exposure Levels (SEL) are appropriate proxies for other metrics of interest, including particle motion. This is not the case within near-shore fields (i.e., closer to the seismic sources) where acoustic signals are much more complicated, being affected by water depth, bathymetry profile along the propagation path, the geological layering of the seabed and the associated geo-acoustic properties, and the sound speed profile of the water column. Different taxa also detect different components of the acoustic signal, further complicating assessments. While there is clearly a need for more research into separating and clarifying the effects of the various components of seismic discharge on individual taxa, knowledge of the overarching effects of these components on various taxa is already substantial and hence can be assessed, as has been done for the Regia MSS EP. There is considerable evidence to support the manifestation of lethal and/or sub-lethal effects of seismic (irrespective of the exact mechanisms) on individual animals within proximity to a seismic source, as CGG have consistently noted. However, multiple scientific studies across multiple species indicates seismic effects are significantly lower than natural rates of mortality (~variation) to be found in regional populations of fish and invertebrates and will therefore be immeasurable in this context. As stated in response to Matter #01, CGG has been unable to find any correlation of seismic activity across the region with measures of recruitment and/or CPUE which would indicate that seismic impacts are having quantifiable impacts on the sustainability of populations of fish, invertebrates and sharks. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References**:* *McCauley RD, Meekan MG, Parsons MJ (2021) Acoustic pressure, particle motion, and induced ground motion signals from a commercial seismic survey array and potential implications for environmental monitoring. Journal of Marine Science and Engineering 9(6):571.*
F03	**Matter**: Additional information to support impact assessment for fish **Claim**: Provide fish species list relevant to the proposed survey area, classifying fish into groups based on known information of their biology (presence of swim bladder; proximity and connections to ear) with the addition of a group IV, for species whose biology remains unknown. **Claim**: CGG should carry out a thorough analysis of pelagic (and migratory), reef (or site attached) and demersal species over the survey area and how these patterns differ due to habitat, depth, and wave exposure over the spatial area of the survey in order to make accurate considerations around the impacts to fish and assess areas where mitigation bay be required. **Claim**: CGG has failed to provide evidence to confirm there are no aggregations of breeding sites that are critical for the ongoing viability of fish species. We recommend this statement be revised. **Claim**: CGG have also stated "significant spawning aggregation areas are not known to occur in the vicinity of the survey area". The evidence source for this claim is not cited.	CGG acknowledges claims that more information is required to understand the potential impacts of the Regia MSS on fish and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. To ensure that a thorough assessment of seismic effects on fish was possible CGG utilised all available scientific peer-reviewed literature, and reporting from government agencies such as Fisheries Authorities, which are considered authoritative and credible sources of information. The Regia MSS EP (Appendix B6: Commercial Fisheries Review), provides a comprehensive assessment of all Commercial Fisheries Species that are operating within the Environmental Planning Area which also includes the Activity Planning area where active sonar would operate. Maps of fishing effort are included allowing for visual understanding of the extent of fishing range for each fishery and its overlap within the proposed Regia MSS area. The Regia MSS EP (Appendix E3: Underwater Sound – Fish) provides a general assessment of the biological behaviour of 27 key species and whether they are found in the proposed Regia MSS area. Additionally, the Regia MSS EP (Appendix F3: Acceptability Assessment) provides a more detailed assessment of key species or groups identified through consultation as being of particular importance to the region. In combination these Appendices provide an extensive listing of those species relevant to the proposed survey area. **Re-assessment of the literature clarifies that there is no evidence of significant spawning aggregations occurring within the proposed Regia MSS area.** CGG define 'significant' as referring to aggregation events that have been identified as core to the population sustainability of each species in question. For further clarity around this Matter, CGG has provided reference to literature confirming this re-assessment for those species that have an established presence in the proposed Regia MSS area. **Blue Warehou** – highly mobile species that is genetically well-connected over its range. Larval sampling has found that the major spawning locations are along the west coast of Tasmania (Bruce et al 2001. Marine and Freshwater Research Vol 52: 631-636) **Orange Roughy** – incidental catch in the area only. Main spawning location is on Tasmania east coast (Knucky & Smith 1997. FRDC Pilot egg survey of OR in Western Zone) **Gulper Shark** – mostly taken as bycatch in the trawl fishery. Overfishing has been overwhelmingly the biggest driver of declines in this species **School Shark** - mostly taken as bycatch, also because of overfishing. Birthing happens in summer in inshore nursery areas (https://www.afma.gov.au/species/school-shark) **Australian Sardine** – spawning occurs in spring-summer, with the major fishing grounds out of South Australia. 4 recognised sub-populations centred on South Western Australia, Eastern Australia, South Eastern Australia and Southern Australia. Stocks are considered sustainable (https://www.afma.gov.au/species/australian-sardine).

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		Blue Grenadier - Catch rates in Australia are highest off the west coast of Tasmania on the shelf slope during winter where the species aggregates to spawn, and this region has been confirmed as a major spawning ground for the species (Gunn et al. 1989, MFR Vol 40(1):97-112 and Bulman et al. 1999, MFR Vol 50(3):197-207). **Blue-eye Trevalla** - Most spawning activity occurs in waters from central New South Wales to north-eastern Tasmania. Part of SESSF with majority of catches from Tasmania and East Coast (https://www.afma.gov.au/species/blue-eye-trevalla) **Elephant fish** - Elephant Fish has a broad distribution across much of southern Australia, but actual biological stock structure is unknown. The species is caught in relatively low quantities in NSW, Victoria and Tasmania. In Victoria, Elephantfish were historically landed in low to moderate quantities by commercial bay and inlet fisheries, particularly in Western Port Bay (WPB). Elephantfish are oviparous, and females move inshore to lay pairs of leathery egg cases on sandy or muddy bottoms (https://www.afma.gov.au/species/elephant-fish). **Gummy Shark** – Gummy Shark are considered a single genetic stock across their entire range from Bunbury, WA to Jervis Bay, NSW, with 3 sub-stocks consisting of Bass Strait, Tasmania and Southern Australia. Gummy shark are born during the summer months after an 11-12 month gestation period. They are capable of moving large distances in excess of 2000 km but average is mostly around 100-200 km. Targeted in the SESSF Gillnet Hook and Trap (https://www.fish.gov.au/report/301-Gummy-Shark-2020). Catches have remained stable over many years. **Pink Ling** - Spawning aggregations have been reported by commercial fishers off Strahan, Tasmania, Lakes Entrance Victoria, and Gabo Island NSW (Bruce et al 2002 Targeted review of fisheries research in SE Australia region.) Ling are found throughout the Southeast marine region on the outer shelf and slope out to 900 m but are mostly caught between 300-600m (Daley et al 2000 FRDC Report 97/117). **Tiger Flathead** - a demersal species that is found at depths of 10-400 metres. Spawning occurs over an extended period from spring to autumn, with some variation on the timing of spawning depending on location. The exact locations of spawning are unknown, however more large mature fish are found in inshore waters during the spawning period (Morton et al 2005 Tasmanian Aquaculture & Research Institute). Tiger Flathead is primarily caught by the Commonwealth managed Southern and Eastern Scalefish and Shark Fishery (SESSF) with small catches from New South Wales, Tasmania and Victoria. The southern Australian population is considered sustainable under current fishing effort (https://www.fish.gov.au/report/325-Tiger-Flathead-2020). **The EP Appendix E3 (Impact Assessment Underwater Sound: Fish) has been updated to clarify that there is no evidence of significant spawning aggregations occurring within the proposed Regia MSS area, as detailed in the above information.**
F04	**Matter**: Impacts of underwater sound on fish **Claim**: There is an absence of knowledge regarding the impact of seismic blasts on marine fish and a need for CGG to conduct more studies into the impact of seismic blasts on fish, before conducting any seismic blasts. **Claim**: Using a single study from 1996 that investigated a single species in the northern hemisphere (Cod in Norway) is not an acceptable and complete assessment on impacts to a group of fishes within the proposed survey area. **Claim**: CGG states they have used metrics from Popper et al. (2005) to help establish guidelines. The research carried out in this survey were on 3 freshwater species only found in the Northern Hemisphere: a pike, whitefish, and a lake chub. The paper clearly states, "Care must be taken, however, in extrapolation to other species and to fishes exposed to airguns in deeper water or where the animals are exposed to a larger number of airgun shots over a longer period of time." Given this proposal will be impacting marine species, in depths greater than 100 m, further investigation and research is required to establish real world effects to bony fish in the Otway basin. **Claim**: As stated in the EP, the guidelines used to determine injury or mortality to fish are based on Popper et al. (2014) classifications. These classifications were based on pile driving, not seismic activity, with pile driving considerably less impactful than seismic (Hildebrand, 2009). Whilst the guidelines provide some guidance,	CGG acknowledges claims that more information is necessary to understand the potential impacts of seismic sound on fish in the proposed Regia MSS area and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG utilised all available scientific peer-reviewed literature, and reporting from government agencies such as Fisheries Authorities, which are considered authoritative and credible sources of information, to ensure that a thorough assessment of seismic effects on fish has been undertaken. Potential impacts and risks to fish from underwater sound are described and assessed in the following sections: • Modelling Report Sound Emissions (Appendix B7a and B7b) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. Noise exposure guidelines have been estimated for all groups based on all the available scientific literature. The criteria for fish are taken from Popper et al (2014) and represent thresholds at which damage can occur to fish, these values do not represent peak source levels. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including fish. • Impact Assessment Underwater Sound: Fish (Appendix E3) describes and assesses potential impacts and risks to fish from underwater sound generated by the Regia MSS • Acceptability Assessment (Appendix F3) provides a more detailed interrogation of seismic effects on select taxa identified through community consultations as very important. These sections provide a thorough examination of seismic effects from which our assessments have been made. They reference the latest literature available. Mitigation measures will be implemented to significantly reduce the risk to individuals as outlined in the Fauna Management Plan (Appendix G2). M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection.). M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

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	there are many caveats that are not addressed and evidence in relation to this is extrapolated and taken out of context. For example, CGG claims it is possible to use guidelines "extrapolated from simulated pile driving signals which have a more rapid rise time and greater potential for trauma than pulses from a seismic source". However, the studies referenced to support this claim (Popper et al., 2014) do not reflect this information. **Claim**: The information provided by CGG in relation to sound effects on fish is inadequate, many statements provided lack references, whilst other references do not support the claims made by CGG. Furthermore, many information gaps are not appropriately acknowledged, and information provided is not relevant to the acquisition area. **Claim**: Claims that due to the depth of the survey site attached fish are not at risk of mortal injury or mortality should be revised, given both the lack of evidence and the inappropriate extrapolation of cited study findings. **Claim**: It is well known that seismic blasts kill fish (10). We also know that these surveys change the behaviour of fish: they can disorient them, make them avoid reef sites and they can make them more vulnerable to predators (1). 1. https://www.gcrc.uga.edu/wp-content/uploads/2021/02/Effect-of-Seismic-Surveys-o n-Marine-Organisms.pdf; 10. https://www.courthousenews.com/wp-content/uploads/2021/07/Seismic-factsheet. -fish-and-invertebrates.-Oct19.pdf **Claim**: There is evidence of damage to fishes ears at a distance of 500m to several kilometres from the seismic blasts. (43). Risk evaluation and management strategies in the environmental plan do not appear to adequately explore the long-term impacts that changes to fish populations will have on other species and on ocean health overall, nor how to mitigate them. 43. https://bowmanslaw.com/insights/shipping-aviation-and-logistics/seismic-testing-effect-marine-environment/ **Claim:** Sources referenced such as Sætre and Ona (1996) are outdated and CGG fails to incorporate more recent literature when completing the risk analysis on larvae. We therefore recommend the risk assessment and mitigation procedures are revised based on recent literature relevant to the seismic location.	
F05	**Matter**: Impacts of underwater sound on blue warehou **Claim**: Notably, the EPBC Act specifically states that lack of scientific knowledge is no reason to allow a particular activity to proceed. In conclusion, there is inadequate evidence regarding impacts on blue warehou provided by the applicants. **Claim**: The Stock Rebuilding Strategy notes both short- and long-term environmental variability as a key threat to the ongoing management of the population. The legislation also states that impacts of environmental variability on blue warehou are unknown and further research is required to gain an understanding of threats to the recovery of the species (AFMA, 2022). Given this information, CGG	CGG acknowledges claims that more information is necessary to understand the potential impacts of seismic sound on Blue Warehou in the proposed Regia MSS area and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of seismic effects to fish has been completed. The Regia MSS EP (Appendix E3: Underwater Sound – Fish) provides an assessment of the impacts of underwater sound on blue warehou. To summarise the information provided on Blue Warehou; this species has been classified as a depleted stock from overfishing with standardised CPUE being below the limit reference point since 1995. Commercial catches are small and included as part of incidental catch in the Western Zone which extends from western Tasmania northward to western Victoria (Hartmann & Chick 2020 Stock status overview; https://www.fish.gov.au/report/266-Blue-Warehou-2020)

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	should undertake further investigation to confirm that the change in environmental variability by increased background noise and potential displacement of spawning aggregations will not negatively impact the vitality of future populations for this species, both for spawning events, early life stage developments and migration to settlement areas **Claim**: CGG failed to adequately assess impacts in relation to EBPC species (such as blue warehou) in line with stock rebuilding strategies.	Recruitment is the means by which the population of Blue Warehou is renewed. If indiscriminate harvesting of a population occurs, the number of animals that reach maturity can be reduced to the extent that the reproductive capacity of the population is diminished. Fishing is the overwhelming driver behind the lack of adult standing stock and subsequent poor health of Blue Warehou populations. There have not been any specific studies on seismic effects to Blue Warehou, nor many other species common to the region. However, weight-of-evidence approaches allow for informed decisions to be made on the level of risk associated with seismic to fish species and there have been no recorded seismic-related fatalities to free-swimming fish that have caused measurable changes to population health. What is known about Blue Warehou is that they are a highly mobile species with a patchy distribution and a wide range of spawning/breeding areas. This type of stock structure and behaviour is going to promote mitigation of any potential seismic effects. Evidence also indicates that the main spawning area for the general region is off the NW coast of Tasmania (Bruce et al. 2001) although larvae can be found as far west as Kangaroo Island. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2). M#01 Activity Limitation stipulates the seismic source will not be operated within the West Tasmania Canyons Key Ecological Feature (KEF). This is protective for fish species associated with this KEF. M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection.) M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. CGG conclude that the risk to the short and long-term stability of regional Blue Warehou populations, from the proposed Regia MSS, is minimal. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References:*** *Bruce BD, Neira FJ, Bradford RW. Larval distribution and abundance of blue and spotted warehous (Seriolella brama and S. punctata: Centrolophidae) in south-eastern Australia. Marine and Freshwater Research. 2001;52(4):631-6.*
F06	**Matter**: Impacts of underwater sound on eels **Claim**: A quantitative longitudinal study to explore the impact of seismic blasting on the lifespan of eels should be conducted prior to further exploration for gas. **Claim**: Eels subject to seismic blasts have shown a reduction in anti-predator avoidance, which makes them susceptible to predators. Seismic blasts block out the noise of approaching predators and the additional, unexpected noise causes more stress to the eels (14). 14. https://pubmed.ncbi.nlm.nih.gov/26686756/ **Claim**: The Plan concentrates on the mortality rate caused by seismic blasts, rather than other impacts. If seismic blasts make Short-fin eels more susceptible to predators, this will be a direct cause of their mortality. This could move the Short-fin eels into a category classed as vulnerable, an increase from the current level of near threatened, as noted in CGG's plan. **Claim**: Submitter recommends CGG conducts studies into the effects of seismic blasts on eel behaviours and populations; and Formulate a plan for risk mitigation and management of the risks that seismic blasting has on eel behaviour and populations. **Claim**: Mortality of eels (both immediate and delayed) is not predicted based on no documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions (DFO 2004; Boeger et al. 2006; Popper et al. 2014; Popper et al. 2016; Carroll et al. 2017; Popper and Hawkins 2019).â€� This statement is not acceptable and does not	CGG acknowledges claims that more information is necessary to understand the potential impacts of seismic sound on eels in the proposed Regia MSS area and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of seismic effects to eels has been completed. Potential impacts and risks to eels from underwater sound are described and assessed in the following sections of the EP: • Cultural Heritage Assessment (Appendix B10:) provides cultural context to historical eel fishing in the area through a description and recognition of the Budj Bim National Heritage Landscape and the historical fishing traps found therein. • Underwater Sound – Fish: Section 4.1.9 (Appendix E3:) provides a synopsis of the life cycle of the Short-finned Eel which highlights the incredible journey that adult eels make to the Coral Sea to spawn each year. After community consultation further highlighted the importance of the eels in the public consciousness a more detailed interrogation of seismic effects on Short-finned eels was undertaken and included in the EP: Acceptability Assessment (Appendix F3). While there have not been any specific studies on seismic effects to short-fin eels, weight-of-evidence approaches allow for informed decisions to be made on the level of risk that a seismic program such as the proposed Regia MSS might have on the health of glass eel populations. As outlined in the EP Acceptability Assessment (Appendix F3), the lifecycle of eels predisposes this species to incredibly high mortality rates. Because individual animals die after spawning, and they are many thousands of kilometres from their natal streams, they must produce extraordinary amounts of larvae such that a critical proportion will survive the journey and settle into rivers to become adults who can contribute to the cycle again. This lifecycle requires production of enough larvae and survival of enough adults to ensure the population remains viable year-on-year. Mortality of migrating adults has been estimated to be as high as 30% (Koster et al 2021) while larval mortality could easily be >80-90% as shown by many studies into survival rates in plankton communities. Hence any potential mortality rates by the proposed Regia MSS will be immeasurably small compared to the very large natural mortality which operates year-on-year to these populations. Australasian Short-Finned Eels are listed as 'near threatened' on the IUCN Red List of Threatened Species, with barriers to riverine movement and freshwater habitat loss identified as key threats. These are land-based sources of impacts. In addition, changes in ocean currents, primary production, and thermal regimes may affect eel migration, spawning success, and recruitment (Koster et al 2021). These processes operate at landscape scales and are heavily influenced by long term climate trends. Changes to riverine flows and water quality are affected not only by changing climates but also land management

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	assess the impact on glass eels migration. There is no data / scientific evidence available. **Claim**: An absence of long-term monitoring data of the effects of seismic on eels in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.	regimes adjacent to riverine systems. The most powerful test of the significance of climate drivers was the millennium drought through the late 90's and 2000's where commercial catches declined from a pre-drought peak of >300 tonnes/year to current levels of ~50 tonnes/year. Adult eels are undertaking their migrations over an extended period of 5 months and the work of Crook et al (2014) indicates that migration from estuaries is a highly variable process. Given the extended and volatile timing of migration from estuaries and the high mobility of individual animals CGG do not anticipate any critical effects to the local populations of eels from the Regia MSS. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2). M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References**:* *Crook DA, Macdonald JI, Morrongiello JR, Belcher CA, Lovett D, Walker A, Nicol SJ (2014) Environmental cues and extended estuarine residence in seaward migrating eels (A nguilla australis). Freshwater Biology 59(8):1710-20.* *Koster WM, Aarestrup K, Birnie-Gauvin K, Church B, Dawson D, Lyon J, O'Connor J, Righton D, Rose D, Westerberg H, Stuart I (2021) First tracking of the oceanic spawning migrations of Australasian short-finned eels (Anguilla australis). Scientific Reports 11(1):22976.*
F07	**Matter**: Impacts of underwater sound on elasmobranchs (sharks, rays, etc) (general) **Claim**: The risk assessment does not consider cause and effect pathways for potential negative impacts to elasmobranchs as a result of the survey. [**Claim**: CGG has not taken a conservative or precautionary approach to assessing potential impacts to elasmobranchs. **Claim**: There is severe lack of evidence in relation to the impact of seismic activity on elasmobranchs, for example, issues around impact of particle motion, mentioned below. Notably, the word "skate" is not utilised within the Regia Environmental Plan at all, and "elasmobranch" is mentioned only twice. When no available evidence is available, the proponent should take a conservative approach to assess potential impacts. **Claim**: Given that most fish species are expected to display avoidance behaviour and there is the potential for particle motion to interfere with sensory receptors in elasmobranchs, cumulative impacts of seismic surveys may negatively/ detrimentally affect populations of elasmobranchs in the area. **Claim**: Submitter recommends CGG reassess the risk to elasmobranchs based on the principle that there is currently very limited evidence available to make accurate risk assessments for the species. Both a conservative approach and the precautionary principle needs to be applied. **Claim**: There is an absence of knowledge regarding the impact of seismic blasts on sharks and we request that CGG conduct more studies into the impact of seismic blasts on sharks, before conducting any seismic blasts. **Claim**: Submitter recommends studies into the effects of seismic blasts on shark behaviours and populations; a plan is formulated for	CGG acknowledges claims that more information is necessary to understand the potential impacts of seismic sounds on elasmobranchs in the proposed Regia MSS area and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of seismic effects to elasmobranchs has been completed. Potential impacts and risks to elasmobranchs from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including sharks. • Impact Assessment Underwater Sound: Fish (Appendix E3) describes and assesses potential impacts and risks to elasmobranchs from underwater sound generated by the Regia MSS Recent research by McCauley et al (2021) has concluded that at distances of hundreds of metres or greater, measurements of Sound Exposure Levels (SEL) are appropriate proxies for other metrics of interest, including particle motion. This is not the case within near-shore fields (i.e., closer to the seismic sources) where acoustic signals are much more complicated, being affected by water depth, bathymetry profile along the propagation path, the geological layering of the seabed and the associated geo-acoustic properties, and the sound speed profile of the water column. Different taxa also detect different components of the acoustic signal, further complicating assessments. CGG considers sharks and rays as similar with respect to assessing the impacts of the proposed Regia MSS on elasmobranchs. Rays/ Skates are not a targeted group for commercial fisheries in the region and are taken as bycatch only. There is limited information on the population dynamics of these species. However, the evidence is overwhelming that (over)fishing is the singular largest impact on elasmobranch populations. There is no evidence that the area encompassing the proposed Regia MSS is holding significantly large populations of elasmobranchs that would require a precautionary approach to be taken. White Sharks are targeting seal colonies in the region centred around Lady Julia Percy Island, so this has been recognised as a Biologically Important Area (BIA) for White Shark foraging. Accordingly, the proposed Regia MSS area has been adjusted to provide appropriate mitigation of any possible effects from seismic (M#01: Activity Limitation). **<u>The EP has been updated to highlight activity limitation M#01 and it's mitigating effect against potential impacts to sharks and rays.</u>** Sharks and rays are most sensitive to low frequency sounds which are sensed through particle-motion only as they do not have a swim bladder. Sharks especially are attracted to sounds that suggest struggling prey, but they do not like large changes in sound intensity, such that they will swim away, even from a favourable sound, if its intensity suddenly increases by more than 20dB (Myrberg 2001). Slow ramping up of seismic pulse intensity over a period of time is a standard procedure with MSS and eliminates sudden changes in intensity. Chapuis et al (2018) tested the effects of underwater sound on a variety of shark species including White Sharks, by playing artificial sounds including Orca calls, through a speaker attached to a baited underwater camera system. Ultimately, the large variability shown in the results agrees with other studies investigating the effects of sounds and noise on marine fauna, where interspecific differences, intrapopulation variation, context of exposure and prior experience may change the responses of the animals to the stimulus. There is no uniform response.

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	risk mitigation and management of the risks that seismic blasting has on shark behaviour and populations.	The hearing sensitivity of some rays and bottom-feeding sharks has been examined and found to be less sensitive than species of sharks that feed throughout the water column (Casper et al 2003). While a study by Bruce et al (2018) looking at seismic effects on behaviour found little evidence for consistent behavioural or catch rate changes induced by the seismic survey in the targeted species of shark. For those elasmobranch species caught in commercial fisheries there is no evidence for moderate or high risks to their populations from MSS. **CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above, but has include reference to activity limitation M#01 and it's mitigating effect against potential impacts to sharks and rays in EP Appendix E3, Section 8.** ***References:*** *Bruce B, Bradford R, Foster S, Lee K, Lansdell M, Cooper S, Przeslawski R (2018) Quantifying fish behaviour and commercial catch rates in relation to a marine seismic survey. Marine Environmental Research 140:18-30.* *Casper BM, Lobel PS, Yan HY (2003) The hearing sensitivity of the little skate, Raja erinacea: a comparison of two methods. Environmental Biology of Fishes. 68:371-9.* *Chapuis L, Collin SP, Yopak KE, McCauley RD, Kempster RM, Ryan LA, Schmidt C, Kerr CC, Gennari E, Egeberg CA, Hart NS (2019) The effect of underwater sounds on shark behaviour. Scientific Reports 9(1):6924.* *McCauley RD, Meekan MG, Parsons MJ (2021) Acoustic pressure, particle motion, and induced ground motion signals from a commercial seismic survey array and potential implications for environmental monitoring. Journal of Marine Science and Engineering 9(6):571.* *Myrberg AA (2001) The acoustical biology of elasmobranchs. Environmental Biology of Fishes 60:31-45.*
F08	**Matter**: Impacts of underwater sound on white sharks **Claim:** Firstly, it should be established that the presence of sound clearly and directly modifies the habitat that great white sharks reside in. Satellite tracking data taken from Bruce et al. (2018; Figure 2) indicates a clear and substantial overlap of tracked sharks. This is site-specific, and important information around the species necessary - by law - for their assessment and protection. **Claim**: White sharks are listed as vulnerable and are protected in Australian waters under the EBPC Act and the Marine Bioregional Plan for the South West Marine Bioregion. It is a requirement under the EBPC to "implement measures to reduce adverse impacts of habitat degradation and/or modification." Despite this, the EP does not state how CGG plans to implement measures to reduce impacts to their critical habitat. **Claim**: The Marine Bioregional Plan for the South-West Marine Region outlines that white sharks have a low reproductive rate, which contributes to their vulnerability and identifies human disturbance as a potential pressure of concern to the species. The points considered above (under elasmobranchs) are all relevant to the white shark, which indicates a potential for adverse risks to the white shark from the proposed seismic survey. Advice provided in this instance from the Marine Bioregional Plan for the South-West Marine Region is to complete an EPBC Federal Referral of the proposed action for thorough assessment. **Claim**: Submitter recommends that CGG submits an EPBC Federal Referral pertaining to their proposed action and subsequent impacts to white sharks.	CGG acknowledges claims that White Sharks are protected and hence should not be subject to adverse impacts to population health and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of seismic effects to white sharks from the proposed Regia MSS has been completed. Potential impacts and risks to white sharks from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including sharks. • Impact Assessment Underwater Sound: Fish (Appendix E3) describes and assesses potential impacts and risks to white sharks from underwater sound generated by the Regia MSS The White Shark is widely but not evenly distributed in Australian waters including in and around some fur seal and Australian Sea Lion colonies such as: the Neptune Islands (South Australia); areas of the Great Australian Bight as well as the Recherche Archipelago and the islands off the lower west coast of Western Australia (Malcolm et al., 2001; EA, 2002). Juveniles aggregate seasonally in certain key areas including the Corner Inlet to 90 Mile Beach area of eastern Victoria and the coastal region between Newcastle and Forster in New South Wales (Bruce & Bradford, 2008, 2012). These regions of higher concentration have been mapped as part of the Australian Government's marine bioregional planning process. Appendix B12 (Regia MSS EP: Map –REG-EPM-077_A) shows the Biologically Important Areas (BIAs) for White Sharks within the EPA for the proposed Regia MSS. This map shows the broad distribution of White Sharks within the region and identifies the high-density foraging sites, around seal and sea lion colonies, notably Lady Julia Percy Island. The White Shark is not known to form and defend territories and is only a temporary resident in areas it inhabits. However, its ability to return on a highly seasonal or more regular basis implies a degree of site fidelity that has implications for repeat interactions with site-specific threats (Bruce et al., 2005). This behaviour has been identified for the areas around Lady Julia Percy Island and hence the Regia MSS program has been modified to avoid this important aggregation zone (M#01: Activity Limitation). **EP Appendix E3 (Impact Assessment Underwater Sound: Fish) Section 6.3 (and 8) has been updated to include the following information:** • **The White Shark foraging BIA within the area that may be impacted by underwater sound above the behavioural threshold for sharks, is centred on Lady Julia Percy Island / Deen Maar which is a known seal breeding colony. The sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar (M#01 Activity Limitation) which will significantly reduce the potential impacts of underwater sound on White Shark behaviour in close proximity to the foraging BIA.**

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		It remains the case that fishing is and was the primary driver of depleted White Shark populations across Australia and the globe (e.g. Reid et al 2011). Protections afforded to this species have halted declines in Australia, however it remains unclear what the rates of recovery are (Braccini et al 2017, Davenport et al 2020). Having assessed all the available literature on White Shark behaviour within the regional context, CGG have concluded that the only likelihood of a potentially significant impact from seismic on White Shark behaviour is if the survey was to be conducted within the nearshore bounds of Lady Julia Percy Island and this likelihood has been addressed through modification of the proposed area for seismic to occur (M#01 Activity Limitation). **CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above, but has include additional information on the White Shark BIA and activity limitation M#01, and it's mitigating effect against potential impacts to White Sharks, in EP Appendix E3, Sections 6.3 and 8.** ***References:*** *Braccini M, Taylor S, Bruce B, McAuley R (2017) Modelling the population trajectory of West Australian white sharks. Ecological Modelling 360:363-77.* *Bruce BD, Stevens JD, Bradford RW (2005) Site Fidelity, Residence Times and Home Range Patterns of White Sharks Around Pinniped Colonies. Final Report to Australian Govt. Dept. Env. Her. CSIRO, Hobart, Tasmania. 46 pp.* *Bruce BD, Bradford RW (2008) Spatial dynamics and habitat preferences of juvenile white sharks - identifying critical habitat and options for monitoring recruitment. Final Report to the Dept. Env. Water Her. & Arts, CSIRO, Hobart Tasmania 75 pp.* *Bruce BD, Bradford Russell W (2012) Ch 17: Habitat use and spatial dynamics of juvenile White Sharks, Carcharodon carcharias, in Eastern Australia in Global Perspectives on the Biology and Life History of the White Sharks Ed. Domeier M, CRC Press.* *Davenport D, Butcher P, Andreotti S, Matthee C, Jones A, Ovenden J (2021) Effective number of white shark (Carcharodon carcharias, Linnaeus) breeders is stable over four successive years in the population adjacent to eastern Australia and New Zealand. Ecology and Evolution 11(1):186-98.* *Malcolm H, Bruce BD, Stevens JD (2001) A review of the biology and status of white sharks in Australian waters. CSIRO, Hobart, Tasmania 113 pp.* *Reid DD, Robbins WD, Peddemors VM (2011) Decadal trends in shark catches and effort from the New South Wales, Australia, Shark Meshing Program 1950–2010. Marine and Freshwater Research 62(6):676-93.*
F09	**Matter**: Impacts of underwater sound on scallops, the scallop fishery, and squid **Claim**: Not mentioned in the Regia application is the fact that seismic blasting [has been connected to temporary and permanent hearing loss, habitat abandonment, mating and feeding disruption and possible death in marine mammals like whales.] It is linked to scallop deaths by compromising their immune systems [and has been found to irreversibly damage the organs of lobsters]. **Claim**: CGG have opposed the findings of Day et al. (2017) citing a study conducted by Przeslawski et al. (2018), stating "no evidence of increased scallop mortality ... attributable to exposure to seismic disturbance." Not only did the Przeslawski et al. (2018) study not examine any long-term effects, but assessed the impacts of a 2D seismic survey, not a 3D seismic survey. By contrast, the study by Day et al. (2017) assessed the impacts of a 3D seismic survey on scallops, and is therefore significantly more relevant to this EP given CGG are proposing a 3D seismic survey. 3D seismic surveys are more intense and create far greater environmental impacts in comparison to 2D seismic surveys, and the findings of a 2D survey should not be used to discredit the findings of a 3D seismic survey, as CGG have done. **Claim**: CGG has contested the findings of Day et al. (2017) by referencing a study conducted by Przeslawski et al. (2018), which reported no evidence of increased scallop mortality due to seismic disturbance. However, it's crucial to recognize that the Przeslawski et	CGG acknowledges claims that seismic has been found to cause damage to scallop and squid and this this must be appropriately addressed in the Regia MSS EP and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on scallops and squid from the proposed Regia MSS has been completed. Potential impacts and risks to scallops and squid from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7a and B7b) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including scallops and squid. • Impact Assessment Underwater Sound: Invertebrates (Appendix E4) describes and assesses potential impacts and risks to scallops and squid from underwater sound generated by the Regia MSS Acceptability Assessment (Appendix F3) provides a more detailed interrogation of seismic effects on select taxa identified through community consultations including scallops and squid. There have been multiple studies into the effects of seismic surveys on scallops with key work published by Harrington et al. (2010), Przeslawski et al. (2016a, 2016b, 2018) and Day et al (2016b, 2017). The results of this work are in keeping with studies on seismic effects to other invertebrates with impacts clearly noted within very close proximity to seismic pulses. However estimated mortality rates in all cases remained well below natural mortality rates which can be as high as 50% in wild scallop populations (Day et al 2016b). Appendix B8: Regia MSS Seismic Studies gives a thorough review of the relevant literature and the outcomes as briefly summarised here with full citation information available. Overfishing remains the largest anthropogenic influence on scallop stocks across the region, which can naturally fluctuate by several orders of magnitude, as has been demonstrated in Port Philip Bay stocks (Coleman 1998). The Victorian Scallop (Ocean) Fishery which operates out to 20nm from the coast is considered a depleted stock with fishing effort severely restricted. With respect to the potential influence of the proposed Regia MSS on scallop populations in the region the risk is very low. The map of commercial scallop fisheries (see below; https://fish.gov.au/report/280-Commercial-Scallop-2020) indicates they are all operating to the east of the proposed survey area within Bass Strait. Bass strait is the centre of *Pecten fumatus* distribution in Australia because of the combination of suitable habitat and the convergence of three major oceanic currents which are a key requirement for filter feeders (Ovenden et al 2016).

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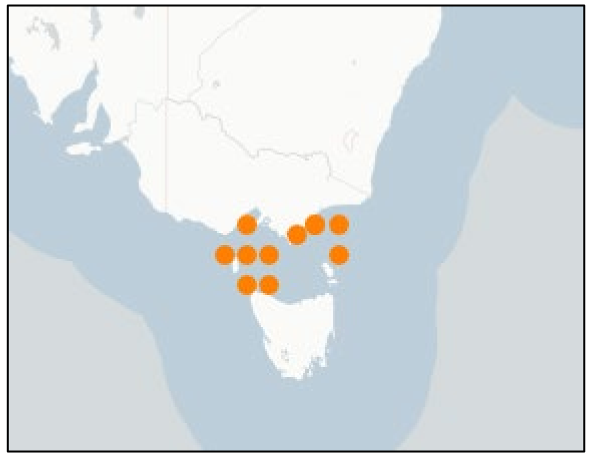
	al. (2018) study did not examine long-term effects and evaluated the impacts of a 2D seismic survey, not a 3D survey like the one proposed by CGG. Given that CGG is proposing a 3D seismic survey, the study by Day et al. (2017) is more relevant as it specifically assessed the effects of 3D seismic surveys on scallops. It's inappropriate to dismiss the findings of a 3D survey based on the results of a 2D survey, as the environmental impacts and intensity of these surveys differ significantly. **Claim**: Submitter recommends the mortality and impacts of 3D seismic surveys on scallops are appropriately represented within the EP. We recommend Regia reassess the risks and impacts of seismic on scallops following appropriate representation of the scientific literature. **Claim**: Physiological damage and behavioural changes have been observed in molluscan species such as scallops [15] and squid [16] in response to intense sound exposure, however long-term implications for a typical seismic survey on survivability are yet to be ascertained. 15. Day RD, McCauley RD, Fitzgibbon QP, Hartmann K and Semmens JM. 2017. Exposure to seismic air gun signals causes physiological harm and alters behavior in the scallop, Pecten fumatus. Proceedings of the National Academy of Sciences, 114. 16. Mooney TA, Hanlon RT, Christensen-Dalsgaard J, Madsen PT, Ketten DR and Nachtigall PE. 2010. Sound detection by the longfin squid (Loligo pealeii) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. Journal of Experimental Biology, 213. **Claim**: Another fishing industry staple, scallops are more profoundly affected by seismic blasting than rock lobsters. They are also less able to escape an impacted area. **Claim**: Scallops and other bivalves are filter feeders and so feed on plankton. If zooplankton stocks are killed off significantly in the Operating Area from seismic blasting, this could affect food supply for scallops and other bivalves and affect the fisheries industry in the Port Fairy area. **Claim**: Submitter recommends the mortality and impacts of 3D seismic surveys on scallops are appropriately represented within the EP. We recommend Regia reassess the risks and impacts of seismic on scallops following appropriate representation of the scientific literature. **Claim**: Studies show that seismic blasting has the following impacts; • Lowering of scallop immune system resulting in death **Claim**: Regarding scallops, CGG states "scallops are not commercially fished in this area indicating an absence of commercial quantities". This is factually incorrect. An absence of fishing does not indicate an absence of commercial quantities of scallops, without a spatial and temporal survey of the region. Given the absence of such a survey, this assumption by CGG warrants removal, and impacts to scallop populations reassessed. **Claim**: The Bass Strait Central Zone Scallop Fishery region extends over the proposed survey area (AFMA, 2024). Based on the known	 **Figure 3:** Distribution of reported catch of commercial scallop On the basis of all the information assessed, CGG have concluded that the risk to scallop populations from the proposed Regia MSS is very low. Appendix B8: Regia MSS Seismic Studies also gives a thorough review of the relevant literature on seismic effects to squid. However, based on community consultation concerns a further analysis was conducted on Gould's Squid (Appendix F3-Acceptability Assessment; 5.2.6 Gould's Squid), which is the primary squid species targeted by the Southern Squid Jig Fishery and an important contributor to the regional economy. This species only lives for a year and reproduces 4 times over that period. Modelling of fishing effort in the fishery has shown that 90% of biomass can be removed without impeding stock recovery and sustainability. CGG have therefore assessed risk to squid populations from the proposed Regia MSS as low. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2). M#01 Activity Limitation stipulates No discharge of the sound source at full power in water depths of less than 50 m. This is protective for immobile or short ranging invertebrate species that are more likely to be present in water depth < 50 m. M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References****:* *Coleman N (1998) Counting scallops and managing the fishery in Port Phillip Bay, south-east Australia. Fisheries Research 38(2):145-57.* *Ovenden JR, Tillett BJ, Macbeth M, Broderick D, Filardo F, Street R, Tracey SR, Semmens J (2016) Stirred but not shaken: population and recruitment genetics of the scallop (Pecten fumatus) in Bass Strait, Australia. ICES Journal of Marine Science 73(9):2333-41.*

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	impacts of seismic to scallops, Fisheries and communities should be made aware of the likely damage to stocks throughout the operational and surrounding areas. **Claim**: The proposed survey area overlaps with the Bass Strait Central Zone Scallop Fishery region. Considering the known impacts of seismic activity on scallops, it's imperative to inform fisheries and communities about the potential damage to scallop stocks within the operational and surrounding areas. **Claim**: The scallop fishers of Bass Strait have previously reported the loss of hundreds of millions of tonnes of scallops following seismic blasting operations. **Claim**: Dr. Ryan Day, himself at the University of Tasmania informed me that CGG's claim of: "The "increased mortality was within natural variation" is not a correct interpretation of the results of that study. You are correct in your interpretation that our results showed significantly elevated mortality and physiological harm in scallops following exposure." To me, this sounds like a gross and misleading misinterpretation of the expected effects of seismic blasting on scallops by CGG CLAIM which was concerning 3 fold: 1. What may actually happen to the scallops. 2. What may happen to the local scallop fishing industry. 3. That CGG was either not capable of using scientific research correctly to base their activity on in as safe a manner as possible for marine species OR that they were intentionally misleading the Port Fairy community to allay fears and carry on with their activity regardless of the effect on the scallops.	
F10	**Matter**: Impacts of underwater sound on crustacea, including lobsters **Claim**: Not mentioned in the Regia application is the fact that seismic blasting [has been connected to temporary and permanent hearing loss, habitat abandonment, mating and feeding disruption and possible death in marine mammals like whales.] It [is linked to scallop deaths by compromising their immune systems and] has been found to irreversibly damage the organs of lobsters. **Claim**: Recent studies funded by CGG found uncontrollable impacts from seismic blasting. Seismic blasting causes lasting injuries to lobsters as well as slowing their development and growth, and causing physiological stress.[3] Ryan D Day et al., 'Examining the Potential Impacts of Seismic Surveys on Octopus and Larval Stages of Southern Rock Lobster - Part A Southern Rock Lobster' (Fisheries Research and Development Corporation,2021), https://www.frdc.com.au/sites/default/files/products/2019-051-Examining-potential-impacts-of-sesmic-PART%20A-SRL-larval-stages-15July2021.pdf. **Claim**: At present there is little data available on the impacts of seismic exposure on longer-term survivability of crustacea, however, mounting evidence for impacts to normal physiology and behaviour suggests that species such as Southern Rock Lobster are likely to incur elevated levels of mortality for unknown periods following exposure to a seismic source.	CGG acknowledges claims that seismic has been found to cause damage to southern rock lobsters and other species of crustacea and has reviewed the Environment Plan (EP) to ensure that this has been adequately considered. As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on lobster and other relevant crustaceans from the proposed Regia MSS has been completed. Potential impacts and risks to lobster from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7a and B7b) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including lobsters. • Impact Assessment Underwater Sound: Invertebrates (Appendix E4) describes and assesses potential impacts and risks to lobster from underwater sound generated by the Regia MSS • Acceptability Assessment (Appendix F3) provides a more detailed interrogation of seismic effects on select taxa identified through community consultations including lobster. The scientific evidence is clear that seismic surveys can cause semi-lethal effects on various crustaceans when they are within proximity to a seismic source, which has been well documented within the Regia MSS EP. Such effects have also been shown to be highly variable and will operate differently depending on what life-stages are involved. It is also the case that testing of seismic effects has required caging of animals which makes extrapolation to free-roaming populations problematic. Outcomes from caged individuals cannot be directly extrapolated to effects on wild populations and especially population-level effects. CGG have utilised a weight-of-evidence approach to assess the likelihood of adverse effects from the proposed Regia MSS Survey on resident crustacean populations. Appendix B8 – Regia MSS Seismic Studies provided a general summary of seismic effects on rock lobsters and snow crabs and concluded that while sub-lethal effects as noted by experimentation are likely in a seismic survey, they will be highly variable with no evidence of large-scale mortality that would be considered detrimental to population health.

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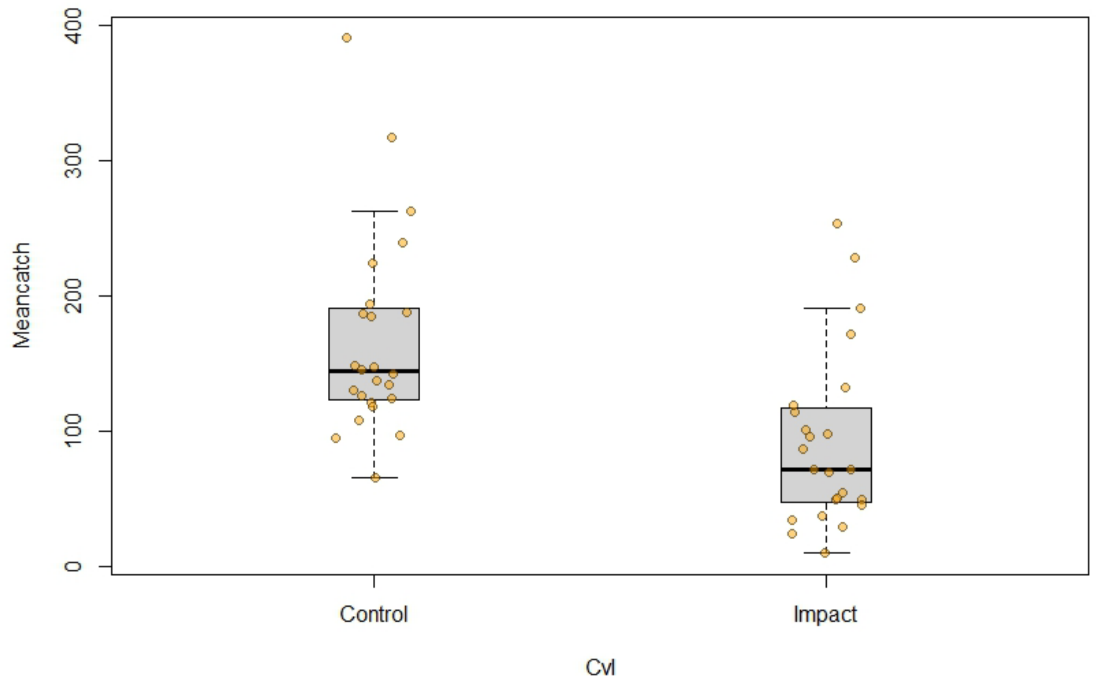
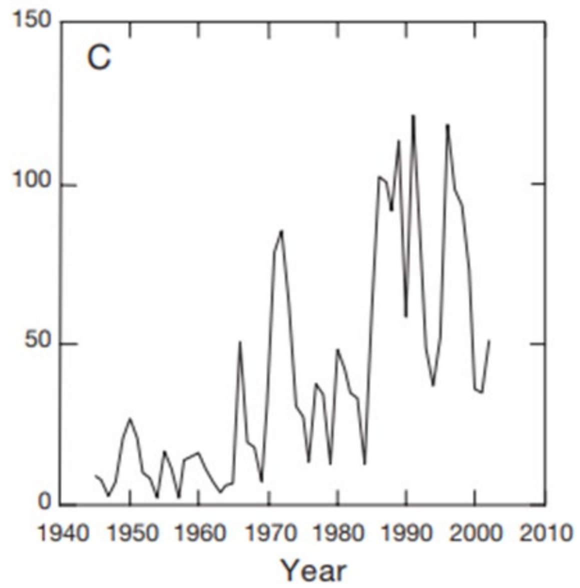
	Claim: Research has shown impairment to the righting reflex used by Southern Rock Lobster to orient themselves following exposure to an acoustic source [12] . This was linked to damage to the sensory hairs of the statocyst that may also result in other impairments that have not yet been quantified, which in turn may adversely affect a range of reflex and behavioural responses important for lobster to locate food and escape predators. In adults this damage is present after one moult, however juveniles appear to show a more persistent impact [10] . Juveniles exposed directly to a seismic source have also showed an increased intermoult duration, indicating impaired development or growth [10]. 10. Richardson AJ, Matear RJ and Lenton A. 2017. Potential impacts on zooplankton of seismic surveys. CSIRO, Australia. 12. Day RD, McCauley RD, Fitzgibbon QP, Hartmann K, Semmens, JM. 2019. Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex. Proceedings of the Royal Society Biological Sciences, 286. **Claim**: ROCK LOBSTERS – Seismic blasting causes significant damage to the special organ, called the mechanosensory organ, which provides a sense of balance, body position and movement, which are critical for predator avoidance (Day et.al, 2021). This affects their ability to avoid predation and may affect the populations of lobsters, which are an important part of the local fishing industry in Moyne. **Claim**: Southern Rock Lobsters, a significant fishing resource in Victorian waters and food source for numerous marine species, show damage to the sensory organ responsible for their buoyancy and balance (Day, R. et. al., Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex, The Royal Society, 20198). This reduces their ability to avoid predation and in some cases led to their floating belly up on the surface of the ocean resulting in their being easy prey for seabirds. **Claim**: Preliminary findings regarding impacts of seismic sources to Western Rock Lobster (highly related to Southern Rock Lobster) reported significantly greater righting time and greater limb loss [13] . In the same study, an approximate 30% reduction in recapture rates of exposed animals after one month suggested elevated mortality. 13. Consultation Update: Eureka 3D MSS - November 2023. **Claim**: Prior research has also reported negative impacts of seismic sources on the nutritional condition and immune competency of Southern Rock Lobster for months following seismic air gun exposure [14]. 14. Fitzgibbon QP, Day RD, McCauley RD, Simon CJ and Semmens JM. 2017. The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, Jasus edwardsii. Marine Pollution Bulletin, 125. **Claim**: The environment plan does not appear to adequately assess the long-term impacts of seismic testing on rock lobster populations and therefore any discussion of risk management strategies is inadequate and incomplete. **Claim**: Submitter recommends studies into the effects of seismic blasts on rock lobster health, behaviours, and populations; and a plan is formulated for risk mitigation and management of the risks	In response to community feedback an additional assessment was done on Southern Rock Lobsters and Giant Crab to provide greater certainty around potential seismic effects from the proposed Regia MSS (see Appendix F3 - Acceptability Assessment: Sections 5.2.3 & 5.2.4). All Southern Rock Lobster (SRL) located within the MSS operational area are considered part of a single genetic stock spread across southern Australia (Ovenden et al. 1992; Thomas & Bell 2013). The huge geographical spread of this species means that larval supply to any individual area, such as the MSS operational area, comes from many other areas and hence is not linked to the number of reproductively active animals in any one place. Research has highlighted the complex processes affecting settlement strength in SRL which indicate that environmental conditions that reduce settlement strength in one region of the fishery often increases settlement strength in other regions. A system such as this is extremely resistant to localised disturbances as it receives larvae each year from what is effectively, a 'bank' of SRL stretching across southern Australia. Commercial fishing statistics from the VFA 20/21 season SRL Stock Assessment Report also highlight that CPUE has almost tripled from 2009/10 even though over 14 marine seismic surveys have been conducted along the Victorian coastline over this time period. Hence our assessment has concluded that the risk profile for SRL from the proposed Regia MSS is low. Giant crabs are a long-lived slow growing species that is found across southern Australia inhabiting depths between 120-370m. Genetic studies have indicated that the species is effectively a single stock with little evidence of sub populations. This is likely due to the 3-4 month larval phase and the ability of individual adults to move up to 400km. Seismic effects on individuals have been shown to be limited to larvae within very close proximity to the discharge source. Timing the MSS to avoid the peak period in the reproductive cycle period will mitigate any potential impacts during this critical period. Fishing days within the Regia MSS Active Source Area have also decreased from 17.3 % of total fishing days from 2011-2022 to 7.5% of total fishing days from 2018-2022. As discussed above there is no evidence to support an expectation of significant and measurable cumulative impacts to P. gigas as a result of the Regia MSS. Large scale environmental drivers driven by a changing climate, and fishing effort, will continue to be the major influences on the population health of giant crab. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2. M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References***: *Ovenden JR, Brasher DJ, White RW (1992) Mitochondrial DNA analyses of the red rock lobster Jasus edwardsii supports an apparent absence of population subdivision throughout Australasia. Marine Biology 112:319-26.* *Thomas L, Bell JJ (2013) Testing the consistency of connectivity patterns for a widely dispersing marine species. Heredity. 111(4):345-54.*

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	that seismic blasting has on rock lobster health, behaviour and populations. **Claim:** Research demonstrates its adverse impact on various marine species, including the deafening of whales, disruption of their feeding and migration patterns, impairment of southern rock lobsters' functioning and navigation abilities, and mortality among small fish and zooplankton. As such, repercussions extend to industries such as commercial fishing and tourism. Given that this project benefits a select few at the expense of the wider community, including residents along the South-west Victorian coastline, it needs to be refused by NOPSEMA. **Claim**: The adverse effects of seismic blasting extend beyond the immediate vicinity of the operation. Studies have shown a direct correlation between seismic activity and increased mortality rates in shellfish and marine mammals, as well as significant disruptions to the marine food chain. **Claim**: Studies show that seismic blasting has the following impacts; • Rock lobster lose their ability to quickly right themselves if they find themselves upside down leaving them open to predation, • Delayed moul3ng of larval rock lobster which results in death **Claim:** The studies mention permanent sub- lethal effects on rock lobster and mortal injury to zoo plankton. The Environmental plan accepts these as non-critical risks however there seems to be no independent modelling of the impact of underwater sound as recommended by the preliminary environmental statement.	
F11	**Matter**: Impacts of underwater sound on octopus **Claim**: Recent studies funded by CGG found uncontrollable impacts from seismic blasting. Another study from the same research program tested effects on octopus from blasting up to one kilometre away. It found that blasting cause developmental delays in octopus eggs, and exposed octopus showed significantly reduced feeding, maternal care of eggs and adventurous behaviour. Octopus' sensory systems were significantly damaged. This study was not able to determine a safe operating distance for seismic blasting. [3] Ryan D Day et al., 'Examining the Potential Impacts of Seismic Surveys on Octopus and Larval Stages of Southern Rock Lobster - Part A Southern Rock Lobster' (Fisheries Research and Development Corporation,2021), https://www.frdc.com.au/sites/default/files/products/2019-051-Examining-potential-impacts-of-sesmic-PART%20A-SRL-larval-stages-15July2021.pdf. **Claim**: Potential impacts to "pruning" of egg clutches by female octopus is of particular concern given octopus populations rely on a small number of well-developed offspring [7]. 7. Day RD, McCauley RD, Leon R, Fitzgibbon QP, Baker K, Hartmann K, Semmens, JM. 2023. Examining the potential impacts of seismic surveys on octopus and larval stages of southern rock lobster. FRDC Project No. 2019/051. Institute for Marine and Antarctic Studies, University of Tasmania, Hobart.	CGG acknowledges claims that experiments on seismic testing effects on octopus have found some impacts. CGG has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. As stated in response to multiple other Matters, CGG utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on octopus from the proposed Regia MSS has been completed. Potential impacts and risks to octopus from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7a and B7b) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including octopus. • Impact Assessment Underwater Sound: Invertebrates (Appendix E4) describes and assesses potential impacts and risks to octopus from underwater sound generated by the Regia MSS Acceptability Assessment (Appendix F3) provides a more detailed interrogation of seismic effects on select taxa identified through community consultations including octopus. In response to community feedback further assessment of the literature was undertaken to clarify any potential effects of the proposed Regia MSS (Appendix F3: Acceptability Assessment: Section 5.2.7). This assessment was updated with the release of the final report by Day et al. (2023) *Examining the potential impacts of seismic surveys on Octopus and larval stages of Southern Rock Lobster.* Day et al. 2023 found no impact of seismic on Octopus fishery CPUE, they also found no mortality in either male or female octopus, and no indication of harm to offspring, with hatches generally completing fully with live, competent hatchlings. There was some indication of a reduction in maternal care of eggs and changes in blood chemistry associated with immunity to pathogens. The overall level of impact was considered negligible at 500m from the seismic source. From a fisheries perspective, the main fishery for Octopus is in Eastern Victoria with fishing in central and western Victoria less established and managed through exploratory, temporary permits. There is therefore no established fishery for Octopus across the coastal areas adjacent to the proposed Regia MSS.

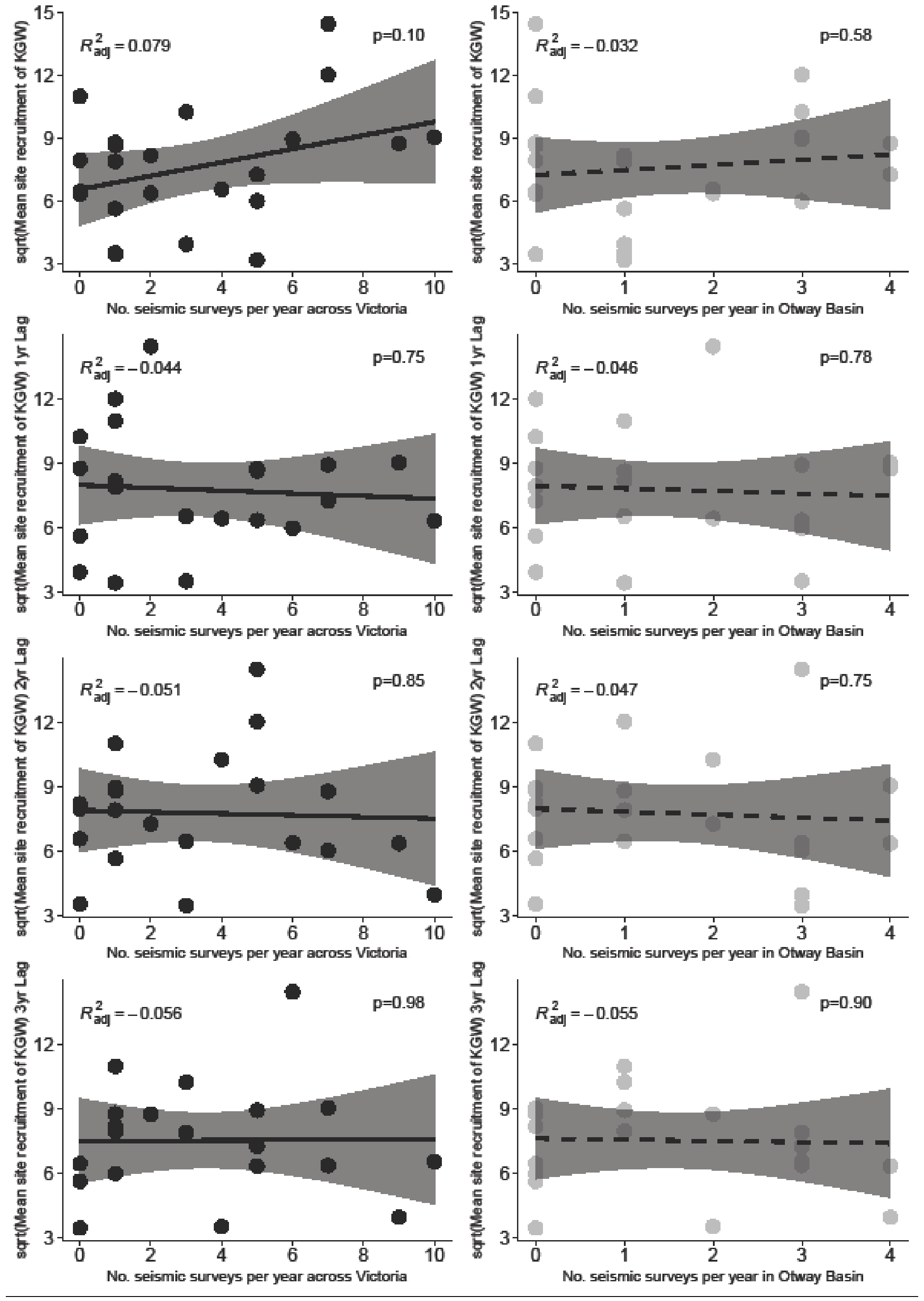
	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	Claim: Characterising the mechanism and effects of seismic sources on behaviour of brooding octopus is a priority for future research, as this could have the potential to affect octopus at a population level. **Claim**: Reports on the impacts of a commercial seismic survey off the coast of Victoria on the Pale Octopus indicated inhibition of enzyme activity that suggested a sub-lethal neurotoxic effect capable of altering behaviour and locomotor abilities [5]. As cephalopods demonstrate a high level of intelligence and are reliant on neuromuscular coordination, impairment of normal neurotransmitter systems could have severe impacts on their ability to find and capture food, escape predators and manipulate their environment. 5. Hamer PA and Jenkins GP. 2007. Migratory dynamics and recruitment of snapper, Pagrus auratus, in Victorian waters. FRDC Project No. 199/134. Primary Industries Research Victoria, Marine and Freshwater Systems, Queenscliff. **Claim**: Research has been conducted by Associate Professor Jayson Semmens et.al. at the University of Tasmania into the effect of seismic blasting on octopus where males were found to have reduced adventurousness and depressed feeding, females were shown to have reduced maternal care of their eggs, there were significant increases in stress as shown by pH levels and neuromuscular function was affected (Day et.al., 2023). Given that octopi are limited with their ability to move quickly out of a given area, seismic blasting would be a cruel practice for them to experience, with a potential impact on populations in relation to behavioural changes that may affect survival and reduced care of unhatched young. **Claim**: In the few months following the seismic blasting conducted by CGG at Lakes Entrance in 2020, the ABC reported on fishers saying that their octopus catch was down by 80% (Davis & Burns, 2020).	This species has no pelagic larval life so there is no planktonic component to consider. As is the case with the majority of targeted fisheries species, the greatest threat to stocks is localised heavy fishing pressure which can lead to a progressive reduction in female fecundity, which would eventually impact upon recruitment. Control measures to reduce impacts to octopus are outlined in in EP Appendix E4 (Impact Assessment – Underwater Sound: Invertebrates). M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. CGG have therefore concluded that the risk level for Regia MSS effects to octopus is low. **<u>CGG has considered these claims and to ensure that the most up-to-date assessment has been made has provided an extra Acceptability Assessment within Appendix F3 of the EP, which more clearly defines the levels of risk to Octopus from the proposed Regia MSS.</u>** ***References:*** *Day RD, McCauley RD, Leon R, Fitzgibbon QP, Baker KB, Semmens JM (2023) Examining the potential impacts of seismic surveys on Octopus and larval stages of Southern Rock Lobster. FINAL REPORT for FRDC Project no. 2019/051.*
Key Matter: Impacts on Fishers and Fisheries		
F12	**Matter**: Impacts on Fisheries (general) **Claim**: The proposed operational area for the Regia MSS overlaps sensitive habitats important to the life cycle for several species integral to the economic and social benefits derived from sustainable Victorian fisheries. Of primary concern is the paucity in knowledge regarding potential impacts of seismic survey methods to recruitment and long-term survivability of species such as Southern Rock Lobster (Jasus edwardsii), Giant Crab (Pseudocarcinus gigas), Pale Octopus (Octopus pallidus), King George Whiting (Sillaginodes punctatus) and Australasian Snapper (Pagrus auratus). **Claim**: Additional research on the impacts of seismic sources on important biological processes such as migration, reproduction and larval development, along with longer-term survival rates associated with normal foraging, predator evasion and communication are clearly lacking for key species sustainably harvested in Victoria and adjacent Commonwealth waters. This knowledge is required to	CGG acknowledges claims that seismic testing will have some effects on fisheries species that are an important part of the regional economy. CGG has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on fisheries species has been completed. Additionally, CGG continue to monitor the relevant databases and websites to ensure new scientific information is captured as it comes to light. The Regia MSS EP contains multiple sections that summarise and review fisheries species and what is known about the impacts of seismic to these species (see Regia EP: Appendix B6, Appendix B7a and B7b, Appendix B8, Appendix E3 and Appendix F3). Where specific information is not available on a particular species then a weight-of-evidence approach is used where results from a broad range of similar species or taxa are used to make informed assessments. Government fisheries assessments are a key reference tool for this as they provide up-to-date assessments of the fisheries health and links to relevant scientific literature to understand the life-history and distribution of the targeted species. Appendix B6 – Regia MSS Commercial Fisheries Review provides an assessment of all the fisheries species that are targeted within the Environmental Planning Area. Of 9 fisheries managed by the Commonwealth, 6 of them overlap with the Activity Planning Area while of 10 fisheries managed by the Victorian Fisheries Authority 5 of them overlap with the Activity Planning Area. Thus ~57% of commercial fisheries overlap spatially with all or part of the Regia MSS Activity Area. Appendix B8 – Regia MSS Seismic Studies provides a detailed assessment of the literature on seismic effects to fish, invertebrates and plankton amongst others. The weight-of-evidence from studies across multiple fish and invertebrate species – including plankton communities – indicates highly variable, but mostly negative outcomes within proximity to a seismic source but dissipating with distance.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	establish appropriate guidelines for seismic surveying in areas such as that proposed for the Regia MSS. **Claim**: The Regia application shows no acceptance of the damage done to fisheries around the world and Australia from seismic tests and the consequent need for the elimination of seismic blasting. **Claim**: The CGG proposal is totally senseless in every respect, unless they deliberately intend to destroy Australian fisheries. **Claim**: If fish populations were negatively affected either directly or indirectly from seismic blasting, it would not only affect the marine ecosystems, but the local fisheries industry. **Claim**: Seismic blasts also reduce catch rates of commercial fish).	There is no uniform effect of seismic detected, with acoustic signals being affected by water depth, bathymetry profile along the propagation path, the geological layering of the seabed and the associated geo-acoustic properties, and the sound speed profile of the water column. Then there are the inter-species differences and lifecycle stage-specific differences, and these are all in turn affected by powerful and large-scale environmental parameters such as water temperature. Appendix F3 of the EP- Acceptability Assessments provides a more detailed and species-specific examination of what the likely level of seismic impacts are and whether population stability is threatened. These species have been identified as important through ongoing community consultation and include the Southern Rock Lobster, Giant Crab and Gould's squid, all of whom have overlap with the Regia MSS Area of Activity. The assessments of these species in Appendix F3 provide detailed arguments as to why the proposed Regia MSS is unlikely to deliver medium or high risks to the stability of resident populations. While there is a high probability of lethal and/or semi-lethal effects for individuals that will be very close to the seismic pulses these outcomes dissipate with distance from source and are further mediated by the huge variability in environmental and geophysical properties that make up the system. CGG investigated potential correlations between long term recruitment data and long term seismic data for a number of species but found no relationship; good recruitment to a fishery (e.g. King George Whiting and Snapper) was just as likely when seismic activity was high in any given year. For those species of commercial interest fishing effort remains the single biggest driver of population-level changes with reduced fishing effort almost always improving the health of a targeted species. The southern ocean has also been identified as a climate change hotspot so associated changes in water temperatures are also becoming increasingly important to the long term health of marine populations. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2). M#01 Activity Limitation stipulates No discharge of the sound source at full power in water depths of less than 50 m. This is protective for immobile or short ranging invertebrate species that are more likely to be present in water depth < 50 m. M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. **CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. Nevertheless, CGG have added specific analyses of further species including Abalone, Snapper and Octopus to the Acceptability Assessment Appendix F3 to ensure all concerns have been investigated and level of risk has been clarified according to the available evidence.**
F13	**Matter**: Impacts on catch rates of whiting **Claim**: Hugely reduced catch rates and decreased abundance have subsequently been reported near seismic surveys. For example, the flathead and whiting all but disappeared from the coast of Lakes Entrance after CGG conducted a seismic blasting regime for 6 months in 2020 (Davis, 2020). Whiting catch went down 99.5% and flathead catch went down 71%, as found in research conducted by FRDC. **Claim**: Fish catch has been negatively affected both in Australia and elsewhere in the world as a result of seismic blasting. https://www.abc.net.au/news/2020-08-04/whiting-catch-down-because-of-seismic-testing/12502930 **Claim**: King Island fishers have reported losing an entire year class of pelagic fish following previous seismic blasting operations.	CGG acknowledges claims that seismic testing within the proposed Regia MSS area will affect catch rates of whiting and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on fisheries species has been completed. Additionally, CGG continue to monitor the relevant databases and websites to ensure new scientific information is captured as it comes to light. Impact Assessment Underwater Sound: Fish (Appendix E3) describes and assesses potential impacts from underwater sound generated by the Regia MSS. In response to general concerns over seismic survey impacts to fisheries in the region around Lakes Entrance on Victorias East coast, an FRDC funded project was implemented in 2019 to look at the effects of seismic testing on Danish Seine catch rates for Eastern School Whiting (ESW) and Tiger Flathead (TF). The preliminary results suggested there was a large initial drop in catch rates of whiting > 95% and this drop took ~100 days to dissipate, while flathead catch rates dropped by >75% and took up to 200 days to dissipate. These results do indicate that seismic testing can cause disruption to the natural distribution of ESW and TF for a period of time. However, the size of this effect both spatially and temporally remains unclear. Historically, catches of ESW and TF show very large year-to-year variation, for e.g. ESW seine catches dropped 85% in the Control Area of the study between 2016 and 2017 and by 95% in the Impact Area of the study between 2016 and 2018. These declines are equal in magnitude to any declines suggested by the study and have occurred without the presence of seismic. Box plots illustrating the range of mean catches shows how variable they can be and with this background variability it is extremely difficult to quantify changes specific to an external event.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
		 **Figure 4:** Boxplots illustrating the range of mean annual catches between 2014 and 2021, of Eastern School Whiting from the designated Control and Impact areas for the FRDC funded BACI study, before the seismic experiment. The results of this study clearly indicate that seismic can have a displacement effect on ESW and TF however the report of this study remains preliminary and has not yet been completed nor subject to vigorous review as is standard for such work. Box plots illustrating the range of mean catches - before the seismic test - illustrates how variable they can be and with this background variability it is extremely difficult to quantify changes specific to an external event. With respect to the proposed Regia MSS, this is located over 500km from Lakes Entrance and does not encompass key Eastern Sand Whiting habitat. In summary, CGG has considered these claims and is satisfied that the concerns raised are not applicable to the Regia MSS for the reasons outlined above. Nevertheless, CGG notes the outcome of the FRDC preliminary report and its relevance to obtaining a better understanding of potential seismic effects on whiting and flathead species. CGG await a final report that has been through appropriate review to gain a better understanding of the scale of effects that can be attributed to seismic testing. Mitigation measures will be implemented to significantly reduce the risk to individuals, as outlined in the Fauna Management Plan (Appendix G2). M#03: Fauna Management System stipulates The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For demersal and pelagic fish species including eels, they would move away from the source before it is at full power, providing them a level of protection. M#07: Adjustment Protocol stipulates an adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. It is important to acknowledge that the Regia ‘Adjustment Protocol’ provides a mechanism for compensation to fishers if they are deprived of access to regular fishing returns in any way. However, the effectiveness of this protocol is predicated on quality data to ensure any adjustments represent an unbiased appraisal process. CGG has considered these claims and is satisfied that the potential impacts have been adequately addressed in the EP for the reasons outlined above. As a result, the EP has not been updated in response to these claims
F14	**Matter**: Impacts on spawning aggregation areas for King George Whiting	CGG acknowledges claims that seismic testing within the proposed Regia MSS area will affect spawning, recruitment and catch rates of King George Whiting in the Corner Inlet Fishery. CGG has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	Claim: My comment and concern relates to the impact of the proposed seismic survey on our business which relies on King George Whiting recruitment that according to scientific surveys, comes from the area in question. The proposed survey would possibly severely impact spawning and recruitment success for our fishing business. We have approximately ten workers and five fishing vessels in Corner Inlet, Victorian Inshore Trawl and Tasmanian Purse seine and beach seine A fisheries. Nuch of our catch is King George Whiting. We would need to be adequately and pre-emptively compensated for losses. Please see the paper: Determination of spawning areas and larval advection pathways for King George whiting in southeastern Australia using otolith microstructure and hydrodynamic modelling. I. Victoria, Gregory P. Jenkins, Kerry P. Black and Paul A. Hamer, Marine Ecology Progress Series. Vol. 199 (June 26 2000), pp. 231-242 (12 pages). **Claim**: While Klarite may try and put a lobbyist spin on the survey that the larval King George Whiting actually like seismic blasting, that is not supported by any research. It is beholden on CGG to demonstrate that our businesses will not be destroyed by their seismic testing. This has to be independent science. Reference: Determination of spawning areas and larval advection pathways for King George whiting in southeastern Australia using otolith microstructure and hydrodynamic modelling. I. Victoria, Gregory P. Jenkins, Kerry P. Black and Paul A. Hamer, Marine Ecology Progress Series. Vol. 199 (June 26 2000), pp. 231-242 (12 pages). **Claim**: We fish mainly in the Corner Inlet Fishery which relies on larval advection from the spawning grounds between Western Victoria and South Eastern South Australia. So we have spawning stock traveling through the proposed survey site and then planktonic juveniles drifting back through the site. While consultants Klarite claim any impact will be small from this overlap, there is no science to demonstrate there will be a small impact on our stock and therefore businesses in Corner Inlet, the Inshore Trawl Fishery and Tasmania. Such claims by Klarite are without any scientific merit or basis. **Claim**: What we do know is that there is significant overlap of the site of the proposed survey and the advection pathway for the larvae. This is an unacceptable risk. Previous surveys have not covered the advection pathway for our species so thoroughly and to dismiss the risk to the species would be a rejection of the onus of proof that the proponent has to demonstrate their activities will not impact existing stakeholders and businesses.	As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on fisheries species has been completed. Additionally, CGG continue to monitor the relevant databases and websites to ensure new scientific information is captured as it comes to light. As described in the seminal work on spawning locations for King George Whiting (KGW) (Jennings et al 2000) a significant proportion of recruitment to Victorian KGW habitats in Western Port Bay and Port Philip Bay is derived from spawning grounds to the far west of Victoria around an area adjacent to the Victoria/ SA border. These spawning grounds are distinct from the known spawning grounds in SA although they are still genetically similar. As the most easterly bay for significant KGW populations in Victoria, Corner Inlet still receives a significant supply of larvae from the Vic/SA border region, however it is also highly likely to be receiving larvae from spawning stock located much closer to the Inlet. The drivers of measurable population level impacts remain regional climate patterns such as decadal wind changes, SST changes and unmanaged commercial fishing or large-scale pollution of essential habitat.  **Figure 5: Graph taken from from (Jenkins et al 2005) showing the changes in annual catch of KGW from Corner Inlet.** Figure 3 from Jenkins et al (2005) shows the changes in annual catch of KGW from CI and illustrates how it is not possible to 'measure' or distinguish a potential effect on KGW populations from the proposed Regia MSS. There have been many seismic surveys across the greater region for decades yet the dynamics of interannual patterns in KGW catches remain clearly linked to these large-scale climate events. This is not to say that seismic surveys won't have some effect on KGW populations, but that these effects will be immeasurably small and extremely unlikely to have any influence on population dynamics. **Nevertheless, in response to community feedback/concerns further interrogation of the literature has been undertaken for King George Whiting and other highlighted taxa. For these groups CGG defined acceptable levels of impact and risk to provide a clear framework for understanding what effects seismic might have on individual health and population-level health. The updated assessment can be found in Appendix F3 Section 5.2.10, which now includes King George Whiting.** CGG sought to understand if there was any relationship between the annual frequency of seismic programs running in Victorian waters and the annual recruitment levels of King George Whiting in Port Philip Bay (PPB). PPB is the main area for KGW stocks in Victoria and hence where any correlations would be most likely to show up. One of the arguments used by both sides of the "effects of marine seismic testing" issue is that the persistent presence of seismic testing in Victoria over a prolonged period has either been a primary driver of declines in fishing catches or it is evidence that the systems are relatively resilient to the scale of these effects. Providing a direct cause and effect is virtually impossible given the scale of the operating environment and the large number of confounding factors that are also acting at any given point in time and/or space. In lieu of this, one approach is to look at long term datasets of a resource such as fish and see if the patterns revealed have any coherency with long-term patterns of MSS in the greater region. If seismic testing is having a significant effect on a stock at population level, then it might be argued that the more seismic testing that is done then the greater any likely impact will be. Hence in years of multiple seismic there will be a greater impact than in years where there has been little or no seismic.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
		To investigate this hypothesis CGG compared a long-term dataset of annual counts of newly settled King George Whiting recruits within Port Philip Bay as described in VFA 2021 – Review of key Victorian fish stocks. Patterns of recruitment into this bay are representative of the other 2 catchments of Western Port Bay and Corner inlet as described in multiple papers and reports already submitted as part of the EP. A simple linear regression approach was used to test for any correlations between the annual recruitment of KGW to Port Philip Bay and the annual count of seismic surveys across Victorian waters. For each of the two seismic datasets CGG compared KGW recruitment counts in the same year and then lagged by 1 year, 2 years and 3 years. For example, with a 1-year lag CGG compare the seismic accounts from 1999 with the recruitment counts in 2000, 2000 with 2001, 2001 with 2002 and so on. For a 2-year lag CGG compared seismic in 1999 with KGW recruitment in 2001 and so on.



	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
		Figure 6: Relationship between frequency of seismic surveys and KGW recruitment levels in PPB CGG found no evidence of a relationship between annual recruitment levels of KGW to PPB and annual seismic levels, whether in the same year or lagged by multiple years. High recruitment of KGW was just as evident during years with high seismic activity or low seismic activity. **CGG has considered these claims and has added specific analyses for King George Whiting to the Acceptability Assessment within Appendix F3 (Acceptable Levels of Impact and Risk) to ensure all concerns have been investigated and the level of risk has been clarified according to the available evidence.** ***References:*** *Jenkins GP, Black KP, Hamer PA (2000) Determination of spawning areas and larval advection pathways for King George whiting in southeastern Australia using otolith microstructure and hydrodynamic modelling. I. Victoria. Marine Ecology Progress Series 199:231-42.* *Jenkins GP (2005) The influence of climate on the fishery recruitment of a temperate, seagrass-associated fish, the King George whiting Sillaginodes punctata. Marine Ecology Progress Series 288:263-71.*
F15	**Matter**: Impacts on lobster fisheries **Claim**: Not to mention my local community relies on the lobster fishing industry to provide many jobs in this area. **Claim**: This proposal is putting at risk out Southern Lobster fisheries. **Claim**: Not to mention my local community relies on the lobster fishing industry to provide many jobs in this area	CGG acknowledges claims around concerns for the impacts of the Regia MSS on the viability of the Southern Rock Lobster Fishery and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. Appendix B8 – Regia MSS Seismic Studies provides an assessment of seismic impacts to crustacean species as reported in the scientific literature, including studies on Southern Rock Lobsters (SRL). Impacts to SLR's is extensively addressed in Matter F10 above. Given the high profile and community concerns associated with SRL a further analysis was done (Appendix F3- Acceptability Assessments) which provides a more detailed and species-specific examination of what the likely level of seismic impacts are and whether population stability is threatened. The Acceptability Assessment identifies: • Mitigation of MSS effects to SRL can best be implemented by limiting the spatial boundaries of the survey to minimise interaction with areas of high SLR density and fishing activity, which is predominantly located shoreward of the 40m depth contour. Additionally, timing the MSS to avoid the June-September period when peurulis are settling is also advisable. The period after release of fertilised eggs is the preferred window as this is when natural mortality is extremely high and localised seismic effects are likely to be subsumed into this mortality schedule. SRL is a highly dispersed genetically homogenous population. A system such as this is extremely resistant to localised disturbances as it receives larvae each year from what is effectively, a 'bank' of SRL stretching across southern Australia. Commercial fishing statistics from the VFA 20/21 season Stock Assessment Report highlight that CPUE has almost tripled from 2009/10. The fishery is characterised as stable and healthy. With respect to the area where the proposed Regia MSS will operate it is lightly fished for SRL with only ~2% of total fishing days occurring within this area over the past 12 years which largely reflects the lack of suitable habitat within. CGG has considered these claims and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
F16	**Matter**: Impacts on abalone fisheries **Claim**: The impact upon commercial fisheries, such as Abalone, whose diet consists almost exclusively of seaweed (see recent research published Dr. Holland, Deakin university), has also not been noted. **Claim**: As has been highlighted in previous correspondence, submitter is concerned about the cumulative impact of the multiple surveys proposed for the Otway basin area in the coming years. Of particular concern is the impact that Marine Seismic Surveys (MSS) have on abalone during their early life stages, when they are most vulnerable to stressors. **Claim**: To date, there has been no research undertaken studying the impacts of MSS on abalone, juvenile or mature. **Claim**: We appreciate the measures taken by CGG where by seismic operations will not be undertaken in waters less than 50m to reduce	CGG acknowledges claims regarding impacts of the Regia MSS on Black Lip Abalone stocks and the associated fishery, and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on fisheries species has been completed. Additionally, CGG continue to monitor the relevant databases and websites to ensure new scientific information is captured as it comes to light. Potential impacts and risks to molluscs from underwater sound are described and assessed in the following sections of the EP: • Modelling Report Sound Emissions (Appendix B7a and B7b) provides a detailed numerical modelling study of underwater sound levels and their anticipated effects on relevant taxa and/or species. • Seismic Studies Summary (Appendix B8) provides a general review of seismic effects to all taxa of noted importance, including molluscs. • Impact Assessment – Underwater Sound: Invertebrates (Appendix E4) describes and assesses potential impacts and risks to molluscs from underwater sound generated by the Regia MSS. Mitigation measures will be implemented to significantly reduce impacts to abalone fisheries, including M#01: Activity Limitation, which stipulates no discharge of the sound source at full power in water depths of less than 50 m. This is protective for immobile or short ranging invertebrate species that are more likely to be present in water depth < 50 m.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	impacts on abalone, although we remain concerned about Abalone Viral Ganglioneuritis (AVG), and the potential of an outbreak as a stress response to seismic activity in the vicinity. This is a key concern for our industry noting this devastating virus has been directly responsible for in excess of $100 million in lost revenue. **Claim**: Notwithstanding, uncertainty remains with regard to how any MSS activity impacts mature blacklip abalone, juvenile blacklip abalone and their planktonic larvae. Until such time that this research has been completed, our members will not be fully satisfied that the impacts of any Marine Seismic Survey are non-detrimental to the abalone resource.	**Given concerns from abalone fishers about potential seismic effects, further assessment was done (see Appendix F3- Acceptability Assessments, Section 5.2.8) providing a more detailed species-specific examination of likely impacts.** Blacklip Abalone (*Haliotus rubra*) stocks in Victoria are in relatively poor condition having suffered greatly from disease and overfishing. In addition, the southeast coast of Australia is in a climate change 'hot-spot' where sea surface temperatures (SST's) are experiencing rapid warming at rates 3–4 times the global average. Increasing SST's are predicted to have negative impacts on the abundance of *H. rubra* in South coast waters. There has not been any direct testing of seismic effects on Abalone so a weight-of-evidence approach is utilised where results from testing on other molluscs, notably scallops and pearl oysters are used, Testing outcomes on scallops were consistent with studies on seismic effects to other invertebrates, with impacts clearly noted within very close proximity to seismic pulses (i.e. hundreds of metres) but then rapidly dissipating (see response to Matter F09). Estimated mortality rates in all cases remained well below natural mortality rates. A recent, major study into seismic effects on silverlip pearly oysters found no evidence of reduced productivity or mortality (Parsons et al. 2024). CGG do not therefore, find compelling evidence for a high likelihood of significant lethal or sub-lethal effects to abalone stocks from the proposed Regia MSS. As already stated, Abalone stocks are being influenced by climate, overfishing and disease and these remain the areas of concern. The fishery for *H. rubra* within Victoria is divided into three active commercial fishing zones (Western, Central and Eastern). Two of those zones (Western and Central) have suffered major recent declines due to the disease Abalone Viral Ganglioneuritis and the third from range expansion of an urchin species *Centrostephanus rodgersii* which overgrazes kelp beds (creating 'barrens' or underwater deserts) and indirectly impacts abalone and other associated species. The latest assessments for the Western Zone leading into the 2023/24 season indicate that catches are highly variable between locations, with the Portland Zone suffering most from the disease outbreak. The pelagic larval duration of abalone is short at ~10 days, however genetics studies have shown that abalone stocks along Victorias south coast are well connected with high levels of gene flow within and between reef patches. Gene flow and dispersal/connectivity are aided by the marine physical environment of the south coast, which is highly variable, driven by converging ocean currents, strong environmental gradients, habitat discontinuities and varying degrees of exposure to wave energy. The spawning/recruitment period for *H. rubra* falls within the Spring /Summer months from September to February with the peak from November – January. Given that many key species target the austral summer period for spawning and recruitment, CGG weights this period accordingly, when managing the scheduling and location of the proposed Regia MSS. **CGG has considered these claims, and is satisfied that through scheduling management of the proposed Regia MSS any potential interaction with abalone stocks can be minimised; and has conducted a further assessment on abalone in EP Appendix F3 (Acceptability Assessment), Section 5.2.8,which provides a more detailed species-specific examination of impacts.** ***References:*** *Parsons MJ, Barneche DR, Speed CW, McCauley RD, Day RD, Dang C, Fisher R, Gholipour-Kanani H, Newman SJ, Semmens JM, Meekan MG (2024) A large-scale experiment finds no consistent evidence of change in mortality or commercial productivity in silverlip pearl oysters (Pinctada maxima) exposed to a seismic source survey. Marine Pollution Bulletin 199:115480.*
F17	**Matter**: Impacts to dive-based fisheries **Claim**: It is necessary to ensure divers are not within the vicinity of any type of seismic activity. As has been suggested previously, this can be achieved simply by surveying outside daylight hours.	CGG acknowledges claims around concerns for impacts on diver-based fisheries from the Regia MSS. The Regia MSS EP: Appendix E8: Underwater Sound – Divers, provides an assessment of the effects of seismic activity on areas where swimmers, divers and/or surfers may be found. Based on feedback from community consultation about areas of concern, sound propagation modelling identified a number of areas where there was potential for received sound levels to exceed the (medically) recommended safe level of 145dB. **Further sound modelling has been undertaken to provide an appropriate response framework for minimising potential impacts to divers (EP Appendix B7b Sound Emissions Secondary Modelling Report).** **CGG has considered this claim and, based on the updated sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged from areas which result in an exceedance of the safety criterion for recreational divers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1, F3 G1, and G2.**
F18	**Matter**: Impacts on recreational fishers	CGG acknowledges claims around concerns for impacts on recreational fisheries from the Regia MSS and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP.

	THEME	FISH, SHARKS, INVERTEBRATES AND FISHERIES (F)
#	***Comments received***	***Titleholder response***
	Claim: I have serious concerns that this testing could have serious impacts upon recreational fisheries in the Warrnambool and Port Fairy region.	As stated in response to Matter F12, the Regia EP has provided extensive documentation and interpretation of potential impacts of seismic on marine fauna in the region (see Regia EP: Appendix B6, Appendix B7a and B7b, Appendix B8, Appendix E3 and Appendix F3). It follows that those species that are targeted by recreational fishers are commonly targeted by commercial fisheries. These fisheries are subject to management oversight and continual research and assessment. Results of such research demonstrate that overfishing remains the single biggest contributor to declining fisheries stocks. There is no evidence to support seismic testing, as proposed by the Regia MSS, having serious (i.e. measurable) impacts on recreational fishers in the Warrnambool and Port Fairy region. CGG reiterate that the Regia MSS EP, provides detailed and extensive analysis of seismic effects on groups and/or individual species all of which provide relevant information to adequately address recreational fishers concerns. In the event of the proposed Regia MSS operating when a fisher/s may be targeting the same area, there is a multiple layered system of communication available that will use spotter vessels and geospatial SMS coverage to reduce and/or remove potential impacts. CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no further changes have been made to the EP in response to these claims.
Other Matters Related to Fish, Sharks, Invertebrates and Fisheries		
F19	**Matter**: Impacts on migratory pathways **Claim**: **Claim**: The proposed operational area for the Regia MSS will likely conflict with migratory patterns of mature fish transitioning to spawning areas. In the case of King George Whiting (KGW), juveniles are known to migrate from bays and inlets in central Victoria to deeper water where they mature and reproduce within key spawning grounds in the West of the State4 . Adult Australasian Snapper migrate from deeper water into Victoria's largest estuary, Port Phillip Bay, to undertake spawning activity that supports the entire Western Victorian stock [5]. 5. Hamer PA and Jenkins GP. 2007. Migratory dynamics and recruitment of snapper, Pagrus auratus, in Victorian waters. FRDC Project No. 199/134. Primary Industries Research Victoria, Marine and Freshwater Systems, Queenscliff. **Claim**: It has been acknowledged that the potential for behavioural changes in fish exposed to seismic sources to alter distributions or migratory paths is poorly understood [6] making it difficult to assume a negligible impact of the proposed Regia MSS on population recruitment of species such as King George Whiting and Australasian Snapper. 6. Fewtrell J and McCauley R. 2012. Impact of air gun noise on the behaviour of marine fish and squid. Marine Pollution Bulletin, 64	CGG acknowledges claims around concerns for impacts on migratory pathways of some species from the Regia MSS and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. As stated in response to multiple other Matters, CGG has utilised all readily available scientific peer-reviewed literature and reporting from government agencies to ensure that a thorough assessment of potential seismic effects on fisheries species has been completed. Additionally, CGG continue to monitor the relevant databases and websites to ensure new scientific information is captured as it comes to light. As stated in response to Matters F14 and F15 and discussed within Regia MSS EP Appendix F3 (Acceptability Assessment), the risk level for the Proposed Regia MSS on King George Whiting (KGW) and Pink Snapper health has been assessed as minimal. This is based on extensive examination of the literature around seismic effects and life-history dynamics of each species. Nevertheless, in response to community feedback/concerns further interrogation of the literature was undertaken for KGW and Pink Snapper, amongst others. For these groups CGG defined acceptable levels of Impact and Risk to provide a clear framework for understanding what effects seismic might have on individual health and population-level health. In brief, the drivers of measurable population level impacts on KGW stocks remain regional climate patterns such as decadal wind changes, sea surface temperature (SST) changes and unmanaged commercial fishing or large-scale pollution of essential habitat. There was also no evidence of a relationship between annual recruitment levels of KGW to PPB and annual seismic levels, whether in the same year or lagged by multiple years. High recruitment of KGW was just as evident during years with high seismic activity or low seismic activity. For Pink Snapper, there was also no relationship between long-term recruitment levels and annual seismic levels, with research identifying local-scale processes (i.e. at the estuary level) as having more influence. CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no further changes have been made to the EP in response to these claims.
F20	**Matter**: Vessel collision with sharks **Claim**: The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017a mentioned in the plan identifies sharks as being vulnerable to vessel strikes, however the Plan makes no mention on how these strikes are to be avoided.	CGG acknowledges claims around concerns for sharks being at risk of vessel strikes from the proposed Regia MSS and has reviewed the Environment Plan (EP) to ensure that this was adequately considered within the EP. The Regia MSS EP: Appendix D2 – Collisions with Marine Fauna; Section 8 - Identification of Mitigation and Management Measures and Demonstration of ALARP, indicates that seismic vessel speed would be reduced to a maximum of 5 knots during acquisition periods which is recognised as good industry practice where fauna are undertaking important behaviours. The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna does not consider sharks to be an at-risk group from vessel strikes. Whale sharks, Cetaceans, Dugongs and Turtles are the most at-risk groups identified. CGG has considered this claim and is satisfied that the concerns raised were adequately addressed, for the reasons outlined above. As a result, no further changes have been made to the EP in response to these claims.

9. Birds

	THEME	BIRDS (B)
#	***Comments received***	***Titleholder response***
Key Matter: Little Penguins		
B01	**Matter**: Encounter rates and impacts on little penguins **Claim**: Little penguins breed from August to February and travel long distances to feed in continental shelf waters, making it highly likely that penguins will travel through the proposed blasting area. In contrast, the EP states that "encounter rates with little penguin[sic] in the Activity Planning Area is considered unlikely", and "seabirds spend very little time underwater", and that despite evidence that African penguins exhibit behavioural responses to seismic blasting, "impacts to birds from underwater sound emissions are not predicted and will not be evaluated further" (p.186). The EP should be refused based on this egregious failure to acknowledge not only the presence of penguin colonies in close proximity to the OA, but also the impacts that seismic blasting might have on these animals as they migrate and forage through the area. **Claim:** This proposal, if approved, poses an imminent threat to our [marine ecosystems and endangered marine species, including southern right whales, pygmy blue whales, Australian sea lions, and] little penguins. **Claim**: There are studies showing significant impacts on animals from seismic blasting, such as one that observed penguins affected who were 100km away from a seismic blasting site. Prohibit blasting within a minimum 100 km range plus precautionary principle buffer distance of Little Penguins. https://theconversation.com/are-seismic-surveys-driving-penguins-from-their-feeding-grounds-90864 **Claim**: Scientific research demonstrates that seismic blast noise travels over 100 km's in the oceans. The impact to marine life is well beyond the described zone in this EP. **Claim**: Despite evidence that African penguins exhibit behavioural responses to seismic blasting, the plan states that impacts to birds from underwater sound emissions are not predicted and will not be evaluated further https://www.wildlife.vic.gov.au/__data/assets/pdf_file/0023/91391/Little-Penguin.pdf **Claim**: Due to their largely aquatic existence and lack of flight ability, Little Penguins are expected to be more susceptible to effects from seismic blasting than other seabirds. **Claim**: Contact calls have been primarily recorded for penguins at the surface when at sea (Jouventin, 1982 and Bronti, 1985). As seismic testing may impair hearing ability, this may lessen an individual's ability to detect socially relevant signals which therefore could affect biologically important processes. **Claim**: There are significant concerns that seismic blasting will cause the disruption of essential behaviours for Little Penguin survival such as breeding, foraging, displacement from crucial habitat and physical injury including temporary or permanent hearing loss.	CGG acknowledges claims regarding impacts on Little Penguins and has reviewed the Environment Plan (EP) to ensure that these was adequately considered and addressed. The Preliminary Impact and Risk Assessment (PEIRA), prepared in March 2023 to support consultation, predicted that encounter rates with Little Penguins in the Activity Planning Area would be 'unlikely' and did not predict impacts to birds from underwater sound emissions. During relevant person consultation CCG learned more about the importance of Little Penguins and the presence of other colonies along the Victorian coastline. We also identified that, even though these colonies do not represent breeding or foraging Biologically Important Areas (BIAs), they are of significant value to local communities. Consequently, we committed to conducting an underwater sound impact assessment for Little Penguins which was included in EP Appendix 5 (Impact Assessment – Underwater Sound: Birds), Section 6 (Predicted Levels of Impact) which found: • Underwater sound modelling for Little Penguins did not predict any mortality or injury impacts, although the Temporary Threshold Shift (TTS) criteria was reached within 50 – 60 m of the source. However, it would be highly unlikely for a diving bird or penguin to be within that limited distance from the source, particularly given the use of soft starts. • Impacts to diving birds and penguins were predicted to be limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas, and would be expected to revert to normal foraging behaviours after the cessation of the survey, and • A temporary increase in foraging distances associated with a seismic survey is unlikely to have a significant impact on individual penguins or the population. CCG also included requirements for MMOs to spot for seabird activity, which would indicate a food source for Little Penguins rather than detect the penguins themselves, and for the seismic source to be reduced to the low power setting if foraging birds are within 500 m of the source. This will ensure that foraging birds are not startled by the seismic source and can continue to forage once the vessel has moved passed. Regarding claims around contact calls, referenced material (e.g., Broni 1985) state that penguins are highly vocal species that have been recorded to emit vocalisations at the sea surface, a behaviour possibly associated with group formation and group foraging, and suggest that it is likely they also communicate socially underwater. However, no evidence is provided. While assessing this claim a more recent study was found which assessed the emission of vocalisations underwater by three species of penguin (Thiebault et al. 2019). A total of 203 underwater vocalisations were emitted, 50% of which were directly linked to foraging behaviours. However, there was no recorded underwater vocalisations concomitantly to synchronised diving activity (even when such activity was recorded) and it is therefore unlikely that these vocalisations could have been used to coordinate feeding activities. Thiebault et al. (2019) concluded the function of vocalisations to be speculative and were unable to demonstrate the significance of the behaviour. Although this study provides first evidence of underwater vocalisations in penguin species, penguins species are anticipated to exhibit avoidance to impulsive sound sources (Pichegru et al. 2017). Regarding claims of effects out to 100 km, Pichegru et al. (2017) assessed the foraging behaviour of African Penguins before, during and after an MSS that occurred within 100 km of breeding colonies. Penguins foraging within 100 km of the active acoustic source showed a change in foraging direction, increasing the distance between feeding areas and the Seismic Vessel. Displaced penguins reverted to normal foraging behaviours following the cessation of seismic activities, suggesting effects are relatively short-lived. The avoidance behaviour by penguins observed in this study may be explained by either a direct disturbance from the noise generated by the operation or a change in fish distribution during that period (possibly because of seismic activities). Small-scale acoustic fish surveys assessing distribution and abundance of small pelagic fish in Algoa Bay around both penguin colonies did not show a significant change in distribution and/or abundance of small pelagic fish in the region in March 2013 compared to a few months prior to or after the seismic operations. Therefore, African Penguins likely relocated away from their traditional feeding zone to avoid the disturbance generated by the noise of the seismic vessels, rather than to follow their prey. It is important to note that the specific acoustic source used in the Pichegru et al. (2017) study had a total volume of 4,230 in^3 compared to the 2,820 in^3 proposed for the Regia MSS and this, along with a difference of bathymetry, would account for the smaller distances of 10.4km-72.6 km to the behavioural criteria for the Regia MSS. Consequently, the application of a 100 km distance for assessment of effect would be inappropriate. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References:*** *Broni, S. C. Social and spatial foraging patterns of the jackass penguin, Spheniscus demersus. South Afr. J. Zool. 20, 241–245 (1985).* *Pichegru, L., Nyengera, R., McInnes, A.M. et al. Avoidance of seismic survey activities by penguins. Sci Rep 7, 16305 (2017). https://doi.org/10.1038/s41598-017-16569-x*

	THEME	BIRDS (B)
#	***Comments received***	***Titleholder response***
	https://www.nzherald.co.nz/nz/seismic-surveys-could-be-hurting-penguins-experts/ KEB5TG25QPAQLUVL7DW4SIFFCQ/ https://theconversation.com/are-seismic-surveys-driving-penguins-from-their-feedin g-grounds-90864 https://www.nature.com/articles/s41598-017-16569-x **Claim**: In addition to the impacts on marine mammals, the proposal neglects to adequately address the potential consequences for other marine species, such as [pinnipeds and] penguins. Endangered species like [Australian sea lions and] little penguins are at risk of significant harm from seismic activities in their habitats, yet the EP fails to implement adequate measures to protect these vulnerable populations.	*Thiebault A, Charrier I, Aubin T, Green DB, Pistorius PA. 2019. First evidence of underwater vocalisations in hunting penguins. PeerJ 7:e8240 https://doi.org/10.7717/peerj.8240*
B02	**Matter**: Acknowledgement of breeding colonies **Claim**: Little penguins are an EPBC-listed marine species endemic to Australia and New Zealand. They have breeding and foraging BIAs within the Environment Planning Area. The EP fails to acknowledge the breeding colonies present at Middle Island (Warrnambool), Port Campbell/London Bridge, and Gibson Steps near the Twelve Apostles. **Claim**: FAIRY PENGUINS – There are a number of breeding colonies along the Western Victoria coastline: Middle Island (Warrnambool) - a breeding colony which is of great significance to the township of Warrnambool. It already has significant challenges with fox predation. They made a movie out of the wonderful achievement of the community saving the colony using a maremma dog! "Oddball". Any adverse effects from seismic blasting will add negatively to their already challenging living and breeding situation. **Claim**: The Environment Plan identifies areas important for breeding and foraging for the Little Penguin and their presence around King Island on page 186, however it is important to note the Warrnambool (Middle Island) breeding colonies have not been recognised in the Plan, which incorrectly states that the Little Penguin is outside of the Activity Planning Area. **Claim**: Recommendations: Recognise the Middle Island Little Penguin population, and consider them during the development of risk evaluation and management strategies.	CGG acknowledges claims regarding Little Penguin breeding colonies and has reviewed the Environment Plan (EP) to ensure that impacts to the identified colonies were adequately assessed. During relevant person consultation CCG learned more about the importance of Little Penguins and the presence of other colonies along the Victorian coastline. Relevant persons consultation is intended to identify additional environmental values and sensitivities that we would not otherwise be aware of. This proved effective in capturing this information that was not available via the federal government's Species Profile and Threats (Database) Tool (SPRAT) as this species is not listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999 nor the Victorian Flora and Fauna Guarantee Act. Information on the Middle Island and Deen Maar (Lady Percy Island) colonies is included in Appendix E5 (Impact Assessment – Underwater Sound: Birds) and Appendix D4 (Accidental Release of Fuel). CCG identified that, even though these colonies do not represent breeding or foraging Biologically Important Areas (BIAs), they are of significant value to local communities. Consequently, CCG committed to conducting an underwater sound impact assessment for Little Penguins which was included in EP Appendix 5 (Impact Assessment – Underwater Sound: Birds), Section 6 (Predicted Levels of Impact). In summary, this assessment found: • Underwater sound modelling for Little Penguins did not predict any mortality or injury impacts, although the Temporary Threshold Shift (TTS) criteria was reached within 50 – 60 m of the source. However, it would be highly unlikely for a diving bird or penguin to be within that limited distance from the source, particularly given the use of soft starts. • Impacts to diving birds and penguins were predicted to be limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas, and would be expected to revert to normal foraging behaviours after the cessation of the survey, and • A temporary increase in foraging distances associated with a seismic survey is unlikely to have a significant impact on individual penguins or the population. Studies by Hoskins et al. (2008) show that Little Penguins were found to forage in discrete areas within a maximum distance of 5.6 km to 36 km from breeding colonies while travelling total distances of 17.7 to 80.4 km. A study by McCutcheon et al. (2011) reported that during the winter non-breeding period, some individuals conduct single-day trips of between 8 – 14 km from the colony, while other individuals conducted longer trips of 2 – 49 days with maximum distances of 62–147 km with movements generally alongshore and within continental shelf waters. Poupart et al (2017) noted that while primarily an inshore forager, Little Penguins had a range generally limited to 30 km of breeding sites during the nesting period but some nesting birds travelled up to 214 km to feed. Whilst the noise EMBA for behavioural disturbance may overlap Little Penguin foraging areas, studies have shown that Little Penguins are capable of foraging over large distances. In addition, any behavioural disturbance caused by the Regia MSS will be short-term and temporary. Although other colonies, such as those mentioned in the claims, are not specifically listed, the EP does state that the species occurs from Western Australia (Carnac Island) to New South Wales (Broughton Island) and Tasmania but that the distribution is not continuous, with sections of the southern coast of Australia without occurrence of breeding colonies (CoA 2020a). Declared Biological Important Areas (BIAs) for Little Penguins, shown in Figure MAP-REG-EPM-064, are located well outside of the operational area. CGG has considered these claims and is satisfied that the concerns raised in relation to underwater noise emissions have been adequately addressed in the EP, for the reasons outlined above. **However, for information the noise EMBA has been added to Figure MAP-REG-EPM-064 to show that the declared BIAs occur outside of the noise EMBA.** **In addition, during the review of EP Appendix E9 (Impact Assessment – Light Emissions), it was identified that impacts associated with light were assessed for declared biologically important areas (BIAs), i.e. those near King Island, and that impacts to Little Penguins at other locations such as Middle Island and Deen Maar (Lady Julia Percy Island) were not explicitly addressed. Consequently, CGG has included additional detail in EP**

	THEME	**BIRDS (B)**
#	***Comments received***	***Titleholder response***
		Appendix E9, Section 5.1.5 (Little Penguin) and 6.1.1 (Birds) and to assess impacts to breeding colonies at Middle Island and Deen Maar and other coastal locations in response to these claims. ***References*:** *Hoskins A, Dann P, Ropert-Coudert Y, Kato A.C, Costa A and Arnould J (2008). Foraging behaviour and habitat selection of the little penguin Eudyptula minor during early chick rearing in Bass Strait, Australia. Marine Ecology-Progress Series. 366. 293-303. 10.3354/meps07507.* *McCutcheon, C., Dann, P., Salton, M., Renwick, L., Hoskins, A. J., Gormley, A. M., & Arnould, J. P. Y. (2011). The foraging range of Little Penguins (Eudyptula minor) during winter. Emu - Austral Ornithology, 111(4), 321–329. https://doi.org/10.1071/MU10078* *Poupart TA, Waugh SM, Bost C, Bost C-A, Dennis T, Lane R, Rogers K, Sugishita J, Taylor GA, Wilson KJ, Zhang J, Arnould JPY (2017) Variability in the foraging range of Eudyptula minor across breeding sites in central New Zealand. New Zealand Journal of Zoology 44(3):225-244*
B03	**Matter**: Impacts on prey species **Claim**: Protect the West members request that Regia guarantees that the local penguin population, which is dependent upon sardines in the region, would not be affected by seismic testing and destruction of their food source. **Claim**: As well as being potentially affected directly, their food supply may well be impacted by seismic blasting too, whether directly or in a flow-on effect up the food chain from zooplankton being killed in the Operating Area.	CGG acknowledges claims regarding impacts on prey for Little Penguins and has reviewed the Environment Plan (EP) to ensure that impacts to the prey species were adequately assessed. As stated in EP Appendix E (Impact Assessment – Underwater Sound: Birds), Little Penguins are a generalist feeder, with large variability in diet amongst colonies and even between years at the same colony. They feed mainly on clupeids, such as anchovy and sardines, when feeding chicks, but they may also feed on krill and several species of cephalopods at all stages of breeding (CoA 2020a). Impacts to prey species, such as krill (*Nyctiphanes australis*), are expected to be limited by intermittent exposure, dispersive characteristics of the open water in the operational areas, and high reproductive rates. The magnitude of noise impacts on species such as krill, will be highly localised with mortality and sub-lethal injury limited to within tens of metres of seismic sources as detailed in Appendix E2 (Impact Assessment Underwater Sound: Plankton). Impacts will be not be discernible at the regional scale when considering natural variation in their spatial and temporal abundance. Continuous reproduction through the year coupled with a high growth rate means krill have very high productivity (IMAS 2011). Considering the localised and temporary impact to krill with rapid replacement of the species, any impacts from short term activities are not expected to be ecologically significant. If plankton species are impacted, localised predicted impacts to plankton do not remove them from the food web. Nutrients and energy they contain are retained in the water column for several days as their carcasses remain are likely scavenged before any remaining matter sinks to the seafloor to be consumed by opportunistic benthic organisms (Kirillin et al. 2012, Tang et al. 2014, Dubovskaya et al. 2015). Thus, impacts to primary production and ecosystem function are not predicted. Mortality or physiological damage to other prey species such as cephalopods (squid) is not predicted with impacts limited to behavioural startle response and potentially inking. Therefore, long term population impacts to this prey species are not expected. For fish species considered prey for the Little Penguin, it is highly unlikely that there would be physical damage as a result of the Regia MSS unless the animals are very close to the source (perhaps within a few meters). However, if temporary threshold shift (TTS) does take place, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, accumulation of energy for fish species, over longer periods than a few hours, is probably not appropriate. The distribution of spawning areas for sardines is extensive across the south and southeast coast and connected at a much larger scale than the Regia MSS area with the scale of any effects to the spawning output of sardines across the greater region expected to be immeasurable. Therefore, long term population impacts to this prey species are also not predicted. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References***: *Citation: Dubovskaya OP, Tang KW, Gladyshev MI, Kirillin G, Buseva Z, Kasprzak P, et al. (2015) Estimating In Situ Zooplankton Non-Predation Mortality in an Oligo-Mesotrophic Lake from Sediment Trap Data: Caveats and Reality Check. PLoS ONE 10(7): e0131431. doi:10.1371/journal. pone.0131431* *IMAS (Institute for Marine and Antarctic Studies) (2011) 'Zooplankton, Nyctiphanes australias', IMAS, University of Tasmania, Hobart.* *Kirillin G, Grossart H-P, Tang KW. Modeling sinking rate of zooplankton carcasses: Effects of stratification and mixing. Limnol Oceanogr 2012; 57: 881–894.* *Tang KW, Gladyshev MI, Dubovskaya OP, Kirillin G, Grossart H-P. Zooplankton carcasses and nonpredatory mortality in freshwater and inland sea environments. J Plankton Res 2014; 36: 597–612.*
B04	**Matter**: Cumulative impacts on little penguins and their habitat **Claim**: The effect of continued seismic testing operations by multiple companies, over a sustained period could have a significantly detrimental effect on the penguin population, their foraging habits and their welfare. Further studies and monitoring must be undertaken to	CGG acknowledges claims regarding cumulative impacts on Little Penguins and their habitat and has reviewed the Environment Plan (EP) to ensure that cumulative impacts were appropriately considered. EP Appendix E10 (Otway Cumulative Impact assessment) did not identify any cause-effect pathway for cumulative impacts associated with the Regia MSS and one other reasonably foreseeable future seismic survey located in waters off the continental shelf. The Regia MSS is a short-term, temporary activity that

	THEME	BIRDS (B)
#	***Comments received***	***Titleholder response***
	assess the welfare of the penguins as a result of sustained seismic testing by multiple operators. **Claim**: Recommendation: Undertake further studies and monitoring, to assess the welfare of the penguins as a result of sustained seismic testing by multiple operators in the same area.	is not 'sustained' over an extended duration and no other surveys are proposed to occur in the 'same' area'. Further, CGG will implement the industry standard control of a 40 km separation distance between operating seismic sources. The commitment from CGG and other operators in the region to maintain a separation between activities of 40 km results in a low likelihood of cumulative effects. When coupled with the unlikely concurrence of the Regia MSS with the other survey, the overall cumulative impact is considered low. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
B05	**Matter**: Additional controls near little penguins and their colonies **Claim**: Fairy Penguins forage at NIGHT! (As I have already informed you on the Social Pinpoint map). They would be impossible to spot and prone to harm with any seismic blasting within their range. The plan to turn down the seismic blasting sound level as detailed in your Environmental Plan, if and when Fairy Penguins are spotted, is ridiculous. Even if it was broad daylight, they would be hard to see, being underwater swimmers and so small. **Claim**: Marine Mammal Observers will be useless in locating any in the suggested way of noting the presence of seabird activity to maybe indicate a food source. The suggestion is preposterous. They won't be out and about in broad daylight. The only way I can see is to not seismic blast at night within Fairy Penguin colony foraging areas. This would be an extreme minimum of 20km from the colonies, plus whatever the safe distance is from the blast source for them.	CGG acknowledges claims regarding additional controls near Little Penguins and their colonies and has reviewed the Environment Plan (EP) to ensure that measures to protect this species were appropriately considered. As detailed in response to Matter: B01, there are no predictions of harm i.e., injury, to seabirds, including Little Penguins, as a result of seismic noise with underwater sound impact assessment included in EP Appendix 5 (Impact Assessment – Underwater Sound: Birds), Section 6 (Predicted Levels of Impact) which found: • Underwater sound modelling for Little Penguins did not predict any mortality at any distance from the source, although the Temporary Threshold Shift (TTS) criteria was reached within 50 – 60 m of the source. However, it would be highly unlikely for a diving bird or penguin to be within that limited distance from the source, particularly given the use of soft starts. • Impacts to diving birds and penguins were predicted to be limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas, and would be expected to revert to normal foraging behaviours after the cessation of the survey, and • A temporary increase in foraging distances associated with a seismic survey is unlikely to have a significant impact on individual penguins or the population. Seabird activity associated with aggregations of prey typically involve multi-species and CCG believe these would be visible within near distances (i.e. 300-500 m) depending on the elevation of the bridge of the vessel. It is understood that most penguins return to their colony at night, however during summer, most of the adults are out at sea feeding for the next breeding. Whilst the noise EMBA for behavioural disturbance may overlap Little Penguin foraging areas, studies have shown (as detailed in response B02), that Little Penguins are capable of foraging over large distances and multiple locations with any behavioural disturbance by the Regia MSS being short-term and temporary. CGG has committed to reducing the seismic source to the low power setting if foraging birds are within 500 m of the source, with full power recommencing when the seismic source is > 500 m from any foraging birds. This measure was adopted in response to feedback from consultation as detailed in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds). The objective of this control is to mitigate startle response. Whilst CCG recognise this measure is only effective in daylight hours, the adopted control measures reduce the likelihood of interactions with marine fauna and are considered effective and appropriate to the nature and scale of predicted environmental impacts. In accordance with the control measures set out within the EP, the Regia MSS will be managed so that the potential impacts and risks will be mitigated to ALARP and Acceptable Levels in accordance with all environmental regulatory requirements. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
B06	**Matter**: Additional studies and regulation **Claim**: Recommendations: Request comprehensive studies into the effects of seismic blasts on Little Penguins and their prey species; Establish regulatory thresholds to assess potential hearing impairment or behavioural responses by diving birds to underwater noise. **Claim**: NOPSEMA should reject the Environment Plan by CGG if a safe plan for the Fairy Penguin colonies is not formed. This should be in conjunction with knowledgeable penguin scientists from Victoria that are familiar with the colonies.	CGG acknowledges claims regarding additional studies and regulations on Little Penguins and has reviewed the Environment Plan (EP) to ensure that this was appropriately considered. CGG considers that EP Appendix E5 (Impact Assessment – Underwater Sound: Birds), along with previous responses to Matters B01- B05, provide sufficient justification that predicted impacts to diving birds and penguins will be temporary / reversible and small-scale behavioural response that are likely to be within natural variation of foraging behaviours. CGG is not in authority to set regulatory thresholds. However, through the ALARP process and as detail is responses to Matters: B01 – B05, CGG believes it has shown sufficient justification that there will be negligible residual consequences associated with noise emissions to seabirds, including Little Penguins. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
Key Matter: Shearwaters		
B07	**Matter**: Acknowledgement of breeding colonies	CGG acknowledges claims regarding information on additional shearwater colonies and has reviewed the Environment Plan (EP) to ensure that the claims are appropriately considered.

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	Claim: The Environment Plan recognises the shearwater breeding grounds at Lady Julia Percy Island but fails to recognise the colony at Middle Island, Warrnambool. **Claim:** Recommendation: Recognise the Middle Island shearwater population and consider them during the development of risk evaluation and management strategies.	EP Appendix E5 (Impact Assessment – Underwater Sound: Birds), Section 4.7 (Shearwaters) acknowledges that Short-tailed Shearwaters are common in the South-east Marine Region and largely found on numerous islands off Victoria and Tasmania during breeding (Baker and Hamilton 2013, Skira et al. 1996). Section 4.7 has been updated to include specific mention of the Short-tailed Shearwater colony on Middle Island, Victoria. This amendment does not affect impact assessment which did not predict mortality or injury for birds, with impacts to diving birds limited to temporary behavioural impacts such as startle response or moving away from the seismic survey to forage in other areas, being reversible and likely within natural variation of foraging behaviours. **<u>CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, the Short-tailed Shearwater colony on Middle Island has been added to EP Appendix E5 (Impact Assessment – Underwater Sound: Birds), Section 4.7, however, no changes have been made concerning the impact assessment in response to these claims.</u>** ***References***: *Baker B & Hamilton S. (2013). South-east Marine Region — Review of Biologically Important Areas [for EPBC-listed seabirds]. Reports I and II. Unpublished reports to the Department of Sustainability, Environment, Water, Population and Communities. Latitude 42 Environmental Consultants Pty Ltd, Hobart.* *Skira IJ, Brothers NP and Pemberton D. (1996). Distribution, abundance and conservation status of Short-tailed Shearwaters Puffinus tenuirostris in Tasmania, Australia. Marine Ornithology 24:pp 1–14.*
B08	**Matter**: Underwater sound impacts on shearwaters **Claim**: The Short Tailed Shearwater colony at Griffiths Island are a significant species for the township of Port Fairy. They arrive late Sept and stay until April, before their huge migration. Shearwaters feed on tiny crustaceans in the zooplankton, small fish and squid. They immerse their heads before diving up to 20m deep in search of prey. Foraging from just before sunrise through to sunset, both near and far from their nesting colony, they wouldn't necessarily be easy to spot and in such numbers, they would be nigh on impossible to avoid harming whilst underwater, when in the vicinity of the blasting. **Claim**: Recommendation: Request comprehensive studies into the effects of seismic blasts on all relevant shearwater populations.	CGG acknowledges claims regarding impacts to shearwaters and their prey and has reviewed the Environment Plan (EP) to ensure that these impacts were adequately assessed. The Wildlife Conservation Plan for Seabirds (CoA 2020) does not identify underwater sound as a threat to these species. However, an assessment of potential impacts associated with underwater sound as been conducted in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds). Section 4.7 provides information on the behaviours and distribution of shearwaters. As explained in EP Appendix E5, there are no regulatory thresholds for underwater sound for bird species with other carnivores in water (OCW), from Southall et al. (2019), used as a proxy. This hearing group has been selected for assessment within the EP, due to similar hearing sensitivity in the frequency bands of underwater hearing for diving birds and otariid pinnipeds. Similarly, as there are also no regulatory thresholds or criteria established to assess potential behavioural responses by diving birds to underwater sound, an onset criterion for behavioural responses of 120 dB re 1 μPa (SPL) for impulsive sources was used based on information from Sørensen et al. (2020). The impact assessment demonstrated that permanent threshold shift criteria were not reached, and temporary threshold shift criteria were only reached within 50 – 60 m of the sound source. Consequently, injury to diving shearwaters is not predicted, with impacts limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas. CGG considers that EP Appendix (Impact Assessment – Underwater Sound: Birds) demonstrates sufficient justification that predicted impacts will minor, with no long-term, serious, or irreversible impacts to seabirds. **<u>CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, the Short-tailed Shearwater colony on Griffiths Island has been added to EP Appendix E5 (Impact Assessment – Underwater Sound: Birds), Section 4.7; however, no changes have been made concerning the impact assessment in response to these claims.</u>** *<u>References:</u>* CoA (2020). Wildlife Conservation Plan for Seabirds, Commonwealth of Australia 2020. Accessed at: <https://www.dcceew.gov.au/environment/biodiversity/publications/wildlife-conservation-plan-seabirds-2022> *Sørensen K., Neumann C., Dähne M., Hansen K.A., Wahlberg M, "Gentoo penguins (Pygoscelis papua) react to underwater sounds" Royal Society Open Science, vol. 7, no. 2, Feb. 2020.* *Southall, B.L., Finneran, J.J., Reichmuth, C., Nachtigall, P.E., Ketten, D.R., Bowle,s A.E., Ellison, W.T., Nowacek, D.P., Tyack, P.L., (2019). 'Marine Mammal Noise Exposure Criteria: Updated Scientific Recommendations for Residual Hearing Effects'. Aquatic Mammals 45(2): 125-232.*
B09	**Matter**: Impacts on prey species **Claim**: The shearwaters' food supplies would be affected by the seismic blasting and could have a substantial effect on the health of the adult birds and their chicks.	CGG acknowledges claims regarding impacts on prey species for shearwaters and has reviewed the Environment Plan (EP) to ensure that these impacts were adequately assessed. Shearwater feed on fish particularly mycotphids, crustaceans, squid, cephalopods, insects, jellyfish and prawns (DCCEEW 2023, Weimerskirch and Cherel 1998). EP Appendix E3 (Impact Assessment – Underwater Sound: Fish) predicts a minor effect level on fish, including potential prey species for shearwaters, as impacts are not considered significant or at a level to affect the population. Any behavioural impacts are likely to be short-lived as fish would return to normal behaviours once the vessel has moved away based on research by Miller and Cripps (2013) and Wardle et al. (2001). EP Appendix E4 (Impact Assessment – Underwater Sound: Invertebrates) predicts a negligible effect level on invertebrates including potential prey species such as crustaceans and squid. Impacts will be localised and temporary.

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		Information has been added to EP Appendix E5 Section 6 on the assessment of impacts associated with increased energy expenditure of shearwaters at sea to locate food as follows: **Seabirds feed on multiple prey species and have widespread foraging areas. Indirect impacts including displacement of prey species such as fish will be limited to the close proximity of the sound source. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past. Given their widespread foraging areas (ACAP 2020) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities.** ***References:*** *ACAP. 2020. ACAP Species Assessment. Agreement on the Conservation of Albatrosses and Petrels, Last updated September 2020. www.acap.aq.* *DCCEEW 2023. Ardenna pacifica, Wedge-tailed Shearwater -- Species Profile and Threats Database. Department of Climate Change, Energy, the Environment and Water.* *Miller IR and Cripps E. 2013. Three-dimensional marine seismic survey has no measurable effect on species richness or abundance of a coral reef associated fish community. Marine Pollution Bulletin, 77(1-2), 63-70. 10.1016/j.marpolbul.2013.10.031.* *Wardle CS, Carter TJ, Urquhart GG, Johnstone ADF, Ziolkowski AM, Hampson G and Mackie D. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21: 1005-1027.* Weimerskirch, H. & Cherel, Y., 1998. Feeding ecology of short-tailed shearwaters: breeding in Tasmania and foraging in the Antarctic? Marine EcologyProgress Series, 167: 261-274.
B10	**Matter**: Consideration of multiple species **Claim**: Recommendations: Ensure that where multiple subspecies share the habitat, for example Sooty Shearwaters and Short tailed Shearwaters, the impacts on both are evaluated as there may be differences in the risks and impacts based on behaviours, habitat and vulnerability status of the different subspecies.	CGG acknowledges claims regarding impacts on multiple species, particularly when they share habitats, and has reviewed the Environment Plan (EP) to ensure that impacts to these species were adequately assessed. CGG recognises that although species may belong to the same genus, they may display different behaviours (i.e. movement patterns, prey or habitat preferences) or be susceptible to different threats. The Short-tailed Shearwater was specifically identified in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds) as this species was identified to have a foraging Biologically Important Area (BIA) that overlaps the operational area, with the Protected Matter Search Tool (PMST) (DCCEEW 2024) reporting that breeding is known to occur within the Light Environment that May Be Affected. Whereas, foraging and breeding BIAs identified for the Sooty Shearwater are located on the southern coast of Tasmania and NSW which are hundreds of kilometres from the operational area. BIAs are designed to inform decision making about actions which may impact protected marine species. Therefore, as the Short-tailed Shearwater has BIAs located within the operational area it was assessed as a higher priority species. Regardless of potentially different lifestyle characteristics of the two species, considering they are subspecies, any control measure or mitigation approach that has been applied to protect the Short-tailed Shearwater will also subsequently protect the Sooty Shearwater. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. ***References:*** *DCCEEW 2024. Protected Matter Search Tool. Department of Climate Change, Energy, the Environment and Water. Available at <https://pmst.awe.gov.au/ >*
B11	**Matter**: Light and collision impacts on shearwaters **Claim**: A further example is the impact of artificial light on shearwaters. The management plan appears to summarise the risk management as applying inward facing lights where possible, and a statement that they are then no worse than other boats. Aiming to simply cause no more harm than others is not an adequate risk management strategy. **Claim**: Investigate the cumulative impacts of artificial lighting on migratory shorebirds' populations. **Claim**: Collision and strike risk is also an issue where lit structures intersect flight paths when foraging and during migration (Collins et al., 2022). Despite the plan referencing the impacts on shearwaters, the plan does not adequately address or offer solutions on how to mitigate these issues. Specify the control measures needed to reduce the	CGG acknowledges claims regarding impacts associated with light and risks associated with vessel collision (ship strike) and has reviewed the Environment Plan (EP) to ensure that these impacts and risks to shearwaters were adequately assessed. The control measures associated with industry best practice are considered appropriate to ensure the environmental impacts relating to light emissions from survey vessels are considered to be ALARP and at Acceptable Levels; these control/mitigation measures are provided in EP Appendix EP (Impact Assessment – Light Emissions). In addition, contracted vessels are require to have Light Management Plan to minimise light emissions while meeting vessel navigational requirements, in consideration of the National Light Pollution Guidelines for Wildlife. Light emissions will be reduced to a level where wildlife will not be disrupted within, nor displaced from, important habitat; and will be able to undertake critical behaviours such as foraging, reproduction and dispersal. All incidents involving seabirds will be recorded and reported, and handling and release procedures will be detailed within the Light Management Plan. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

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	impact of seismic vessels and towed vessels for shearwater populations.	
Key Matter: Diving Seabirds		
B12	**Matter**: Impacts to diving birds and their prey **Claim:** Recommendation: Reassess the risk to albatross and giant petrels given the close relationships between prey distribution, energetic costs and breeding success. **Claim:** Recommendation: Review and address potential impacts to the life history of albatrosses and petrels. The survey should not overlap with breeding or important breeding related foraging times for these protected species. **Claim**: Whilst CGG addresses the potential for seabirds to be on the surface or above the water (leading to reduced impacts), they have failed to thoroughly address details of diving birds. CGG have failed to identify two important considerations for birds utilising the area, and potential shift in their food source due to the presence of seismic activity: 1) mitigation efforts to prevent harm to diving birds, and 2) sea birds reliance on food sources. **Claim**: In the case of the Albatross, it has been found that changes in food distribution, leading to increased foraging times, has resulted in lower reproductive outcomes for populations with increased energetic expenditures (Thorne et al., 2015). Therefore, the statement that reduced foraging within the vicinity of seismic operations would minimise impacts to these species is false and holds substantial flaws. **Claim**: Given the lack of knowledge on the direct impacts of seismic noise on sea birds, it is impossible to determine a range that is adequate to minimise physiological impacts to seabirds. Therefore, a few key points should be considered, for example, sea birds are able to travel very long distances to forage and find prey, and diving is the primary mechanism used to do this. **Claim**: Furthermore, within the predicted levels of impact on birds, CGG state (without reference) “mortality and injury impacts are not predicted for birds” and suggest that seabirds may be startled by the presence of a vessel, therefore fly away, and cease diving activities. This assumption is not supported by peer-reviewed literature. **Claim**: Request studies into the effects of seismic blasts on fish behaviours and populations. **Claim**: Request studies into the impacts of a reduction in fish populations in the Operational Area on ocean health, biodiversity and environment. **Claim**: Request studies into the impacts of a reduction in fish populations in the Operational Area on other marine animals and birds with whom they may share a symbiotic relationship.	CGG acknowledges claims regarding impacts to diving birds and their prey and has reviewed the Environment Plan (EP) to ensure that these impacts were adequately assessed. The National Recovery Plan for Albatrosses and Petrels (CoA 2022) does not identify underwater sound as a threat to these species. However, an assessment of potential impacts associated with underwater sound as been conducted in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds). Section 4.1 provides information on the behaviours and distribution of albatrosses and petrels, with all waters within Australian jurisdiction being considered foraging habitat, and the most critical foraging habitat being waters south of latitude 25° where many species spend much of their foraging time (CoA 2022). Further, the breeding season of albatrosses and petrels is typically protracted. As explained in EP Appendix E5, there are no regulatory thresholds for underwater sound for bird species with other carnivores in water (OCW), from Southall et al. (2019) used as a proxy. This hearing group has been selected for assessment within the EP, due to similar hearing sensitivity in the frequency bands of underwater hearing for diving birds and otariid pinnipeds. Similarly, as there are also no regulatory thresholds or criteria established to assess potential behavioural responses by diving birds to underwater sound, an onset criterion for behavioural responses of 120 dB re 1 µPa (SPL) for impulsive sources was used based on information from Sørensen et al. (2020). The impact assessment demonstrated that permanent threshold shift criteria were not reached and temporary threshold shift criteria were only reached with 50 – 60 m of the sound source. Consequently, injury to diving birds is not predicted, with impacts limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas. Regarding impacts to prey species, albatrosses feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP 2020). Petrel species feed on small fish, cephalopods (octopus, squid and cuttlefish) and crustaceans. EP Appendix E3 (Impact Assessment – Underwater Sound: Fish) predicts a minor effect level on fish including potential preys species, as impacts are not considered significant or at a level to affect the population, with any behavioural impacts likely to be short-lived as fish would return to normal behaviours once the vessel has moved away based on research by Miller and Cripps (2013) and Wardle et al. (2001). EP Appendix E4 (Impact Assessment – Underwater Sound: Invertebrates) predicts a negligible effect level on invertebrates including potential preys species such as octopus and squid. Impacts will be localised and temporary, and octopus and squid have the capacity to recover from the impact without significant harm. **<u>Information has been added to EP Appendix E5 on the assessment of impacts associated with increased energy expenditure at sea to locate food as follows:</u>** **<u>Seabirds feed on multiple prey species and have widespread foraging areas. Indirect impacts including displacement of prey species such as fish will be limited to the close proximity of the sound source. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past. Given their widespread foraging areas (ACAP 2020) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities.</u>** ***References:*** *ACAP. 2020. ACAP Species Assessment. Agreement on the Conservation of Albatrosses and Petrels. Last updated September 2020. www.acap.aq.* *Miller IR and Cripps E. 2013. Three-dimensional marine seismic survey has no measurable effect on species richness or abundance of a coral reef associated fish community. Marine Pollution Bulletin, 77(1-2), 63-70. 10.1016/j.marpolbul.2013.10.031.* *Wardle CS, Carter TJ, Urquhart GG, Johnstone ADF, Ziolkowski AM, Hampson G and Mackie D. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21: 1005-1027.*
B13	**Matter**: Consideration of olfactory foraging in seabirds **Claim**: The proponent has also failed to address olfactory foraging in seabirds, it is known that many sea birds use scents (sometimes known	CGG acknowledges claims regarding olfactory foraging in seabirds and has reviewed the Environment Plan (EP) to ensure that impacts to these species were adequately assessed.

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	as chemical tracers) to help find food and follow migration pathways, this works by a combination of scents from other species and wind directions and a variation of flight patterns by the individual to efficiency utilise this mechanism. The sudden displacement of prey could negatively impact this process in both migrating and foraging birds, which has not been assessed within the EP. **Claim**: Depending on the species, life history, and reproductive habits, impacts to olfactory foraging and migration could have varying results at a population level, a topic that CGG has also not addressed.	Seabirds have the ability to travel vast distances including across oceans or continents in order to perform biologically important behaviours such as migration, breeding or foraging. Many seabirds, particularly in the order Procellariiformes utilise a range of environmental cues, including their olfactory senses, to assist with foraging and navigational activities (Van Buskirk and Nevitt, 2007; Reynolds et al., 2015). Research suggests that navigational activities are often linked to olfactory cues influenced by naturally released odours when prey such as phytoplankton are consumed by zooplankton. This initially elevates the concentration of compounds on the water surface before becoming airborne enabling detection by seabirds alerting them to a potentially productive foraging location (Nevitt, 2000; Van Buskirk and Nevitt, 2007). However, airborne odour concentrations are highly intermittent due to the presence of atmospheric turbulence, and, as a result, olfactory cues for navigation will not always be present (Reynolds et al., 2015). Considering the characteristic metocean conditions of the Otway Basin atmospheric turbulence is expected to be a common natural influence on the ability of seabirds to utilise olfactory cues in detecting prey assemblages. Further, outside of upwelling events, prey resources are often dispersed patchily throughout species foraging ranges. Activities associated with Regia MSS will not result in the displacement of prey across the entire foraging range and seabirds will be able to continue to utilise olfactory cues to detect prey away from the Regia MSS survey vessel. Any displacement of prey by the proposed activity will be short term and temporary and is therefore not expected to cause population level impacts to seabirds foraging or navigational habits. Impacts to prey populations such as small fish and zooplankton have been assessed in Themes: Fish, Sharks, Invertebrate and Fisheries; and Productivity. In summary, although seismic activities can cause lethal and sub-lethal effects to animals within proximity to the seismic pulses, these types of responses decrease with distance from the seismic source and are not rigid. The scale of lethal or sub-lethal effects measured across multiple scientific studies and species indicates seismic effects are significantly lower than natural rates of mortality (~variation) to be found in regional populations and will be immeasurable in this context. Further, there has been no evidence to support the proposed Regia MSS operational area or underwater sound EMBA for fish being a "critical" area for populations of fishes and invertebrates and therefore is not expected to cause population-level effects. **Information has been added to EP Appendix E5 on the assessment of impacts associated with foraging as follows:** **Seabirds feed on multiple prey species and have widespread foraging areas. Indirect impacts including displacement of prey species such as fish will be limited to the close proximity of the sound source. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past. Given their widespread foraging areas (ACAP 2020) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities.** ***References:*** *ACAP. 2020. ACAP Species Assessment. Agreement on the Conservation of Albatrosses and Petrels, Last updated September 2020. www.acap.aq.* *Buskirk, R.W and Nevitt, G.A (2007) 'The influence of developmental environment on the evolution of olfactory foraging behaviour in procellariiform seabirds', Journal of Evolutionary Biology, 21 (1) 67-76. https://doi.org/10.1111/j.1420-9101.2007.01465.x* *Nevitt, G.A (2000) 'Olfactory Foraging by Antarctic Procellariiform Seabirds: Life at High Reynolds Numbers', Biology Bulletin, 198(2): 245-253. doi: 10.2307/1542527* *Renyolds, A.M, Cecere, J.G, Paiva, V.H, Ramos, J.A and Focardi, S (2015) 'Pelagic seabird flight patterns are consistent with a reliance on olfactory maps for oceanic navigation', Proceedings of the Royal Society B, 282(1811). https://doi.org/10.1098/rspb.2015.0468*
B14	**Matter**: Community level and cumulative impacts **Claim**: Research indicates seabirds within Bass Strait utilise varying niches due to factors such as life history, flight ability, prey availability, reproductive habits and environmental variability (Fromant et al., 2020). It is a baseline principle in biology and ecology that species competing for the same resources cannot co-exist within the same ecological niche because of competition. Therefore it is reasonable to suggest that disturbance and displacement to prey species could have community level impacts to species vulnerable to increased competition (such as the albatross discussed later). **Claim**: Many species of albatross and petrel found within the proposed survey area are protected under the EPBC Act and the National Recovery Plan for Albatrosses and Petrels (2022). CGG has highlighted marine pollution as a relevant threat from the proposed activity. In addition to marine debris, CGG must also consider the relevant key	CGG acknowledges claims regarding community level and cumulative impacts and has reviewed the Environment Plan (EP) to ensure that community level and cumulative impacts to seabirds were adequately assessed. The baseline principal referred to by the relevant persons is termed the competitive exclusion principle which states that two species with identical niches cannot coexist indefinitely (Kneitel, 2008). This is supported by the segregation of foraging niches which is reported to have occurred within the Bass Strait across 4 types of seabirds (Fromant et al., 2020). This study found that these species occupy different tropic niches but note that prey availability is not the singular factor that influences resource separation in species. Several dimensions such as diving depth and time of breeding also influence resource separation and the segregation of foraging niches which can vary significantly between regions, years and seasons as a result of changes in prey availability driven by natural environmental variation (Fromant et al., 2020). The activities proposed by the Regia MSS survey will be short-term, temporary and localised and will not result in the long-term displacement of prey and therefore will not 'indefinitely' impact the trophic niche of species by increasing competition as the principle requires. Although impacts to prey species, which are limited to within close proximity of the sound source, may result in the displacement of seabirds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past allowing individuals to return, therefore community level impacts to seabirds from increased competition are not expected. Threats defined by the National Recovery Plan for Albatrosses and Petrels (2022) via human disturbance, competition and environmental variability are defined and discussed below. • Human disturbance: '*Threats from human disturbance at or adjacent to breeding sites including direct habitat destruction, damage, and disturbance, as well as interactions with built structures and artificial lighting' (DCCEEW, 2022).*

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	threats to the recovery plan, including human disturbance, environmental variability and competition. **Claim**: Although CGG claim they have assessed impacts to foraging behaviours, we argue that this has not been done in a thorough manner or with any relevance to sea birds. Cumulative impacts are completely disregarded in this context. **Claim**: Although, CGG uses the above study and evidence that the penguins will revert to normal behaviour after cessation of the seismic testing activity, we would like to draw NOPSEMA's attention to the fact that CGG is not the only company proposing a seismic test in the area close to the Middle Island population. There are many other companies such as ConocoPhillips, TGS etc. who have submitted environmental plans to conduct seismic tests and they cannot be looked at in isolation.	○ Coastal development is not within the scope of the Regia MSS survey and therefore does not result in any coastal impacts including direct habitat destruction, damage or disturbance to albatross and/or petrel species breeding sites. Further there are no built structures with artificial lighting associated with the proposed activity. • Competition: '*Threats from competition with fisheries for prey species' (DCCEEW, 2022).* ○ Marine threats to albatross and petrels from competition are defined by competition with fisheries for prey species and are therefore not relevant to the Regia MSS survey. • Environmental variability and change: *'Threats from climatic changes resulting in significant weather changes beyond historical variance, with effects on food dispersion and availability' (DCCEEW, 2022).* ○ The National Recovery Plan for Albatrosses and Petrels (2022) lists climate variability and change as a threat to these species. Although the Regia MSS survey will result in atmospheric emissions they were assessed within the EP Appendix B4 (Preliminary Environmental Assessment) as negligible and will not result in a threat to albatross and petrel species. Therefore, as defined by the National Recovery Plan for Albatrosses and Petrels (2022) the Regia MSS survey does not result in a threat to albatross and petrel species via human disturbance, competition or environmental variability. EP Appendix E10 (Otway Cumulative Impact assessment) did not identify any cause-effect pathway for cumulative impacts associated with the Regia MSS and another reasonably foreseeable future seismic survey located in waters off the continental shelf. The Regia MSS is a short-term, temporary activity that is not 'sustained' over an extended duration and no other surveys are proposed to occur in the 'same' area'. Further, CGG will implement the industry standard control of a 40 km separation distance between operating seismic sources resulting in a low likelihood of cumulative effects. Given the widespread foraging areas of seabirds (ACAP 2020) and the small area possibly affected by prey displacement across all reasonably foreseeable future projects occurring during the Regia MSS survey, no cumulative effect pathway was identified for the displacement of foraging seabirds. Regarding the claim that other companies have submitted environment plans to conduct seismic tests close to Middle Island, CGG is aware on only one other company proposing a marine seismic survey, being TGS which is located 59 km from Middle Island. Other titleholders in the region are proposing drilling with short-term well formation evaluation (<20 hours per well) using vertical seismic profiling, production drilling and tie-in, and decommissioning activities. This information is detailed in EP Appendix E10 (Otway Cumulative Impact Assessment). This assessment evaluated the potential for cumulative impacts associated with elevated levels of light on Albatrosses, Petrels and Shearwaters but did not identify a cumulative impact pathway. Further, there was no cumulative effect pathway identified for underwater sound with the consequence of underwater sound on birds, including little penguins, assessed as minor in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds), Section 6. **Information has been added to EP Appendix E5 on the assessment of impacts associated with foraging as follows:** **Seabirds feed on multiple prey species and have widespread foraging areas. Indirect impacts including displacement of prey species such as fish will be limited to the close proximity of the sound source. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past. Given their widespread foraging areas (ACAP 2020) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities.** ***References:*** *ACAP (2020). ACAP Species Assessment. Agreement on the Conservation of Albatrosses and Petrels, Last updated September 2020. www.acap.aq.* *DCCEEW (2022)* 'The National Recovery Plan for Albatrosses and Petrels' Commonwealth of Australia, Department of Climate Change, Energy, the Environment and Water, Canberra. *Kneitel, J (2008) 'Gause's Competitive Exclusion Principle', Encyclopaedia of Ecology, 3: 110-113. https://doi.org/10.1016/B978-008045405-4.00794-1* *Fromant, A., Schumann, N., Dann, P., Cherel, Y and Arnould, J.P.Y (2020) 'Trophic niches of a seabird assemblage in Bass Strait, south-eastern Australia', Peer Journal, 8: e8700. doi: 10.7717/peerj.8700*
B15	**Matter**: Mitigating sound exposure impacts to seabirds **Claim**: As most sea birds spend most of the time in flight or at the sea surface, it is likely that soft start will not help mitigate sound exposure impacts. Furthermore, the additional requirement for MMOs to spot and control for seabirds within 500m of the source is a significant addition to an existing capacity-intense role, especially given the rapidity of flight and foraging behaviours, and double-counting bias that foraging behaviour can cause during surveys. **Claim**: Additional bird-specific MFOs should be stationed onboard if this mitigation technique is employed to ensure seabirds are	CGG acknowledges claims regarding mitigation measures for seabirds and has reviewed the Environment Plan (EP) to ensure that measures were appropriately considered. A soft start procedure, as defined in EP Appendix A2 (Description of Activity), will provide early warning to diving birds and penguins in the area, allowing them to move away from the source before it is at full power. This is a precautionary approach to mitigate behavioural impacts, such as startle response, as underwater noise modelling for bird species shows that permanent threshold shift (PTS) thresholds are not reached and temporary threshold shift (TTS) thresholds are within 50-60 m of the sound source, as described in response to Matter: B12 above. CGG does not agree with the claim that Marine Fauna Observers (MFO) would not be able to visually detect flocks of rafting or foraging birds within 500 m of the vessel. **Clarification has been provided in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds) and EP Appendix G2 (Fauna**

	THEME	BIRDS (B)
#	***Comments received***	***Titleholder response***
	adequately controlled for during acquisition. The effectiveness of this mitigation strategy can be assessed by deploying recording equipment at the stern of the ship (close to the source) to cross check bird-specific MFO controls.	**Management Plan) that the acoustic source will be reduced to the low power setting if flocks of foraging birds are observed by the Marine Fauna Observer within 500 m of the source. Full power can commence when the seismic source is > 500 m from any flocks of foraging birds.** Further, the presence of a Survey Environment Advisor (SEA) on the vessel, as detailed in the EP Appendix (Implementation Strategy) and Appendix G2 (Fauna Management Plan) provides for any additional actions or reporting requirements associated with observations for and detections of other fauna.

10. Spills

	THEME	SPILLS (S)
#	***Comments received***	***Titleholder response***
Key Matter: Risk assessment for oil spills		
S01	**Matter**: Lack of project specific modelling **Claim**: As a mitigation measure, CGG has said it will keep the fuel volume under 250 m3, though this will be almost impossible to enforce. Coupled with CGG's failure to properly evaluate the specific risk of an MDO spill through custom modelling, this failure to implement stringent mitigation measures to protect the region's significant ecological value is cause for the EP to be refused. **Claim**: The report continues with an extraordinary statement that highlights the unsuitability of using other projects' modelling to assess the risks of the present project: "However, as the Regia MSS Activity Planning Area extends out ~120km from the Victorian Coast and ~100 km from King Island, the Annie-1 location [which was used to model an MDO spill] may not accurately predict oil exposure to King Island or Tasmania." (Oil Spill Modelling Review, p.851). This lack of effort to properly model MDO spill risk for this specific project is an extraordinary failure to fully explore and consider potential impacts to the marine environment. All risk assessment based on this incomplete evaluation must be rejected outright. **Claim**: According to the EP, the size of the Environment Planning Area was established "using professional judgement and a review of previous impact and risk assessments for similar activities in the region" (EP, p. 849). As a result, no independent modelling of a marine diesel oil spill was conducted for this project. Incredibly, the EP acknowledges that the modelling by these proponents used slightly different parameters and thresholds to calculate the maximum extent of an MDO spill, which was 60 km in one instance; however, the EP then asserts without any evidence that "even if this distance was double it would still be within the 150 km used for the Environmental Planning Area'', an assumption which fails to acknowledge the complexity of hydrocarbon modelling and assumes the distance can simply be doubled. **Claim**: The EP has failed to adequately model the impact of a fuel spill from the survey vessel or supporting vessels. **Claim**: We are shocked to note the absence of credible modelling for potential fuel spills from the operating vessel, or its support vessels and believe that this is a sufficient omission on the part of the titleholder and their environmental consultant, Klarite, as to warrant a refusal to award a title.	CGG acknowledges claims regarding a perceived lack of project specific spill modelling and has reviewed the Environment Plan (EP) to ensure that the method for assessing the extent of credible worst-case spill scenarios was adequate and appropriately detailed. In addressing the critiques presented, it's crucial to recognise the complexity and nuance inherent in environmental risk assessments such as those conducted for the Regia MSS. Isolating individual statements or findings from the broader context of comprehensive environmental planning and analysis can inadvertently misrepresent the meticulous and holistic approach undertaken (shown in Appendix B11). Such out-of-context interpretations may lead to misconceptions or perceived errors that do not reflect the entirety of the diligent, science-based evaluation and planning efforts. Our approach integrated a wide array of data, modelling outcomes, and expert judgments to ensure a robust understanding of the risks presented, and it is within this comprehensive framework that our findings and strategies should be considered. The environmental planning for the Regia MSS meticulously incorporated a range of oil spill models from similar projects within the region. This decision was underpinned by a detailed analysis of these models' applicability to the Regia MSS's specific conditions, including the geographical and oceanographic context. The models selected for our review were identified based on rigorous criteria, ensuring their relevance to the environmental and operational parameters of the Regia MSS. Such a methodology allows for leveraging extensive existing research and modelling efforts, providing a more robust foundation for understanding the nature and scale of the consequence from only one modelling report, and without unnecessarily duplicating effort. It would be irrational to ignore the statistical power achieved by evaluating all these data points. Critically, the approach to modelling and risk assessment for the Regia MSS was not solely reliant on extrapolation from previous projects. The decision to set the Environmental Planning Area at 155 km was grounded in application of the precautionary principle and is conservative, factoring in the potential maximum extent of diesel dispersion based on the most comprehensive data available. This distance exceeds the extents suggested by several models, underscoring our commitment to environmental protection. The assertion regarding the 250 m^3 fuel volume limit reflects our dedication to minimising potential spill volumes; this commitment is a testament to our proactive management strategies, which are designed to be enforceable and practical within operational contexts. Regarding the criticisms of not conducting project-specific modelling, it's important to clarify that the reliance on existing, validated models is a common practice within the industry, especially when those models closely mirror the conditions of the current project. This approach is not only efficient but also ensures that risk assessments are based on scenarios that have been meticulously reviewed and accepted in similar contexts. Furthermore, the continuous reference to professional judgment and review of previous assessments underscores a reliance on expert consensus and a deep understanding of the regional environmental dynamics, reinforcing the robustness of our planning process. The critique regarding the absence of evidence for the assertion that spills would be contained within the 150 km Environmental Planning Area fails to consider the comprehensive analysis and conservative assumptions that underlie our environmental planning. This boundary was not arbitrarily chosen but was based on a thorough review of historical data, spill scenarios, and the latest oceanographic understanding, which collectively inform a prudent and cautious approach to environmental risk management. Lastly, the assertion of insufficient effort in modelling specific to the Regia MSS overlooks the extensive groundwork laid by Appendix B11 and adaptation of existing, relevant oil spill models. These models, place in the context of the Regia MSS, provide a sound and scientifically valid basis for anticipating and mitigating environmental impacts. It's also critical to note that our approach is in line with NOPSEMA's guidelines, which advocate for the use of established, peer-reviewed models wherever applicable. In conclusion, the environmental planning and risk assessment for the Regia MSS has been conducted with a high degree of diligence, scientific integrity, and adherence to regulatory standards. The strategies for mitigation, including the management of fuel volumes and the adoption of existing, validated oil spill models, are grounded in a commitment to environmental stewardship and the precautionary principle. We are confident that our methodologies not only meet but exceed the requirements for assessing and mitigating the environmental impacts associated with the Regia MSS, demonstrating our unwavering commitment to protecting the marine environment in which we operate. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. Note: Mitigation measures are address in response to Matters: S07 – S11; Claims regarding the volume of a spill are addressed in response to Matter: S07.
S02	**Matter**: Likelihood of a spill	CGG acknowledges claims regarding the oil spill risks and has reviewed the Environment Plan (EP) to ensure that the information provided allows for an appropriate analysis of likelihood.

	THEME	SPILLS (S)
#	***Comments received***	***Titleholder response***
	Claim: There is always a risk of oil spills simply from the presence of the seismic blasting vessels for significant periods of time in sensitive environmental areas where marine animals, such as whales, penguins, etc., feed and breed.	EP Appendix D4 (Accidental Release of Fuel) predicts the levels of risk to environmental receptors, establishing criteria for sensitivity and has predicted level of risk to be medium. This is mainly due to the rare likelihood of a spill event occurring based on the absence of any reported collision of a seismic vessel leading to an oil spill in Australia, based on historical data. A rare likelihood is defined as: the event is expected to occur only in exceptional circumstances, or it may have never occurred before in similar circumstances. This level of likelihood implies that the event is highly unlikely to occur, with a probability of less than 1%. CGG recognises that it cannot eliminate the risk of a spill and has developed detailed response plans to demonstrate preparedness in the highly unlikely event that a spill occurs. In the highly unlikely event of a spill, the response would be integrated with local and national control agencies as required, to mobilise resources including experts and specialist equipment. Details on resourcing and response arrangements for a spill are included in the Oil Pollution Emergency Plan (OPEP) in EP Appendix G3. Further, additional mitigation and management measures such as adoption of the vessel bunkering procedure, the marine assurance system, and the comprehensive OPEP and operational and scientific monitoring program (OSMP) provide for reducing the consequences of a spill. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
Key Matter: Oil spill risks		
S03	**Matter**: Risks to marine flora and benthic sediments **Claim**: Spills also smother mangrove roots, asphyxiate kelp forests, and accumulate in benthic sediments, harming the species living within them. **Claim**: CGG admits in their environmental plan that the Giant Kelp Marine Forests of South East Australia are endangered. These marine forests overlap the Operational Area, but because CGG believes the giant kelp requires clear, shallow water no deeper than 35m in depth and they are outside of the depths for the Regina MSS Operational Area, the threat has not been assessed further. CGG has not identified and conducted research into the effects of an oil spill on Kelp Forests, and no mitigation strategies have been put in place. **Claim**: If there is an oil spill from a seismic blasting vessel, this will have a devastating impact on the health of South East Australia's Kelp Forests. CGG has stated that with a dense canopy extending upwards to surface waters, Giant kelp are vulnerable to the effects of an oil spill. In the event of a worst-case scenario oil spill, the surface extent of any canopy may be exposed to shallow dissolved and entrained hydrocarbon fractions, which can cause damage to the kelp forests, or even their destruction.	CGG acknowledges claims regarding the risks to marine flora and benthic sediments from an oil spill and has reviewed the Environment Plan (EP) to ensure that the information provided allows for an appropriate analysis of likelihood. EP Appendix D4 (Risk Assessment – Accidental Release of Fuel) presents the risk assessment for an accidental release of fuel and describes the potential impacts to sediment quality (Section 6.2) and benthic assemblages including marine flora (Section 6.3). Section 6.2 (Sediment Quality) provides a detailed assessment of the predicted level of risk for sediment quality which found that, as the majority of surface oil will have evaporated or entrained in the water column within ~ 24 hours, only a small proportion is likely to move to shoreline areas above the low threshold. Furthermore, wave action in shoreline areas will further breakdown the remaining oil. Consequently, predicted level of consequence to sediment quality from a 250 m^3 MDO spill is assessed as minor as consequences will be short-term (< 30 days) within a localised area with full recovery. Section 6.3 (Benthic Assemblages) provides a detailed assessment of the predicted level of risk for marine flora including kelp, and concludes that the predicted level of consequence to benthic assemblages, including marine flora, from a 250 m^3 spill is assessed as moderate as the consequences could be longer lasting (> 30 days) if kelp and other macroalgal areas are exposure to oil above the low threshold level. The likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
S04	**Matter**: Risks to areas of conservation significance and species **Claim**: The Area also includes 4 Commonwealth Marine Parks, 4 Ramsar wetlands, 11 Threatened Ecological Communities, 6 Commonwealth Heritage Places, 2 Key Ecological Features and other Matters of National Environmental Significance (MNES). These highly biodiverse species and habitats would be harmed by any marine diesel oil spills or incidents during proposed operations, as well as any time vessels are in the area preparing for seismic blasting, refuelling, resupplying or in transit. Such a spill could stay in the water column for up to 30 days, coating seabirds and contaminating plankton, fish, crustaceans, and invertebrates that provide food for higher trophic levels	CGG acknowledges claims regarding the risks to protected areas from an oil spill and has reviewed the Environment Plan (EP) to ensure that the information provided allows for an appropriate assessment of this risk. EP Appendix D4 (Risk Assessment – Accidental Release of Fuel) presents the risk assessment for an accidental release of fuel and describes the potential impacts to protected areas (Section 6.17). The predicted level of consequence to protected areas and their values from a 250 m^3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur in protected areas nearshore of the Operational Area, though if consequences occurred, they are likely to only affect a small portion of coastal areas or marine areas for a short duration (hours to days) due to the low spill volume and short duration of any exposure, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium. The predicted level of consequences for species and food sources is assessed in: - Section 6.5 (Plankton) - Section 6.6 (Invertebrates) - Section 6.7 (Fish) - Section 6.8 (Birds) - Section 6.9 (Marine Reptiles)

	THEME	SPILLS (S)
#	***Comments received***	***Titleholder response***
		- Section 6.10 (Marine Mammals) CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
S05	**Matter**: Risks to recreational activities and coastal habitats **Claim**: The coastlines connected and adjacent to the Operational Area and the Environment Planning Area are used for various socially and recreational activities, including surfing, important to the coastal communities surrounding the Otways region. These areas include highly biodiverse habitats which would be harmed by any marine diesel oil (MDO) spills or incidents during proposed operations, as well as any time vessels are in the area preparing for seismic blasting, refuelling, resupplying or in transit. **Claim**: Such a spill could stay in the water column for up to 30 days, which would disrupt use of those coastal areas by recreational marine users, including surfers.	CGG acknowledges claims regarding the risks to protected areas from an oil spill and has reviewed the EP to ensure that the information provided allows for an appropriate assessment of this risk. EP Appendix D4 (Risk Assessment – Accidental Release of Fuel) presents the risk assessment for an accidental release of fuel and describes the potential impacts to protected areas (Section 6.17). This assessment states that, although visible nearshore and shoreline hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas, the low volumes, light nature of marine diesel and substantial wave action with the nearshore areas mean that impacts are likely to only affect a small portion of the coastal area, be short term and not require intrusive clean-up response. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
S06	**Matter**: Risks and response plans for birds and their habitat **Claim**: The potential for oiling, or external contamination of seabirds is particularly problematic and could lead to a loss of insulation, buoyancy and the ability to fly or swim (as observed for penguins).15 On page 2700, the Plan notes that penguins are especially vulnerable to oil because they spend a high portion of their time in the water and will lose insulation and buoyancy if their feathers are oiled. **Claim**: Another risk that has not been accurately identified is the risk of hydrocarbon spills on the nesting habitat of these species. Although the risk of a spill is low, if it were to occur, there is risk to all 3 breeding grounds for albatross in Tasmania, including Mew stone, Pedra branca and Albatross Island. **Claim**: Submitter recommends development of a recovery plan in the event of an oil spill for Mew stone, Pedra Branca and Albatross Island.	CGG acknowledges claims regarding mitigation strategies to protect of birds and their habitat in the event of a spill and has reviewed the Environment Plan (EP) to ensure that impacts to birds and oiled wildlife response measures were adequately described. EP Appendix D4 (Risk Assessment – Accidental Release of Fuel) presents the risk assessment for an accidental release of fuel and describes the potential impacts to birds. Section 6.8 (Birds) provides a detailed assessment of the predicted level of risk for birds within the assessment area. Little Penguins are most likely to encounter the low concentration of hydrocarbons due to its broader extent than moderate and high concentrations, and the low threshold level of exposure is not expected to result in the lethal impacts of feather matting and hypothermia. Further, given the offshore location of the spill, the small volume and area of exposure, and temporary nature of the release on the sea surface (~ 24 hrs) it is unlikely that a spill would limit Little Penguins ability to forage for unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. Regarding impacts to habitat, the predicted maximum extent that fuel spill could extend from the operational area is 150 km in any direction. The basis for this distance is explained in Section 3.2 of the Appendix D4. Due to the proximity to the Victorian coastline, the predicted level of consequence to shorebirds from a 250 m^3 fuel spill is assessed as moderate as consequences could be longer lasting (> 30 days) if shorebirds are exposure to oil above low threshold, though if consequences occurred, they are likely to only affect a small portion of the shorebird population due to the low volume of oil that would come onshore. The accumulation of hydrocarbons on shorelines within the 150 km distance is considered unlikely (rare) based on the absence of any reported seismic vessel collisions in Australia. Further, Pedra Branca, Albatross Island and Mew Stone are well beyond this distance and are not predicted to affected in the extremely unlikely event of a release. EP Appendix G3 (OPEP and OSMP) describes the spill response preparedness, proposed response strategies and operational and scientific monitoring that would be employed in the extremely unlikely event of an accidental release of fuel. Section 8.3.1 (Oiled Wildlife Response) describes how the relevant control agencies will determine if an oiled wildlife response is required. The accumulation of hydrocarbons on shorelines is considered unlikely based on the credible scenarios; however, to allow for an adaptable response, consideration will be given to migratory shorebird feeding and roosting sites/nesting colonies and any seal colonies in and adjacent to the environment that may be affected (EMBA), and species protected under Part 3 of the EPBC Act will be given particular attention. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Project specific modelling is addressed in response to Matter: S01.
Key Matter: Preparedness for and mitigation of oil spill risk		
S07	**Matter**: Minimising spill volumes **Claim**: As a mitigation measure, CGG has said it will keep the fuel volume under 250 m^3, though this will be almost impossible to enforce. Coupled with CGG's failure to properly evaluate the specific risk of an MDO spill through custom modelling, this failure to implement stringent mitigation	CGG acknowledges claims regarding enforceability of fuel volumes and has reviewed the Environment Plan (EP) to ensure that these were adequately described such that the grounds for enforcement could be reasonably ascertained by both CGG and NOPSEMA. When a vessel refuels (called bunkering) there are international protocols and marine orders which govern the procedures and record keeping. Detailed records of the product bunkered must be maintained and tank inventories recorded before and after bunkering events. Vessels carefully monitor and record tank levels for ballast requirements and an electronic record of fuel levels in all tanks is routinely kept onboard. This is often supplemented by

	THEME	SPILLS (S)
#	***Comments received***	***Titleholder response***
	measures to protect the region's significant ecological value is cause for the EP to be refused.	manual soundings of tanks on a routine basis. CGG's Marine Assurance System (M#05) is the primary control measure that will ensure that all vessels contracted for the survey will comply with the legislative requirements in Australia and will maintain accurate records of bulk fuel tank levels throughout the activity. Therefore, the commitment to maximum fuel levels is able to be easily monitored and, if breached, can be enforced. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Project specific modelling is addressed in response to Matter: S01.
S08	**Matter**: A plan to mitigate and manage spill risk is needed **Claim**: Submitter recommends a plan is formulated to mitigate and manage the potential risk of oil spills caused by seismic blasting.	CGG acknowledges claims regarding spill risk and has reviewed the Environment Plan (EP) to ensure that the measures to mitigate and manage this risk were adequately described. EP Appendix D4 (Risk Assessment – Accidental Release of Fuel) presents the risk assessment for an accidental release of fuel and describes the measures that will be in place to mitigate the risk of a spill, e.g. the marine assurance system, and the plans that will be in place to respond in the extremely unlikely event of a spill, i.e. the Oil Pollution Emergency Plan (OPEP) and Operational and Scientific Monitoring Plan (OSMP). These plans are provided in EP Appendix G3 (OPEP and OSMP). CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
S09	**Matter**: Oil spill mitigations for marine fauna **Claim**: The EP has failed to adequately model the impact of a fuel spill from the survey vessel or supporting vessels. It has failed to offer adequate mitigation strategies to protect cetaceans, seals and sea lions, or invertebrates.	CGG acknowledges claims regarding mitigation strategies to protect marine fauna in the event of a spill and has reviewed the Environment Plan (EP) to ensure that the oiled wildlife response measures were adequately described. EP Appendix G3 (OPEP and OSMP) describes the spill response preparedness and proposed response strategies to be used in the extremely unlikely event of an accidental release of fuel. Section 8.3.1 (Oiled Wildlife Response) describes how the relevant control agencies will determine if an oiled wildlife response is required. The accumulation of hydrocarbons on shorelines is considered unlikely based on the credible scenarios; however, to allow for an adaptable response, consideration will be given to migratory shorebird feeding and roosting sites/nesting colonies and any seal colonies in and adjacent to the environment that may be affected (EMBA), and species protected under Part 3 of the EPBC Act will be given particular attention. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims. NOTE: Project specific modelling is addressed in response to Matter: S01.
S10	**Matter**: Access for clean-up **Claim**: In the case of an oil spill, much of the Victorian and Tasmanian coastlines are inaccessible to enable amelioration of the damage.	CGG acknowledges claims regarding shoreline protection and clean up and has reviewed the Environment Plan (EP) to ensure that this proposed response strategy was adequately described. EP Appendix G3 (OPEP and OSMP) describes the spill response preparedness and proposed response strategies to be used in the extremely unlikely event of an accidental release of fuel. Table G3-1 (Assessment of Spill Response Strategies) explains that the spreading and relative thickness of Marine Gas Oil (fuel) slicks on shorelines would mostly be below the 10 g/m^2 impact threshold and that this, along with the exposed and high energy shorelines of the Otway coast, make this strategy ineffective. Further, the accumulation of hydrocarbons on shorelines is considered unlikely. Consequently, CGG is not proposing shoreline protection or clean up. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
S11	**Matter**: Chemical dispersants are carcinogenic **Claim**: Many of the chemicals utilised by industry to clean up oil spills are known carcinogens. (39)(40) 39. https://hub.jhu.edu/2022/06/03/deepwater-horizon-oil-spill-cleanup/ 40. https://scienceline.org/2017/11/clean-chemical-bp-oil-spill-tied-health-problems/	CGG acknowledges claims regarding spill response strategies and has reviewed the Environment Plan (EP) to ensure that the proposed response strategies were adequately described. EP Appendix G3 (OPEP and OSMP) describes the spill response preparedness and proposed response strategies to be used in the extremely unlikely event of an accidental release of fuel. Table G3-1 (Assessment of Spill Response Strategies) explains that due to the spreading and relative thickness of slicks on water, chemical dispersants would not be used as they are unlikely to be effective on a marine gas oil (fuel) spill (CSIRO 2016) and that this, along with the exposed and high energy shorelines of the Otway coast, make this strategy ineffective. Consequently, CGG is not proposing the use of dispersant. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

11. Climate Change

	THEME	CLIMATE CHANGE (CL)
#	***Comments received***	***Titleholder response***
CL01	**Matter:** Impacts associated with global warming **Claim:** Seismic blasting poses irreparable harm to ocean ecosystems and is incompatible with global warming and zero extinction targets. **Claim:** Approval of this application will have disastrous impacts on marine species, the local fishing industry and, ultimately, the climate. **Claim**: I think it is insanity to under go operations such as this in such a crucial marine ecosystem with total disregard for not only the inhabitants it will effect but also the devastating impact this and other projects like this one will contribute to the climate crisis. **Claim**: The oil and gas exploration plans proposed by REGIA will contribute DIRECTLY to global warming and have a negative impact on Australia's land, environment, community and economy. **Claim**: Allowing REGIA and other companies to explore and extract oil and gas will contribute greatly to global warming.	CGG acknowledges claims regarding global warming and has reviewed Environment Plan (EP) Appendix B4 (Regia MSS Preliminary Environmental Impact and Risk Assessment (PEIRA)), which provided preliminary information on the potential impacts and risks to support consultations with relevant persons and provided the context to the subsequent impact and risk assessments. An assessment of atmospheric emissions was conducted as part of the PEIRA which concluded that, while emissions from the use of fuel to power vessel engines, generators and mobile and fixed plant add to the GHG load in the atmosphere which adds to global warming potential, they are relatively small on a state, national and global scale, representing an insignificant contribution to overall GHG emissions. Emissions will be small in quantity and short-term. The emissions from up to three vessels for 90 days will not significantly contribute to climate change. Therefore, impacts to ecological components of the environment from atmospheric emissions from the Regia MSS are not predicted and have not been evaluated further. CGG acknowledges claims regarding the concerns about the future potential for natural gas extraction; however, CGG is not proposing the commercial extraction of natural gas as part of the Regia MSS. The activity presented in the Environment Plan is for a short-term, temporary marine seismic survey. Consequently, this claim is not relevant to the adverse effects of the proposed Regia MSS to which the EP relates and is beyond the scope of this assessment. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.
CL02	**Matter**: Consideration of existing pressures associated with climate change **Claim**: In the enormous volume of pages within the EP there is no consideration for marine ecosystems already under the stress of warming oceans facing additional pressure from seismic blasting operations. Further, we as relevant persons for the purposes of industry consultation on this and other similar projects are instructed that climate change is not a consideration for our submissions. We argue that given that this operation is to locate oil and gas reserves, climate should certainly be a consideration. Oil and gas are key drivers of climate change and the consequences of their production would not be possible without exploration projects such as this one proposed by CGG Regia. **Claim**: On the grounds that this EP fails to consider how the impacts of current and rising ocean temperatures, combined with the likely impacts of the operational plan (OP) under deployment we urge NOPSEMA to reject this EP and refuse to award the SPA.	CGG acknowledges claims regarding existing pressures associated with climate change and has reviewed the Environment Plan (EP) to ensure that these pressures were adequately considered. Appendix F3 (Acceptable Levels of Impact and Risk) included a number of species-specific sensitivity analyses to evaluate the potential for the Regia MSS, in conjunction with existing pressurise and threats, to result in cumulative impacts on those species, for example: - Section 5.2.1.3 (Cumulative impacts) assesses the cumulative impacts of the Regia MSS with the other highest rated threats identified within the updated draft National Recovery Plan for the southern right whale (DCCEEW 2023), which includes anthropogenic climate change and climate variability. - Section 5.2.3.3 (Cumulative impacts) assesses the cumulative impacts of the Regia MSS on southern rock lobster in light of the long-range forecast for sea surface temperatures. - Section 5.2.4.1 (Species-specific sensitivity) assesses the cumulative impacts of the Regia MSS on giant crab in light of the southerly shift of the austral subtropical high-pressure belt, with models predicting more upwelling-favourable winds which has the potential to increase productivity at the population level. Section 5.4 (Search for unacceptable impacts) provides for additional consideration of potential ecosystem vulnerabilities to ensure that ecosystem integrity, meaning the ability of all species within an ecosystem to survive and reproduce such that the overall health of their ecosystem, is maintained and that potential unacceptable impacts are identified. This included an evaluation of potential ecosystem weaknesses, including vulnerability to climate change, and concluded that no measurable changes to ecological integrity or population structures are likely because of the Regia MSS. CGG has considered these claims and is satisfied that the concerns raised have been adequately addressed in the EP, for the reasons outlined above. As a result, no changes have been made to the EP in response to these claims.

12. Other

	THEME	OTHER (O)
#	***Comments received***	***Titleholder response***
O01	**Matter**: Consideration of alternative survey technology **Claim**: If such proposed projects are necessary now at all, alternative, proven, far less harmful methods of surveying should be utilised in place of seismic blasting, instead of assuming that marine species and ecosystems are robust enough to handle it. **Claim**: There is no need to blast seismically when more modern USA technology exists that uses low frequency harmonic vibrations that are less energetic and less harmful that still enables the strata to be identified without injuring sea creatures. **Claim**: It should also be pointed out there are much less destructive, and also much more effective, ways of generating the seismic images of that area. Namely using ocean bottom cables (3 axis geophones plus hydrophone) and a low level continuous wave seismic source. That seismic source can be as little as near field monitored ship noise.	CGG acknowledges claims regarding the consideration of alternative survey technologies and has reviewed the Environment Plan (EP) to ensure that this was adequately addressed. As stated in Ep Appendix F2 (ALARP Assessment), the technology that will be utilised for the Regia MSS involves a series of acoustic sources that create acoustic emissions within a specified frequency and amplitude, to detect geological formations. The technology that will be used is the only technology currently available that is feasible for the Regia MSS. Alternative technologies are in development, are unproven and are technically unfeasible. Further, the non-optimal data generated by alternative technologies increases the likelihood that additional surveys and exploration wells would be required, and presents an increased risk when drilling. **EP Appendix F2 (ALARP Assessment) has been updated to include additional information on the assessment of alternative technologies.** A comprehensive assessment of the potential impacts and risks associated with seismic surveys is provided in the EP. In accordance with the control measures set out in EP Appendix G1 (Control Measures and Environmental Performance) that will be adopted for the duration of the Regia MSS, seismic activities will be managed so that potential impacts and risks are mitigated to levels that are as low as reasonably practicable and acceptable in accordance with environmental regulatory requirements.
O02	**Matter**: Consideration of bubble curtains **Claim**: I am asking why the government hasn\'t insisted on bubble curtaining for this project as is used extensively in the North Sea to protect the sea dwellers. **Claim**: Has no one heard of bubble curtaining to protect the whales and their calves? Look at how it is used in the North Sea.	CGG acknowledges claims regarding alternative controls and has reviewed the Environment Plan (EP) to ensure these are adequately considered. It is understood that bubble curtains have been used in shallow water offshore wind farm installations during pile driving operations. CGG is not proposing to conduct pile driving. The activity presented in the Regia MSS EP is for a short-term, temporary marine seismic survey. During these surveys the seismic vessel and acoustic source move continuously through the survey area. The Bureau of Ocean Energy Management (CSA Ocean Sciences Inc. 2014) examined current and emerging technologies that have the potential for reducing noise generated during certain ocean activities and concluded that for mobile seismic sound sources bubble curtains showed generally poor performance at reducing sound levels except at short distances from the source. More recent tank experiments focussed on stationary changes to high-frequency sound (Wehner et al 2020), with acknowledgement that the important practical issue (of a moving source) needs consideration. Consequently, given that the application of bubble curtains to a moving sound source has yet to be demonstrated as effective in practice, the use of bubble curtains has not been considered further and no changes have been made to the Regia MSS EP in response to these claims. ***References:*** CSA Ocean Sciences Inc. 2014. Quieting Technologies for Reducing Noise During Seismic Surveying and Pile Driving Workshop. Summary Report for the US Dept. of the Interior, Bureau of Ocean Energy Management BOEM 2014-061. Contract Number M12PC00008. 70 pp. Daniel Wehner and Martin Landrø, (2020), "The impact of bubble curtains on seismic air-gun signatures and its high-frequency emission," GEOPHYSICS 85: P1-P11. https://doi.org/10.1190/geo2019-0451.1

13. Out of Scope

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
Key Matter: The regulatory/approvals process		
OS01	**Matter**: Special Prospecting Authorities **Claim**: The proposal to conduct seismic blasting using a Special Prospecting Authority (SPA) permit sidesteps the usual government bidding and decision making process, facilitating hasty and highly damaging oil and gas exploration proposals to progress rapidly through the regulatory approvals process. **Claim**: Furthermore, the proposal to conduct seismic blasting under a Special Prospecting Authority (SPA) permit circumvents standard government bidding processes, enabling expedited approval of potentially harmful exploration activities. **Claim**: The SPA process does not take into consideration the cumulative impact of multiple seismic blasting projects on ocean ecosystems or marine life. Any previous seismic blasting conducted in a given location is not considered in the environmental impacts of new proposed seismic blasting in that same area. https://www.marineconservation.org.au/what-is-a-special-prospecting-authority-spa-everything-you-need-toknow/ **Claim**: It is of great concern to both the fishing industry and the local community that the seismic blasting companies aim to use the cheap and fast permit called a Special Prospecting Authority (SPA) to conduct some of the world's largest seismic blasting projects in the south-east oceans between Tasmania and Victoria. **Claim**: That SPAs mean a lack of oversight of conduct and methods used in surveys, it would be unethical and unprofessional if NOPSEMA were to grant exploration licences and SPAs to Regia and members of the offshore gas and oil industries.	Claims regarding Special Prospecting Authorities do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims they have not been considered further in preparing the EP. An EP is required for all offshore activities. An EP is an activity-specific permissioning document that provides a detailed environmental impact and risk assessment of the proposed offshore activity and demonstrate how those impacts and risks will be reduced to a level that is as low as reasonably practicable and acceptable for the life of the activity. The Regia MSS will be conducted in accordance with the control measures set out within an accepted EP to ensure that impacts and risks, including cumulative impacts, are managed to levels that are as low as reasonably practicable and acceptable, in accordance with relevant environmental regulatory requirements.
OS02	**Matter**: The right of the Australian government to approve impacting processes. **Claim**: No politician or government bureaucrat has any real world authority to approve any environmental impacting process anywhere any time. Due processes call for all stakeholders or representatives to be involved in any decision. **Claim**: Seismic blasting and fracking cannot be approved by any state or federal government in Australia."	Claims regarding the rights of the Australian government do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity. Further, CGG is not proposing fracking as part of the Regia MSS. The activity presented in the EP is for a short-term, temporary marine seismic survey. Consequently, the claims are not relevant to the adverse effects of the Regia MSS to which the EP relates and are beyond the scope of this assessment.
OS03	**Matter:** The government continuing to approve new fossil fuel projects in light of climate change and biodiversity losses. **Claim**: Further, as the federal government, with any sense of environmental protection, should ban drilling and permanent extraction of gas so close to the coast and sensitive marine areas, there is no point in seismic blasting this area. For the future environmental protection of the area this proposal, Regia MSS, should therefore be rejected. **Claim**: I implore governments and NOPSEMA to abandon this notion and seriously consider the detrimental impacts this propsal (sic) would have on our environment.	Claims regarding Australian government processes do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006.

	THEME	**OUT OF SCOPE (OS)**
#	***Comments received***	***Titleholder response***
	Claim: It is well proven, by the latest IPCC reports and Australian State of The Environment Report that the future stability of our climate and biodiversity are critically endangered. We cannot continue with business-as-usual in this climate. NOPSEMA must base its decisions on the well-being and prosperity of all Australians, now and into the future, not on the profitability of corporations. **Claim**: October of every year the federal government opens bidding to oil and gas companies to make bids for more projects, which leads to more exploration with seismic blasting. An appalling approach to managing the greatest environmental crisis (global warming) of our time. **Claim**: Our government has the power to protect our unique marine life from seismic blasting projects and the expansion of the fossil fuel industry. Stop listening to the fossil fuel lobbyists, making decisions that support a select few and irreversibly destroy our marine environment. **Claim**: The fact that this proposal by CGG has progressed to this level reflects very poorly on our federal and state governments to have measures in place to protect both conservation and community interests and those of future generations. **Claim**: Allowing this project to proceed would be an admission by this Government that it has learnt nothing at all about the imminent dangers to our planet and its suitability as a home for our human, as well as all animal species, despite all the talk.	The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity.
OS04	**Matter**: Independence of the regulatory process **Claim**: The current system in which proponents act as their own judge and jury on these matters is not acceptable.	Claims regarding the independence of regulatory processes do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA's regulatory processes have long been regarded as world-class. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements.
OS05	**Matter**: NOPSEMA considering comments as irrelevant **Claim**: Furthermore I am appalled that NOPSEMA considers any comments on oil and gas activity in submissions to the environment plan as 'irrelevant'.	Claims regarding NOPSEMA's consideration of comments do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. NOPSEMA provides advice on how its processes adhere to the principles of good administrative decision-making and how it does not consider information provided through consultation with relevant persons and/or public comment that is irrelevant to the specific offshore project or activity and the requirements of the Environment Regulations. Some examples provided by NOPSEMA include: • statements of fundamental objection • information that contains personal threats or profanities • SPAM mail and petitions, and • comments made through online social media channels.
Other Out of Scope Matters		

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
OS06	**Matter**: No need for new gas supplies/ no benefit to Australia. **Claim**: There is no need to go looking for new oil and gas in the Southern Ocean or anywhere else. This submission acknowledges that this consideration is outside of the scope of the public comment process for an EP under a Special Prospecting Authority, however we believe that it is relevant so explicitly mention it here. For the bargain price of $8250, an applicant with a history of prior breaches can commit one of the most damaging activities permitted in oceans today over an area previously mapped by seismic surveys and with little in the way of meaningful interventions by the community. **Claim**: Our southern oceans are teaming with sensitive species and the cumulative impacts imposed by fossil fuels is not necessary. **Claim**: Investing in new gas is unlikely to be financially viable in the future, so why are local communities bearing the environmental, tourism and industry impacts for little-to-no benefit? **Claim**: Not only is it against everything we should eb doing to limit warming, it is extremely damaging for the natural environment In this time when the focus is on moving to net zero in order to save all species on earth from a catastrophic future, it beggars belief that we would engage in these devastating practices in search of more fossil fuel. We ahem more than enough energy to power Australia without resorting to such drastic and detrimental measures.and all the unique and precious marine life it houses.	Claims regarding the ongoing role of gas do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. CSS is not proposing to extract commercial quantities of gas as part of the Regia MSS. The activity presented in the EP is for a short-term, temporary marine seismic survey. Consequently, the claims are not relevant to the adverse effects of the proposed Regia MSS to which the EP relates and are beyond the scope of this assessment. Exploration activities in the Otway Basin are undertaken to help meet Australia's ongoing energy needs. Australia is facing challenges to the security of its domestic gas supply, specifically in the east coast gas market and a domestic gas supply shortfall could have serious consequences for Australians (DISR, 2022). Australians rely on gas for residential heating and cooking. Australian industry and manufacturers rely on gas as feedstock and for energy. Insufficient gas supply could impact the stable operation of Australia's electricity network. ***References****:* *DISR, 2022. Securing Australia's domestic gas supply – Options to improve the Australian Domestic Gas Security Mechanism (1 August 2022), Australian Government Department of Industry, Science and Resources. https://consult.industry.gov.au/securing-australias-domestic-gas-supply*
OS07	**Matter:** Seismic surveys lead to fossil fuel extraction, which is incompatible with the Paris Agreement/ limiting global warming. **Claim**: As seismic blasting is the stepping stone to fossil fuel extraction, plans to continue exploration are incompatible with achieving the Paris target of limiting global warming to 1.5 °C. **Claim**: Seismic blasting not only poses a significant threat ecosystems but also contradicts efforts to limit 1.5°C as outlined in the Paris Agreement. **Claim**: Summary purpose of oil and gas exploration is contrary to the terms of the 2015 Paris Agreement To be clear, the purpose of oil and gas exploration is to identify oil and gas deposits, the exploitation of which is contrary to the intent of the legally binding (https://www.un.org/en/climatechange/paris-agreement) 2015 Paris Agreement to limit the extent of global warming to 1.5Â°C above pre-Industrial global average temperature, . The International Energy Agency has already found that it is not possible to achieve the goal of the Paris Agreement if any new fossil fuel projects are permitted to proceed (see, for example, â€œThe path to limiting global warming to 1.5 Â°C has narrowed, but clean energy growth is keeping it openâ€, International Energy Agency News statement, 26 September 2023, https://www.iea.org/news/the-path-to-limiting-global-warming-to-1-5-c-has-narrowed-but-clean-energy-growth-is-keeping-it-open). As such, should NOPSEMA approve CGGâ€™s Regia Marine Seismic Surveying then Australia may arguably be in breach of its obligations under the 2015 Paris Agreement. **Claim**: Plans to continue gas exploration are incompatible with achieving Australia'a commitment to the 2015 Paris target of limiting global warming to 1.5°C. They are also inconsistent with the agreement at the COP28 climate talks last November to reduce global consumption of fossil fuels for which Australia was reportedly disappointed that 'the deal' didn't include a universal commitment to phase out fossil fuel use. **Claim**: Seismic blasting is a pathway to fossil fuel extraction, plans to continue exploration go against Australia's commitments to reduce greenhouse gas emissions by 43% from 2005 levels, and net zero emissions by 2050. **Claim**: By allowing projects such as this to go ahead, it is one step closer to contributing unnecessarily to climate change and the subsequent demise of our marine species and ecosystems. You may say this point about CGG contributing indirectly to climate is irrelevant for this project, but by doing so, you are using the current submission process as a way to side-step responsibility and accountability on this issue. **Claim**: This plan contradicts the goal of achieving the Paris target of limiting global warming to 1.5°C. **Claim**: This CCG is the gateway to fossil fuel exploration, which is incompatible with the Paris climate target. It will fast track climate change.	CGG is not proposing to extract gas as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity. NOPSEMA have provided an overview of the offshore petroleum lifecycle: A653855.pdf (nopsema.gov.au). This document explains the staged approach taken by offshore developments, whereby the impacts and risks of each stage are assessed. CGG is proposing to conduct a marine seismic survey which is the first stage of exploration.

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	Claim: By facilitating the expansion of the offshore oil and gas industry, this undermines our collective efforts to mitigate climate change and protect our planet\'s future. **Claim**: The proposal to conduct seismic blasting [using a Special Prospecting Authority (SPA) permit sidesteps the usual government decision making process, and] will contribute also to the climate crisis we are all facing. **Claim**: NOPSEMA must reject this because it vital ecosystems and enable the extraction of polluting fossil fuels which will continue to damage our climate in the immediate and long term. **Claim**: Global oil and gas exploration should cease immediately if we are to save our planet from catastrophic man made global warming. **Claim**: Gas is a fossil fuel, which means producing and burning gas helps contribute to climate change (33). Which is a This concern must be be addressed, as despite the direct threat to marine animals in the observation area, climate change is an indirect threat to them, and this poses a fundamental threat to whales, dolphins and porpoises. (34) 33. https://www.climatecouncil.org.au/resources/why-is-gas-bad-for-climate-change-an d-energy-prices/ 34. https://au.whales.org/our-4-goals/create-healthy-seas/climate-change/#:~:text=The %20rapid%20warming%20of%20the,even%20their%20ability%20to%20reproduce **Claim**: Moreover, we cannot achieve our targets to stop rising temperatures, if we open up new resources to burn fossil fuels. **Claim**: The object of this assault is to allow the burning of huge quantities of fossil fuels which are not only endangering this ecosystem but are already compromising the very existence of ourselves on this planet. **Claim**: When the fossil fuels are finally extracted, much of it will presumably be burned and exacerbate our already seriously damaged climate. **Claim**: Seismic blasting for oil and gas exploration in our oceans is not acceptable to met Paris target we cannot extract more fossil fuels. **Claim**: By facilitating the expansion of the offshore oil and gas industry, this undermines our collective efforts to mitigate climate change and protect our planet\'s future.	
OS08	**Matter**: Australia's greenhouse gas and fossil fuel commitments **Claim**: Plans to continue gas exploration are incompatible with achieving Australia'a commitment to the 2015 Paris target of limiting global warming to 1.5°C. They are also inconsistent with the agreement at the COP28 climate talks last November to reduce global consumption of fossil fuels for which Australia was reportedly disappointed that 'the deal' didn't include a universal commitment to phase out fossil fuel use. **Claim**: Primarily, we should not be opening up new areas for gas mining if Australia is to meet its planned emissions targets. **Claim**: The proposal to explore gas and extract this from our oceans is extremely alarming and will mean that Australia cannot meet its green house emission reductions. **Claim**: Seismic blasting is a pathway to fossil fuel extraction, plans to continue exploration go against Australia's commitments to reduce greenhouse gas emissions by 43% from 2005 levels, and net zero emissions by 2050. **Claim**: Emissions from the extraction, processing and export of gas have been one of the main drivers behind Australia's official emissions level staying so high. If Australia is heading to net zero, this plan will compromise this aim.	CGG is not proposing to extract gas as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity. NOPSEMA have provided an overview of the offshore petroleum lifecycle: A653855.pdf (nopsema.gov.au). This document explains the staged approach taken by offshore developments, whereby the impacts and risks of each stage are assessed. CGG is proposing to conduct a marine seismic survey which is the first stage of exploration.
OS09	**Matter**: No fossil fuel development/ unspecified impacts **Claim:** I am simply against this type of survey due to the impacts on marine life and don't believe we need to be mining in this part of Australia.	CGG is not proposing mining or extracting gas as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary seismic survey. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	Claim: We have already destroyed forever many of our unique and beautiful flora, fauna and marine life. You have the power to say enough, the damage from this blasting will overwhelm any perceived benefit that is to come from it. **Claim**: l would like to add that these inoffensive creatures have been on the earth far longer than we have, we don\'t have the right to wipe them out just for the sake of continuing old technologies we simply do not need any more, in fact, we should scaling these technologies back not creating more l am bitterly opposed to this project in every way so l ask you to use common sense and reason to stop this before it is to **Claim**: PLEASE do NOT allow oceans. The damage it is potentially huge and irreparable. Considering it is outrageous and shows no thought for our children and future generations. **Claim**: Fossil fuel is a liability for the future, The approval of seismic blasting at this sensitive location by the Victorian government confirms a lack of understanding of issues of such importance, that it condem\'s them to being a liability. **Claim**: These plans are an attack on all young citizens of Australia who will suffer as a result of future gas and oil extraction with a lower standard of living and poorer health outcomes **Claim**: I vehemently disagree with seismic blasting and indeed any operations relating to the development of fossil fuels. **Claim**: This blasting is for oil and gas. And these operation and what they fuel have done damage to the earth and our climate which is becoming more noticeable each day. **Claim**: I REJECT SIESMIC BLASINTING ANYWHERE, BUT ESPECIALLY IN SENSITIVE MARINE LIFE ZONES. **Claim**: This sort of activity will negatively impact the environment in totally unacceptable ways including the fossil fuels it is trying to discover. **Claim**: Development of any fossil gas sources that might be found would be even more damaging to ocean life, and also politically highly contentious. **Claim**: The mining and use of fossil fuels generate an unacceptable risk not just to marine life, but to tourism, farming, fishing, and the cultural values of first nation peoples. We can control the amount **Claim**: Australia needs any resources but not at the cost of our precious environment. We can have both if we are smart but this is not a smart idea. **Claim**: I am simply against this type of survey due to the impacts on marine life and don't believe we need to be mining in this part of Australia.	Petroleum activities conducted in offshore waters are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA is Australia's independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity.
OS10	**Matter:** Unethical behaviour by companies and regulators. **Claim**: On the grounds of facilitating significant environmentally irresponsible projects alone, this seismic blasting project should not be allowed to proceed. **Claim**: There is no reason to conduct damaging testing for a Fossil fuel Gas that should be phased out. The Seismic Blasting will then pave the way for even more devastating gas extraction for an even more remote multi national Company and the local consumer will not benefit as we have seen recently the gas companies make the local consumer pay international prices for our natural resource that we allow them to profit from. **Claim**: This utterly irresponsible and betrayal to humanity. Your company will be responsible for the destruction of a liveable world. It will create a world in which I will experience a higher frequency and intensity of catastrophic weather and environmental disasters. **Claim:** Finally, with the importance of our Government and industry ambition to reach net zero by 2050, projects like this not only destroy valuable marine habitat and potentially wipe out a variety of marine animal species for nothing more than GREED. **Claim**: It\'s 2024 - and over 2 decades since the world became enlightened to the gas and oil industries disasters for the environment. The above information will be read, and received, over and over, yet I can\'t imagine if those profiting from the decision, if their children and family members knew that their financial existence is at the expense of wildlife and the environment. Destruction for oil and gas need to end. **Claim**: I think that this proposal discussed below should be rejected outright, we have endangered our precious ocean wildlife enough with our disregard & abuse of the planet, we dont need more oil/gas rigs in our oceans they should be diversifying into clean energy sources instead of forcing, coercing & pushing the government to approve their greedy new	These claims do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Activities conducted on petroleum titles are regulated by the Commonwealth National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). NOPSEMA is an independent expert statutory authority established under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. NOPSEMA's regulatory processes have long been regarded as world-class. NOPSEMA is regularly subject to a range of external reviews and audits to ensure it continues to be effective in bringing about improvements in occupational health and safety, well integrity, and environmental management across the offshore oil and gas industry. The Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023 impose a duty on CGG to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOPSEMA's acceptance of the EP provides the authorisation necessary for the activity to begin and forms legally binding requirements by which CGG must undertake the activity.

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	dirty fuel projects. [Not to mention my local community relies on the lobster fishing industry to provide many jobs in this area] and havent we tortured whales enough over the past centuries!! **Claim**: I cannot express how discussed I am at this company\'s proposal, and their greed for Australia\'s resources to sell overseas. All the while showing a complete disregard for other regular uses. **Claim**: We can no longer close our eyes to the devastating impacts of Climate Change that are manifest internationally . If we are to have a world fit to pass on to our grandchildren ,we must draw the line at the rapacious demands of the extractive Fossil fuel lobby that knows no bounds in it\'s mindless pursuit of profit . **Claim**: What is wrong with our Govermant Dept\'s & the Government in general, giving their \"OK\" for this seismic activity to go ahead, anywhere near marine life of any kind. As usual they think of \"MONEY\", ahead of the ENVIRONMENT, which affect EVERYONE. I am disgusted & angry that this keeps happening today, with all the knowledge we have about looking after our environment. Shame on you!!!!!! **Claim**: Don\'t allow the poisoning of our future generations for financial convenience and corruption. **Claim**: I am very concerned at this proposed foolhardy venture by yet another multinational geotechnical company who have zero concerns about the damage their seismic blasting will do. **Claim**: The planet is not a mere resource to be consumed ad lib until exhausted. Other values exist, such as behaving as wise stewards of the biosphere: this percussive project is anything but. Additionally, it is simply too late for yet more fossil fuels. Much damage is being done. We must change course. **Claim**: This seismic blasting proposal must not be approved, a multinational company.? Their only interest is monetary profits, blowing up the ocean would be catastrophic for the southern right whales. **Claim**: The proposal, is a deceptive and disingenuous attempt at cloaking the proposal in legitimacy. Please do not allow this con to proceed. We have a responsibility to protect the ocean for the good of all mankind and future generations, allowing this to proceed would be outrageously irresponsible to the future. **Claim**: There is no comparison between the permanent massive damage this would do to ecosystems and the narrow corporate greed which would be the beneficiaries if this dreadful proposal were to go ahead. **Claim**: It is ridiculous that thousands of people are calling out for our corrupt and influenced government to allow the devastation of our marine food webs for the sake of multinational profiteering for so few powerful and elite people. **Claim**: There is evidence that the Oil and Gas industry were advised about the adverse effects on climate caused by their activities. They chose to not only ignore the science but to supress it. **Claim**: You are short-sighted and guilty of destroying this environment and earth for pathetic, short term gain. Your greed should be a curse upon your head.	
OS11	**Matter**: Unspecified/ unreferenced science / impacts/ claims **Claim:** There is enough evidence in the scientific literature that indicates that loud noises interfere with the growth and development of marine and coastal ecological patterns. Independent longitudinal worldwide scientific studies, are needed to actually determine that harvesting of the oceanic riches is causing little to no harm. **Claim**: I am shocked that such operations are still being allowed to occur when scientifically and from our experiences we know what irreparable damage they can cause. **Claim:** The evidence about both climate chnage and the changing situration of the oceans is irrefutable as is the evidence that the oil an gas industries are major contributors to both ecological destruction and the inevitable effects of global climate chaos. **Claim**: The evidence is abundant illustrating the harm that underwater seismic testing does to numerous species an ecosystems. That\'s before you even consider the wisdom of allowing exploration for more oil and gas, when those two things have been clearly identified by the United Nations, the IPCC and any number of other world-leading authorities as the primary causes of our current climate crisis. **Claim**: I am shocked that such operations are still being allowed to occur when scientifically and from our experiences we know what irreparable damage they can cause.	These claims do not provide specific references to scientific literature related to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the inability to substantiate the claims, they have not been considered further in preparing the EP. CGG is not proposing to extract gas as part of the Regia MSS. The activity presented in the Environment Plan is for a short-term, temporary seismic survey. The EP for the proposed activity includes references to peer reviewed, published literature to support the impact and risk assessment process.

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	Claim: It is unacceptable that knowing the scientific knowledge on the ongoing ecological and irreversible collapse of the marine ecosystems **Claim**: I urge NOPSEMA to reject the REGIA (MSS) Environment Plan in the basis that it fails to adequately protect and preserve the marine environment of Bass Strait and the sea life that live there.	
OS12	**Matter**: The state of the planet. **Claim:** It is unacceptable that knowing the scientific knowledge on the ongoing ecological and irreversible collapse of the marine ecosystems. **Claim:** Our ocean produces more than 50% of the oxygen we breathe and controls the climate and weather that provides us with water to drink and sustain crops. Without a healthy ocean, ecosystems and economies will collapse worldwide. **Claim**: Use the power you have to ensure a healthy future for all generations and deny approval for the blasting must Human life is not separate to the intricate weave of land based and ocean based ecosystems. Our survival depends on healthy ecosystems, including those in the ocean. **Claim**: I am deeply concerned for the future of those children, the environment they grow up in and all the creatures that live in this space, be it on land, in the air or in the water. **Claim**: We are supposed to share this earth with all other life forms. We are the custodians of this land and water. We need to care for it and leave it in pristine condition for following generations. **Claim**: Our ocean produces more than 50% of the oxygen we breathe and controls the climate and weather that provides us with water to drink and sustain crops. Without a healthy ocean, ecosystems and economies will collapse worldwide. **Claim**: Please do not allow this proposal to be passed, we are after all suppose to changing our ways & not causing further harm to our already distressed plant. **Claim**: Scientists tell us we are facing an existential triple planetary crisis of climate change, pollution, and biodiversity loss. Each of these issues must be addressed and resolved if we are to have a viable future on this planet. It follows that the age-old precautionary principle applies now more than ever	Claims regarding the state of the planet do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. The comments do not raise specific issues relevant to the short-term, temporary, nature of the proposed Regia MSS, nor the localised and recoverable environment impacts, as described in EP, nor the environmental management and monitoring of the activity. CGG has a duty to demonstrate to NOPSEMA that petroleum activities will be carried out in a manner that is consistent with the principles of ecologically sustainable development (as set out in section 3A of the Environment Protection and Biodiversity Conservation Act 1999), and by which the impacts and risks of the activity will be reduced to ALARP, and separately, that the impacts and risks of the activity will be of an Acceptable Level, among other considerations and requirements. NOTE: Impacts to lobster fishing industry addressed in fish, Sharks, Invertebrates and Fisheries.
OS13	**Matter:** Transition to renewables **Claim**: It is also worth noting that at a time when we are moving towards net-zero targets and renewable forms of energy production whilst lessening our reliance on fossil fuels, there is no reasonable justification for approving this EP and proceeding with this project. **Claim**: Recommendations: 16. Reject this proposed seismic testing proposal and divert resources towards clean energy proposals instead. **Claim**: These gas mining operations usually operate for 50 or so years, long after Australia is projected to replace gas with more environmentally friendly sources such as solar and wind, yet there is no mention by CGG as to whether this project helps or hinders the government goal to replace gas.	Claims regarding the transition to renewable energy do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. Exploration activities in the Otway Basin are undertaken to help meet Australia's ongoing energy needs. If commercially viable gas reserves are discovered, additional approvals and further consultation would be required to support the development of a commercial project by the relevant titleholder/s. Australia is facing challenges to the security of its domestic gas supply, specifically in the east coast gas market and a domestic gas supply shortfall could have serious consequences for Australians (DISR, 2022). Australians rely on gas for residential heating and cooking. Australian industry and manufacturers rely on gas as feedstock and for energy. Insufficient gas supply could impact the stable operation of Australia's electricity network. ***References****:* *DISR, 2022. Securing Australia's domestic gas supply – Options to improve the Australian Domestic Gas Security Mechanism (1 August 2022), Australian Government Department of Industry, Science and Resources. https://consult.industry.gov.au/securing-australias-domestic-gas-supply*
OS14	**Matter**: Use seismic for other purposes onshore **Claim**: Victoria has so much to offer by using siesmic exploration to start Geothermal energy plants, that are safe and non polluting. Why is this technology not being used. Leave the oceans alone. We all know what happened in the Gulf of Mexico. It can happen again.	Claims regarding alternative energy projects do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	Claim: Why not use the technology to search fir Geothermal spots on land. It's safe, no polluting and without risk to the environment.	Exploration activities in the Otway Basin are undertaken to help meet Australia's ongoing energy needs. If commercially viable gas reserves are discovered, additional approvals and further consultation would be required to support the development of a commercial project by the relevant titleholder/s. Australia is facing challenges to the security of its domestic gas supply, specifically in the east coast gas market and a domestic gas supply shortfall could have serious consequences for Australians (DISR, 2022). Australians rely on gas for residential heating and cooking. Australian industry and manufacturers rely on gas as feedstock and for energy. Insufficient gas supply could impact the stable operation of Australia's electricity network.
OS15	**Matter**: Consideration of blue whales outside of the BIA **Claim**: MFOs on a recent 2D seismic survey in the Otway region in 2020 recorded over 100 blue whales in a total of 58 sightings (Seiche Environmental, 2020). Of the 58 blue whale sightings on this survey, more than double occurred outside of the blue whale BIA and buffer zone, indicating widespread habitat usage in the area. The 2020 report recommended the number of blue whales sighted outside of the BIA warrants consideration in relation to future seismic surveys in the area (Seiche Environmental report, 2020).	Claims regarding blue whale activity in areas not affected by the proposed Regia MSS do not relate to the Environment Plan (EP), or the activity to which the EP relates. The activity and the area that may be affected by underwater sound from the activity do not occur outside of the Pygmy Blue Whale foraging (annual high use) biologically important area (BIA) (Appendix B12 MAP-REG-EPM-068). Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.
OS16	**Matter**: Impacts associated with other projects in other locations. **Claim**: Oil extraction in the Great Australian Bight presents unacceptable risks to our marine life, coastal communities, fisheries and tourism across Australiaâ€™s south-east. While oil giants BP and Chevron have dropped their plans to drill in the Bight, Equinor (formerly known as Statoil) has taken over the oil and gas leases that BP discarded and still intends to drill in this iconic Australian area. An oil spill here would be catastrophic. Equinorâ€™s own draft Environment Plan shows that an oil spill in the Great Australian Bight could reach as far as Bondi! Placing such an immense stretch of the Australian coast at risk is clearly unacceptable. To date, 17 South Australian councils and 3 in Victoria, representing well over half a million people, have expressed concern or outright opposition to risking the Great Australian Bight. In addition, thousands of individual Australians have voiced their own opposition to industrialisation of the Bight. All political parties need to support a ban on oil and gas in the Great Australian Bight given its importance for coastal communities, fisheries, tourism, internationally significant ecosystems and some of Australiaâ€™s most threatened marine life. I urge you to do all you can to ensure your party opposes Equinorâ€™s plans, and supports a ban on drilling for oil and gas in the Great Australian Bight." **Claim**: The Great Australian Bightâ€™s extraordinary waters are a haven for 36 types of whales and dolphins, including the worldâ€™s most important nursery for the endangered southern right whale. Theyâ€™re also home to Australiaâ€™s most important sea lion nursery. In fact, 85% of the marine species in the Bight are unique, and exist nowhere else in the world. Oil extraction in the Great Australian Bight presents unacceptable risks to our marine life, coastal communities, fisheries and tourism across Australiaâ€™s south-east. **Claim**: I respectfully ask that NOPSEMA requests a revised map to be provided by the [another proponent] that includes the full geospatial area of the Bonney Upwelling. **Claim**: I reject most strongly to the granting of a licence which will allow seismic blasting to occur in the Great Australian Bight in valuable breeding grounds of whales and other marine species.	Claims regarding oil extraction, the Great Australian Bight, other projects and other project proponents do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. CGG is not proposing the extraction of oil (or gas) within the Great Australian Bight as part of the Regia MSS EP. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey in the Otway Basin. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.
OS17	**Matter**: Seismic is stepping stone to drilling **Claim**: Moreover, as seismic blasting is the stepping stone to fossil fuel extraction as evidenced by CCG's Otway Exploration Drilling Program Environmental Plan submitted to NOPSEMA last year. https://docs.nopsema.gov.au/A1032340 **Claim**: This seismic blasting project by CGG is being undertaken to support a gas drilling project by ConocoPhillips, the extraction and burning of which, will contribute to global warming, which will further threaten marine species and ecosystems.	Claims regarding drilling and the activities of other proponents do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. CGG is not proposing to undertake drilling as part of the Regia MSS EP. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.
OS18	**Matter**: Impacts of sonic waves	Claims regarding sonic waves or sonic blasting do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. The activity presented in the Environment Plan (EP) is for a short-term,

	THEME	OUT OF SCOPE (OS)
#	***Comments received***	***Titleholder response***
	Claim: Especially whales are known to be sensitive to sonic waves and the impact to them from the strong blasts is unknown. **Claim**: NO TO SONIC BLASTING! IT KILLS THE KRILL, AND OTHER FISH AND SEA CREATURES. DEAFENS AND DISORIENTATES WHALES, WHO END UP BEACHING THEMSELVES DUE TO LOSS OF COMMUNICATION WITH OTHER WHALES.	temporary marine seismic survey using airguns which do not do not produce sonic waves, booms or blasts. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP. ***References***: Senate Inquiry into Seismic Testing (nopsema.gov.au)
OS19	**Matter**: Use of air horns **Claim**: Have you ever stood next to an air horn blown into your ear at regular intervals all day for consecutive days? You should - then youâ€™d think twice about causing such detrimental damage to marine life like whales.	Claims regarding air horns do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey using airguns in water, not air horns in air. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.
OS20	**Matter**: Risk of project becoming a stranded asset. **Claim**: Putting aside the fact that continued fossil fuel exploration is pointless because it will only yield trapped \"assets,\" the effect on marine wildlife is unknown but highly likely to be detrimental. **Claim**: The IPCC clearly states as have many international authorities, that to have any chance of achieving the Paris goal of 1.5C, we must not allow any new investments in fossil fuels. All investment should be diverted to the development of renewable energy and storage backup. So this seismic blasting is a waste of money. Any exploration asset will simply become a stranded asset.	Claims regarding the viability of future assets do not relate to the Regia MSS Environment Plan (EP), or the activity to which the EP relates. The activity presented in the Environment Plan (EP) is for a short-term, temporary marine seismic survey. Consequently, due to the irrelevancy of the claims, they have not been considered further in preparing the EP.
OS21	**Matter**: Increase in asset value and unreliability of technology **Claim**: At the moment the offshore mining of in the form of gas is problematic for a number of reasons but mainly due to the current technology still in its infancy! The stage is hit & miss unknown long term consequences for compounded by the unreliable technology to effectively capture&harness the gas for storage and/or transport once located! Please consider the increase in value of our assets, ie resources in the ground both on&offshore but particularly offshore when the technology to access & capture all of the resource for storage & use is refined & improved to prevent the current unknown loss of the valuable resource while attempting to harness the gas and the unpredictable loss over the of the mine. To reiterate my point, surely we can afford to wait until the offer is more favourable to Australians and our marine life. The asset carries neglible risk of deterioration and therefore guaranteed to increase in value over time so there\'s less benefit to us if we accept this first offer! Conversely the interested parties will be just as keen in future when competition will surely improve Australia\'s position at the negotiation stage hence the possibility of REDUCING our RISK & INCREASING our RETURN on our priceless ASSETS.	CGG is not proposing to install infrastructure, mine for gas, nor capture or harness gas as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary seismic survey. Consequently, the claims are not relevant to the Regia MSS to which the EP relates and are beyond the scope of this assessment.
OS22	**Matter**: Methane leaks/ emissions **Claim**: Please do not allow seismic blasting which is potentially very cruel and lethal to ocean life in the vicinity. There is also always a risk that methane could continue to escape without containment and contribute further to the dangerous increase in greenhouse gases in the atmosphere. **Claim**: Methane spillage into the atmosphere will further exacerbate climate change. **Claim**: As indicated in the EP the concentrations of the two most common GHGs carbon dioxide (CO_2) and methane (CH_4) continue to grow. What the EP plan did not state, was that in Australia CH_4 emissions in particular, with a high global warming potential (GWP), have increased almost four times faster than CO_2 since 2005.	CGG is not proposing to install infrastructure nor extract gas as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary seismic survey. Consequently, the claims are not relevant to the proposed Regia MSS to which the EP relates and are beyond the scope of this assessment.
OS23	**Matter**: Fugitive emissions from other activities and infrastructure **Claim**: The EP indicated that there would several measures to reduce the GHG emissions from Regia MSS exploration processes. However, fugitive emissions, in particular, have been generally underestimated and likely have grown due to new gas wells, converting Gas to LNG, fracking, decommissioning old wells, and extending pipelines as well as leakages from aging pipelines.	CGG is not proposing to drill to install new wells, convert gas to LNG, frack, decommission old wells, nor install or extend pipelines as part of the Regia MSS. The activity presented in the Environment Plan (EP) is for a short-term, temporary seismic survey. Consequently, the claims are not relevant to the proposed Regia MSS to which the EP relates and are beyond the scope of this assessment.

	THEME	**OUT OF SCOPE (OS)**
#	***Comments received***	***Titleholder response***
	Claim: The Federal Government data assumes that leaky pipes or cracked pipes do not release gas and never have. This is a false statement, but because the monitoring is so poor, there is no evidence to say how much additional greenhouse gas is added to the atmosphere each year. The plan makes no mention how this will be avoided. **Claim**: The EP needs to be clearer in stating how fugitive emissions will be monitored and moderated over the entire duration of the testing and drilling.	

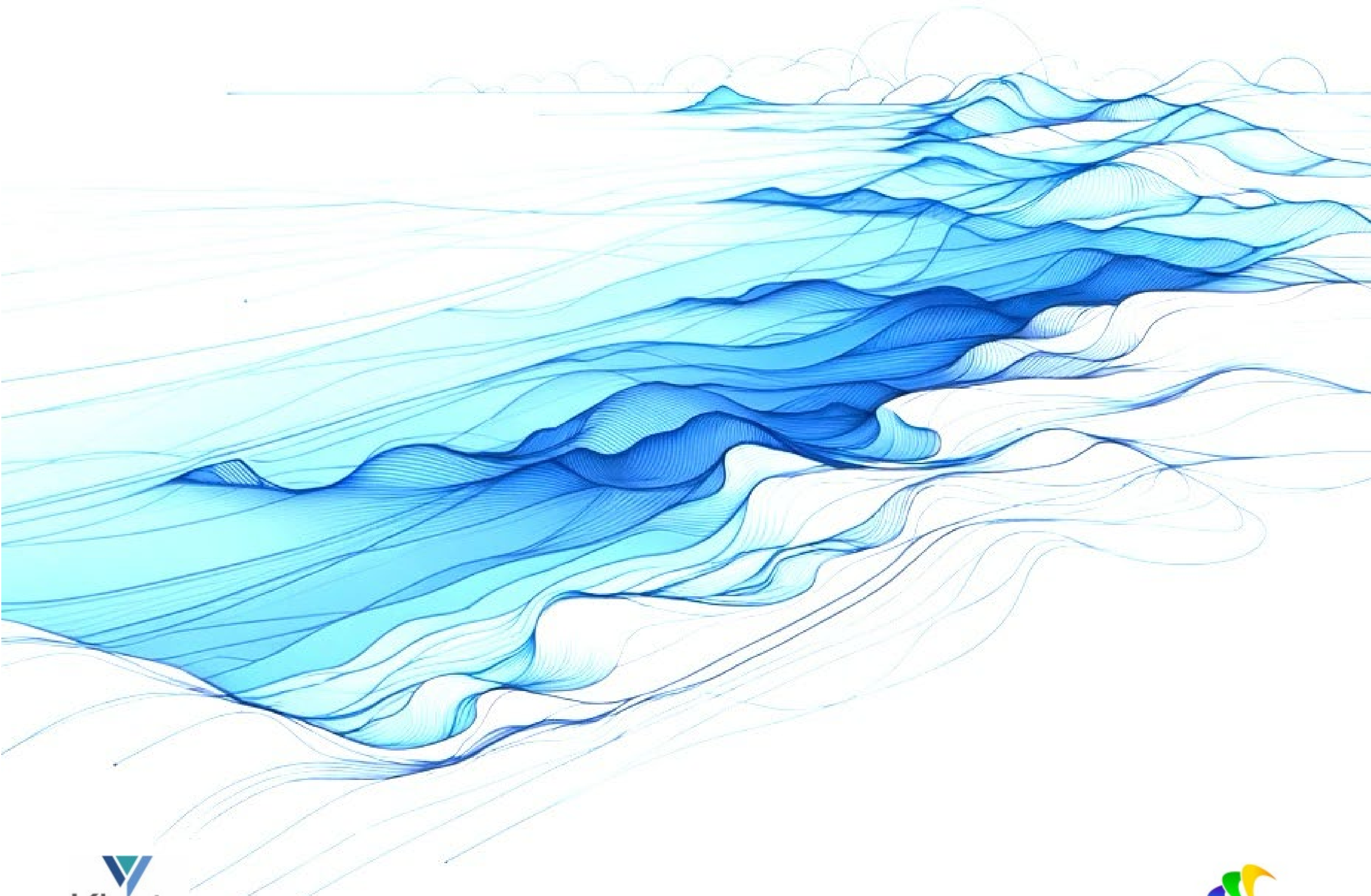
REGIA
Marine Seismic Survey

Risk Assessment
Accidental Release of Materials or Waste Overboard

Appendix D1: REG-EP-016-D1

Rev 2

May 2024



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1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment.

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table D1-2-1 shows the feedback received related to this environmental aspect.

2 Assessment Input

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table D1-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table D1-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Concerned about fuel spillage and need assurance that the project would not increase in rubbish washing up.	79	Provide garbage management plan when a vessel is allocated.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. TableD1- 2-2 shows how this feedback has been incorporated into the environmental assessments.

TableD1- 2-2- Public comment input since the beginning of the public comment period starting 25 January 2024.

Matter	Matter ID	Changes made arising from public comment
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Accidental Release of Materials or Waste Overboard

3.1 How the Aspect Occurs

An accidental release of materials or waste may occur from the seismic and support vessels.

No materials or solid wastes will be disposed at sea from vessels undertaking the Regia MSS.

3.2 Extent and Duration of the Aspect

Duration: 90 days

Extent: Operational Area

The extent of the area where the risk of an accidental release of materials or waste may occur is within the Operational Area and the risk could occur while the activity is undertaken.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to an accidental release of materials or waste, and how the requirements will be met.

4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for an accidental release of materials or waste for the following environmental components:

- Water quality
- Benthic assemblages
- Birds
- Sharks
- Marine reptiles
- Marine mammals
- Coastal developments
- Commercial fishing and aquaculture
- Indigenous culture
- Marine protected areas
- Marine industries

The PEIRA identified that risk of an accidental release of materials or waste to the following environment components was ranked as having a negligible level of effect and are not assessed further in this section:

- Water quality
- Benthic assemblages

There is the potential for materials or waste to be accidentally released overboard due to open bins, crane operator error or improper storage or handling. Materials or wastes that could potentially be released overboard are typically inert such as paper, cardboard, foam (earplugs) and plastics (wrapping material, hard hats). These materials or waste could pose a risk marine fauna via ingestion or entanglement. They may also result in visual pollution in the ocean and on shorelines impacting the values of coastal developments, indigenous culture, and marine protected areas.

Larger dropped objects may also occur such as loss of towed equipment (streamers, acoustic sources, paravanes for streamer steering) and sea containers. These may pose a navigational or entanglement hazard to commercial fishers and other marine users.

5 Description of the Existing Environment that May be Affected by the Activity

As detailed in the Section 3.2, the Operational Area has been adopted as the extent of the area where an accidental release of materials or waste may occur. To identify the presence of those species that may be at risk of ingestion or entanglement with materials or waste accidentally released overboard (birds, dolphins, pinnipeds, sharks, turtles, whales) a Protected Matters Search was undertaken for the Operational Area with the report available in Appendix B5. Annex 2 details those species identified, any biologically important areas and conservation advice or management plans.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. Conservation Advice has also been updated for several species and subsequent changes have been made to Annex 1 (Legislative and Other Requirements Relevant to Release of Materials or Waste Overboard) and Annex 2 (EPBC Act Listed Species within the Operational Area Relevant to Release of Materials or Waste Overboard). Changes relevant to the assessment of an accidental release of material or waste include:

- Changes to EPBC Act status of several bird species
    - Red Knot is listed as Vulnerable (previously Endangered)
    - Sharp-tailed Sandpiper is listed as Vulnerable (previously not listed as threatened)
    - Sooty Shearwater is listed as Vulnerable (previously not listed as threatened)
- Updates to conservation advice for several bird species
    - Conservation Advice for *Calidris canutus* (Red Knot) (DCCEEW 2024)
    - Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)
    - Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)
    - Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DCCEEW 2023m)
    - Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)

These changes have been incorporated throughout the EP and the risk assessment has been revised accordingly. [Section added in response to Matters: I16 and I17]

Information is provided for those species undertaking biologically important behaviour within the Operational Area as these species are more likely to be at risk from ingestion or entanglement with materials or waste accidentally released overboard.

5.1 Birds

The PMST Report identified multiple bird species or species habitat within the Operational Area. Annex 2 provides a summary of the PMST Report. Several of these bird species were identified to be undertaking biologically important behaviours and/or have BIAs within the Operational Area. No habitat critical to the survival of the bird species were identified within the Operational Area.

The orange-bellied parrot, which is critically endangered is likely to migrate through Operational Area, however, it does not land at sea or use coastal areas as habitat so risks to this species are not predicted from marine debris.

Seabird species that forage at sea are more likely to encounter marine debris and hence are discussed further in this section.

Several albatross species were identified as foraging behaviour likely within the Operational Area with the White-capped Albatross identified as foraging behaviour known to occur (Annex 2). In addition, the following albatross species have foraging BIAs within the Operational Area:

- Antipodean – Appendix B12 MAP-REG-EPM-059
- Black-browed - Appendix B12 MAP-REG-EPM-060
- Buller's - Appendix B12 MAP-REG-EPM-071
- Campbell - Appendix B12 MAP-REG-EPM-061
- Indian Yellow-nosed - Appendix B12 MAP-REG-EPM-063
- Shy - Appendix B12 MAP-REG-EPM-066
- Wandering - Appendix B12 MAP-REG-EPM-072

These BIAs cover either most or all the South-east Marine Region (CoA 2015a).

Albatrosses and petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (CoA 2022). Albatross and petrel species exhibit a broad range of diets and foraging behaviours, and hence at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is those waters south of 25° where many species spend most of their foraging time (CoA 2022).

Albatrosses have a widespread distribution throughout the southern hemisphere. They feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP 2020). Albatrosses are colonial, usually nesting on isolated islands and foraging across oceans in the winter months with most observations along the edge of the continental shelf (CoA 2022).

The Flesh-footed Shearwater and Northern Giant Petrel were also identified as foraging behaviour likely within the Operational Area. No BIAs for these species occur within the Operational Area. The Common Diving-petrel (Appendix B12 MAP-REG-EPM-062), Short Tailed Shearwater (Appendix B12 MAP-REG-EPM-065) and Wedge-tailed Shearwater (Appendix B12 MAP-REG-EPM-067) were identified as having foraging BIAs within the Operational Area.

Petrels are oceanic and have a widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between 40°S and 60°S. Petrel species feed on small fish, cephalopods (octopus, squid and cuttlefish) and crustaceans along the edge of the continental shelf and open waters (CoA 2022).

The Australasian Gannet was also identified as having a foraging BIA within the Operational Area (Appendix B12 MAP-REG-EPM-073). The Australasian Gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers (CoA 2015a).

Several shorebirds were identified from the PMST Report as being present in the Operational Area with the Australian Fairy Tern and White-fronted Tern identified as foraging behaviour likely within the Operational Area. Threatened shorebirds that may occur within the Operational Area are the Australian Fairy Tern, Curlew Sandpiper, Eastern Curlew, Red Knot and Sharp-tailed Sandpiper. These species are commonly found on coastal shores including beaches and rocky shores and either feed at low tide on worms, crustaceans and molluscs or fish species or feed on aquatic biota. Many of the wader species are migratory travelling from the Northern Hemisphere in non-breeding months. Most inhabit intertidal mudflats, rocky islets, sand beaches, mangroves, rocky coastline, and coral reefs. Roosting occurs in similar habitats and species are found feeding on fish, crustaceans, aquatic insects, as well as plants and seeds (Higgins & Davies 1996).

5.2 Pinnipeds

The PMST Report identified the Australian Fur-seal is likely to occur within the Operational Area, and the Australian Sea-lion and the New Zealand Fur-seal may occur. No biologically important behaviours or BIAs were identified within the Operational Area for these species.

5.3 Sharks

The PMST Report identified five shark species, that may (School), likely (Porbeagle, Mako, Little Gulper) or known (White) to occur within the Operational Area. Foraging and distribution BIAs were identified for the White Shark (Appendix B12 MAP-REG-EPM-057).

The White Shark is listed as Vulnerable. White Sharks are long-lived, living for 30 years or more (Bruce and Bradford 2008), and are found throughout temperate and sub-tropical regions in the northern and southern hemispheres (Last & Stephens 2009). The species is also commonly found in inshore waters in the vicinity of islands, and often near seal colonies (Malcolm et al. 2001). The foraging BIA that is within the Operational Area is centred on Lady Julia Percy Island which is a known seal breeding colony. The Operational Area also overlaps the distribution BIA that covers Australian waters from Barrow Island/Montebello Islands, WA to Yeppoon/Swains Reef, Qld (Appendix B12 MAP-REG-EPM-057).

5.4 Turtles

The PMST Report identified three turtle species, that may (green) or are likely (leatherback and loggerhead) to occur within the Operational Area. No BIAs or habitat critical to the survival of the species were identified.

5.5 Dolphins and Whales

The PMST Report identified several dolphin and whale species that are known, likely or may occur within the Operational Area. Table D1-5-1able D-51 details those species that have biologically important areas or biologically important behaviours identified within the Operational Area.

Table D1-5-1: Cetacean Species Biologically Important Behaviours and/or BIAs within the Operational Area

Receptor	Biologically Important Behaviour
Blue Whale	Foraging, feeding or related behaviour known to occur within area
	Foraging (annual high use area) BIA (Appendix B12 MAP-REG-EPM-068)
Fin Whale	Foraging, feeding or related behaviour known to occur within area
Pygmy Right Whale	Foraging, feeding or related behaviour likely to occur within area
Sei Whale	Foraging, feeding or related behaviour known to occur within area
Southern Right Whale	Breeding known to occur within area
	Migration BIA (Appendix B12 MAP-REG-EPM-069)

5.5.1 Blue whale

The Blue Whale (*Balaenoptera musculus*) is listed as an endangered species under the EPBC Act. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the Pygmy Blue Whale (*B. m. brevicauda*) and the Antarctic Blue Whale (*B. m. intermedia*). The Otway region, where the Operational Area is located, is an important migratory and foraging area for Blue Whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov 2012, McCauley et al. 2018, Gill et al. 2011). Underwater acoustic monitoring programs have detected Antarctic and Pygmy Blue Whale calls in the Otway Region (McCauley et al. 2018).

Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015c). Pygmy Blue Whales then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015c).

The Blue Whale was extremely abundant until the early 20th century when they were hunted to near extinction. Approximately 341,830 Blue Whale takes were recorded by commercial whaling in the Antarctic and sub-Antarctic in the 20th century, of which 12,618 were identified as Pygmy Blue Whales (Branch et al. 2004). The current global population of Blue Whales is uncertain but is plausibly in the range of 10,000 to 25,000, corresponding to about 3-11% of the 1911 estimated population size (Reilly et al. 2008).

The Operational Area is within the foraging (annual high use) BIA where Pygmy Blue Whales predominately occur between January to April (DoE 2015c) (Appendix B12 MAP-REG-EPM-068).

5.5.2 Fin whale

The Fin Whale is a cosmopolitan migratory species that is listed as vulnerable and occurs from polar to tropical waters but is rarely sighted in inshore waters. Fin Whales show well defined migratory movements between polar, temperate, and tropical waters which are essentially north–south with little longitudinal dispersion.

While Australian Antarctic waters are important feeding grounds for Fin Whales, the species also feeds in the Bonney Upwelling during summer/autumn sometimes in the company of Blue and Sei Whales (DCCEEW 2023b). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat with the species feeding on planktonic crustacea, krill, some fish, and cephalopods (DCCEEW 2023b). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed.

There are no BIAs for the Fin Whale within Australian waters. Fin Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.5.3 Pygmy Right Whale

The Pygmy Right Whale is a little-studied baleen whale species that is found in temperate and sub-Antarctic waters in oceanic and inshore locations. No population estimates are available for Pygmy Right Whales globally, or in Australian waters (DCCEEW 2023p). The species has never been hunted commercially and is listed as a migratory species under the EPBC Act.

Species distribution in Australia is found close to coastal upwellings and the Subtropical Convergence may be important for regulating distribution (Bannister et al. 1996). Key locations include south-east Tasmania, Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to upwelling habitats rich in marine life and zooplankton upon which it feeds (Bannister et al. 1996).

There are no BIAs for the Pygmy Right Whale within Australian waters. Pygmy Right Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.5.4 Sei Whale

The Sei Whale is listed as vulnerable under the EPBC Act. Sei Whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. Sei Whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for Sei Whales in Australian waters.

In Australia, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian

Bight, Northern Territory and Western Australia (Parker 1978, Bannister et al. 1996, Thiele et al. 2000, Chatto and Warneke 2000, Bannister 2008).

Sightings of Sei Whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al. 2012), where opportunistic feeding has been observed between November and May (Gill et al. 2015).

There are no BIAs for the Sei Whale within Australian waters. Sei Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.5.5 Southern Right Whale

The Southern Right Whale (*Eubalaena australis*) is listed as endangered under the EPBC Act. Southern Right Whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al. 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because Southern Right Whales have a slow rate of increase (7% per annum) compared to other marine mammals, their numbers remain low (IWC 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia, and New Zealand.

Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012).

The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by Southern Right Whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA. Southern Right Whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al. 2017). A number of additional areas for Southern Right Whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (CoA 2012). These emerging areas off Victoria align with the Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) which provides an update to BIAs and emerging aggregation areas (Figure D1-51-). The proposed changes are:

- Reproductive areas - Areas where mating, calving, nursing and/or presence of neonates are known, or likely, to occur. For Victoria this is the nearshore area between Portland and Port Campbell.
- Migration areas - Areas where Southern Right Whales are known, or likely, to use for movement between regions that support biologically important behaviour (e.g., coastal movement between reproductive areas).

The Operational Area overlaps the Southern Right Whale Migration BIA where the whales are present between April and October (NCVA 2023) (Appendix B12 MAP-REG-EPM-069).

5.6 Coastal Developments

No coastal developments are within the Operational Area. The closest coastal developments to the Operational Area are the towns of Port Campbell, Port Fairy, and Warrnambool. The Great Ocean Road, a major tourist draw card is popular for its pristine beaches. The nearest coastline is ~ 7 km from the Operational Area.

5.7 Commercial Fishing and Aquaculture

No aquaculture is undertaken within the Operational Area.

Based on the Commercial Fisheries Analysis report (Appendix B6), the Operational Area overlaps the following commercial fisheries that have catch effort:

- Commonwealth
  - Southern and Eastern Scalefish and Shark Fishery following sectors:
  - Shark Gillnet sector
  - Trawl – otter board
  - Southern Squid Jig Fishery
- Victorian:
  - Giant Crab
  - Multi-species Ocean
  - Octopus
  - Southern Rock Lobster
  - Wrasse

5.7.1 Commonwealth Fisheries

5.7.1.1 Southern and Eastern Scalefish and Shark Fishery

The Southern and Eastern Scalefish and Shark Fishery (SESSF) stretches south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern Western Australia. Information on the Shark Gillnet Sector and Commonwealth Trawl Sector are from the Fishery Status Reports (Patterson et al. 2022).

The Shark Gillnet Sector is part of the Gillnet, Hook and Trap Sector of the SESSF. Most fishing in the sector using nets occurs in Bass Strait targeting Elephantfish, Gummy Shark, Sawsharks and School Shark. Fishing is generally concentrated east of King Island. In the 2021-22 fishing season there were 32 active trawl vessels.

The Commonwealth Trawl Sector of the SESSF extends south from Barrenjoey Point in northern New South Wales to east of Kangaroo Island off South Australia. The Commonwealth Trawl Sector is a multispecies fishery, targeting a variety of fish and shark species. Effort in the fishery is widely distributed. However, since 2007 – after the closure to trawling of most SESSF waters deeper than 700 m – effort has become increasingly concentrated on the shelf (to 200 m) rather than on the slope. In the 2021-22 fishing season there were 27 active gillnet vessels.

5.7.1.2 Southern Squid Jig Fishery

A single species fishery that operates year-round. Portland and Queenscliff are the major Victorian landing ports. Jigging typically occurs midwater at depths between 50 and 100 m at night using large lights that illuminate the waters around a boat. In 2021 there were eight active vessels in the fishery with the landing ports being Triabunna (Tasmania); Queenscliff and Apollo Bay (Victoria) (Patterson et al. 2022).

5.7.2 Victorian Fisheries

5.7.2.1 Giant Crab

A small fishery operating in western Victoria and closely linked with the Rock Lobster Fishery. Most vessels are used primarily for rock lobster fishing with giant crab taken as by-product. Fishing effort is concentrated on continental shelf edge (~200 m deep). Giant crabs inhabit the continental slope at approximately 200 m depth and are most abundant along the narrow band of the shelf edge. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) giant crabs. Data for 2020/21 is not available due to insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data) (VFA 2021).

5.7.2.2 *Multi-species Ocean*

The wrasse, inshore trawl, southern rock lobster and giant crab Victorian fisheries are able to catch gummy shark and school sharks as part of their fishery. Snapper are caught using lines, nets and haul seine. Over 90% of the catch is from Port Phillip Bay, and around 5% from coastal waters. In 2020/21, 45 tonnes were landed but a value could not be provided as there is insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data) (VFA 2021).

5.7.2.3 *Octopus*

The octopus fishery is a new fishery harvesting mainly pale octopus (*Octopus pallidus*) in East Gippsland. The fishery may also catch maori octopus (*Macroctopus maorum*) and gloomy octopus (*Octopus tetricus*). Octopus are caught using purpose-built unbaited traps. The fishery commenced on 1st August 2020. Three zones have been established for the management of commercial octopus fishing in Victoria. Octopus Fishery Access Licences authorise commercial take of octopus from the eastern octopus zone where the majority of commercial octopus fishing in Victoria has occurred to date (VFA 2023). The Operational Area is within the western zone where fishing is less established and being managed by the Victorian Fishing Authority through exploratory, temporary permits.

5.7.2.4 *Southern Rock Lobster*

Victoria's second most valuable fishery with a production value of A$13.6 million in 2020/21 (VFA 2021). Since 2009/10, annual quotas for the western zone that overlaps the Operational Area have been set at between 230 and 260 tonnes and have been fully caught each year (VFA 2023a). In the western zone, most catch is landed through Portland, Port Fairy, Warrnambool, Port Campbell and Apollo Bay. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) lobsters. Southern rock lobsters are found to depths of 150 m, with most of the catch coming from inshore waters less than 100 m deep (VFA 2023a).

5.7.2.5 *Wrasse*

The fishery extends the length of the Victorian coastline from high tide mark to 20 nm offshore (VFA 2023b). Fishers mostly use hook and line. Limited entry fishery with 22 current licences. Total annual catch in 2019/20 was 21.5 tonnes (VFA 2023b).

5.8 Indigenous Culture

The Operational Area is adjacent to Eastern Maar and Gunditjmara Native Title determinations (Appendix B12 MAP-REG-EPM-076). Native Title has not been identified to occur within the Operational Area. Appendix B10 outlines the cultural heritage values and sensitivities

Cultural values that may be at risk from a release of materials or waste overboard are Southern Right Whales. The Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) provides information on the cultural significance of southern right whales to Indigenous Australians. The plan details:

In Victoria, *Koontapool* (Southern Right Whales) occur along the coastlines of south-west Victoria in Gunditjmara Sea Country to feed and birth. These *Koontapool Woorrkngan Yakeen* (Whale Birthing Dreaming Sites), are in coastal bay areas from Port Campbell to Portland, including Warrnambool. These places on Gunditjmara Country are known resting and feeding sites for mothers and calves and are directly related to Gunditjmara *Neeyn* (midwives), explaining why Gunditjmara is a Matrilineal Nation.

5.9 Marine Protected Areas

No marine protected areas are within the Operational Area (Appendix B12 MAP-REG-EPM-078 and MAP-REG-EPM-079).

The closest Australian Marine Parks (AMPs) are the Zeehan Marine Park which is ~49 km and the Apollo Marine Park which is ~36 km from the Operational Area (Appendix B12 MAP-REG-EPM-078).

The Operational Area is ~6 km from the Victorian Twelve Apostles Marine National Park (Appendix B12 MAP-REG-EPM-079). The Twelve Apostles Marine Park is managed in conjunction with the Arches Marine Sanctuary under the Management Plan for Twelve Apostles Marine National Park and The Arches Marine Sanctuary (Parks Victoria 2006b) and is classified as IUCN II. The Plan describes the key environmental, cultural, and social values as:

- Unique limestone rock formations, including the Twelve Apostles.
- Range of marine habitats representative of the Otway marine bioregion.
- Indigenous culture based on spiritual connection to sea country and a history of marine resource use.
- Wreck of the Loch Ard (shipwreck).
- Underwater limestone formations of arches and canyons.
- Diverse range of encrusting invertebrates.
- Spectacular dive site.

5.10 Marine Industries

Marine industries within the Operational Area that could be impacted by an accidental release of materials or waste are the offshore energy and shipping.

5.10.1 Offshore Energy

Within the Operational Area is the Beach Energy Otway Development consisting of subsea infrastructure and the Thylacine-A unmanned platform and the Cooper Energy Casino Henry Netherby Development consisting of subsea infrastructure. During the Regia MSS design envelope (1 November 2023 to 31 October 2028) there is the potential for exploration and development activities such as infrastructure inspection, maintenance and repairs campaigns, seabed surveys, seismic surveys, drilling, and infrastructure installation to be undertaken with vessels and drill rigs to support the ongoing energy supply of oil and gas and potentially renewables within the Otway Basin.

5.10.2 Shipping

The South East Marine Region is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania. Ports Australia provide statistics for port operations throughout Australia's main commercial ports. Based on the latest information (2021) the majority of commercial shipping traffic transiting to and from Victorian ports were container (3,682), general cargo (2,663), bulk liquid carriers (2,019), dry bulk (1,715), car carrier (1,342), bulk gas (220), other cargo (47) and livestock (9).

6 Predicted Levels of Risk

6.1 Injury/mortality to marine fauna

An accidental release of materials or waste may pose a risk marine fauna through ingestion and entanglement. Marine fauna such as birds, pinnipeds, sharks, turtles, dolphins and whales can be severely injured or die from entanglement in marine debris, causing restricted mobility, starvation, infection, amputation, drowning and smothering (DoEE 2018). Seabirds entangled in plastic packing straps or other marine debris may lose their ability to move quickly through the water, reducing their ability to catch prey and avoid predators, or they may suffer constricted circulation, leading to asphyxiation and death. In marine mammals and turtles, this debris may lead to infection or the amputation of flippers, tails, or flukes (DoEE 2018).

Fishing gear (ropes and nets made from synthetic fibres), balloons and plastic bags are the biggest entanglement threat to marine fauna, and plastic bags and utensils are the biggest ingestion risk for seabirds, turtles, and marine mammals (Wilcox et al. 2016). Studies published between 1985 and 2012 identified general plastic as the main debris ingested by marine turtles, followed by soft plastic, rope and styrofoam (Schuyler et al. 2014).

Australia is party to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which regulates garbage pollution from ships. The discharge of plastic into the sea has been prohibited under MARPOL Annex V since 1988; the discharge of all types of garbage into the sea, with very limited exceptions (not related to plastics), has been prohibited since 2013. All vessels used for the Regia MSS will comply with the MARPOL requirements with no discharge of solid waste to the marine environment (M#05: CGG Marine Assurance System). In addition, waste with the potential to be windblown shall be stored in covered containers (M#05: CGG Marine Assurance System) reducing the potential for solid waste to be lost overboard.

If a loss of equipment or streamer occurred, they would not result in an entanglement risk to fauna as they are not flexible enough for fauna to become entangled.

The predicted level of consequence to marine fauna from an accidental release of materials or waste is assessed as minor (consequence may occur to an individual but is unlikely to affect species, populations, or ecosystems) with a likelihood of unlikely (event is possible but not expected to occur under normal circumstances) and the predicted level of risk is assessed as medium.

6.2 Changes to the functions, interests, or activities of other users

In the event of an accidental release of equipment or a streamer which cannot be recovered, if the object was buoyant, it may present a navigation or entanglement hazard to commercial fishers and other marine users. In addition, buoyant objects may become non-buoyant overtime and sink to the seabed, where it may present a snagging hazard for commercial trawling activities and create a potential risk to vessel safety and damage fishing equipment or may require commercial fishers to avoid a localised area for a period of time to avoid interaction.

Shipments to and from the survey vessel will be stored in containers (~ 10ft). These will be lifted onboard the seismic vessel, emptied, and returned to supply vessel. All containers will be secured on deck. In the unlikely event these are lost overboard, closed container will typically float while open top containers will sink. The loss of equipment or streamers could result in entanglement with other marine user's infrastructure or equipment (i.e., fishing gear, propellers) or damage to fishing, shipping, or other marine industry vessels if hit.

In the event of an accidental release of equipment or a streamer which cannot be recovered, the vessel would notify any known vessels in the area and notify Australian Safety Marine Authority who would provide any navigation warnings if required.

Historically there has been a report that a seismic streamer contacted a production platform. This occurred during extreme weather conditions and the vessel was not undertaking acquisition at the time. As detailed in the Existing Environment (Section 5.10.1), the Beach Energy Thylacine-A unmanned platform is within the Operational Area. The platform has a 500 m Petroleum Safety Zone which unauthorised vessels cannot enter. In addition, if due to acquisition requirements any equipment is required to enter the 500 m Petroleum Safety Zone a Simultaneous Operations Plan (M#02) will be implemented.

An accidental release of materials or waste may also result in visual pollution changing the aesthetic values of coastal developments, marine protected areas such as marine parks and sea country. As detailed in the Existing Environment (Section 0) though there are no coastal developments or marine protected areas within the Operational Area, materials or waste could move from the offshore area to coastal areas or marine protected areas via wind and currents. The Great Ocean Road, Victorian Twelve Apostles Marine National Park and the towns of Port Campbell, Port Fairy and Warrnambool are along the coast adjacent to the Operational Area. These areas are major tourist draw cards and our popular for their pristine beaches.

As detailed in the assessment of an accidental release of materials or waste to fauna Australia is party to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which regulates garbage pollution from ships. The discharge of plastic into the sea has been prohibited under MARPOL Annex V since 1988; the discharge of all types of garbage into the sea, with very limited exceptions (not related to plastics), has been prohibited since 2013. All vessels used for the Regia MSS will comply with the MARPOL requirements with no discharge of solid waste to the marine environment (M#05: CGG Marine Assurance System). In addition, waste with the potential to be windblown shall be stored in covered containers (M#05: CGG Marine Assurance System) reducing the potential for solid waste to be lost overboard.

It is unlikely that an accidental release of materials or waste would occur and if it did occur it would be a one-off event that is not predicted to pose a risk to the values of the coastal developments, tourism, marine protected areas, or sea country.

The predicted level of consequence to the functions, interests, or activities of other users from an accidental release of materials or waste is assessed as minor (consequences would be minor and temporary (days) but vessels or fishing gear may require some level of repair or replacement) with a likelihood of unlikely (event is possible but not expected to occur under normal circumstances) and the predicted level of risk is assessed as medium.

7 Comparison of Predicted Level of Risk with Defined Acceptable Levels

Defined Acceptable Level		**Predicted Level of Risk**	**Predicted Level of Risk Below Defined Acceptable level?**
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	An accidental release of materials or waste is not predicted.	Yes
	The impact and risk assessments are based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government management plans, recovery plans and conservation advice were used to inform the risk assessment. An accidental release of materials or waste is not predicted. There is high confidence in the prediction of risks to environmental components that are at risk from an accidental release of materials or waste.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1: Legislative and Other Requirements Relevant to Release of Materials or Waste Overboard .	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	The risks of an accidental release of materials or waste to biological features would be temporary and small scale and would not result in environmental damage at population levels.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	The risks of an accidental release of materials or waste to ecological features is not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	The risks of an accidental release of materials or waste is predicted to be a one-off event that would not result in affected persons being worse off as a result of the activity. As per M#07: Adjustment Protocol an adjustment process will be implemented in the event there is a financial loss to marine users from an accidental release of materials or waste.	Yes

Defined Acceptable Level		Predicted Level of Risk	Predicted Level of Risk Below Defined Acceptable level?
Category	**Level**		
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	The risks of an accidental release of materials or waste is predicted to be a one off event that would have a to temporary / reversible, small scale, and low intensity risk to cultural values.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental risks as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted risk level is medium.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the risk.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons as per the stakeholder feedback of: We want to be assured that your activities out at sea will not result in increased rubbish washing up. The dominant form of rubbish we collect is from ocean sources such as rubbish discarded from international shipping and fishing boats. We would like to see your waste management plan and have assurances that you will commit to zero rubbish disposed of at sea. I whale and seal and bird watch for pelagic and shorebirds along the southwest coast of Victoria and are concerned about their welfare in relation to the Regia MSS. As detailed in the Section below, Identification of Mitigation and Management Measures and Demonstration of ALARP, M#05: CGG Marine Assurance System will be implemented to ensure no waste material is disposed of overboard and all vessels used for the Regia MSS will be required to have a Garbage Management Plan. The risk assessment undertaken predicted that if an accidental release of materials or waste did occur and impacted marine fauna, it would be restricted to an individual and not affect the species at a population level. Thus, impacts to marine fauna watching along the southwest coast of Victoria is not predicted to be affected.	Yes

Defined Acceptable Level		Predicted Level of Risk	Predicted Level of Risk Below Defined Acceptable level?
Category	**Level**		
	The views of public have been considered in the impact and risk assessment.	No public comments have been received in relation to an accidental release of materials or waste.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental risks will be of an acceptable level and ALARP.

No measures were assessed and not adopted.

Measures	Justification	Adopted
M#05: CGG Marine Assurance System	As part of CGG's contracting process, vessels will undergo OVID-style inspections to verify that systems are in place to ensure no waste material is disposed of overboard. Australia is party to Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which regulates garbage pollution from ships. The discharge of plastic into the sea has been prohibited under MARPOL Annex V since 1988; the discharge of all types of garbage into the sea, with very limited exceptions (not related to plastics), has been prohibited since 2013. However, the MARPOL requirements only apply to: Vessels 100 gross tonnes (or certified for 15 persons on-board) will have a Garbage Management Plan. Vessels ≥400 gross tonnes (or certified for 15 persons on-board) will have a garbage record book. All vessels, no matter their size or number of people, used for the Regia MSS are required to have: Garbage Management Plan. Garbage Record Book detailing waste transferred to shore. Covered containers for waste that has the potential to be blown overboard.	Yes
	Streamers will have recovery units fitted to prevent benthic disturbance in the event of loss.	Yes
	The seismic vessel will have procedures for streamer inspection, maintenance, deployment, and retrieval.	Yes
	In the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.	Yes
M#02: Consultation Management System	If a loss of equipment poses a risk to other marine users, they will be notified via VHF Channel 16 and the event will be reported to AMSA, within 2 hrs.	Yes
	A simultaneous operations plan will be developed if the seismic vessels or any equipment will enter the 500 m Petroleum Safety Zone of the Thylacine-A platform.	Yes
M#07: Adjustment Protocol	An adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Other titleholders in the region will be invited to participate in the review, update, and implementation of the adjustment process.	Yes

9 Conclusions

This risk assessment has demonstrated that an accidental release of materials or waste causing a change to marine fauna and functions, interests, or activities of other users has a:

- **Predicted level of consequence of minor.**
- **Likelihood of unlikely.**
- **Predicted level of risk of medium.**

10 Recommendations

As demonstrated in this risk assessment, the predicted level of risk is medium and is clearly below the pre-defined acceptable levels of risk and the mitigation and management measures in place provide reliable prevention to have confidence in the predicted likelihood levels, thus there are no further recommendations.

11 Document Control

Table D1-2 - Revision History

Date	Revision	Update
6 July 2023	A	Draft prepared for initial comment
23 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Updated following public comment and rerun of the PMST search.**

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Annex 1: Legislative and Other Requirements Relevant to Release of Materials or Waste Overboard

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Environment Protection and Biodiversity Conservation Act 1999	Injury and fatality to vertebrate marine life caused by ingestion of, or entanglement in, harmful marine debris has been listed as a key threatening process under the Act.	Materials or waste accidentally released overboard from vessels could pose a risk to listed species. Marine debris resulting from the legal disposal of garbage at sea is excluded from the key threatening process. Under the International Convention for the Prevention of Pollution from Ships, overboard disposal of food, paper, glass, metal, and crockery (but not plastics) is permitted from vessels more than 12 nautical miles from land.	This requirement is met by the implementation of M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels meet all legislative requirements including the International Convention for the Prevention of Pollution from Ships.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983 Part IIIC (Prevention of pollution by garbage) Marine Order 95: Marine Pollution Prevention –Garbage	The Act and Marine Order sets out the requirements for: • Garbage Management Plans • Garbage Record Books	Vessels, if >400 gross tonnes, are required to adhere to the Act and relevant MOs by having a Garbage Management Plans and Garbage Record Book.	This requirement is met by the implementation of M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book.
Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life (CoA 2018)	This plan incorporates new actions needed to abate the listed key threatening process, particularly actions to develop understanding about microplastic impacts and the potential role of new technologies in waste management. The actions are intended to be feasible, effective and efficient, as required by the EPBC Act. The plan binds the Commonwealth and its agencies to respond to the impact of marine debris on vertebrate marine life, and identifies the research, management and other actions needed to reduce the impacts of marine debris on affected species.	The plan details harmful marine debris includes land-sourced garbage, fishing gear from recreational and commercial fishing abandoned or lost to the sea, and vessel-sourced, solid, non-biodegradable floating materials disposed of or lost at sea. The management actions relevant to marine debris are: • Implementation of the requirements of Annex V of the International Convention for the Prevention of Pollution from Ships (MARPOL), which regulates garbage pollution from ships.	This requirement is met by the implementation of M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels meet all legislative requirements including the International Convention for the Prevention of Pollution from Ships.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Birds - Seabirds			
Wildlife Conservation Plan for Seabirds (CoA 2020a)	The plan aims to provide a national framework for the research and management of listed marine and migratory seabirds and to outline national activities to support the conservation of listed seabirds in Australia and beyond. Threatened species are not covered by the plan and receive separate, approved conservation advice and, in some cases, a recovery plan which sets out what should be done to stop the decline and support the recovery of the species.	The plan identifies that marine debris can affect seabirds either through ingestion or entanglement. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
National Recovery Plan for Albatrosses and Petrels (CoA 2022)	The recovery plan provides a national strategy to guide the activities of government, industry, research organisations, and other stakeholders in the protection, conservation and management of listed threatened albatross and petrel species. The plan replaces the previous plan adopted in 2011.	The plan identifies marine debris as a threat. Relevant actions are: • Improve understanding of and reduce the effects of marine debris, plastics and pollution on albatrosses and petrels.	
Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)	Eligible for listing as vulnerable under the EPBC Act.	Listing advice does not identify marine debris as a threat.	NA
Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice *Halobaena caerulea* Blue Petrel (TSSC 2015)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA
Conservation Advice *Pachyptila turtur subantarctica* Fairy Prion (southern) (TSSC 2015e)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA
Commonwealth Listing Advice on *Ardenna carneipes* (Flesh-footed Shearwater) (TSSC 2014)	Assessed as ineligible for listing.	Listing advice identifies plastic ingestion as a threat.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)	Constitutes the formal Commonwealth and New South Wales recovery plan for Gould's Petrel. It identifies the actions to be taken to ensure the long-term viability of the Gould's Petrel in nature and the parties who will carry these out.	Recovery plan does not identify marine debris as a threat.	NA

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Approved Conservation Advice for *Thalassarche chrysostoma* (Grey-headed Albatross) (DEWHA 2009)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies ingestion or entanglement in marine debris as a threat. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)	Assessed as ineligible for listing.	Listing advice does not identify marine debris as a threat.	NA
Conservation Advice *Thalassarche cauta* Shy Albatross (TSSC 2020)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies marine plastics as a threat. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice *Pterodroma mollis* Soft-plumaged Petrel (TSSC 2015a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA
Commonwealth Listing Advice on *Macronectes giganteus* (Southern Giant-Petrel) (TSSC 2001a)	Recommends that the species be listed as Endangered under the EPBC Act	Listing advice does not identify marine debris as a threat.	NA
Birds - Shorebirds			
Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)	The plan provides a framework to guide the conservation of migratory shorebirds and their habitat in Australia and, in recognition of their migratory habits, outlines national activities to support their appreciation and conservation throughout the East Asian-Australasian Flyway (EAAF).	Conservation plan does not identify marine debris as a threat.	NA
EPBC Act Policy Statement 3.21—Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act Listed Migratory Shorebird Species (CoA 2017)	The purpose of this policy statement is to assist proponents in avoiding, assessing, and mitigating significant impacts on migratory shorebirds listed under the EPBC Act. This policy statement is a key action under the Wildlife Conservation Plan for Migratory Shorebirds.	Thresholds of significance impacts on migratory shorebirds relevant to an accidental release of materials or waste are: • Degradation of habitat leading to a substantial reduction in migratory shorebird numbers. • Increased disturbance leading to a substantial reduction in migratory shorebird numbers. • Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers. The guidelines details that defining substantial reduction is made on a case-by-case basis. Factors to consider include:	As detailed in the risk assessment section, in the event an accidental release of materials or waste occurred risks to migratory shorebirds are predicted to be limited to an individual but is unlikely to affect species or populations or ecosystems. Thus, a significant risk to migratory shorebirds is not predicted.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
		• The number of migratory shorebirds historically using an area (based on surveys and historical data). • Likely result in changes in bird numbers and species diversity. • Alterations to the value, quality, geographic extent of the area (for example, will the area still be classed as important habitat). • The function and role of the area (roosting, foraging) and likely changes in ecology and hydrology. • The regional and local context of the area. • The nature, extent, duration and timing of impacts, their likelihood and consequence.	
National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the long-term viability of the species, and the parties that will undertake those actions.	Recovery plan does not identify marine debris as a threat.	NA
Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies dumping of rubbish and debris as a threat. Relevant actions are: • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice for Calidris ferruginea Curlew Sandpiper (DCCEEW 2023m)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies dumping of rubbish and debris as a threat. Relevant actions are: • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies dumping of rubbish and debris as a threat. Relevant actions are: • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (Western Pacific)) (TSSC 2002)	Advice is that it is ineligible for listing as conservation dependent.	Conservation listing advice does not identify marine debris as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)	The recovery plan outlines the long-term strategy, and short-term objectives and actions, for the recovery of the Orange-bellied Parrot.	Recovery plan does not identify marine debris as a threat.	NA
Conservation Advice for *Calidris canutus* Red Knot (DCCEEW 2024)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies dumping of rubbish and debris as a threat. Relevant actions are: • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Pinnipeds			
Conservation Advice *Neophoca cinerea* Australian Sea Lion (TSSC 2020b)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies entanglement in marine debris and ingestion of plastics as threats.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC. 2013a)	The overarching objective of this recovery plan is to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: • Improving the population status, leading to future removal of the Australian sea lion from the threatened species list of the EPBC Act. • Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future.	Recovery plan identifies marine debris as a threat. Relevant actions are: • Develop and implement measures to mitigate the impacts of marine debris on Australian sea lion populations, noting the linkages with the Threat Abatement Plan for the Impact of Marine Debris on Vertebrate Marine Life.	overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Sharks			
Commonwealth Listing Advice on *Centrophorus zeehaani* (Southern Dogfish) (TSSC 2013a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation listing advice does not identify marine debris as a threat.	NA
Commonwealth Listing Advice on *Galeorhinus galeus* (TSSC 2009a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation listing advice does not identify marine debris as a threat.	NA
Listing Advice *Isurus oxyrinchus* Shortfin Mako Shark (TSSC 2014a)	Recommends as not listing.	Listing advice does not identify marine debris as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC 2013b)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in nature and the parties that will undertake those actions.	Recovery plan does not identify marine debris as a threat.	NA
Turtles			
Recovery Plan for Marine Turtles (DoEE 2017)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.	The plan identifies floating non-degradable debris, such as lost or discarded fishing gear (e.g. discarded nets, crab pots, synthetic ropes, floats, hooks, fishing line and wire trace), land-sourced garbage (e.g. plastic bags and bottles) and ship-sourced materials disposed of at sea (e.g. fibreglass, insulation) can pose a threat to marine turtles at all life stages through entanglement and ingestion. Relevant actions are: • Primary approach to management must be source reduction.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) (DEWHA 2008)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies ingestion of marine debris as a threat. No actions specific to vessels marine debris were identified.	

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Whales			
Conservation Management Plan for the Blue Whale (DoE 2015c)	The long-term recovery objective for Blue Whales is to minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list.	Plan identifies marine debris as a threat. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)	Recommends removal as a threaten species but remain a Matter of National Environmental Significance under the EPBC Act as a listed Migratory Species.	Listing advice identifies entanglement with marine debris as a threat. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.
Conservation Advice *Balaenoptera borealis* Sei Whale (TSSC 2015c)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify marine debris as a threat.	NA
Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Plan identifies entanglement with marine debris as a threat. No actions specific to vessels marine debris were identified.	These requirements are met by the implementation of: • M#05: CGG Marine Assurance System to ensure no waste material is disposed of overboard and that vessels have a Garbage Management Plans and Garbage Record Book, and covered containers for waste that has the potential to be blown overboard. • M#05: CGG Marine Assurance System to ensure that in the event of an accidental release of materials or waste the support vessels will search for and retrieve the material or waste where possible and safe to do so.

Annex 2: EPBC Act Listed Species within the Operational Area Relevant to Release of Materials or Waste Overboard

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Birds - Seabirds							
Antipodean Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)
Blue Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice *Halobaena caerulea* Blue

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							Petrel (TSS 2015)
Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Campbell Albatross, Campbell Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Common Diving-petrel						Foraging: year round Breeding: July – January Buffer around Tasmania and Victoria	None identified
Fairy Prion	Species or species habitat may occur within area				Listed	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Fairy Prion (southern)	Species or species habitat may occur within area	Vulnerable				None identified	Conservation Advice *Pachyptila turtur subantarctica* fairy prion (southern) (TSSC 2015e)
Flesh-footed Shearwater, Fleshy-footed Shearwater	Foraging, feeding or related behaviour likely to occur within area		Migratory	Migratory Marine Birds	Listed (as *Puffinus carneipes*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Commonwealth Listing Advice on *Ardenna carneipes* (Flesh-footed Shearwater) (TSSC 2014)
Gould's Petrel, Australian Gould's Petrel	Species or species habitat may occur within area	Endangered				None identified	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)

Common Name	**Presence**	**Threatened Category**	**Migratory Status**	**Migratory Category**	**Marine Status**	**Biologically Important Area**	**Management Plan Conservation Advice Listing Advice**
Grey-headed Albatross	Species or species habitat may occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Approved Conservation Advice for *Thalassarche chrysostoma* (Grey-headed Albatross) (DEWHA 2009)
Indian Yellow-nosed Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Most of the South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Northern Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable			Listed (as *Thalassarche sp. nov.)*	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Northern Giant Petrel	Foraging, feeding or related behaviour likely	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
	to occur within area						and Petrels (CoA 2022) Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)
Northern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Salvin's Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Shy Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)) Conservation Advice

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							Thalassarche cauta Shy Albatross (TSS 2020)
Soft-plumaged Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice *Pterodroma Mollis* Soft-plumaged Petrel (TSS 2015a)
Sooty Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Sooty Shearwater	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed (as *Puffinus griseus*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Conservation Advice for *Ardenna grisea* (Sooty Shearwater)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							(DCCEEW 2023i)
Southern Giant-Petrel, Southern Giant Petrel	Species or species habitat may occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on *Macronectes giganteus* (Southern Giant-Petrel) (TSSC 2001a)
Southern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wandering Albatross	Foraging, feeding or related behaviour likely	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
	to occur within area						
White-capped Albatross	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Birds - Shorebirds							
Australian Fairy Tern	Foraging, feeding or related behaviour likely to occur within area	Vulnerable				None identified	Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPaC. 2011) National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Brown Skua	Species or species habitat may occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Common Sandpiper	Species or species habitat may occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Curlew Sandpiper	Species or species habitat may occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for Calidris ferruginea Curlew Sandpiper (DCCEEW 2023m)
Eastern Curlew, Far Eastern Curlew	Species or species habitat may occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							(DCCEEW 2023n)
Fork-tailed Swift	Species or species habitat likely to occur within area		Migratory	Migratory Marine Birds	Listed - overfly marine area	None identified	None identified
Orange-bellied Parrot	Migration route likely to occur within area	Critically Endangered			Listed - overfly marine area	None identified	Commonwealth Listing Advice on *Neophema chrysogaster* (TSSC 2006). National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)
Pectoral Sandpiper	Species or species habitat may occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Red Knot, Knot	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Calidris canutus* Red Knot (DCCEEW 2024) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Sharp-tailed Sandpiper	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
White-fronted Tern	Foraging, feeding or related behaviour likely to occur within area				Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Dolphins							
Bottlenose Dolphin	Species or species habitat may occur within area					None identified	None identified
Common Dolphin, Short-beaked Common Dolphin	Species or species habitat may occur within area					None identified	None identified
Dusky Dolphin	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Species or species habitat likely to occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Risso's Dolphin, Grampus	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale Dolphin	Species or species habitat may occur within area					None identified	None identified
Pinnipeds							
Australian Fur-seal, Australo-African Fur-seal	Species or species habitat likely to occur within area				Listed	None identified	None identified
Australian Sea-lion, Australian Sea Lion	Species or species habitat may occur within area	Endangered			Listed	None identified	Conservation Advice *Neophoca cinerea* Australian Sea Lion (TSSC 2020b) Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC. 2013a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Long-nosed Fur-seal, New Zealand Fur-seal	Species or species habitat may occur within area				Listed	None identified	None identified
Sharks							
Little Gulper Shark	Species or species habitat likely to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Centrophorus zeeha* (southern dogfish) (TSSC 2013)
Porbeagle, Mackerel Shark	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Species or species habitat may occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Galeorhinus galeus* (TSSC 2009a)
Shortfin Mako, Mako Shark	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Isurus oxyrinchus* shortfin mako

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							shark (TSSC 2014)
White Shark, Great White Shark	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		Distribution and foraging	Recovery Plan for the White Shark (*Carcharodon carcharias*). (DSEWPaC 2013b)
Turtles							
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle	Species or species habitat likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							Turtle*)* *(*DEWHA 2008)
Loggerhead Turtle	Species or species habitat likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Whales							
Andrew's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Antarctic Minke Whale, Dark-shoulder Minke Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Arnoux's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blainville's Beaked Whale, Dense-beaked Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Blue Whale	Foraging, feeding or related behaviour known to occur within area	Endangered	Migratory	Migratory Marine Species		Foraging (annual high use area)	Conservation Management Plan for the Blue Whale (DoE 2015c)
Cuvier's Beaked Whale, Goose-beaked Whale	Species or species habitat may occur within area					None identified	None identified
Dwarf Sperm Whale	Species or species habitat may occur within area					None identified	None identified
False Killer Whale	Species or species habitat likely to occur within area					None identified	None identified
Fin Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)
Gray's Beaked Whale, Scamperdown Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Hector's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Humpback Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)
Killer Whale, Orca	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Long-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Minke Whale	Species or species habitat may occur within area					None identified	None identified
Pygmy Right Whale	Foraging, feeding or related behaviour likely		Migratory	Migratory Marine Species		None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
	to occur within area						
Pygmy Sperm Whale	Species or species habitat may occur within area					None identified	None identified
Sei Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera borealis* sei whale (TSSC 2015c)
Short-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale	Breeding known to occur within area	Endangered	Migratory (as Balaena glacialis australis)	Migratory Marine Species		Migration	Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							Whale (DCCEEW 2022)
Sperm Whale	Species or species habitat may occur within area		Migratory	Migratory Marine Species		None identified	None identified
Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
True's Beaked Whale	Species or species habitat may occur within area					None identified	None identified

Risk Assessment
Collision with Marine Fauna

Appendix D2: REG-EP-017-D2

Rev 2

May 2024

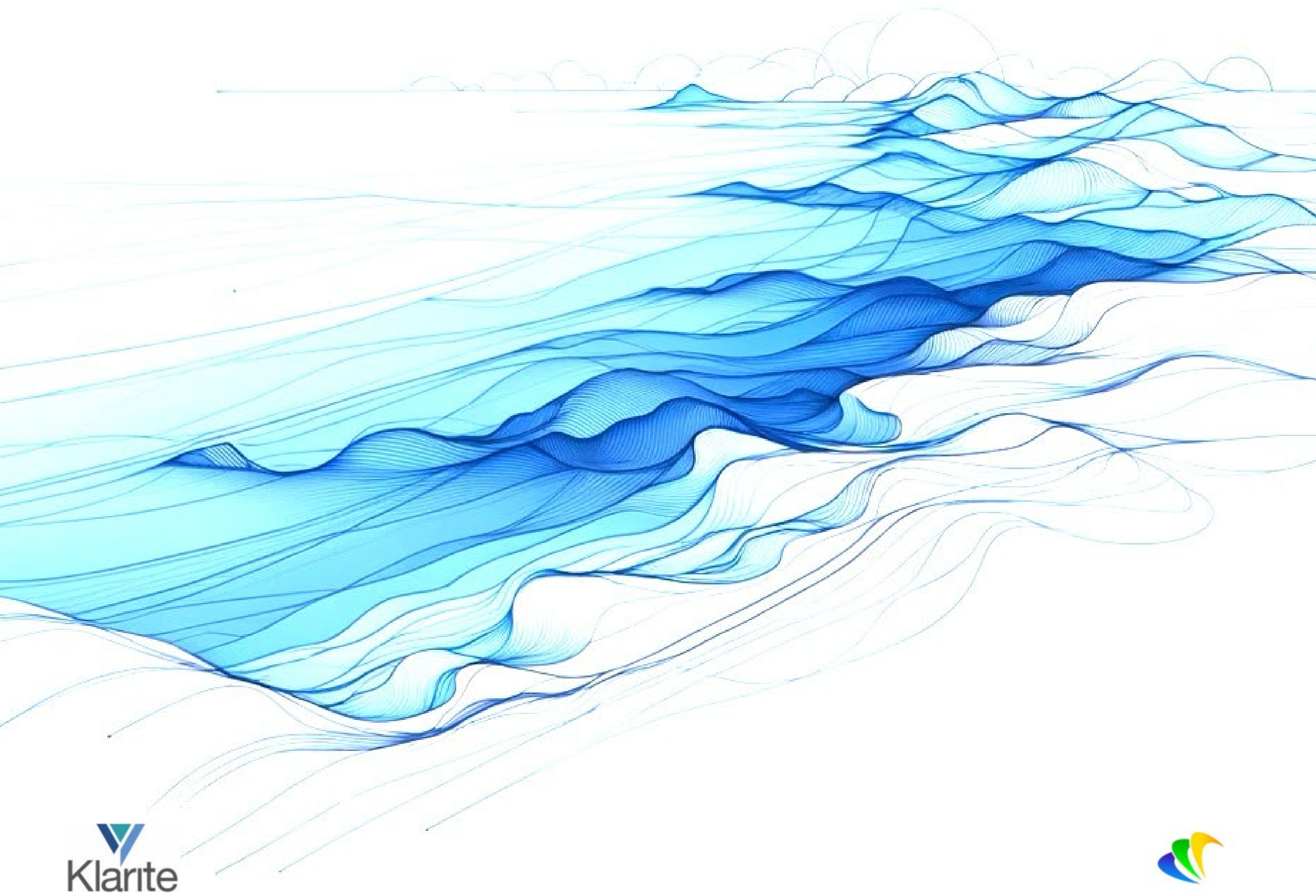


Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment.

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document.

2 Assessment Input

2.1 Aspect Specific Relevant Person Objections and Claims

There was no feedback received during the preparation of the Regia MSS EP about this environmental aspect, or the draft chapter.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table 1 shows how this feedback has been incorporated into the environmental assessments.

Table D2- 1 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Appendices E2 -E7, F1 and F3 to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Effectiveness of mitigation measures	E08	EP Appendices D2 and E5 have been updated to include existing mitigation and management measures that will reduce the likelihood of injury associated with vessel collision and underwater sound including M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure), which provides for marine turtles to move away from the activity before the airguns reach full power.
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Collisions with Fauna

3.1 How the Aspect Occurs

The presence of the seismic and support vessels and towed equipment provides a risk of collision or entrapment of marine fauna potentially causing injury or mortality.

3.2 Extent and Duration of the Aspect

Duration: 90 days

Extent: Operational Area

The extent of the area where the risk of a vessel collision with marine fauna may occur is within the Operational Area and the risk could occur while the activity is undertaken.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to collisions with fauna and species that may be affected, and how the requirements will be met.

4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for collisions with fauna for the following environmental components:

- Fish
- Marine reptiles
- Marine mammals

Though vessel collisions with marine fauna occur within Australia they have not be reported during seismic surveys.

There have been no reported cases of marine fauna becoming entangled in seismic survey streamers in Australian waters. As the streamers are towed, they have a level of tautness that would not result in entanglement of fauna. Thus, there is no cause effect pathway for entanglement of fauna in streamers.

Historically turtles have been recorded as being trapped in the streamer tail buoys. Tail buoys are now of a design that does not represent an entrapment risk to turtles or turtle guards are used as standard equipment if the tail buoy is not of the newer design (M#05: CGG Marine Assurance System). Thus, there is no cause effect pathway for entrapment of turtles in streamer buoys.

The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017a) identifies cetaceans, dugong, marine turtles, and whale sharks as being vulnerable to vessel collisions. Though vessel collisions with marine fauna occur within Australia they have not be reported during seismic surveys.

5 Description of the Existing Environment that May be Affected by the Activity

As detailed in the Section Extent and Duration of the Aspect, the Operational Area has been adopted as the extent of the area with collision with marine may occur. To identify the presence of those species that may be at risk of vessel collision (cetaceans, dugong, marine turtles, and whale sharks) a Protected Matters Search was undertaken for the Operational Area with the report available in Appendix B5.

The PMST Report identified cetaceans and marine turtles may be present within the Operational Area. Dugongs and whale sharks were not identified in the PMST Report for the Operational Area. Annex 2 details those species and identifies any biologically important areas and conservation advice or management plans.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. There are no changes to protected matters information for species that may be at risk of vessel collision [Section added in response to Matters: I16 and I17].

5.1 Turtles

The PMST Report identified three turtle species, that may (green) or are likely (leatherback and loggerhead) to occur within the Operational Area. No BIAs or habitat critical to the survival of the species were identified.

5.2 Cetaceans

The PMST Report identified several cetacean (whales and dolphin) species that are known or are likely to occur within the Operational Area. Table D2-5-1 details those species that were identified as having biologically important areas or biologically important behaviours identified within the Operational Area.

Table D2-5-1: Cetacean Species Biologically Important Behaviours and/or BIAs within the Operational Area

Receptor	Biologically Important Behaviour
Blue Whale	Foraging, feeding or related behaviour known to occur within area
	Foraging (annual high use area) BIA (Appendix B12 MAP-REG-EPM-068)
Fin Whale	Foraging, feeding or related behaviour known to occur within area
Pygmy Right Whale	Foraging, feeding or related behaviour likely to occur within area
Sei Whale	Foraging, feeding or related behaviour known to occur within area
Southern Right Whale	Breeding known to occur
	Migration BIA (Appendix B12 MAP-REG-EPM-069)

5.2.1 Blue whale

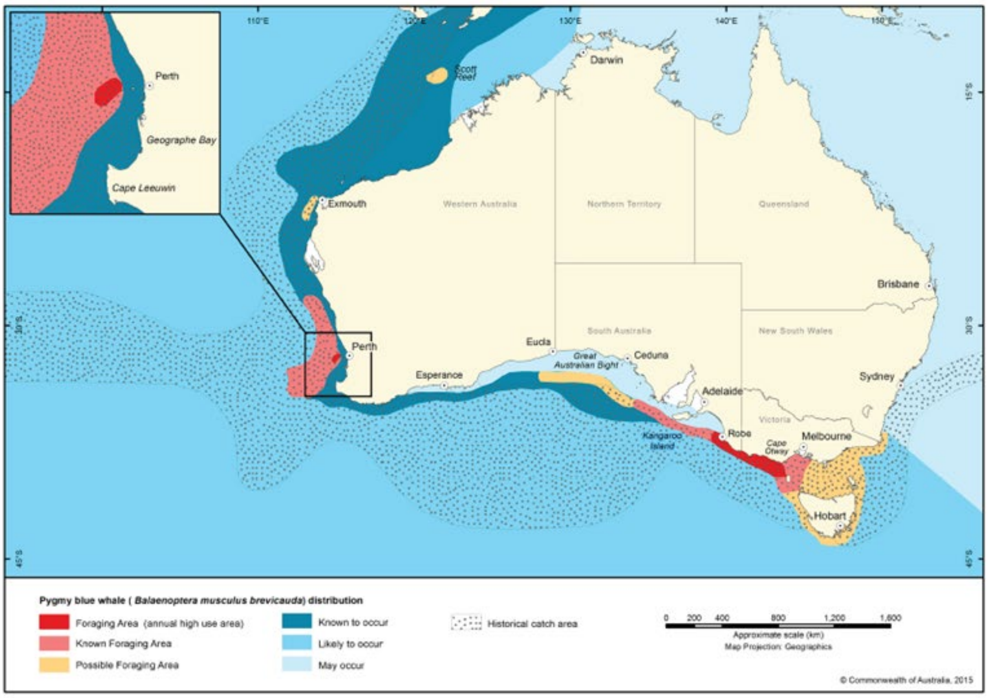
The Blue Whale (Balaenoptera musculus) is listed as an endangered species under the EPBC Act. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the Pygmy Blue Whale (B. m. brevicauda) and the Antarctic Blue Whale (B. m. intermedia). The Otway region, where the Operational Area is located, is an important migratory and foraging area for Blue Whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov 2012, McCauley et al. 2018, Gill et al. 2011). Underwater acoustic monitoring programs have detected Antarctic and Pygmy Blue Whale calls in the Otway Region (McCauley et al. 2018).

Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria where (Figure D2-5-1igure D2-51tab). Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian

Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015c). Pygmy Blue Whales then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015c).

The Blue Whale was extremely abundant until the early 20th century when they were hunted to near extinction. Approximately 341,830 Blue Whale takes were recorded by commercial whaling in the Antarctic and sub-Antarctic in the 20th century, of which 12,618 were identified as Pygmy Blue Whales (Branch et al. 2004). The current global population of Blue Whales is uncertain but is plausibly in the range of 10,000 to 25,000, corresponding to about 3-11% of the 1911 estimated population size (Reilly et al. 2008).

The Operational Area is within the foraging (annual high use) BIA where blue whales predominately occur between January to April (DoE 2015c) (Appendix B12 MAP-REG-EPM-068).



Foraging Area (Annual high use area)	Blue whales are regularly observed feeding on a seasonal basis	Known to occur	Blue whales are known to occur based on direct observations, satellite tagged whales or based on acoustic detections
Known Foraging Area	Known foraging occurs in these areas but is highly variable both between and within seasons	Likely to occur	Blue whales are likely to occur based on occasional observations in the area and nearby areas
Possible Foraging Area	Evidence for feeding is based on limited direct observations or through indirect evidence, such as occurrence of krill in close proximity of whales, or satellite tagged whales showing circling tracks. Blue whales travel through on a seasonal basis, possibly as part of their migratory route	May occur	Evidence for the presence of blue whales through strandings or rare observations
		Historical catch area	Blue whales were caught during the whaling period based on whaling data

Figure D2-5-1: Pygmy Blue Whale Areas around Australia (DoE 2015c)

5.2.2 Fin whale

The Fin Whale is a cosmopolitan migratory species that is listed as vulnerable and occurs from polar to tropical waters but is rarely sighted in inshore waters. Fin Whales show well defined migratory movements between polar, temperate and tropical waters which are essentially north–south with little longitudinal dispersion.

While Australian Antarctic waters are important feeding grounds for Fin Whales, the species also feeds in the Bonney Upwelling during summer/autumn sometimes in the company of Blue and Sei Whales (DCCEEW 2023b). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat with the species feeding on planktonic crustacea, krill, some fish and cephalopods (DCCEEW 2023b). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed.

There are no BIAs for the Fin Whale within Australian waters. Fin Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.2.3 Pygmy Right Whale

The Pygmy Right Whale is a little-studied baleen whale species that is found in temperate and sub-Antarctic waters in oceanic and inshore locations. No population estimates are available for Pygmy Right Whales globally, or in Australian waters (DCCEEW 2012c). The species has never been hunted commercially and is listed as a migratory species under the EPBC Act.

Species distribution in Australia is found close to coastal upwellings and the Subtropical Convergence may be important for regulating distribution (Bannister et al. 1996). Key locations include south-east Tasmania, Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to upwelling habitats rich in marine life and zooplankton upon which it feeds (Bannister et al. 1996).

There are no BIAs for the Pygmy Right Whale within Australian waters. Pygmy Right Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.2.4 Sei Whale

The Sei Whale is listed as vulnerable under the EPBC Act. Sei Whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. Sei Whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for Sei Whales in Australian waters.

In Australia, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978, Bannister et al. 1996, Thiele et al. 2000, Chatto and Warneke 2000, Bannister 2008).

Sightings of Sei Whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al. 2012), where opportunistic feeding has been observed between November and May (Gill et al. 2015).

There are no BIAs for the Sei Whale within Australian waters. Sei Whales are likely to be foraging in the Operational Area at similar time as Blue Whales, predominately occur between January to April.

5.2.5 Southern Right Whale

The Southern Right Whale (*Eubalaena australis*) is listed as endangered under the EPBC Act. Southern Right Whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al. 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because Southern Right Whales have a slow rate of increase (7% per annum) compared to other marine mammals, their numbers remain low (IWC 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia and New Zealand.

Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). They are distributed across thirteen primary aggregation areas along the southern coast of Australia. In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012).

The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by Southern Right Whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA (CoA 2012). Southern Right Whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al. 2017). A number of additional areas for Southern Right Whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (CoA 2012). These emerging areas off Victoria align with the Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) which provides an update to BIAs and emerging aggregation areas. The proposed changes are:

- Reproductive areas - Areas where mating, calving, nursing and/or presence of neonates are known, or likely, to occur. For Victoria this is the nearshore area between Portland and Port Campbell.
- Migration areas - Areas southern right whales are known, or likely, to use for movement between regions that support biologically important behaviour (e.g., coastal movement between reproductive areas).

The Operational Area overlaps the Southern Right Whale Migration BIA where the whales are present between April and October (NCVA 2023) (Appendix B12 MAP-REG-EPM-069).

6 Predicted Levels of Risk

Though vessel collisions with marine fauna occur within Australia they have not be reported during seismic surveys. The extent of the area of where the risk of a vessel collision with marine fauna may occur is within Operational Area and the risk could occur while the activity is undertaken. The worst potential impact from vessel collision would be mortality or serious injury of an individual.

6.1.1 Turtles

No habitat critical to the survival of marine turtles or biologically important areas have been identified within the Operational Area, from the Recovery Plan for Marine Turtles in Australia (DoEE 2017) or PMST Report (Appendix B5). Thus, it is likely that the three marine turtle species identified in the PMST Report (Green, Leatherback and Loggerhead) may be present in low numbers within the Operational Area.

The Recovery Plan for Marine Turtles in Australia (DoEE 2017) details that impact from vessels can cause serious injury and/or death to individual marine turtles and is particularly an issue in shallow coastal foraging habitats and internesting areas where there are high numbers of recreational and commercial craft, and in areas of marine development. Although the outcome can be fatal for individual turtles, boat strike (as a standalone threat) has not been shown to cause stock level declines.

The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017c) found speed to be a critical factor in determining a flee response in marine turtles being approached by vessels. The proportion of flee responses decreased significantly with increasing speed, particularly with close encounters. While speed is a particularly important factor, so too is the movement patterns of the vessel for example, whether a vessel is transiting a dedicated route or is a recreational boat that is moving erratically.

The predicted level of consequence to marine turtles from a vessel collision is assessed as major (injury or death of individuals of a protected species) with a likelihood of rare (almost impossible / unheard of in the industry) with a predicted level of risk of medium, based on:

- Though vessel collisions with marine fauna occur within Australia they have not been reported during seismic surveys.
- There is no habitat critical to the survival of marine turtles or BIAs within Operational Area.
- There are no shallow coastal marine turtle foraging habitats or internesting areas within the Operational Area.
- The seismic and support vessels will operate at low speed of no more than 5 knots during acquisition (M#01: Activity Limitation).
- The seismic survey is undertaken in a set racetrack pattern (see the Description of Activity in Appendix A2) so the vessels will be following a set path and not moving erratically.
- Marine fauna observers will be on the seismic vessel watching for fauna (M#03: Fauna Management System).
- If an incident occurred, it would be restricted to individual marine turtles and will not affect turtle species at a population level.

6.1.2 Cetaceans

Twenty-three whale species (or species habitat) may occur within the Operational Area (Annex 2). Foraging behaviours were identified for the Blue, Fin, Pygmy Right and Sei Whale and breeding for the Southern Right Whale. The Operational Area overlaps Southern Right Whale migration BIA and the Pygmy Blue Whale foraging (annual high use area) BIA. Other whale species identified are transient within the Operational Area.

The Conservation Management Plan for the Blue Whale (DoE 2015c) details that collisions will impede recovery of blue whale populations if enough individuals in the population lose reproductive fitness or are killed. Although all forms of vessels can collide with whales, severe or lethal injuries are more likely to occur by larger or faster vessels. Blue Whales in the Bonney Upwelling region regularly feed at the surface on krill aggregations and are likely to be more vulnerable to ship strike.

The Conservation Management Plan for the Blue Whale (DoE 2015c) assesses the threat of vessel collision to Antarctic and Pygmy Blue Whales as having a moderate consequence (population recovery stalls or reduces) with a possible likelihood (might occur at some time) giving an overall rating of high. Relevant actions from the recovery plan are ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.

The Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) details that in Australia, Southern Right Whales are the second most common species involved in Australian vessel strikes, which is consistent with worldwide data. At present, there have been ten vessel strike reports of Southern Right Whales in Australian waters between 1997 and 2015, with at least four mortalities including mother-calf pairs in the region of the eastern population.

The Conservation Management Plan for the Southern Right Whale (DCCEEW 2022) assesses the threat of vessel collision as having a major consequence (population declines) with an almost certain likelihood (expected to occur every year) giving an overall rating of very high. Relevant actions from the recovery plan are ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs.

The Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) details that proven effective mitigation measures for addressing vessel strike are to reduce co-occurrence of vessels with whales through separation of vessels from areas with high concentrations of whales and to reduce vessel speeds. Mitigation actions to prevent injury and minimise disturbance from vessels to Southern Right Whales include seasonal or temporary area restrictions/exclusions and speed restrictions in biologically important areas and habitat critical for survival.

The Conservation Advice for the Sei Whale (TSSC 2015c) and Fin Whale (TSSC 2015b) lists vessel strike as a threat with a minor consequence rating.

The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017c) details that speed is a concern when considering collision risk and the outcome. Vanderlaan and Taggart (2007) observed that an escalation in speed of the vessel caused an increase in the severity of injury to large cetaceans. Slower moving vessels provide greater opportunity for both fauna and vessel to avoid collision.

Large, high-speed vessels have become a major concern as they can travel at speeds of up to 35 to 40 knots, which correlates to an increase in collisions (Weinrich 2004, Ritter 2010). According to Laist et al. (2001), 89 per cent of incidences where the whale was severely hurt or killed occurred at vessel travelling speeds greater than 14 knots and were most serious in large vessels (> 80 m). Furthermore, the chance of an injury being lethal increases significantly as vessel speed increases up to 13-15 knots (Vanderlaan and Taggart 2007).

The predicted level of consequence to cetaceans from a vessel collision is assessed as major (injury or death of individuals of a protected species) with a likelihood of rare (almost impossible / unheard of in the industry) with a predicted level of risk of medium, based on:

- Though vessel collisions with marine fauna occur within Australia they have not been reported during seismic surveys.
- The seismic and support vessels will operate at low speed of no more than 5 knots during acquisition (M#01: Activity Limitation).
- Separation distances will be applied to cetaceans as per the EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with cetaceans (M#03: Fauna Management System)

- Marine fauna observers will be on the seismic vessel watching for fauna (M#03: Fauna Management System).
- If an incident occurred, it would be restricted to individual whales or dolphins and will not affect the species at a population level.

7 Comparison of Predicted Level of Risk with Defined Acceptable Levels

Defined Acceptable Level		**Predicted Level of Risk**	**Predicted Level of Risk Below Defined Acceptable level?**
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted risks are low intensity environmental damage as risks would be restricted to individual fauna and will not affect the species at a population level.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government management plans, recovery plans and conservation advice were used to inform the risk assessment. Serious or irreversible environmental damage is not predicted as risks would be restricted to individual fauna and will not affect the species at a population level. There is high confidence in the prediction of risks to species that are at risk from vessel collisions.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1 of this document.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted risks are low intensity environmental damage as risks would be restricted to individual fauna and will not affect the species at a population level.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Predicted risks to ecological features associated with marine fauna are temporary / reversible, small scale, as risks would be restricted to individual fauna and will not affect the species at a population level.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Predicted risks to economic features associated with marine fauna are temporary / reversible, small scale, as risks would be restricted to individual fauna and will not affect the species at a population level.	Yes

Defined Acceptable Level		**Predicted Level of Risk**	**Predicted Level of Risk Below Defined Acceptable level?**
Category	**Level**		
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Predicted risks to cultural features associated with marine fauna are temporary / reversible, small scale, as risks would be restricted to individual fauna and will not affect the species at a population level.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental risks as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted risk level is medium.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the risk.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	To date no objections or claims in relation to fauna and vessel collisions have been made by relevant persons. A relevant person raised that they whale and seal watch along the southwest coast of Victoria and are concerned about their welfare in relation to the Regia MSS. A collision with a whale or seal is a rare event and has not been reported during seismic surveys. The implementation of M#03: Fauna Management System will ensure that fauna collision risk is as low as practicably possible.: The risk assessment undertaken predicted that if a collision did occur with marine fauna, it would be restricted to an individual and not affect the species at a population level. Thus, risks to marine fauna watching along the southwest coast of Victoria is not predicted to be affected.	Yes
	The views of public have been considered in the impact and risk assessment.	To date there has been no views from the public in relation to fauna and vessel collisions.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental risks will be of an acceptable level and ALARP.

Measures	Justification	Adopted
M#01: Activity Limitation	As detailed in the National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017c) and Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) proven effective mitigation measures for addressing vessel strike are to reduce vessel speeds. Seismic and support vessels will operate at no more than 5 knots (11 km/hr) during acquisition. Reduction in vessel speed is good industry practice in areas where fauna is undertaking biologically important behaviours or there are BIAs. The environmental benefit outweighs the additional cost.	Yes
M#01: Activity Limitation	If the survey period is between September to November, seismic lines will be acquired working from deep to shallow to mitigate interactions with Blue Whales who might traverse the intended MSS area as they move towards their summer feeding grounds.	Yes
M#03: Fauna Management System	The Fauna Management System (Appendix G2) provides details about how the Regia MSS will be carried out in a manner by which the environmental impacts from collisions to marine fauna will be reduced to ALARP and be of an acceptable level. It details how the requirements of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans will be met. The requirements of the EPBC Regulations set out measures to reduce vessel speed and avoid approaching cetaceans. It is a legislative requirement for vessels to comply with the EPBC Regulations.	Yes
M#05: CGG Marine Assurance System	Streamer tail buoys will be of a design that does not represent an entrapment risk to turtles or turtle guards will be used.	Yes
M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure)	The soft-start procedure provides for marine turtles to move away from the activity before the airguns reach full power. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matters E08 and I05].	Yes

Measures assessed and not adopted.

Measure	Justification	Adopted
Surveys only undertaken during daylight hours	Though vessel collisions with marine fauna occur within Australia they have not be reported during seismic surveys. Undertaking the seismic survey only in daylight hours would have a disproportionate cost without a significant environmental benefit. Undertaking the seismic survey only in daylight hours would at best double the time taken to compete the survey. This increase in time would result in increased environmental impacts and risks and a doubling in costs without a significant reduction in the likelihood of a vessel collision with fauna occurring. To significantly reduce the likelihood of a vessel collision with fauna during the hours of darkness the survey and support vessels would need to be stationary. This is not feasible for the survey vessel when it has streamers in the water and during deployment and retrieval of the streamers. It is also not feasible for the support vessels to remain stationary as they are required to be with the survey vessel to reduce the risk of potential collisions with other marine users due to the limited manoeuvrability of the seismic vessel.	No

9 Conclusions

This risk assessment has demonstrated that collision between marine fauna and the survey vessels has a:

- **Predicted level of consequence of major.**
- **Likelihood of rare.**
- **Predicted level of risk of medium.**

10 Recommendations

As demonstrated in this risk assessment, the predicted level of risk is medium and is clearly below the pre-defined acceptable levels of risk and the mitigation and management measures in place provide reliable prevention to have confidence in the predicted likelihood levels, thus there are no further recommendations.

11 Document Control

Date	Revision	Update
6 July 2023	A	Draft prepared for initial comment
23 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	2	Updated following public comment, update to PMST searches, and updated literature.

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Annex 1: Legislative and Other Requirements Relevant to Collisions with Marine Fauna

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Recovery Plan for Marine Turtles (DoEE 2017)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.	Details boat strike is a highly visible threat because it more commonly occurs in highly populated areas. No specific actions are identified in relation to vessel strikes to turtles. Manage anthropogenic activities in Biologically Important Areas to ensure that biologically important behaviour can continue.	This requirement is met by this impact assessment. No impacts to turtle biologically important behaviour are predicted.
Approved Conservation Advice for Dermochelys coriacea (Leatherback Turtle) (DEWHA 2008)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Identifies boat strike as a threat. No action relevant to boat strike.	This requirement is met by this impact assessment. No impacts to turtle biologically important behaviour and the recovery of the Leatherback Turtle are predicted.
EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans	The regulations specify how vessels, aircraft and people must behave around whales and dolphins.	The regulations detail the requirements for interactions with cetaceans for vessels including: Travel at less than 5 knots within the cautionary zone of a cetacean (150 m radius for dolphins, 300 m for whales. Do not approach closer than the caution zones for a cetacean. If a cetacean shows signs of disturbance move away at a constant speed less than 5 knots.	This requirement is met by the implementation of M#03: Fauna Management System which details how the requirements of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans will be met.
EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (DEWHA 2008)	The policy statement provides guidance on how to minimise the impact of seismic surveys on whale populations, which may be affected by underwater noise and disturbance caused by these activities.	EPBC Act Policy Statement 2.1 Part B.1 – Additional Management Measures: Marine Mammal Observers details that as the likelihood of encountering whales increases marine fauna observers (MFOs) should be engaged.	This requirement is met by the implementation of M#03: Fauna Management System which details how the requirements Policy Statement 2.1 will be met.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (CoA 2017c)	The strategy is a guiding framework for identifying species most at risk of vessel collision; areas where these species are most at risk of vessel collision, and appropriate mitigation measures to reduce the risk of vessel collisions with marine megafauna.	Management actions relevant to the activity are: Promote the use of risk assessments in planning facilities and activities in the marine environment to stakeholders, such as government agencies, tourism operators, mariners and port authorities. Identify and adopt best-practice mitigation measures and emerging technologies and encourage the development of new mitigation measures. Adaptive management principles, including the use of regular reviews are used during the implementation of mitigation measures.	This requirement is met by this impact assessment and the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact. Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy.
Conservation Management Plan for the Blue Whale (DoE 2015c)	The long-term recovery objective for Blue Whales is to minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list.	Details that vessel collisions will impede recovery of Blue Whale populations if a sufficient number of individuals in the population lose reproductive fitness or are killed. The management actions relevant to vessel strikes are: Ensure all vessel strike incidents are reported in the National Ship Strike Database. Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented.	This requirement is met by this impact assessment and the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact. Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy.
Conservation Advice Balaenoptera physalus Fin Whale (TSSC 2015b)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Lists vessel strike as a threat with a minor consequence rating. The management action relevant to vessel strikes is ensure all vessel strike incidents are reported in the National Vessel Strike Database.	Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy. In addition, this impact assessment does not predict impacts at a level that will impede the recovery of the Fin Whale, with the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Listing Advice Megaptera novaeangliae Humpback Whale (DAWE 2022a)	Recommends removal as a threaten species but remain a Matter of National Environmental Significance under the EPBC Act as a listed Migratory Species.	Lists vessel strike as a threat with humpback whales are one of the most frequently reported whale species involved in vessel strikes worldwide.	This requirement is met by this impact assessment which does not predict impacts to Humpback Whales, and the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact. Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy.
Conservation Advice Balaenoptera borealis sei whale (TSSC 2015c)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Lists vessel strike as a threat with a minor consequence rating. The management action relevant to vessel strikes is ensure all vessel strike incidents are reported in the National Vessel Strike Database.	Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy. In addition, this impact assessment does not predict impacts at a level that will impede the recovery of the Sei Whale, with the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Details that reducing ship strike mortality can be most easily done either by reducing vessel speed or by separating vessels and whales. The management actions relevant to vessel strikes are: Assess risk of vessel strike to Southern Right Whales in BIAs. Ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs. Ensure all vessel strike incidents are reported in the National Ship Strike Database managed through the Australian Marine Mammal Centre, Australian Antarctic Division.	This requirement is met by this impact assessment and the implementation of M#03: Fauna Management System. The adopted measures will be implemented and monitored as detailed in Appendix B3 Implementation Strategy to ensure they are effective in managing the impact. Whale and vessel strike incidents will be reported in the National Ship Strike Database Reporting as detailed in Appendix B3 Implementation Strategy.

Annex 2: EPBC Act Listed Species within the Operational Area Relevant to Collison

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Turtles							
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle	Species or species habitat likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*)* (DEWHA 2008)
Loggerhead Turtle	Species or species habitat likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Dolphins							
Bottlenose Dolphin	Species or species habitat may occur within area					None identified	None identified
Common Dolphin, Short-beaked Common Dolphin	Species or species habitat may occur within area					None identified	None identified
Dusky Dolphin	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Species or species habitat likely to occur within area					None identified	None identified
Risso's Dolphin, Grampus	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale Dolphin	Species or species habitat may occur within area					None identified	None identified
Whales							
Andrew's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Antarctic Minke Whale, Dark-shoulder Minke Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Arnoux's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blainville's Beaked Whale, Dense-beaked Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Blue Whale	Foraging, feeding or related behaviour known to occur within area	Endangered	Migratory	Migratory Marine Species		Foraging (annual high use area)	Conservation Management Plan for the Blue Whale (DoE 2015c)
Cuvier's Beaked Whale, Goose-beaked Whale	Species or species habitat may occur within area					None identified	None identified
Dwarf Sperm Whale	Species or species habitat may occur within area					None identified	None identified
False Killer Whale	Species or species habitat likely to occur within area					None identified	None identified
Fin Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)
Gray's Beaked Whale, Scamperdown Whale	Species or species habitat may occur within area					None identified	None identified
Hector's Beaked Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Humpback Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)
Killer Whale, Orca	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Long-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Minke Whale	Species or species habitat may occur within area					None identified	None identified
Pygmy Right Whale	Foraging, feeding or related behaviour likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Pygmy Sperm Whale	Species or species habitat may occur within area					None identified	None identified
Sei Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera borealis* sei whale (TSSC 2015c)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Short-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale	Breeding known to occur within area	Endangered	Migratory (as Balaena glacialis australis)	Migratory Marine Species		Migration	Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)
Sperm Whale	Species or species habitat may occur within area		Migratory	Migratory Marine Species		None identified	None identified
Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
True's Beaked Whale	Species or species habitat may occur within area					None identified	None identified

REGIA
Marine Seismic Survey

Risk Assessment
Introduction of Marine Pest Species

Appendix D3: REG-EP-018-D3

Rev 2

May 2024

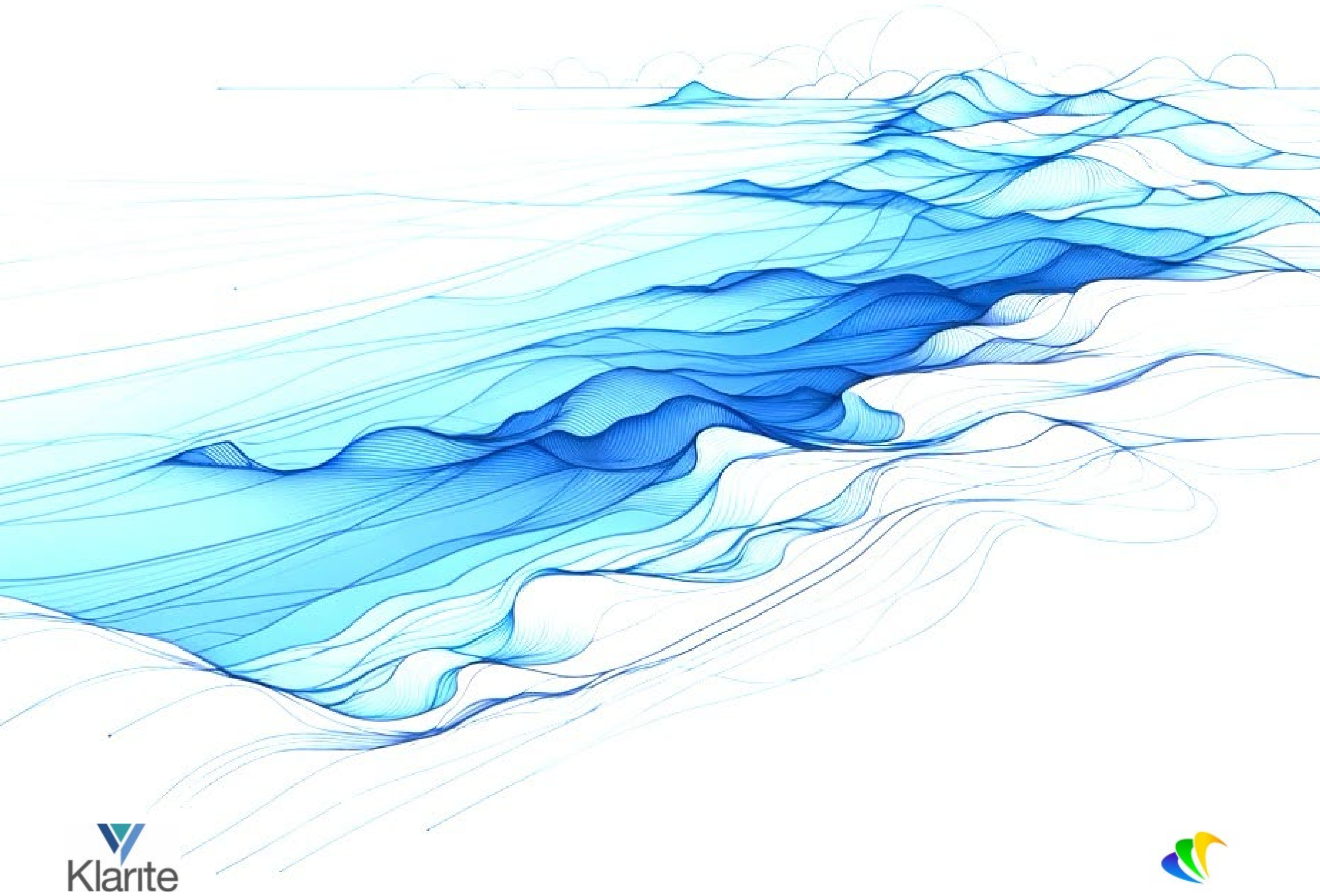

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Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment.

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table D3-2-1able D3-21 shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table D3-2-1, and the feedback received during the public comment period for the completed EP is provided in Table D3-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table D3-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table D3-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Parks Victoria requested a rationale for choosing the 5 km buffer zone around the Twelve Apostles Marine Park was requested.	259	After considering the Twelve Apostles Marine National Park and the Arches Marine Sanctuary Management Plan, the main threat identified to marine habitats of the park was the risk of introducing invasive marine species. CGG carried out a risk assessment and identified the risk of introducing marine species decreases with water depth and distance from the coast. CGG examined the operational and geophysical objectives of the survey and determined that a 5 km buffer around the Twelve Apostles Marine Park would have minimal effect to the operations.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table D3- 2-2 shows how this feedback has been incorporated into the environmental assessments.

Table D3- 2-2 Public comment input since the beginning of the public comment period starting 25 January 2024

Matter	Matter ID	Changes made arising from public comment
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Introduction of Marine Pest Species

3.1 How the Aspect Occurs

The introduction of marine pests could occur from vessels used for the Regia MSS because of:

- Discharge of ballast water containing foreign species.
- Translocation of species through biofouling of the vessel hull and/or niches (e.g., sea chests, bilges, and strainers) or in-water equipment (e.g., source array and streamers).

3.2 Extent and Duration of the Aspect

Duration: 90 days

Extent: Operational Area

The extent of the area where the risk of an introduction of marine pest species may occur is within the Operational Area and the risk could occur while the activity is undertaken.

3.3 Legislative and Other Requirements

Annex 1: Legislative and Other Requirements describes the legal and other requirements that apply to marine pests and how the requirements will be met.

4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for marine pests for the following environmental components:

- Benthic assemblages
- Invertebrates
- Commercial Fishing and Aquaculture
- Diving
- Recreational fishing

No cause-effect pathway for marine pests and marine protected areas such as Australian and Victorian marine parks was identified as the closest Australian Marine Park (Apollo) is ~36 km from the Operational Areas (Appendix B12 MAP-REG-EPM-078). The Victorian Twelve Apostles Marine National Park was identified to abut the previous Activity Planning Area and to reduce the risk of IMS translocation into the park a 5 km buffer was put in place for the final Operational Area making the distance to the park from the Operational Area ~ 6 km (Appendix B12 MAP-REG-EPM-079).

Marine pest may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. However, establishment of introduced marine species is mostly likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

Successful marine pest establishment requires the following three steps (Marine Pest Sectoral Committee 2018):

- Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
- Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., Operational Area).
- Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

The Australian Government Bureau of Resource Sciences (BRS) established that the relative risk of a marine pest incursion around the Australian coastline decreases with distance from the shoreline. Modelling conducted by BRS (2007) estimates:

- 33% chance of colonisation at 3 nm
- 8% chance at 12 nm
- 2% chance at 24 nm.

If the risk of establishment of IMS is realised, the following known and potential environmental impacts may occur:

- Change in ecosystem dynamics.
- Changes to the functions, interests, or activities of other users.

Change in ecosystem dynamics may include reduction in native marine species diversity and abundance, displacement of native marine species, socio-economic impacts on commercial fisheries, and changes to conservation values of protected area.

5 Description of the Existing Environment that May be Affected by the Activity

As detailed in Section 3.2, the Operational Area has been adopted as the extent of the area where marine pest translocation could occur from Regia MSS vessels.

As detailed in the PMST Report for the Operational Area (Appendix B5) there are no marine protected areas within the Operational Area. The Operational Area overlaps the West Tasmanian Canyons Key Ecological Feature (KEF) and the Giant Kelp Marine Forests of Southeast Australia Threatened Ecological Community (TEC). However, giant kelp requires clear, shallow water no deeper than approximately 35 m deep (TSSC 2012) which is outside the water depths for the Regia MSS Operational Area (40 to 1,400 m) and thus it is not assessed further.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. There are no changes to protected matters information for receptors that may be impacted by an introduction of marine pests [Section added in response to Matters: I16 and I17]

5.1 Marine Pests

In the South-east Marine Region, 115 marine pest species have been introduced and an additional 84 have been identified as possible introductions, or 'cryptogenic' species (NOO 2002). Several introduced species have become pests either by displacing native species, dominating habitats or causing algal blooms.

Marine pests in Victoria marine waters according to Parks Victoria (No date) and Agriculture Victoria (2023) are:

- Asian date mussel (*Musculista senhousia*) – prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna. Found in Port Phillip and Western Port, including Yaringa and French Island Marine National Parks; some records from eastern Victoria, particularly the Gippsland Lakes.
- Asian shore crab (*Hemigrapsus sanguineus)* - found on hard surfaces like under rocks, shells, debris or artificial structures (marinas, moorings, etc.) in exposed rocky coasts, estuaries, tidal flats and shallow waters. Currently present in Port Phillip Bay.
- Cord grass (*Spartina anglica* and *Spartina x townsendii sp*) – found at the mouth of Bass River and in drain outlets near Tooradin in Westernport. Widespread in South Gippsland including Anderson's Inlet and Corner Inlet. Invades native saltmarsh, mangroves and mudflats, altering the mud habitat and excluding other species.
- Dead man's fingers (*Codium fragile ssp. fragile*) – widespread in Port Phillip and known to inhabit San Remo and Newhaven in Westernport. It grows rapidly to shade out native vegetation and can regenerate from a broken fragment enabling easy transfer from one area to another. Attaches to subtidal rocky reef and other hard surfaces.
- European fan worm (*Sabella spallanzanii*) - found at depths down to 30 m and is found in nutrient-rich waters in sheltered locations where there are no strong currents and little wave action. It is a filter feeder and grows on soft sediments or anchors itself to rocks, mollusc shells, jetties, pontoons or other solid surfaces. Well established in Port Phillip and some other local ports but not yet observed in Western Port or elsewhere.
- Green Shore Crab (*Carcinus maenas*) - voracious and aggressive predator with a broad diet, it out-competes native crabs for food and habitat. It is a major cause of mortality of native crabs and mollusc populations. Widespread across Victoria and common in Port Phillip and Western Port. This crab has been present in Victoria since the 1800s
- New Zealand screw shell (*Maoricolpus roseus*) – lies on or partially buried in sand, mud or gravel in waters up to 130 m deep. It can densely blanket the sea floor with live and dead shells and compete with native scallops and other shellfish for food. This species is

widespread in coastal areas of Eastern Victoria, including Corner Inlet and has been found west of Wilsons Promontory in Waratah Bay and Shallow Inlet. Its range is slowly expanding westward. Not currently known in Port Phillip or Western Port.

- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m but up to 200 m water depths. It is thought to have been introduced in 1995 through ballast water from Japan.
- Pacific Oyster (*Crassostrea gigas*) - alter habitats by covering substrates, forming reefs and over growing native species. It is fast growing and is a filter feeder, competing with native species for food. Known pest in Western Port. Also observed in Port Phillip, Tidal River, Corner Inlet and Nooramunga Marine and Coastal Park however not considered a pest in these locations.
- Red Algae (*Grateloupia turuturu*) - large size of the plant shades out native algae on the reef. It grows rapidly in summer and dies back in winter causing large change in the availability of food for grazers such as snails. Widespread in northern Port Phillip.
- Wakame (*Undaria pinnatifida*) - grows rapidly and forms dense underwater forests, outcompeting native kelp and algae for light and space, then dies back in summer, changing kelp habitat. Well established in Port Phillip but currently not present in other Victorian locations, apart from Apollo Bay Harbour.

The National Introduced Marine Pests Information System (NIMPIS 2023) indicates that Portland, a potential port for mobilisation, harbours the following marine pests:

- Bryozoan (*Bugula neritina)* - most abundant bryozoans in ports and harbours and an important member of the fouling community. They grow well on pier piles, vessel hulls, buoys, and similar submerged surfaces.
- Bryozoan (*Cryptosula pallasiana)* - typical habitats include seagrasses, drift algae, oyster reef, artificial structures such as piers and breakwaters, man-made debris, rock, shells, ascidians, glass and vessel hulls. It has been reported from depths down to 35 m.
- Dead man's fingers (*Codium fragile ssp. fragile*) - as per Victorian waters.
- East Asian bivalve (*Theora lubrica)* - typically lives in muddy sediments from the low tide mark to 50 m, however it has been found at 100 m.
- European clam (*Varicorbula gibba* - inhabits the shallow sublittoral zone to depths of around 140 m, where it is a shallow burrower in thick muddy sand with coarse elements.
- European fan worm (*Sabella spallanzanii*) - as per Victorian waters.
- Fanworm (*Euchone limnicola)* - burrows into soft sediments, secreting a mucous layer to enable it to build firm burrow walls.
- Solitary ascidian (*Ascidiella aspersa)* - found from intertidal to shallow subtidal waters to 50 m depth attached to clay, stones, rocks, algae and wharf piles, where it can be the dominant fouling species.
- Toxic dinoflagellate (*Alexandrium tamarense)* - found in the photic zone; 1-20 m depth inshore; possibly deeper offshore.
- Toxic dinoflagellate (*Alexandrium minutum)* - found to a depth of 20 m in inshore waters, but may be found deeper offshore.
- Wakame (*Undaria pinnatifida*) – as per Victorian waters.
- White bushy bryozoan (*Amathia distans)* - Usually found in sheltered, often turbid, waters. Rocks, rock reef, oyster reef, docks, pilings, breakwaters, buoys, pontoons, man-made debris, and drift algae are all good substrates for this species.

The National Introduced Marine Pests Information System (NIMPIS 2023) indicates that other ports which may be used for the survey, Warrnambool, Apollo Bay or Port Fairy do not currently harbour any marine pests.

5.1.1 Benthic Assemblages

Benthic assemblages are biological communities that live in or on the seabed. They typically contain light-dependent taxa such as algae, seagrass and corals, which obtain energy primarily from photosynthesis, and/or animals such as molluscs, sponges and worms. Benthic habitats are the seabed substrates that benthic communities grow on or in; these can range from unconsolidated sand to hard substrates (e.g., limestone) and occur either singly or in combination.

Rocky reefs and hard grounds are in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break. On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity. The shallowest depth at which the rocky reefs occur in Commonwealth waters is approximately 50 m (CoE 2015a).

Corals do not occur as a dominant habitat type within the Environmental Planning area. Reef development by hard corals does not occur further south than Queensland (Tzioumis and Keable, 2007). Soft corals are typically present in deeper waters throughout the continental shelf, slope and off-slope regions, to well below the limit of light penetration (BBG 2003, Boreen et al. 1993). Gorgonian corals (soft corals) were identified during seabed surveys of the Beach Otway Development area within the Environmental Planning Area (Ramboll 2020).

James et al (2013) undertook extensive surveys of macroalgal communities along the Otway Shelf from Warrnambool to Portland in south-west Victoria. Sites were adjacent to shore or on offshore rocky reefs covering a depth range of 0 to 36 meters water depth. These surveys did not locate giant kelp at any site but identified that other brown algae species (*Durvillaea, Ecklonia, Phyllospora, Cystophora*, and *Sargassum*) are prolific to around 20 m water depth. Brown algae tend to be replaced by red algae in deeper waters.

5.1.2 Invertebrates

Studies by the Museum of Victoria found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions (Wilson and Poore 1987). Results of sampling in shallower inshore sediments reported high diversity and patchy distribution (Parry et al. 1990). In these areas, crustaceans, polychaetes, and molluscs were dominant.

Throughout the region, a variety of seabed habits support a range of animal communities such as sparse sponges to extensive 'thickets" of lace corals and sponges, polychaete worms and filter feeders (DNP 2013). Echinoderms, such as sea stars, sea urchins and sea cucumbers are also an important fauna species of the southern Australian and Tasmanian waters, with several species at risk of extinction (DPIPWE 2020).

5.1.3 West Tasmanian Canyons Key Ecological Feature

The West Tasmanian Canyons are located on the relatively narrow and steep continental slope west of Tasmania. This location has the greatest density of canyons within Australian waters where 72 submarine canyons have incised a 500 km-long section of slope (Heap & Harris 2008).

The Operational Area overlaps a small portion of the West Tasmanian Canyons KEF (Appendix B12 MAP-REG-EPM-004).

Submarine canyons modify local circulation patterns by interrupting, accelerating, or redirecting current flows that are generally parallel with depth contours. Their size, complexity and configuration of features determine the degree to which the currents are modified and therefore their influences on local nutrients, prey, dispersal of eggs, larvae and juveniles and benthic diversity with subsequent effects which extend up the food chain.

Eight submarine canyons surveyed in Tasmania, Australia, by Williams et al (2009) displayed depth-related patterns with regard to benthic fauna, in which the percentage occurrence of faunal coverage visible in underwater video peaked at 200-300 m water depth, with averages of over 40% faunal coverage. Coverage was reduced to less than 10% below 400 m depth. Species present consisted of low-relief bryozoan thicket and diverse sponge communities containing rare but small species in 150 to 300 m water depth.

Sponges are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m depth. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts. Based upon this enhanced productivity, the West Tasmanian Canyon system includes fish nurseries (blue wahoo and ocean perch), foraging seabirds (albatross and petrels), white shark and foraging blue and humpback whales (CoA 2015a).

5.1.4 Commercial and Recreational Fishing and Aquaculture

As detailed in the Commercial Fisheries Analysis Report (Appendix B6), the Operational Area overlaps the following fisheries that have catch effort:

- Commonwealth:
  - Southern and Eastern Scalefish and Shark (SESS) Fishery SESSF following sectors:
    - Scalefish Hook
    - Shark Gillnet sector
    - Trawl – otter board
  - Southern Squid Jig Fishery
- Victorian:
  - Giant Crab
  - Multi-species Ocean
  - Octopus
  - Southern Rock Lobster
  - Wrasse

Recreational fishing may occur within the Operational Area but there are no known popular areas.

No aquaculture sites have been identified within the Operational Area and thus it is not assessed further.

5.1.5 Diving

No dive sites have been identified within the Operational Area and thus it is not assessed further.

6 Predicted Levels of Risk

6.1.1 Change in ecosystem dynamics

The introduction and subsequent establishment and spread of a marine pest may result in the reduction in native marine species diversity and abundance, displacement of native marine species and changes to conservation values of protected areas. The extent of the initial risk to benthic assemblages are likely to be localised (isolated locations if there is no spread) but may become widespread if establishment and spread occurs.

Receptors which may occur within the Operational Area and are at risk from marine pest introduction are:

- Benthic Assemblages (sponges, bryozoans etc.)
- West Tasmania Canyons KEF
- Invertebrates

Only a small proportion of marine pests become invasive (Wells 2018) with the risk of a marine pest being able to successfully establish itself depending on depth, distance from the coast, water movement and latitude. Survival is not expected in deep oceanic waters (>90 m depth) with establishments more likely within shallower waters (<50m), where vessels are stationary for extended periods of time.

The Regia MSS vessels will not be stationary within the Operational Area and no anchoring will take place further reducing the risk of translocating a marine pest to the seabed. All subsea survey equipment is stored on the vessel so a marine pest would not be able to survive on equipment in these exposed dry conditions. Support vessels will generally not be alongside the survey vessel for more than two hours during support operations, so a cross transfer of a marine pest is highly unlikely.

As the Operational Area at its nearest point is ~7 km from the Victorian coast, BRS (2007) estimates indicate that the chance of colonisation of a marine pest is 33%. However, as detailed in the Existing Environment Section, marine pests which are known to occur in the Bass Strait are limited to either sheltered areas or shallow waters which are not present in the exposed well mixed waters of the Operational Area where water depths range from 40 to 1,400 m.

The CGG Marine Pest Risk Assessment Process ensures contracted vessels meet ballast water and biofouling legislative requirements to prevent the introduction of marine pests.

Values for the West Tasmania Canyons KEF includes sponges that are associated with abundance of fishes and a diversity, greatest between 200 and 350 m, comparable to that of seamounts (DCCEEW 2020d). At the water depths of these values the possibility of a marine pest becoming established is negligible.

No EPBC listed invertebrate species were identified from the PMST Report for the Operational Area (Appendix B5).

The predicted level of consequence of introducing a marine pest causing a change in ecosystem dynamics is assessed as major as there is the potential to alter ecosystem processes and reduce biodiversity, however, the likelihood of a marine pest being present on a Regia MSS vessel and becoming established is assessed as rare due to the implementation of ballast and biofouling management requirements and that a marine pest would be unable to colonize the benthic substrate due to the deep and well mixed waters within the Operational Area. The predicted level of risk is assessed as low.

6.1.2 Changes to the functions, interests, or activities of other users

The introduction of a marine pest may result in the reduction in native marine species diversity and abundance, displacement of native marine species which could result in changes to commercial fish species diversity and abundance. The extent of the initial risk to commercial fisheries is likely to be localised if a marine pest introduction occurred and did not spread but may become more widespread if colonisation and spread occurs.

As detailed in the assessment of a change in ecosystem dynamics, the introduction of a marine pest in the Operational g Area is unlikely to impact on fisheries within the region as colonisation and spread is unlikely based on the Operational Area water depth and distance from shore which BRS (2007) estimates indicate that the chance of colonisation of a marine pest is 33%. In addition, the low light levels (water depth of 40 to 1,400 m) and well mixed marine environment is not conducive to the establishment of marine pests.

The CGG Marine Assurance System ensures contracted vessels meet ballast water and biofouling legislative requirements to prevent the introduction of marine pests. Thus, it is highly unlikely that marine pests would be present on vessels.

None of the fisheries identified as being active in the Operational Area identified marine pests as a threat. Whilst Southern Rock lobster is suspectable to tail fan necrosis, caused by combination of several bacteria and fishing practices such as live holding (Musgrove et al. 2005) and both crab and lobster can be susceptible to paralytic shellfish toxin, none are related to the introduction of marine pests.

The predicted consequence of introducing a marine pest causing a change to the functions, interests or activities of commercial fisheries is assessed as major as there is the potential to alter ecosystem processes and reduce biodiversity, however, the likelihood of a marine pest being present on a Regia MSS vessel and becoming established is assessed as rare due to the implementation of ballast and biofouling management requirements and that a marine pest would be unable to colonize the benthic substrate due to the deep and well mixed waters within the Operational Area. The predicted level of risk is assessed as low.

7 Comparison of Predicted Level of Risk with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Risk	Predicted Level of Risk Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	The introduction and establishment of marine pests is not predicted.	Yes
	The impact and risk assessment are based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government management plans, recovery plans and conservation advice were used to inform the risk assessment. The introduction and establishment of marine pests is not predicted. There is high confidence in the prediction of risk to environmental components that are at risk from the introduction of marine pests.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1 of this document.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	The introduction and establishment of marine pests is not predicted.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	The introduction and establishment of marine pests is not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	The introduction and establishment of marine pests is not predicted.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	The introduction and establishment of marine pests is not predicted.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce the risk of introducing a marine pest as detailed in the following section.	Yes

Defined Acceptable Level		**Predicted Level of Risk**	**Predicted Level of Risk Below Defined Acceptable level?**
Category	**Level**		
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted risk level is medium.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the risk.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	To date no objections or claims in relation to marine pests have been made by relevant persons.	Yes
	The views of public have been considered in the impact and risk assessment.	To date there has been no views from the public in relation to marine pests.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure the environmental risk will be of an acceptable level and ALARP.

Measures	**Justification**	**Adopted**
M#05: CGG Marine Assurance System	Project vessels, as part of the CGG contracting process, will undergo OVID-style inspections to verify the validity and compliance pre-arrival biosecurity checks for international vessels, and ballast water and biofouling requirements including the requirements to have a Ballast Water and Sediment Management Plan, a Ballast Water Record Book, a Biofouling Management Plan and Record Book tailored to the vessel's class and operational requirements.	Yes
	The sound source and towed streamers will be inspected and cleaned (where required) prior to deployment for the Regia MSS.	Yes
	Vessels will conduct pre-port entry checks using the National Introduced Marine Pest Information System database and assess changes in known invasive species.	Yes

Measures assessed and not adopted.

Measure	**Justification**	**Adopted**
No discharge of ballast water from vessels.	Although, ballast water exchange is not expected to occur during the Regia MSS, the possibility of discharge or exchange cannot be ruled out. Ballast water exchange and uptake may be required in unexpected circumstances where the safety of persons on-board the vessel is a necessity. Ballast water will be managed in accordance with the Australian Ballast Water Management Requirements and the likelihood of introducing a marine pest via ballast water is highly unlikely. The control is not practicable to implement and is grossly disproportionate to the limited environmental benefit that would be gained in addition to existing controls.	No
Hull cleaning and/or new antifouling coat application to vessel hull and niche areas prior to the Regia MSS.	Given the existing control measure this control measure is not commensurate to the level of risk. Should the risk assessment determine a vessel to have a medium or high marine pest risk from biofouling, further inspections or cleaning may be implemented. However, the cost of undertaking inspections and hull cleaning could range from tens to hundreds of thousands of dollars. This is not practicable to implement in all cases and is disproportionate to the level of risk if the existing risk profile for a vessel is already low.	No

9 Conclusions

This risk assessment has demonstrated that the introduction of marine pests causing a change to both ecosystem dynamics and to the functions, interests or activities of commercial fisheries has a:

- **Predicted level of consequence of major.**
- **Likelihood of rare.**
- **Predicted level of risk of low.**

10 Recommendations

As demonstrated in this risk assessment the predicted level of risk level is low, thus, good industry practice (including legislation and standards) has been applied and therefore these risks are of an acceptable level without further recommendations being required.

11 Document Control

Date	Revision	Update
6 July 2023	A	Draft prepared for initial comment
23 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Reviewed and update following public comment and rerun of the PSMT searches.**

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Annex 1: Legislative and Other Requirements Relevant to IMS

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Conservation Advice for Giant Kelp Marine Forests of South East Australia (DSEWPaC 2012a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	The conservation advice identifies range expansion of invasive species as a threat. Relevant actions are: Manage shipping and aquaculture practices to minimise potential invasion of exotic species.	This requirement is met by this risk assessment and the implementation of M#05: CGG Marine Assurance System.
Commonwealth Listing Advice on Giant Kelp Marine Forests of South East Australia (TSSC 2012a)	Recommends the ecological community's inclusion on the EPBC Act list of threatened ecological communities.	The listing advice identifies invasive species such as Japanese seaweed (Undaria pinnatifida) as a threat. No relevant actions were identified.	This requirement is met by this risk assessment and the implementation of M#05: CGG Marine Assurance System.
Biosecurity Act 2015	The act provides a framework for managing biosecurity risks associated with the import and export of goods and vessels.	Vessels used for the Regia MSS are required to undertake the following: Pre-arrival information must be reported through MARS before arriving in Australian waters. Biofouling management plan and record book. Offshore Biofouling Risk Assessment Register, which considers biofouling and ballast water related risks, which may lead to inspections by suitably qualified personnel. Antifouling system certification for vessels is current and in accordance with AMSA Marine Order Part 98 (Antifouling systems)	This requirement is met by the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS have met these requirements.
Biosecurity Regulations 2016	The regulations provide additional guidance on the management of biosecurity risks associated with the import and export of goods and vessels.		
Biosecurity Amendment (Biofouling Management) Regulations 2021	The regulations require operators of all vessels to provide information on biofouling management practices prior to arriving in Australia.	Vessels used for the Regia MSS are required to undertake the following: Pre-arrival information must be reported through MARS before arriving in Australian waters and is to include biofouling management practices.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS have met this requirement.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Marine Order 98 - Marine pollution prevention - antifouling systems	Marine Order 98 sets out the requirements for the use of antifouling solutions on ships in Australian waters. The order establishes restrictions on the use of certain types of antifouling coatings, as well as requirements for the management of hull cleaning and maintenance.	Vessels used for the Regia MSS are required to meet the requirements of Marine Order 98 in relation to antifouling coatings and management of hull cleaning and maintenance.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS have met these requirement.
Australian Ballast Water Management Requirements	The requirements provide guidance on how vessel operators should manage ballast water when operating within Australian seas in order to comply with the Biosecurity Act 2015. They align to the International Convention for the Control and Management of Ships' Ballast Water and Sediments 2004.	Vessels used for the Regia MSS are required to manage ballast water exchange/discharge using one of the following approved methods of management including: An approved ballast water management system. Ballast water exchange conducted in an acceptable area * Use of low-risk ballast water (e.g., fresh potable water, water taken up on the high seas, water taken up and discharged within the same place). Retention of high-risk ballast water on-board the vessel. Discharge to an approved ballast water reception facility. *Acceptable area is as defined in the Biosecurity (Ballast Water and Sediment) Determination 2017. Vessels will have an approved Ballast Water Management Plan (BWMP) and valid Ballast Water Management Certificate (BWMC) unless an exemption applies or is obtained. Vessels will maintain complete and accurate records of ballast water exchange that complies with Section B, Regulation B.2. of the Annex to the Ballast Water Convention.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS have met these requirements.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Australia Biofouling Management Requirements	The requirements provide guidance on how vessel operators should manage ballast water when operating within Australian seas in order to comply with the Biosecurity Act 2015, including those conducting a marine seismic survey. They align to the International Convention for the Control and Management of Ships’ Ballast Water and Sediments 2004.	Vessels used for the Regia MSS are required to have a biofouling management plan (BFMP) which: Provides specific details of the antifouling technology used, including antifouling paints and Marine Growth Prevention System (MGPS) and how and when they are operated where relevant. Describes the operating conditions suitable for the chosen technology. Describes the operational profile of the vessel including operating speeds and time spent stationary. Provides details of the areas of the hull that are particularly susceptible to biofouling, such as niche areas, and how the technology applied addresses this increased risk. Provides information relating to the schedule of planned inspections, repairs, maintenance, inspection, and renewal of antifouling systems as well as circumstances by which opportunistic inspection to monitor efficacy might occur. Describes the documentation required to verify any treatments and activities recorded in the biofouling record book.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS have met these requirements.
Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (Biofouling Guidelines)	Provide a globally consistent approach to the management of biofouling.		
Marine Pest Plan 2018–2023: National Strategic Plan for Marine Pest Biosecurity	The plan outlines a coordinated approach to building Australia’s capabilities to manage the threat of marine pests over the next five years. It represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities, and the environment.	Vessels used for the Regia MSS are required to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities, and the environment	This requirement is met by this risk assessment and the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS pose a low risk of having marine pests.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
National Biofouling Management Guidance for the Petroleum Production and Exploration Industry 2009	Includes the following for operators of petroleum industry related vessels, equipment, and infrastructure: Evaluation of biofouling risk of types of structures/facilities. Guidance on biofouling management and decommissioning.	Vessels used for the Regia MSS are required to evaluate and manage their biofouling risk.	This requirement is met by this risk assessment and the implementation of M#05: CGG Marine Assurance System which checks that vessels used for the Regia MSS pose a low risk of having marine pests.

Marine Seismic Survey

Risk Assessment
Accidental Release of Fuel

Appendix D4: REG-EP-019-D4

Rev 2

May 2024

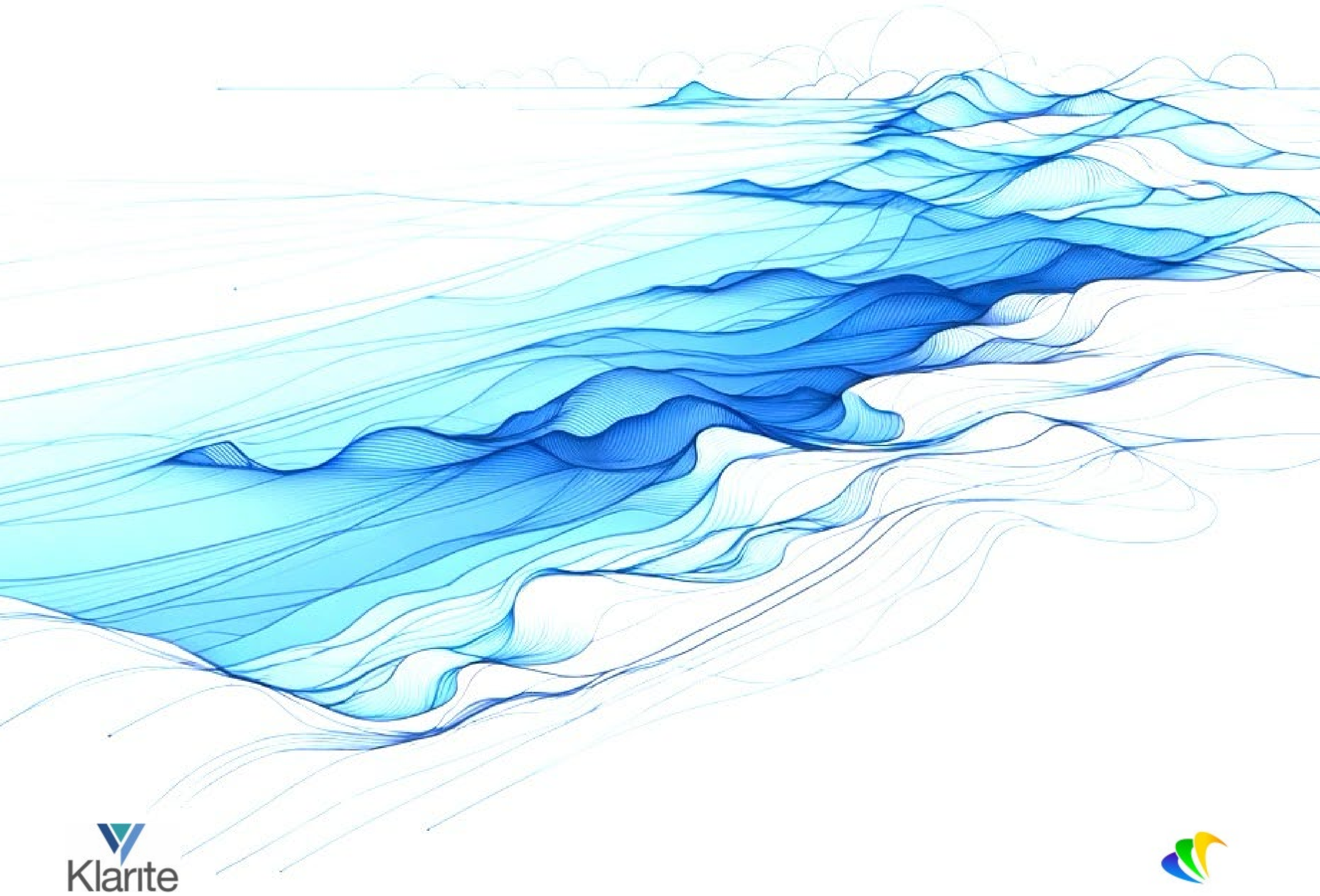

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Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment. This document also uses information in one preceding study:

1. Oil Spill Modelling Analysis (Appendix B11)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table D4-2-1 shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table D4-21, and the feedback received during the public comment period for the completed EP is provided in Table D4-22.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table D4-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table D4-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Concern received through the interactive map stating oil spill risks are too great.	80	CGG will include a risk assessment and analysis provided for scrutiny.
Concern received through the interactive map regarding risk Mitigation for an oil spill	84	CGG agreed to implement the following measures: Class 1A vessel with dual propulsion. Navigations warnings. Bunkering procedures within Marine Assurance System.
Concern received through the interactive map regarding the environmental risk oil spills will pose.	86	CGG will produce OPEP & OSMP.
Concern received through survey regarding the environmental risk oil spills will pose.	194	CGG will produce OPEP and consult with relevant organisations
Relevant organisation raised an objection regarding concerns of an oil spill.	239	CGG will implement a 50km buffer to all marine parks for refuelling.
Request via email that the Director of National Parks be made aware of oil/gas pollution incidences which occur within a marine park or are likely to impact on a marine park as soon as possible.	236	CGG has included the notification request in the Implementation Strategy

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table D4-0-2 shows how this feedback has been incorporated into the environmental assessments.

Table D4-0-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Failure of EP to address coastal erosion due to loss of seaweed	E14	EP Appendix D4 (Accidental Release of Fuel), Section 6.3 (Benthic Assemblages) has been updated in response to these claims to reflect that, impacts resulting in the loss of coastal seaweed to the extent that coastal erosion could be affected, are not predicted.

Matter	Matter ID	Changes made arising from public comment
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Accidental Release of Fuel

3.1 How the Aspect Occurs

The following hydrocarbons and chemicals will be present on the seismic vessel and support vessels:

- Marine diesel oil (MDO) used as fuel for the vessels.
- Hydraulic fluids such as engine and synthetic oils required for equipment and engine use.
- Chemicals for cleaning and maintenance purposes.

Hydrocarbons and chemicals are stored in contained areas but there is the potential for a loss of containment to occur resulting in a release of hydrocarbons or chemicals to the marine environment. Loss of containment scenarios are details in Table D4-3-1.

Table D4-3-1: Accidental Release of Fuel Scenarios

Scenario	Material and Potential Volume	Description
Vessel fuel tank rupture	257.4 m^3 MDO	A collision between the survey vessel, support vessel or a third-party vessel has the potential to result in the breach of the vessel hull and subsequent rupture of a fuel tank. A spill to sea because of vessel collision/grounding is only likely to occur under exceptional circumstances where these conditions resulted in significant damage to one or more of the fuel tanks in the hull of the vessel. These may include: • Navigational error • Vessel loss of power • Floundering due to weather. If a collision/grounding involving the seismic vessel occurred, the worst-case credible scenario would be the loss of the largest single fuel tank volume (consistent with AMSA (2015) guidelines), which is 257.4 m^3 of MDO.
Vessel refuelling failure	1.2 m^3 to 25 m^3 of MDO	A vessel refuelling failure may result in the release of MDO to the marine environment. Using dry-break couplings (which provide an automatic mechanism to seal off both the hose and the fixed pipe end when the hose is disconnected), the maximum credible spill volume from a refuelling failure is the maximum typical volume of a transfer hose (1.2 m^3). In the event dry break couplings fail, guidelines indicate the maximum credible spill volume from a refuelling incident with continuous supervision is equivalent to the volume of MDO transferred within a 15-minute period (AMSA 2053), which represent the estimated time required to shut down refuelling operations following discovery of a spill. Based on a transfer volume of 100 m^3/hr, this may result in a spill volume of 25 m^3.
Loss of containment overboard	1 m^3 of hydraulic fluid, lubricating fluids, or chemicals	A loss of containment may occur because of mechanical/ structural failure, human error, or poor housekeeping. Should a spill occur on a vessel deck, controls such as equipment bunds, scupper plugs and on-board clean up should prevent the spilt material reaching the marine environment. However, in the event these controls fail, or are not implemented, spill volumes released to the environment are likely to be less than 1 m^3 based on the inventory typically used on deck.

3.2 Extent and Duration of the Aspect

Duration: 90 days survey duration +30 days

A loss of containment could occur at any time during the activity (90 days). If there were a loss of containment the consequences of the largest release (fuel tank rupture) MDO may persist for up to 30 days post-incident for water quality to be below low thresholds due to the rapid evaporation and dispersion of the fuel.

Extent: Environmental Planning Area

If there were an accidental release of fuel it could potentially disperse 150 km from the location of the vessel. This area is the Environmental Planning Area (Appendix B12 MAP-REG-EPM-083).

The 150 km is based on the NERA Reference Case: Consequences analysis of an accidental release of MDO (NERA 2018) that found that MDO spills under 700m^3 were reliably predicted to disperse within 150 km from the source of the spill. However, this reference case was based on exposure values that are higher than the current commonly used exposure values for oil spill modelling (NOPSEMA 2019) that are selected to approximate the spatial extent and variability of the receiving environment's contact with oil and subsequently inform risk evaluation and planning for oil spill response and monitoring. Thus, to validate that 150 km was sufficiently conservative a review was undertaken to identify oil spill modelling that has been undertaken in the Otway area since the NOPSEMA Oil Spill Modelling Environment Bulletin was published in April 2019. The review, provided in Oil Spill Modelling Analysis (Appendix B11), confirmed that 150 km was sufficiently conservative to approximate the spatial extent and variability of the receiving environment's contact with oil and subsequently inform risk evaluation and planning for oil spill response and monitoring for a spill up to 250 m^3 of MDO within the Regia MSS Operational Area.

3.3 Legislative and Other Requirements

Annex 1 within this document describes the legal and other requirements that apply to loss of containment, and how the requirements will be met.

4 Cause Effect Pathway

The PEIRA identified a cause-effect pathway for an accidental release of fuel for the following environmental components:

- Water quality
- Sediment quality
- Benthic assemblages
- Coastal habitats and communities
- Plankton
- Invertebrates
- Fish
- Birds
- Marine reptiles
- Marine mammals
- Coastal development
- Indigenous culture
- Commercial fishing and aquaculture
- Marine industries
- Marine Tourism
- Diving
- Recreational Fishing
- Marine Protected Areas

Hydraulic fluids and lubricating fluids behave similarly to MDO when spilt in the marine environment. Hydraulic fluids are oils of light to moderate viscosity and have a relatively rapid spreading rate. Like MDO, they will dissipate quickly, particularly in high sea states, although lubricating oils are more viscous and so the spreading rate of a spill of these oils would be slightly slower.

Impacts associated with a spill of chemicals to the marine environment will depend on the nature of the liquid released, the volume and its behaviour in the marine environment (whether it sinks, floats, disperses, etc.). In the event of a spill to the marine environment, these liquids would be subjected to rapid dispersion and dilution by the open ocean water conditions and prevailing currents and would remain within the surface waters.

Potential impacts from minor spills of hydraulic fluids, lubricating fluids or chemicals include a temporary and highly localised decline in water quality. This would have limited potential for toxicity to marine fauna or impact socio-economic receptors, due to the short duration of exposure and rapid dilution of the released liquids in the marine environment. As there is no likely cause effect pathway to impact fauna or socio-economic receptors and impacts to water quality is predicted to be negligible no further assessment is required.

MDO is a light, refined petroleum product that when spilled on water, most of the oil evaporates or naturally disperses quickly (hours to days). However, the rates differ with both water and air temperature, more so with wind speed (and wave energy).

MDO is much lighter than water, so it is not possible for MDO to sink and accumulate on the seabed as pooled or free oil.

Dispersion into the sea by the action of wind and waves can result in 25–50% of the loss of hydrocarbons from surface slicks and dissolution (solubility of hydrocarbons) can account for 1-10% loss from the surface. While the majority of the MDO evaporates quickly, it is common for the residues of MDO spills after weathering to contain n-alkanes, iso-alkanes and naphthenic hydrocarbons.

Spilled MDO can affect biological receptors via direct contact or through inhalation of vapours as the MDO as it disperses. Visual slicks or oil shoreline oil can have impacts on socio-economic and cultural receptors especially where there is commercial, recreational, and traditional fishing, coastal activities, and tourism.

The known and potential environmental impacts of a MDO spill are:

- Change in water quality leading to:
  - Injury or mortality of fauna.
  - Change in fauna behaviour.
  - Change in ecosystem dynamics.
  - Changes to the functions, interests, or activities of other users (e.g., commercial fisheries).

5 Description of the Existing Environment that may be Affected by the Activity

As detailed in Section 3.2, the Environmental Planning Area has been adopted as the extent of where receptors could be exposed to oil from a MDO spill.

To identify key values and sensitivities that may be present within the Environmental Planning Area a PMST search was undertaken using the Environmental Planning Area with the PMST Report available in Appendix B5: PMST Search Reports. A summary of the values and sensitivities protected under the EPBC Act relevant to a loss of containment is detailed in Annex 2 within this document. The summary also identifies any relevant conservation advice or recovery plans.

In addition, a review was undertaken of commercial fisheries that may fish within the Environmental Planning Area and is documented in the Commercial Fisheries Analysis Report (Appendix B6).

A description of the existing environment that may be affected by an accidental release of fuel is provided for each environmental component in Section 6 Predicted Levels of Risk.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. Conservation Advice has also been updated for several species and subsequent changes have been made to Annex 1 (Legislative and Other Requirements Relevant to Accidental Release of Fuel) and Annex 2 (Loss of Containment Sensitive Species). Changes relevant to the assessment of an accidental release of fuel include:

- Changes to EPBC Act status of several species
  - Red Knot is listed as Vulnerable (previously Endangered)
  - Sharp-tailed Sandpiper is listed as Vulnerable (previously not listed as threatened)
  - Sooty Shearwater is listed as Vulnerable (previously not listed as threatened)
  - Great Knot is listed as Vulnerable (previously Critically Endangered)
  - Western Alaskan Bar-tailed Godwit is listed as Endangered (previously Vulnerable)
  - Common Greenshank is listed as Endangered (previously not listed as threatened)
  - Ruddy Turnstone is listed as Vulnerable (previously not listed as threatened)
  - Latham’s Snipe is listed as Vulnerable (previously not listed as threatened)
  - Terek Sandpiper is listed as Vulnerable (previously not listed as threatened)
  - Grey Plover is listed as Vulnerable (previously not listed as threatened)
  - Eastern Dwarf Galaxias is listed as Endangered (previously Vulnerable)
  - Yarra Pygmy Perch is listed as Endangered (previously Vulnerable)
  - Blue-winged Parrot is listed as Vulnerable (previously not listed as threatened)
- Updates to conservation advice for several species
  - Conservation Advice for *Calidris canutus* (Red Knot) (DCCEEW 2024)
  - Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)
  - Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)
  - Conservation Advice for *Calidris tenuirostris* (Great Knot) (DCCEEW 2024f)
  - Conservation Advice for *Limosa lapponica baueri* (Bar-tailed Godwit western Alaskan) (DCCEEW 2024b)
  - Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e
  - Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c)
  - Conservation Advice for *Gallinago hardwickii* (Latham's snipe) (DCCEEW 2024d)
  - Conservation Advice for *Xenus cinereus* (Terek Sandpiper) (DCCEEW 2024g)
  - Conservation Advice for *Pluvialis squatarola* (Grey Plover) (DCCEEW 2024h)
  - Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)
  - Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DCCEEW 2023m)
  - Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)

  - Conservation Advice for *Charadrius leschenaultii* (Greater Sand Plover) (DCCEEW 2023o)
  - Conservation Advice for *Galaxiella pusilla* (Dwarf Galaxias) (DCCEEW 2023j)
  - Conservation Advice for *Nannoperca obscura* (Yarra Pygmy Perch) (DCCEEW 2023k
- Presence change for Southern Bluefin Tuna from 'species or species habitat may occur within area' to 'species or species habitat known to occur within area'.
- Removal of bird species, Broad-billed Sandpiper (species no longer appears in PMST).
- Removal of National Heritage place, 'Quarantine Station and Surrounds' (doesn't overlap with the Environmental Planning Area).

These changes have been incorporated throughout the EP and the risk assessment has been revised accordingly [Section added in response to Matters: I16 and I17].

6 Predicted Levels of Risk

Based upon an understanding of the cause/effect pathway, an accidental release of fuel releases 250 m^3 of MDO is used to predict the level of risk to receptors as this is the largest loss of containment scenario.

Table D4-6-1 provides the criteria used to determine the sensitivity of receptors within the Environmental Planning Area with the following tables assessing each receptor identified within the Environmental Planning Area having regard to the legislative and other requirement.

Table D4-6-1: Receptor Sensitivity Criteria

Sensitivity	Protected Areas	Species Status	BIA	Coastal Habitat Sensitivity	Relevant Receptors
Low	State - no marine protected areas. Commonwealth - multiple use zones are the dominant component of the protected area.	Species not threatened (or limited to only a few species of a particular faunal grouping). Present in the Environmental Planning Area only occasionally or as vagrants. Populations known to recover rapidly from disturbance.	No BIA (or limited to only a few species of a particular faunal grouping).	Low sensitivity habitat, such as fine-grained beaches, exposed wave-cut platform and exposed rocky shores, with rapid recovery from oiling (~ 1 year or less). Public recreation beaches not present or not widely used. No harbours or marinas.	Sediment quality Plankton Invertebrates Fish Marine protected areas
Medium	State – no marine protected area. Commonwealth -little to no special purpose zonation.	Species may be threatened (or some species of a particular faunal grouping). Species may or may not be present at time of activity. Some susceptibility to oiling. Populations may take a moderate time to recover from oiling.	Some intersection with one or more BIAs, generally for distribution or migration rather than breeding.	Moderately sensitive habitat present, such as sheltered rocky rubble coasts, exposed tidal flats, gravel beaches, mixed sand and gravel beaches, with a medium recovery period from oiling (~2-5 years). Public recreation beaches present but not often used. No harbours or marinas	Water quality Benthic assemblages Coastal habitats and communities Seabirds Marine reptiles Marine mammals Commercial fisheries and aquaculture Marine industries Marine protected areas
High	State - marine protected area present. Commonwealth -special purposes zones are the dominant component of the protected area.	Species are threatened (or most species of a particular faunal grouping). Species known to be present at time of activity. Known to be susceptible to oiling. Populations may take a long time to recover from oiling.	Significant intersection with one or more BIAs, particularly with regard to foraging or breeding.	Sensitive habitat present, such as mangrove, salt marshes, and sheltered tidal flats, with long recovery periods from oiling (> 5 years). Public recreation beaches present that are widely used. Busy harbours or marinas.	Coastal developments Aquatic birds Shorebirds Diving Indigenous culture Marine Tourism Marine protected areas Recreational fishing

6.1 Water Quality

Water Quality	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
Water quality within the Environmental Planning Area is expected to be typical of offshore waters of southern Australia. Water sampling undertaken for the Beach Otway Development area within the Environmental Planning Area (Ramboll 2020) detailed that the water quality at survey areas indicated an undisturbed mid-depth environment.	
Predicted Level of Risk	
The Environmental Planning Area is based on the following thresholds where water quality could be potentially at risk: The low threshold to assess the potential for floating oil exposure of 1 g/m^2 equates to an average thickness of 1 μm, referred to as visible oil. Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (AMSA 2014). This threshold is used to establish the planning area for scientific monitoring. The low threshold of 10 ppb to assess the potential for dissolved and entrained oil exposure represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. This threshold is used to establish the planning area for scientific monitoring. A summary of the mass balance of a MDO spill within the Environmental Planning Area (RPS 2022) showed: Under a constant 5 knot (~2.5 m/s) wind, 40.3% of the oil is predicted to evaporate within 24 hours. Under calm conditions, most of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation shall cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes. Under a variable-wind where the winds are of greater strength on average, entrainment of MDO into the water column is predicted to increase. Approximately 24 hours after the spill, 60.1% of the oil mass is forecast to have entrained and a further 38.4% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<0.1%). The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of 1.5% per day with or ~10.5% after 7 days, compared to <0.1% per day and a total of 0.9% after 7 days for the constant-wind case. Given the proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks. Based on the weathering properties of MDO water quality within the Environmental Planning Area, 40% of a 250 m^3 MDO spill will evaporate within 24 hours with the remaining oil to becoming entrained in the water column where it will decay below threshold levels within 30 days.	

Water Quality
Thus, the predicted level of consequence to water quality from a 250 m^3 MDO spill is assessed as minor as any consequences will be short-term (< 30 days for oil to decay below low thresholds) within a localised area with full recovery, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.2 Sediment Quality

Sediment Quality	
Sensitivity Rating	**Low**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
Sediment quality within the Environmental Planning Area is expected to be typical of coastal and nearshore area of southern Australia. Water sampling undertaken for the Beach Otway Development area within the Environmental Planning Area (Ramboll 2020) detailed that the sediment quality at survey areas had a high oxidation reduction potential and low or undetectable levels of toxicants indicating an unmodified seabed environment.	
Predicted Level of Risk	
In previous risk assessment studies, French-McCay et al. (2005a; 2005b) used a threshold of 10 g/m^2 to assess the potential for shoreline accumulation. It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m2 shoreline accumulation threshold has been selected to define the zone of potential "low shoreline accumulation". As detailed in the assessment of water quality, the majority of surface oil will have evaporated or entrained in the water column within ~ 24 hours, thus only a small proportion is likely to move to shoreline areas above the low threshold. Furthermore, wave action in shoreline areas will further breakdown the remaining oil. Thus, the predicted level of consequence to sediment quality from a 250 m^3 MDO spill is assessed as minor as consequences will be short-term (< 30 days) within a localised area with full recovery, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.	

6.3 Benthic Assemblages

Benthic Assemblages	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	

Benthic assemblages are biological communities that live in or on the seabed. They typically contain light-dependent taxa such as algae, seagrass and corals, which obtain energy primarily from photosynthesis, and/or animals such as molluscs, sponges and worms. Benthic habitats are the seabed substrates that benthic communities grow on or in; these can range from unconsolidated sand to hard substrates (e.g., limestone) and occur either singly or in combination.

Given that MDO would only be present on the sea surface or within the water column to a depth of 10 m (RPS 2019a) the existing environment covers those benthic assemblages along the Victorian, South Australian and King Island coastlines within the Environmental Planning Area.

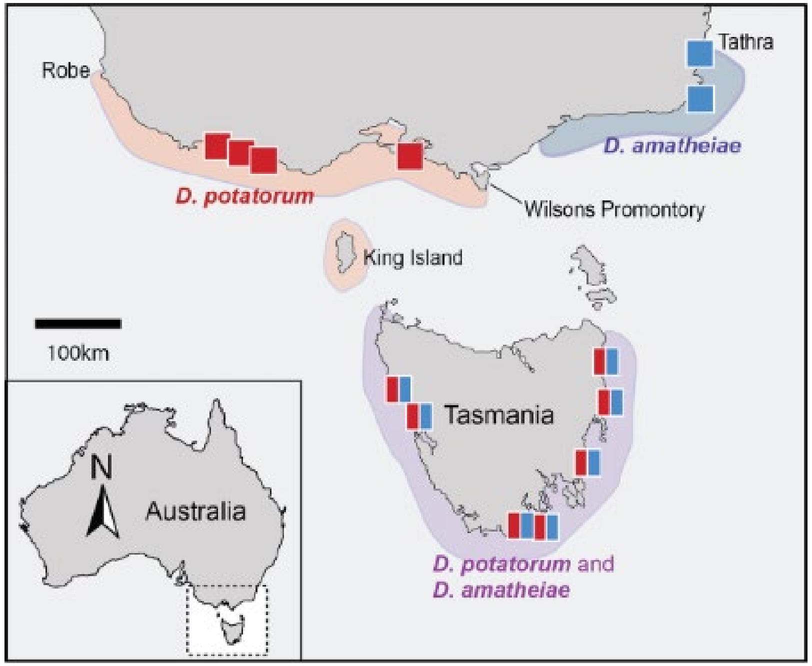
Rocky reefs and hard grounds are located in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break. On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity. The shallowest depth at which the rocky reefs occur in Commonwealth waters is approximately 50 m (CoE 2015a).

Corals do not occur as a dominant habitat type within the Environmental Planning Area. Reef development by hard corals does not occur further south than Queensland (Tzioumis and Keable, 2007). Soft corals are typically present in deeper waters throughout the continental shelf, slope and off-slope regions, to well below the limit of light penetration (BBG 2003, Boreen et al. 1993). Gorgonian corals (soft corals) were identified during seabed surveys of the Beach Otway Development area within the Environmental Planning Area (Ramboll 2020).

James et al (2013) undertook extensive surveys of macroalgal communities along the Otway Shelf from Warrnambool to Portland in south-west Victoria. Sites were adjacent to shore or on offshore rocky reefs covering a depth range of 0 to 36 meters water depth. These surveys did not locate giant kelp at any site but identified that other brown algae species (Durvillaea, Ecklonia, Phyllospora, Cystophora, and Sargassum) are prolific to around 20 m water depth. Brown algae tend to be replaced by red algae in deeper waters.

Bull kelp or southern bull kelp (Durvillaea potatorum) is a fast-growing brown macroalgae (seaweed) with large dark brown and leathery strap-like blades. It consists of a body, called the thallus, with a stipe connecting the blades to the holdfast (a structure adhering the bull kelp to the seafloor. Offshore Victoria and Tasmania there are two main species of Durvillaea, these are D. potatorum and D. amatheiae. The approximate distribution of the species is shown in Figure D4-6-1igure D4-61 with locations within the Environmental Planning Area.

Bull kelp is a significant habitat. The holdfast can be inhabited by a diverse array of epifauna and infauna invertebrates. These burrow into the holdfast creating holes that can be used by a wide variety of animals. In addition, bull kelp grows in large groups or forests that can become important nursery areas and sanctuary areas for fish, crustaceans and other fauna. Bull kelp has a long history of use by First Nations in Australia, New Zealand, and Chile. In Australia this reportedly dates back 65,000 years (Thurstan et al. 2018). First Nation people in Tasmania used dried bull kelp to transport water and food. The species name came from this use: potatorum means ‘to drink’ in Latin (Govt of SA 2023).

Benthic Assemblages
Thurstan et al. (2018) details several First Nations historical references for bull kelp including: Cultural activities and cultural history –mythology and sacred songs. Ceremonial activities –being burned or being used during smoking ceremonies. Medicinal use –bandages and medicinal poultice. Clothing – cloaks and shoes. Diet – raw, jelly, dried and roasted (preserving for several months). Fishing – ropes and fishing nets / traps, traps for short-finned eels, also used to assist during diving for crayfish. Shelter – waterproofing, wind proofing and carpeting. Bulk kelp is also collected by the seaweed industry as described in the assessment of Commercial fishing and aquaculture. 

Benthic Assemblages
Figure D4-6-1: Distribution of bull kelp off Victoria and Tasmania (Velasquez et al. 2029) The PMST Report (Appendix B5) for the Environmental Planning Area did not identify any Key Ecological Features with benthic habitats in water depths > 10 m. The PMST Report (Appendix B5) for the Environmental Planning Area did identify the Giant Kelp Marine Forests of South East Australia threatened ecological community. The Giant Kelp Forests of South East Australia ecological community is defined as giant kelp growing typically at depths greater than eight metres below sea level and forming a closed or semi-closed surface or sub-surface canopy (TSSC 2012). The ecological community is characterised by a closed to semi-closed surface or subsurface canopy of Macrocystis pyrifera which is the only species of kelp able to provide this three-dimensional structure from the sea floor to the sea surface, so if giant kelp plants are lost or removed, the ecological community no longer exists (TSSC 2012). The giant kelp forests provide habitat for other marine flora such as seaweeds and marine fauna including fish, molluscs (sea snails), bryozoans (lace corals), polychaetes (worms), crustaceans (crabs, isopods, amphipods), echinoderms (sea urchins, seastars) and sponges (TSSC 2012). There distribution is restricted to waters off the coast of Tasmania particularly in the Bruny, Freycinet and Davey bioregions, but also the Boags and Franklin, Flinders and Otway bioregions, the coast of South Australia in the Otway and Coorong bioregions as far west as Margaret Bock Reef and the coast of Victoria in the Otway, Flinders, Central Victoria and Twofold Shelf bioregions as far east as Gabo Island.
Predicted Level of Risk
Studies of offshore benthic seaweeds in the northwest Gulf of Mexico prior to and after the Macondo well blowout at Sackett and Ewing banks (in water depths of 55–75 m) found a dramatic die-off of seaweeds after the spill (60 species pre-spill compared with 10 species post-spill) (Felder et al. 2014). Benthic decapod assemblages (crabs, lobsters, prawns) associated with the seaweeds and benthic substrate also showed a strong decline in abundance at both banks post-spill (species richness on Ewing Bank reduced by 42% and on Sackett Bank by 29%), though it is noted that these banks are exposed to influences from Mississippi River discharges that vary year to year, so definitive links to the oil spill are not possible. It is noted, however, that petroleum residues were observed on Ewing Bank, and it is possible that this may have caused localised mortalities, reduced the fecundity of surviving female decapods or reduced recruitment (Felder et al. 2014). Felder et al (2014) also notes that freshly caught soft-sediment decapod samples caught in early and mid-2011 near the spill site exhibited lesions that were severe enough to cause appendage loss and mortality. Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within weeks to months of contact. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Committee on Oil in the Sea 2003). Studies undertaken after the Montara oil spill incident included diver surveys to assess the status of Ashmore, Cartier and Seringapatam coral reefs. These found that other than a region-wide coral bleaching event caused by thermal stress (i.e. caused by sea water exceeding 32°C), the condition of the reefs was consistent with previous surveys, suggesting that any effects of oil reaching these reefs was minor, transitory, or sub-lethal and not detectable (Heyward et al. 2010). This is despite AMSA observations of surface slicks or sheen nears these shallow reefs during the spill (Heyward et al. 2010). Surveys in 2011 indicated that the corals exhibiting bleaching in 2010 had largely survived and recovered (Heyward et al. 2012), indicating that potential exposure to hydrocarbons while in an already stressed state did not have any impact on the healthy recovery of the coral. Macroalgae are generally limited to growing on intertidal and subtidal hard substrata in shallow waters within the photic zone. As such, they may be exposed to subsurface and entrained and dissolved hydrocarbons, however, are susceptible to surface hydrocarbon exposure more so in intertidal habitats as opposed to subtidal habitats. Smothering, fouling, and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer 1971, Cintron et al. 1981). In macroalgae, oil can act as a physical barrier for the diffusion of CO_2 across cell walls (O'Brian & Dixon 1976). The effect of hydrocarbons, however, is largely dependent on the degree of direct exposure and how much of the hydrocarbon adheres to algae, which will vary depending on the oils physical state and relative 'stickiness'. The morphological features of macroalgae, such as the presence of a mucilage layer or the presence of fine 'hairs' will influence the amount of hydrocarbon that will adhere to the algae. A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. The rapid recovery of algae was attributed to the fact that for most algae, new growth is produced from

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near the base of the plant while the distal parts (which would be exposed to the oil contamination) are continually lost. Other studies have indicated that kelp beds oiled by crude oil had a 90% recovery within 3-4 years of impact, however full recovery to pre-spill diversity may not occur for long periods after the spill (French- McCay 2004). Intertidal macroalgal beds are more prone to oil spills than subtidal beds because, although the mucous coating prevents oil adherence, oil that is trapped in the upper canopy can increase the persistence of the oil, which impacts upon site-attached species. Additionally, when oil sticks to dry fronds on the shore, they can become overweight and break as a result of wave action (IPIECA 2002). The toxicity of hydrocarbons to macroalgae varies for the different macroalgal life stages, with water-soluble hydrocarbons more toxic (Van Overbeek and Blondeau 1954, Kauss et al. 1973 cited in O'Brien and Dixon, 1976). Toxic effect concentrations for hydrocarbons and algae have varied greatly among species and studies, ranging 0.002–10,000 ppm (Lewis & Pryor 2013). The sensitivity of gametes, larva and zygote stages however have all proven more responsive to petroleum oil exposure than adult growth stages (Thursby and Steele 2004, Lewis & Pryor 2013). Macrophytes, including seagrasses and macroalgae, require light to photosynthesise. So, in addition to the potential impacts from direct smothering or exposure to entrained and dissolved hydrocarbons, the presence of entrained hydrocarbon within the water column can affect light qualities and the ability of macrophytes to photosynthesise. Experiments verified the susceptibility *of Nereocystis luetkeana* (bull kelp – North America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. Due to the exposed nature of the coastal areas within the Environmental Planning Area and the nature of MDO, long-term effects in areas of moderate MDO exposure are not expected and natural weathering should result in rapid recovery of communities. MDO shoreline loading at the high threshold is not predicted due to the low spill volume. Consequently, impacts resulting in the loss of coastal seaweed to the extent that coastal erosion could be affected are not predicted. [Paragraph added in response to Matter: E14]. The predicted level of consequence to benthic assemblages from a 250 m^3 MDO spill is assessed as moderate as the consequences could be longer lasting (> 30 days) if kelp and other macroalgal areas are exposure to oil above the low threshold level, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.4 Coastal Habitats and Communities

Coastal Habitats and Communities	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	

The Environmental Planning Area overlaps a wide variety of shorelines along Victoria, South Australia, and King Island. Coastal habitats which have the potential to be contacted by MDO spill include sandy shorelines, rocky shorelines, and saltmarsh. Mangroves are not present along the west coast of Victoria or King Island where the Environmental Planning Area.

Sandy and rocky shorelines are the dominant the coastal habitats within the Environmental Planning Area.

The PMST Report (Appendix B5) for the Environmental Planning Area identified the following Threatened Ecological Communities that are present on the shoreline:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community.
- Subtropical and Temperate Coastal Saltmarsh.

The Subtropical and Temperate Coastal Saltmarsh TEC occurs in a relatively narrow strip along the Australian coast, within the boundary along 23°37' latitude along the east coast and south from Shark Bay on the west coast of WA (TSSC 2013). The community is found in coastal areas which have an intermittent or regular tidal influence.

The coastal saltmarsh community consists mainly of salt-tolerant vegetation including grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses generally dominate, and vegetation is generally less than 0.5 m in height (Adam 1990). In Australia, the vascular saltmarsh flora may include many species, but is dominated by relatively few families, with a high level of endism at the species level.

The saltmarsh community is inhabited by a wide range of infaunal and epifaunal invertebrates and low and high tide visitors such as fish, birds and prawns (Adam 1990). It is often important nursery habitat for fish and prawn species. Insects are also abundance and an important food source for other fauna. The dominant marine residents are benthic invertebrates, including molluscs and crabs (Ross et al. 2009). Saltmarsh communities are threatened by clearing and fragmentation, land reclamation, altered hydrology and tidal restriction, invasive species, climate change, mangrove encroachment, recreation, eutrophication, grazing, insect control and inappropriate fire regimes (TSSC 2013).

The coastal saltmarsh community provides extensive ecosystem services such as the filtering of surface water, coastal productivity and the provision of food and nutrients for a wide range of adjacent marine and estuarine communities and stabilising the coastline and providing a buffer from waves and storms. Most importantly, the saltmarshes are one of the most efficient ecosystems globally in sequestering carbon, due to the biogeochemical conditions in the tidal wetlands being conducive to long-term carbon retention. A concern with the loss of saltmarsh habitat is that it could release the huge pool of stored carbon to the atmosphere.

The Assemblages of species associated with open-coast salt-wedge estuaries of western and central KEF are an assemblage of native plants, animals and micro-organisms associated with the dynamic salt-wedge estuary systems that occur within the temperate climate, microtidal regime (< 2 m), high wave energy coastline of western and central Victoria. The ecological community currently encompasses 25 estuaries in the region defined by the border between South Australia and Victoria and the most southerly point of Wilsons Promontory (DoEE 2018a).

Coastal Habitats and Communities
Salt-wedge estuaries are usually highly stratified, with saline bottom waters forming a 'salt-wedge' below the inflowing freshwater layer of riverine waters. The dynamic nature of salt-wedge estuaries has important implications for their inherent physical and chemical parameters, and ultimately for their biological structure and ecological functioning. Some assemblages of biota are dependent on the dynamics of these salt-wedge estuaries for their existence, refuge, increased productivity and reproductive success. The ecological community is characterised by a core component of obligate estuarine taxa, with associated components of coastal, estuarine, brackish and freshwater taxa that may reside in the estuary for periods of time and/or utilise the estuary for specific purposes (e.g. reproduction, feeding, refuge, migration) (DoEE 2018a).
Predicted Level of Risk
Sandy beaches are regularly exposed to wave action and have low sediment total organic carbon and therefore generally a low abundance of marine life (Hook et al. 2016). The low concentration of total organic carbon and large particle size of sand means that any MDO deposited on the beach would not be retained. However, sandy beaches are important socio-economically, so an MDO spill reaching this type of shoreline may attract attention that is disproportionate to its sensitivity (Hook et al. 2016). Depth of penetration in sandy sediment is influenced by: • Particle size – penetration is great in coarser sediments (such as beach sand) compared to mud (in estuaries and tidal flats). • Oil viscosity – MDO quickly penetrates sandy sediments. • Drainage – coarse beach sands allow for rapid drainage (it may reach depths greater than one metre in coarse well-drained sediments). • Animal burrows and root pores – penetration into fine sediments is increased if there are burrows of animals such as worms, or pores left where plant roots have decayed. Areas of heavy oiling (>1,000 g/m^2 threshold) would likely result in acute toxicity, and death, of many invertebrate communities, especially where oil penetrates sediments through animal burrows (IPIECA 1999). However, these communities would be likely to rapidly recover (recruitment from unaffected individuals and recruitment from nearby areas) as oil is removed from the environment. The results of exposure to oil may be acute (e.g., die off of amphipods and replacement by more tolerant species such as worms or chronic (i.e., gradual accumulation of oil and genetic damage) (Hook et al. 2016). Cracks and crevices, rock pools, overhangs and other shaded areas provide habitat for soft bodied animals such as sea anemones, sponges, and sea- squirts, and become places where hydrocarbons can become concentrated as it strands ashore. The same is true on stable boulder shores where the rich animal communities underneath the rocks are also the most vulnerable to hydrocarbon pollution. The vulnerability of a rocky shoreline to oiling is dependent on its topography and composition as well as its position. A vertical rock wall on a wave- exposed coast is likely to remain unoiled if an oil slick is held back by the action of the reflected waves (IPIECA-IOGP 2016). At the other extreme, a gradually sloping boulder shore in a calm backwater of a sheltered inlet can trap enormous amounts of hydrocarbons, which may penetrate deep down through the substratum. The complex patterns of water movement close to rocky coasts also tend to concentrate oil in certain areas. Some shores are well known to act as natural collection sites for litter and detached algae and oil is carried there in the same way. As on all types of shorelines, most of the oil is concentrated along the high tide mark while the lower parts are often untouched. As MDO is less sticky than other oils it is less likely to adhere to rocky shorelines and creates stains. Saltmarshes are considered to have a high sensitivity to hydrocarbon exposure. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil. Evidence from case histories and experiments shows that the damage resulting from oiling, and recovery times of oiled marsh vegetation, are very variable. In areas of light to moderate oiling where oil is mainly on perennial vegetation with little penetration of sediment, the shoots of the plants may be killed but recovery can take place from the underground systems. However, many case studies have shown good recruitment of annual species in the year following a spill (IPIECA-IOGP 2016).

Coastal Habitats and Communities
Due to the exposed nature of the coastal areas within the Environmental Planning Area and the nature of MDO, long-term toxicity or smothering effects in areas of moderate MDO exposure are not expected and natural weathering should result in rapid recovery of communities. MDO shoreline loading at the high threshold is not predicted due to the low spill volume. Potential risks arising from a MDO spill on socio-economic receptors (tourism, cultural and/or other social values) are more likely to occur as a result of visual/ aesthetic impacts, rather than ecological impacts. The predicted level of consequence to coastal habitats and communities from a 250 m^3 MDO spill is assessed as moderate as consequences could be longer lasting (> 30 days) if saltmarsh communities are exposure to oil above the low threshold level the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.5 Plankton

Plankton	
Sensitivity Rating	**Low**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
Plankton is a key component in oceanic food chains and support nearly all marine life. Plankton is divided into two groups, namely phytoplankton (microscopic plants) and zooplankton (microscopic animals). Plankton is the dominant biomass of marine ecosystems (CSIRO 2015). Copepods are the most common zooplankton and are some of the most abundant animals on earth. Plankton communities are highly diverse, with members from almost all phyla. Phytoplankton are photosynthetic organisms that drift with ocean currents and are mostly microscopic; however, some gelatinous plankton can be up to 2 m in diameter. Phytoplankton is grazed by zooplankton such as small protozoa, copepods, decapods, krill and gelatinous zooplankton. The carrying capacity of marine ecosystems (the mass of fish resources) and recruitment of individual stocks is strongly related to plankton abundance, timing and composition. In the Environmental Planning Area, the seasonal Bonney coast upwelling is a productivity hotspot, with high densities of zooplankton and are important for fish and whales. The primary ecological importance of the Bonney coast upwelling is as a feeding area for the Pygmy Blue Whale (PBW) (*Balaenoptera musculus brevicauda*). The upwelled nutrient-rich water promotes blooms of coastal krill (*Nyctiphanes australis*), which in turn attracts PBW to the region to feed. The upwelling is one of only three identified feeding areas consistently used by PBW in Australian coastal waters (Butler et al. 2002). The upwelling occurs when strong south-easterly surface winds induce warm, nutrient-deficient surface waters away from the coastline. This leads to surface upwellings bringing cool, nutrient-rich deep waters closer to the surface where there is enough sunlight for primary production among planktonic organisms to take place (Hosack and Dambacher 2012). Plankton distribution from the upwelling area is dependent upon prevailing ocean currents including the Leeuwin Current, East Australia Current, flows into and from Bass Strait and Southern Ocean water masses. Populations are thought to be highly variable both spatially and temporally and are likely to comprise characteristics of tropical, southern Australian, central Bass Strait and Tasman Sea populations. A detailed analysis of satellite-derived ocean data (chlorophyll a levels) for the periods 1998-2000 and 2005- 2014 suggests that the western Tasmanian shelf also accommodates a productive ecosystem. Based upon the Kampf (2015) study, this region forms part of the Great South Australian Coastal Upwelling System and experiences two phytoplankton blooms per annum: The first and larger bloom – occurs in the late austral summer months (typically February-April) resulting from favourable winds that occur between December-April. Stronger upwelling winds do not always create phytoplankton blooms. The second smaller bloom – occurs in spring (October) coincident with the onset of spring bloom in the western Tasman Sea. The mechanism for this smaller bloom remains unclear. Kampf (2015) identifies that the accuracy of satellite data cannot be used to identify upwelling jets however would suggest the existence of upwelling jets on the western Tasmanian shelf. The significance of these jets is that they operate to disperse nutrient-rich water northwards along the shelf and possibly into western Bass Strait. This advective process would explain elevated chlorophyll a level in western Bass Strait – a typical feature of the region during austral summer months. The western Tasmanian upwelling system lies to the west of the Tasmanian mainland and at least 130 km southeast of the acquisition area.	

Plankton
Predicted Level of Risk
Plankton are likely to be exposed to oil within the upper 10 m of the water column in areas close to the spill source where oil concentrations are the highest. Phytoplankton is typically not sensitive to the impacts of oil, though they do accumulate it rapidly due to their small size and high surface area to volume ratio (Hook et al. 2016). If phytoplankton is exposed to hydrocarbons at the sea surface, this may directly affect their ability to photosynthesize via smothering and would have implications for the next trophic level in the food chain (e.g., small fish) (Hook et al. 2016). In addition, the presence of surface hydrocarbons may result in a reduction of light penetrating the water column, which may affect the rate of photosynthesis, particularly in instances where there is prolonged presence of surface hydrocarbons over an extensive area such that the phytoplankton was restricted from light exposure, in turn affecting the rate of photosynthesis and inhibiting growth, depending on the concentration range. For example, photosynthesis is stimulated by low concentrations of oil in the water column (10-30 ppb) but become progressively inhibited above 50 ppb. Conversely, photosynthesis can be stimulated below 100 ppb for exposure to weathered oil (Volkman et al. 2004). Zooplankton (microscopic animals such as rotifers, copepods and krill that feed on phytoplankton) are vulnerable to hydrocarbons due to their small size and high surface area to volume ratio, along with (in many cases) their high lipid content (that facilitates hydrocarbon uptake and bioaccumulation) (Hook et al. 2016). Water column organisms that come into contact with oil risk exposure through ingestion, inhalation, and dermal contact (NRDA 2012), which can cause immediate mortality or declines in egg production and hatching rates along with a decline in swimming speeds (Hook et al. 2016). Plankton is generally abundant in the upper layers of the water column and acts as the basis for the marine food web, meaning that a MDO spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. Variations in the temporal scale of oceanographic processes typical of the ecosystem have a greater influence on plankton communities than the direct effect of spilt hydrocarbons. This is because reproduction by survivors or migration from unaffected areas would be likely to rapidly replenish any losses from permanent zooplankton (Volkman et al. 2004). Field observations from oil spills show minimal or transient effects on marine plankton (Volkman et al. 2004). Once background water quality conditions have re-established, the plankton community will take weeks to months to recover (ITOPF 2011), allowing for seasonal influences on the assemblage characteristics. Thus, the predicted level of consequence to plankton from a 250 m^3 MDO spill is assessed as minor as consequences will be short-term (days to weeks to months), recoverable and affect a small portion of the plankton population that is widely representative of the region and would be unlikely to impede associated food chains within the region, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.6 Invertebrates

Invertebrates	
Sensitivity Rating	**Low**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
Studies by the Museum of Victoria found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions (Wilson and Poore 1987). Results of sampling in shallower inshore sediments reported high diversity and patchy distribution (Parry et al. 1990). In these areas, crustaceans, polychaetes, and molluscs were dominant. Throughout the region, a variety of seabed habits support a range of animal communities such as sparse sponges to extensive 'thickets" of lace corals and sponges, polychaete worms and filter feeders (DNP 2013). Echinoderms, such as sea stars, sea urchins and sea cucumbers are also an important fauna species of the southern Australian and Tasmanian waters, with several species at risk of extinction (DPIPWE 2020). Rock lobster, giant grab, scallops, abalone, and octopus are fished by commercial and recreational fishers in the Environmental Planning Area. Risks to these fisheries are assessed in the section on commercial fishing.	
Predicted Level of Risk	
The primary modes of exposure for benthic invertebrate communities for a surface oil spill are: Direct exposure to oil within the water column to a depth of 10 m (RPS 2019a). Direct exposure to oil on shoreline or within sediment within 10 m water depth. Indirect exposure to oil through the food web via uptake of oiled plankton, detritus, prey, etc. (NRDA 2012). Acute or chronic exposure, through surface contact, and/or ingestion can result in toxicological risks. Entrained and dissolved hydrocarbons can have negative impacts on marine invertebrates and associated larval forms. Impacts to some adult species (e.g. crustaceans) is reduced as a result of the presence of an exoskeleton, while other invertebrates with no exoskeleton and larval forms may be more prone to impacts from pelagic hydrocarbons. Localised impacts to larval stages may occur which could impact on population recruitment. If invertebrates are contaminated by hydrocarbons, tissue taint can remain for several months, although taint may eventually be lost. For example, it has been demonstrated that it took 2-5 months for lobsters to lose their taint when exposed to a light hydrocarbon (NOAA 2002) (see Commercial Fisheries' assessment). Exposure to microscopic oil droplets may also impact aquatic biota either mechanically (especially filter feeders) or act as a conduit for exposure to semi-soluble hydrocarbons (that might be taken up by the gills or digestive tract) (McCay-French 2009). Toxicity is primarily attributed to water soluble PAHs, specifically the substituted naphthalene (C2 and C3) as the higher C-ring compounds become insoluble and are not bioavailable. ANZECC/ARMCANZ (2000) identifies the following 96-hr LC50 concentrations for naphthalene (a key PAH dissolved phase toxicant in crude oils):	

Invertebrates
For the bivalve mollusc, *Katelysia opima*, a concentration of 57,000 ppb For six species of marine crustaceans, a concentration between 850 and 5,700 ppb. Other possible impacts from the presence of dispersed and non-dispersed oil include effects of oxygen depletion in bottom waters due to bacterial metabolism of oil (and/or dispersants), and light deprivation under surface oil (NRDA 2012). Water quality in benthic habitats exposed to entrained hydrocarbons would be expected to return to background conditions within < 30 day. Several studies have indicated that rapid recovery rates may occur even in cases of heavy oiling (Committee on Oil in the Sea 2003). Due to the low concentrations and physical properties of the MDO, and the exposed nature of shoreline and well- mixed nature of the waters in the Environmental Planning Area coating of invertebrates and prolonged exposure to hydrocarbons is considered highly unlikely. Thus, the predicted level of consequence to invertebrates from a 250 m^3 MDO spill is assessed as minor as consequences will be short-term (days to weeks), recoverable and affect a small portion of the invertebrate population would be unlikely to impede associated food chains within the region the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.7 Fish

Fish	
Sensitivity Rating	**Low**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	

The PMST Report (Appendix B5) identified multiple fish species or species habitat within the Environmental Planning Area as detailed in Annex 2 of this document. None of these fish species were identified to be undertaking biologically important behaviours or have BIAs or habitat critical to the survival of the fish species.

The Dwarf Galaxias is a freshwater species (Saddler et al. 2010) and the Yarra Pygmy Perch occurs in lakes, ponds, and slow flowing rivers (Sadler and Hammer 2010) which are outside the Environmental Planning Area.

The Australian Grayling is a small to medium-sized, slender, silvery fish with soft-rayed fins lacking any spines. It is endemic to south-eastern Australia, including Victoria, Tasmania, and New South Wales, and is a migratory species that inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults (Backhouse et al. 2008).

The Blue Warehou is a medium-sized, deep-bodied fish, reaching a maximum total length of 90 cm and a maximum weight of 7 kg (TSSC 2015). Globally, the Blue Warehou is confined to Australian and New Zealand waters predominantly in coastal shelf, upper continental slope, and seamount waters offshore from New South Wales, Tasmania, Victoria and South Australia (TSSC 2015). Blue Warehou is a target species for the Tasmania Scalefish Fishery.

The eastern population of Gemfish (Eastern Gemfish) is taken as bycatch in commercial fisheries. The largest proportion of catch of the species is taken in the South East Trawl sector of the Commonwealth Southern and Eastern Scalefish and Shark Fishery (SESSF), where it is caught primarily in deepwater trawl nets that are targeting multiple species that are found on the continental shelf. Eastern Gemfish are mesopelagic and inhabit deeper continental shelf habitats and upper slope waters from 100 m to 700 m (down to 1254 m) but are generally found in waters about 250 to 500 m deep (TSSC 2009).

The Orange Roughy is a demersal fish targeted by the Southern and Eastern Scalefish and Shark Fishery. They are widely distributed throughout the world and forms dense spawning and feeding aggregations on or near topographic features such as seamounts, canyons, and plateaus (DCCEEW 2023). No spawning or feeding aggregation areas have been identified in the Environmental Planning Area.

Southern Bluefin Tuna can grow to 225 cm in length and 200 kg in weight (TSSC 2010). They are a highly migratory species that occurs globally in waters between 30°S and 50°S forming on single global population (TSSC 2010). In Australian waters, they range from northern Western Australia, around the southern region of the continent, to northern New South Wales (TSSC 2010). Southern Bluefin Tuna are a target species for the Southern Bluefin Tuna Fishery.

Most of the listed marine ray-finned fish species identified in the PMST Report for the Environmental Planning Area are syngnathids, which includes seahorses and their relatives (sea dragon, pipehorse and pipefish). The majority of these species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Fishes of Australia 2015). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as sargassum.

The PMST Report (Appendix B5) identified five shark species were identified with the White Shark having foraging or feeding related behaviour and foraging and distribution BIAs as detailed in Annex 2 of this document.

Fish
Gulpener Sharks are targeted by the Southern and Eastern Scalefish and Shark Fishery. There are endemic to Australia in habitats on the upper-slope and are mainly demersal (bottom dwelling) between 180 m to 900 m (Williams et al. 2012) of the southern continental shelf. The Porbeagle occurs in waters from southern Queensland to south-west Australia (Last & Stevens 2009). Animals typically occur in oceanic waters off the continental shelf, although they occasionally enter coastal waters (Francis et al. 2002). The Porbeagle is known to undertake seasonal migrations, although the timing and details of these migratory movements are not well-understood (Saunders et al. 2011). Individuals have been tracked moving large distances (i.e. 1500-1800 km along continental shelves and crossing the Atlantic Ocean between Europe and North America) (Francis et al. 2002). School Shark appears to have undergone a significant reduction in numbers as the result of commercial fishing in south eastern Australian waters (TSSC 2009a). School Shark is primarily a deep water demersal (bottom-dwelling) species, although individuals have been recorded undertaking daily vertical migrations, remaining at depths of around 500 m during the day and moving up to around 100 m at night (McLoughlin, 2007). Females and juveniles utilise inshore coastal areas around Victoria, Tasmania and parts of South Australia for nursery areas (Pogonoski et al., 2002). The Shortfin Mako is a large pelagic shark with a circum-global distribution inhabiting tropical and temperate waters. It is rarely encountered in waters with temperatures below 16°C (Last and Stevens 2009). In Australian waters, the shortfin mako has been recorded in offshore waters all around the continent's coastline except for the Arafura Sea, Gulf of Carpentaria, and Torres Strait. The species primarily occurs in offshore, oceanic waters and is pelagic (has no habitat associations with the seafloor) (Last and Stevens 2009). The White Shark is listed as Vulnerable. White Sharks are long-lived, living for 30 years or more (Bruce 2008), and are found throughout temperate and sub-tropical regions in the northern and southern hemispheres (Last & Stephens 2009). The species is also commonly found in inshore waters in the vicinity of islands, and often near seal colonies (Malcolm et al. 2001). The foraging BIA that is within the Environmental Planning Area is centred on Lady Julia Percy Island which is a known seal breeding colony (Appendix B12 MAP-REG-EPM-057). The Environmental Planning Area also overlaps the distribution BIA that covers Australian waters from Barrow Island/Montebello Islands, WA to Yeppoon/Swains Reef, Qld. In addition to protected fish species, commercial fish and shark species such as mackerel, salmon, sardines, snapper, sawsharks, whiting and wrasse are likely to be present in the Environmental Planning Area. Short finned eels, known as Kooyang, are an important Indigenous cultural value, and may migrate through the Environmental Planning Area. The Environmental Planning Area does not overlap any freshwater or estuaries where eels spend most of their life cycle (VFA 2022) or where Indigenous eel traps are present.
Predicted Level of Risk
Fish are exposed to in-water hydrocarbon (entrained and dissolved) through a variety of pathways, including: Direct dermal contact such as swimming through oil or waters with elevated dissolved hydrocarbon concentrations and other constituents, with diffusion across their gills (Hook et al. 2016). Ingestion either directly or via food base, fish that have recently ingested contaminated prey may themselves be a source of contamination for their predators. Inhalation where elevated dissolved contaminant concentrations in water pass over the gills. Exposure to hydrocarbons entrained or dissolved in the water column can be toxic to fish. Studies have shown a range of impacts including changes in abundance, decreased size, inhibited swimming ability, changes to oxygen consumption and respiration, changes to reproduction, immune system responses, DNA damage, visible skin and organ lesions, and increased parasitism. However, many fish species can metabolise toxic hydrocarbons, which reduces the risk of bioaccumulation of contaminants in the food web and human exposure to contaminants through the consumption of seafood (NRDA 2012).

Fish
Sub-lethal impacts in adult fish include altered heart and respiratory rates, gill hyperplasia, enlarged liver, reduced growth, fin erosion, impaired endocrine systems, behavioural modifications and alterations in feeding, migration, reproduction, swimming, schooling, and burrowing behaviour (Kennish 1996). However, fish are highly mobile and unlikely to remain in the area of a spill for long enough to be exposed to sub-lethal doses of hydrocarbons. The toxicity of dissolved hydrocarbons and dispersed oil to fish species has been the subject of a number of laboratory studies (AMSA 1998). Generally, concentrations in the range of 0.1–0.4 mg/L dispersed oil have been shown to cause fish deaths in laboratory experiments (96-hour LC50). No reported studies of the impacts of oil spills on cartilaginous fish (including sharks, rays and sawfish) were found in the literature. The assessment of effects on fish species in the Timor Sea as a result of the Montara well blowout (a light gas condensate), conducted from November 2009 to November 2010 undertaken by Gagnon & Rawson (2011), found that of the species studied (mostly Goldband Snapper Pristipomoides multidens, Red Emperor Lutjanus sebae, Rainbow Runner Elegatis bipinnulata and Spanish Mackerel Scomberomorus commerson), all 781 specimens were in good physical health at all sites. Results show that: Phase 1 study (November 2009, immediately after the blowout ceased) - indicated that in the short-term, fish were exposed to and metabolised petroleum hydrocarbons, however no consistent adverse effects on fish health or their reproductive activity were detected. Phase 2 study (March 2010, 5 months after the blowout ceased) – indicated continuing exposure to petroleum hydrocarbons, as detected by elevated liver detoxification enzymes and PAH biliary metabolites in three out of four species collected close to the spill site, and elevated oxidative DNA damage. Phase 3 study (November 2010, 12 months after the blowout ceased) – showed a trend towards a return to reference levels with often, but not always, comparable biomarker levels in fish collected from reference and impacted sites. This evidence of exposure to petroleum hydrocarbons at sites close to the spill location suggest an ongoing trend toward a return to normal biochemistry/physiology (Gagnon & Rawson 2011). The main finding of the Gagnon & Rawson (2011) study concluded that there were no detectable petroleum hydrocarbons found in the fish muscle samples, limited ill effects were detected in a small number of individual fish, and no consistent adverse effects of exposure on fish health could be detected within two weeks following the end of the well release. Notwithstanding, fishes from close to the Montara well, collected seven months after the discharge began, showed continuing exposure to hydrocarbons in terms of biomarker responses. Two years after the discharge, biomarker levels in fishes had mostly returned to reference levels, except for liver size. However, this was potentially attributed to local nutrient enrichment, or to past exposure to hydrocarbons. Fishes near Heyward Shoal, approximately 100 km southwest of the Montara well, had elevated biomarker responses indicating exposure to hydrocarbons, but were collected close to the Cornea natural hydrocarbon seep. Studies on the Montara discharge have shown recovery in terms of the abundance and composition of fishes, and toxicological and physiological responses of fishes. No reports of oil spills in open waters have been reported to cause fish kills (though mortality in aquaculture pens has), which is likely to be because vertebrates can rapidly metabolise and excrete hydrocarbons (Hook et al. 2016). Recovery of fish assemblages depends on the intensity and duration of an unplanned discharge, the composition of the discharge and whether dispersants are used, as each of these factors influences the level of exposure to potential toxicants. Recovery would also depend on the life cycle attributes of fishes. Species that are abundant, short-lived and highly fecund may recover rapidly. However less abundant, long-lived species may take longer to recover. The range of movement of fishes will also influence recovery. The nature of the receiving environment would influence the level of impact on fishes. None of the conservation advices or recovery plans for fish or sharks identify oil spill as a threat. The syngnathid species are most likely to be present in the top 10 m of the water column where oil may be present. The other fish and shark species are either demersal species (bottom dwelling) or pelagic species which swim large distances and hence these species are unlikely to be affected by oil from a diesel spill. Impacts to syngnathid species are more likely close to the spill location which oil concentrations would be highest, however as there are no reef or seagrass areas in the Operational Areas it is unlikely, they would be present in significant numbers.

Fish
Thus, the predicted level of consequence to fish from a 250 m3 MDO spill is assessed as minor as consequences will be short-term (days to weeks), recoverable and affect a small portion of the fish population would be unlikely to impede associated food chains within the region, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.8 Birds

Birds	
Sensitivity Rating	**Medium– seabirds**
	High - aquatic birds, shorebirds
Predicted Level of Risk	**Low – seabirds, aquatic birds**
	Medium - shorebirds
Environmental Planning Area Existing Environment	
The PMST Report (Appendix B5) identified multiple bird species or species habitat within the Environmental Planning Area as detailed in Annex 2 of this document. Several of these bird species were identified to be undertaking biologically important behaviours and/or have BIAs within the Environmental Planning Area. No habitat critical to the survival of the bird species were identified within the Environmental Planning Area. The orange-bellied parrot, which is critically endangered is known to migrate through the Environmental Planning Area, however, it does not land at sea or use coastal areas as habitat so impacts to this species are not predicted. A number of albatross and two petrel species were identified as foraging behaviour known or likely within the Environmental Planning Area as detailed in Annex 2 of this document. Of these the following have foraging BIAs: Antipodean Albatross (Appendix B12 MAP-REG-EPM-059) Black-browed Albatross (Appendix B12 MAP-REG-EPM-060 Buller's Albatross (Appendix B12 MAP-REG-EPM-071) Campbell Albatross (Appendix B12 MAP-REG-EPM-061) Indian Yellow-nosed Albatross (Appendix B12 MAP-REG-EPM-063) Shy Albatross (Appendix B12 MAP-REG-EPM-066) Wandering Albatross (Appendix B12 MAP-REG-EPM-072) Common Diving Petrel (Appendix B12 MAP-REG-EPM-062) White-face Storm Petrel (Appendix B12 MAP-REG-EPM-075 These BIAs cover either most or all the South-east Marine Region (CoA 2015a). In addition, the Common Diving Petrel has a breeding BIA on Lady Julia Percy Island which is within the Environmental Planning Area (Appendix B12 MAP-REG-EPM-062).	

Birds
Albatrosses and petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (CoA 2022). Albatross and petrel species exhibit a broad range of diets and foraging behaviours, and hence at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is those waters south of 25° where many species spend the majority of their foraging time (CoA 2022). Albatrosses have a widespread distribution throughout the southern hemisphere. They feed mainly on cephalopods, fish, and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP 2020). Albatrosses are colonial, usually nesting on isolated islands and foraging across oceans in the winter months with most observations along the edge of the continental shelf (CoA 2022). Petrels are oceanic and have a widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between 40°S and 60°S. Petrel species feed on small fish, cephalopods (octopus, squid, and cuttlefish) and crustaceans along the edge of the continental shelf and open waters (CoA 2022). Within the Environmental Planning Area Little Penguin breeding and foraging BIAs occur at Black Pyramid, Christmas Island and Councillor Island in Tasmanian waters (Appendix B12 MAP-REG-EPM-064). A small breeding colony also occurs at Middle Island off Victoria. Breeding typically occurs from September to February, but some birds reside at the colony all year round. The Bass Strait supports approximately 60% of the known breeding population, with additional breeding BIAs outside of the Environmental Planning Area located at Albatross Island (Tasmania), Egg Island (Tasmania), Hunter Island (Tasmania), Phillip Island (Victoria), Sisters Island (Tasmania) and Three Hummock Island (Tasmania). The Little Tern and Short-tailed Shearwater (migratory marine birds) were identified as breeding known to occur in the Environmental Planning Area with a proportion of the Short-tailed Shearwater breeding and foraging BIAs overlapping the Environmental Planning Area (Appendix B12 MAP-REG-EPM-065). Birds are typically present between September to May. The Environmental Planning Area also overlaps breeding and foraging BIAs for the Wedge-tailed Shearwater (Appendix B12 MAP-REG-EPM-067) that covers an area 160 km from Mutton bird Island where birds may be present between August and May. The Black-faced Cormorant has two foraging/breeding BIAs within the Environmental Planning Area, at Christmas Island and Councillor Island just off King Island (Appendix B12 MAP-REG-EPM-074). Breeding usually occurs on rocky islands, but also on stacks, slopes, and sea cliffs in colonies of up to 2,500 individuals (del Hoyo et al. 1992). It feeds in coastal waters, sometimes in sheltered places such as bays and islets and can be found entering rivers along the coast (CoA. 2020a). The Australasian Gannet was identified as having a foraging BIA within the Environmental Planning Area (Appendix B12 MAP-REG-EPM-073). The Australasian Gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers (CoA 2015a). Several shorebirds were identified from the PMST Report as being present in the Environmental Planning Area with the threatened species, Black-tailed Godwit, Great Knot, Grey Plover, Lesser Sand Plover, Sharp-tailed Sandpiper, Ruddy Turnstone and Terek Sandpiper identified as roosting in the area. No BIAs for shorebirds were identified. Other threatened shorebirds that are known to occur within the Environmental Planning Area are the Blue-winged Parrot, Common Greenshank, Curlew Sandpiper, Eastern Curlew, Greater Sand Plover, Latham's Snipe, Red Knot and Western Alaskan Bar-tailed Godwit. These species are commonly found on coastal shores including beaches and rocky shores and either feed at low tide on worms, crustaceans and molluscs or fish species or feed on aquatic biota. Many of the wader species are migratory travelling from the Northern Hemisphere in non-breeding months. Most inhabit intertidal mudflats, rocky islets, sand beaches, mangroves, rocky coastline and coral reefs. Roosting occurs in similar habitats and species are found feeding on fish, crustaceans, aquatic insects, as well as plants and seeds (Higgins & Davies 1996). Important coastal habitat where shorebirds are likely to be present within the Environmental Planning Area and have a marine interface are wetlands and shorelines. Impacts to these areas are assessed in the respective sections.

Birds
The King Island Important Bird Area (IBA) is within the Environmental Planning Area. Birdlife International (2008) detail the following regarding the IBA. The IBA includes the entire coastline of King Island, which supports significant numbers of Hooded Plovers; Lavinia State Reserve, which supports the critically endangered Orange-bellied Parrot and endemic subspecies of bush birds; and three inshore islands which support large numbers of nesting seabirds. These islands are Christmas Island (a 63 ha Nature Reserve), New Year Island (a 98 ha Game Reserve, on which harvesting of shearwaters is allowed) and Councillor Island (11 ha of Crown Land). The coastline is a mixture of rocky outcrops and long sandy beaches with beach-washed kelp. The IBA is defined as the coastal strip extending from the low water mark to 1 km inland of the high-water mark around the entire island; this is intended to capture most significant habitat for shorebirds and Orange-bellied Parrots. Two other IBAs within the Environmental Planning Area are Lawrence Rocks Wildlife Reserve, which consists of two rocky islets off the coast from Portland with a resident Australasian Gannett population, and the Discovery Bay Coast through to Picaninnie Ponds in South Australia with resident populations of Australasian Bittern, Hooded Plover, Rufous Bristlebird and Striated Fieldwren, and non-breeding Orange-bellied Parrot (Parks Victoria 2015).
Predicted Level of Risk
Seabirds, shorebirds, and aquatic birds are sensitive to the impacts of oiling, with their vulnerability arising from the fact that they cross the air-water interface to feed, while their shoreline habitats may also be oiled (Hook et al. 2016). Species that raft together in large flocks on the sea surface are particularly at risk (ITOPF 2011). Toxic effects of hydrocarbons on birds may result where the oil is ingested as the bird attempts to preen its feathers, and the preening process may spread the oil over otherwise clean areas of the body (ITOPF 2011). Whether this toxicity ultimately results in mortality will depend on the amount of hydrocarbons consumed and other factors relating to the health and sensitivity of the bird. Birds that are coated in oil also suffer from damage to external tissues including skin and eyes, as well as internal tissue irritation in their lungs and stomachs. Breeding seabirds may be directly exposed to oil via a number of potential pathways. Any direct impact of oil on terrestrial habitats has the potential to contaminate birds present at the breeding sites (Clarke 2010). Bird eggs may also be damaged if an oiled adult sits on the nest. Fresh crude was shown to be more toxic than weathered crude, which had a medial lethal dose of 21.3 mg/egg (Clarke 2010). Studies of contamination of duck eggs by small quantities of crude oil, mimicking the effect of oil transfer by parent birds, have been shown to result in mortality of developing embryos. Engelhardt (1983), Clark (1984), Geraci & St Aubin (1988) and Jenssen (1994) indicated that the threshold thickness of oil that could impart a lethal dose to some intersecting wildlife individual is 10 μm (~10 g/m^2). Scholten et al (1996) indicates that a layer 25 μm thick would be harmful for most birds that contact the slick. *Seabirds* Birds foraging at sea have the potential to directly interact with oil on the sea surface some considerable distance from breeding sites in the course of normal foraging activities. Species most at risk include those that readily rest on the sea surface such as shearwaters and surface plunging species such as terns and boobies. As seabirds are top order predators, any impact on other marine life (e.g., pelagic fish) may disrupt and limit food supply both for the maintenance of adults and the provisioning of young. In the case of seabirds, direct contact with hydrocarbons is likely to foul plumage, which may result in hypothermia due to a reduction in the ability of the bird to thermo-regulate and impair waterproofing (ITOPF 2011). A bird suffering from cold, exhaustion and a loss of buoyancy resulting from fouling of plumage may dehydrate, drown, or starve (ITOPF 2011, DSEWPC 2011). It may also result in impaired navigation and flight performance (Hook et al. 2016). Increased heat loss as a result of a loss of water-proofing results in an increased metabolism of food reserves in the body, which is not countered by a corresponding increase in food intake and may lead to emaciation (DSEPWC 2011). The greatest vulnerability in this case occurs when birds are feeding or resting at the sea surface (Peakall et al. 1987). In a review of 45 marine hydrocarbon spills, there was no correlation between the numbers of bird deaths and the volume of the spill (Burger 1993). Most of the seabird species that are likely to occur in the Environmental Planning Area forage over an extensive area and are distributed over a wide geographic range. Seabirds plunge diving through the sea surface for prey are most likely to encounter the low concentration of hydrocarbons due to its broader extent than moderate and high concentrations. Seabirds rafting, resting, diving or feeding at sea have the potential to come into contact with oil. However, the low threshold level of exposure is not

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expected to result in the lethal impacts or feather matting and hypothermia. However, contact at the high threshold is expected to impart toxicity and ecological impacts. Though, oil at high thresholds is only predicted within a small area around the spill location and for a short duration (days). The extensive ocean foraging habitat available to species such as albatrosses, petrels, shearwaters and terns and the small area and temporary nature of the hydrocarbon release on the sea surface (~ 24 hours) makes it unlikely that a spill will limit their ability to forage for unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. The area where dissolved hydrocarbons would exceed the moderate threshold or entrained hydrocarbons exceed the high threshold during an MDO spill would be relatively small in comparison to the Bass Strait and Otway region where seabirds forage. It is these small areas where sub-lethal or toxic effects to birds may occur. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in areas of higher hydrocarbon thresholds, thus there is low probability of seabirds experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. Seabird interactions with shorelines is expected to be largely during periods of rest and breeding activities. Most seabirds are oceanic and seldom come to land unless breeding in areas associated with burrows on sloping ground in coastal forest, scrubland, shrubland or grassland. As detailed in the assessment of coastal habitats and communities due to the exposed nature of the coastal areas within the Environmental Planning Area and the nature of MDO, long-term toxicity or smothering effects in areas of moderate or high MDO are not expected. The predicted level of consequence to seabirds from a 250 m^3 MDO spill is assessed as minor as consequences are unlikely to occur at thresholds levels where oiling of birds or tainting of food would occur, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low. *Shorebirds* Shorebirds are likely to be exposed to oil when it directly impacts their intertidal feeding habitat. Shorebird species foraging for invertebrates on exposed sand and mud flats at lower tides will be at potential risk of both direct impacts through contamination of individual birds (ingestion or soiling of feathers) and indirect impacts through the contamination of foraging areas that may result in a reduction in available prey items (Clarke 2010). Shorebird species (e.g., plovers, godwits, curlews, etc.) prefer varying habitats including tidal flats, open saltmarsh, freshwater wetlands, open grasslands and sandy beaches. These habitats on the Victorian coastline inshore of the Operational Area could be exposed to moderate or high threshold shoreline oil due that has not yet evaporated or entrained. Exposure to moderate or high threshold shoreline oil at King Island and the King Island IBA is less likely due to the distance from the Operational Area. Due to the proximity to the Victorian coastline, the predicted level of consequence to shorebirds from a 250 m^3 MDO spill is assessed as moderate as consequences could be longer lasting (> 30 days) if shorebirds are exposure to oil above low threshold, though if consequences occurred, they are likely to only affect a small portion of the shorebird population due to the low volume of oil that would come onshore, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium. *Aquatic birds* Penguins may be especially vulnerable to oil because they spend a high portion of their time in the water and readily lose insulation and buoyancy if their feathers are oiled (Hook et al. 2016). The Iron Baron vessel spill (325 tonnes of bunker fuel in Tasmania in 1995) is estimated to have resulted in the death of up to 20,000 penguins (Hook et al. 2016). As characteristic of aquatic birds, Little Penguins forage while swimming and often forage for extended periods of time (dawn to dusk) and may forage up to 50 km from the colony. As such Little Penguins are most at risk of direct contact, ingestion or inhalation while feeding at sea. Little Penguins are most likely to encounter the low concentration of hydrocarbons due to its broader extent than moderate and high concentrations. However, the low threshold level of exposure is not expected to result in the lethal impacts of feather matting and hypothermia. The high threshold is expected to impart toxicity and ecological impacts. Given the offshore location of the spill

Birds
volume, the small area of exposure and temporary nature of the hydrocarbon release on the sea surface (~ 24 hrs) it is unlikely that a spill would limit Little Penguins ability to forage for unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. The area of exposure to dissolved hydrocarbons above the moderate threshold and entrained hydrocarbons above the high threshold during an MDO spill are relatively small in comparison to the Bass Strait and Otway region. It is these small areas where sub-lethal or toxic effects may occur. There is a low probability that Little Penguins would be feeding exclusively or predominantly on fish found in areas of higher hydrocarbon thresholds, thus there is low probability of Little Penguins experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The Little Penguin foraging/breeding BIAs on Black Pyramid Island off Tasmania and Christmas Island and Councillor Island off King Island are unlikely to be exposed to oil above the low threshold due to the distance from the Operational Area and low volume of MDO that could be spilt. The predicted level of consequence to aquatic birds (Little Penguins) from a 250 m^3 MDO spill is assessed as minor as consequences are unlikely to occur at thresholds levels where oiling of birds, next or tainting of food would occur, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low

6.9 Marine Reptiles

Marine Reptiles	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
The PMST Report (Appendix B5) identified three turtle species within the Environmental Planning Area, green, leatherback and loggerhead turtle. No BIAs or habitat critical to the survival of the species were identified. The PMST Report also identified foraging, feeding or related behaviour known to occur within area for the leatherback and loggerhead turtle as detailed in Annex 2 of this document. Green turtles' nest, forage and migrate across tropical northern Australia. Green turtles spend their first 5-10 years drifting on ocean currents. Green turtles are predominantly found in Australian waters off the Northern Territory, Queensland, and Western Australian coastlines, with limited numbers in NSW, Victoria, and South Australia (DoEE 2017). Small numbers of leatherback turtles' nest on the Cobourg Peninsula (NT) and there are unconfirmed accounts of leatherback turtles nesting in Western Australia. Leatherback turtles are more commonly found foraging in Australian waters along the east coast and in Bass Strait. The southern waters of Australia are one of five identified foraging sites (where area restricted behaviour occurs) for Leatherback turtles (DoEE 2017). There are two genetically distinct stocks of loggerhead turtles nesting in Australia, one in Queensland (known as the south-west Pacific stock) and one in Western Australia. Loggerhead turtles forage in all coastal states and the Northern Territory, but are uncommon in South Australia, Victoria, and Tasmania (DoEE 2017).	
Predicted Level of Risk	
The Recovery Plan for Marine Turtles (DoEE 2017) identifies oil spill as a threat detailing that there is well documented evidence of the detrimental effects from encountering oil either via external contact, ingestion, or inhalation, resulting in breathing, sight or gastro-intestinal injuries. Sea turtles are vulnerable to the effects of oil at all life stages—eggs, post-hatchlings, juveniles, and adults in nearshore waters. Several aspects of sea turtle biology and behaviour place them at particular risk, including a lack of avoidance behaviour, indiscriminate feeding in convergence zones, and large pre-dive inhalations. Effects of oil on turtles include increased egg mortality and developmental defects, direct mortality due to oiling in hatchlings, juveniles and adults, and negative impacts to the skin, blood, digestive and immune systems and salt glands. Oil exposure affects different turtle life stages in different ways. Thus, information on oil toxicity needs to be organised by life stage. Turtles may be exposed to chemicals in oil in two ways: Internally – eating or swallowing oil, consuming prey containing oil-based chemicals, or inhaling of volatile oil related compounds; and Externally – swimming in oil or dispersants, or oil or dispersants on skin and body. Records of oiled wildlife during spills rarely include marine turtles, even from areas where they are known to be relatively abundant (Short 2011). An exception to this was the large number of marine turtles collected (613 dead and 536 live) during the Macondo spill in the Gulf of Mexico, although many of these animals did not show any sign of oil exposure (NOAA 2013). Of the dead turtles found, 3.4% were visibly oiled and 85% of the live turtles found were oiled (NOAA 2013). Of the captured animals, 88% of the live turtles were later released, suggesting that oiling does not inevitably lead to mortality.	

Marine Reptiles
There is potential for contamination of turtle eggs to result in similar toxic impacts to developing embryos as has been observed in birds. Studies on freshwater snapping turtles showed uptake of PAHs from contaminated nest sediments, but no impacts on hatching success or juvenile health following exposure of eggs to dispersed weathered light crude (Rowe et al. 2009). However, other studies found evidence that exposure of freshwater turtle embryos to PAHs results in deformities (Bell et al. 2006, Van Meter et al. 2006). Turtles may experience oiling impacts on nesting beaches and eggs through chemical exposure, resulting in decreased survival to hatching and developmental defects in hatchlings. Turtle hatchlings may be more vulnerable to smothering as they emerge from the nests and make their way over the intertidal area to the open water (AMSA 1998). Hatchlings that contact oil residues while crossing a beach can exhibit a range of effects including impaired movement and bodily functions (Shigenaka 2003). Hatchlings sticky with oily residues may also have more difficulty crawling and swimming, rendering them more vulnerable to predation. Ingested oil may cause harm to the internal organs of turtles. Oil covering their bodies may interfere with breathing because they inhale large volumes of air to dive. Oil can enter cavities such as the eyes, nostrils, or mouth. Turtles may experience oiling impacts on nesting beaches when they come ashore to lay their eggs, and their eggs may be exposed during incubation, potentially resulting in increased egg mortality and/or possibly developmental defects in hatchlings. There are no turtle nesting sites within the Environmental Planning Area thus impacts to turtling eggs, post-hatchlings and juveniles are not predicted. Turtle interaction with surface oil is likely to include direct contact due to resting behaviours floating on the sea surface and through inhalation of volatile compounds in the vicinity of unweathered MDO. At moderate and high concentrations, toxicity impacts may occur including sub-lethal irritation of skin or cavities. However, due to the absence of turtle BIAs and nesting locations in the Environmental Planning Area. As low numbers of turtles forage or migrate through the Otway area, individual marine reptiles may come into contact with hydrocarbons on the sea surface or within the water column. This is most likely to be at the low threshold levels as exposure levels above the low thresholds would be within a small area of the spill location for a short period of time (~24 hours). Thus, the predicted level of consequence to marine turtles from a 250 m^3 MDO spill is assessed as minor as consequences will be short-term (days to weeks), recoverable and affect a small portion of the marine turtle population the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.10 Marine Mammals

Marine Mammals	
Sensitivity Rating	Medium
Predicted Level of Risk	Medium
Environmental Planning Area Existing Environment	

The PMST Report for the Environmental Planning Area (Appendix B5) identified the following for marine mammals:

Three species (Blue, Fin and Sei whales) with foraging, feeding or related behaviour known to occur within area.

Pygmy blue whale foraging (annual high use area) BIA and known foraging area BIA.

Southern Right Whale breeding known to occur within area.

Australian Fur-seal breeding known to occur within area.

New Zealand Fur-seal and Australian Sea-lion may occur in the area.

Six dolphin species likely or may occur in the area.

23 whale species likely or may occur in the area.

In addition, the Environmental Planning Area overlaps the Southern Right Whale BIAs for reproduction and migration.

More information is provided on those species undertaking biologically important behaviour within the Environmental Planning Area.

Australian Fur-seal

Australian fur-seals (*Arctocephalus pusillus*) breed on islands of the Bass Strait but range throughout waters off the coasts of South Australia, Tasmania, Victoria and NSW. Numbers of this species are believed to be increasing as the population recovers from historic hunting (Hofmeyr et al. 2008). The species is endemic to south-eastern Australian waters.

In Victorian waters they breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland. In Tasmanian waters they breed on Reid Rocks. There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. Their preferred breeding habitat is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

Haul out sites with occasional pup births are located at Cape Bridgewater, at Moonlight Head, on various small islands off Wilsons Promontory and Marengo Reef near Apollo Bay. Australian fur-seals are present in the region all year, with breeding taking place during November and December.

Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between

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feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al. 2008, Hume et al. 2004, Arnould & Kirkwood 2007). Lady Julia Percy Island and Reid Rocks are within the Environmental Planning Area as is the haul out area at Cape Bridgewater. Blue whale The Blue Whale (*Balaenoptera musculus*) is listed as an endangered species under the EPBC Act. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the Pygmy Blue Whale (*B. m. brevicauda*) and the Antarctic Blue Whale (*B. m. intermedia*). The Otway region, where the Operational Area is located, is an important migratory and foraging area for Blue Whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov 2012, McCauley et al. 2018, Gill et al. 2011). Underwater acoustic monitoring programs have detected Antarctic and Pygmy Blue Whale calls in the Otway Region (McCauley et al. 2018). Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015c). Pygmy Blue Whales then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015). The Blue Whale was extremely abundant until the early 20th century when they were hunted to near extinction. Approximately 341,830 Blue Whale takes were recorded by commercial whaling in the Antarctic and sub-Antarctic in the 20th century, of which 12,618 were identified as Pygmy Blue Whales (Branch et al. 2004). The current global population of Blue Whales is uncertain but is plausibly in the range of 10,000 to 25,000, corresponding to about 3-11% of the 1911 estimated population size (Reilly et al. 2008). The Environmental Planning Area is within the foraging (annual high use) and known foraging area BIA where blue whales predominately occur between January to April (DoE 2015) (Appendix B12 MAP-REG-EPM-068). Fin whale The Fin Whale is a cosmopolitan migratory species that is listed as vulnerable and occurs from polar to tropical waters but is rarely sighted in inshore waters. Fin Whales show well defined migratory movements between polar, temperate and tropical waters which are essentially north–south with little longitudinal dispersion. While Australian Antarctic waters are important feeding grounds for Fin Whales, the species also feeds in the Bonney Upwelling during summer/autumn sometimes in the company of Blue and Sei Whales (DCCEEW 2023b). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat with the species feeding on planktonic crustacea, krill, some fish, and cephalopods (DCCEEW 2023b). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed. There are no BIAs for the Fin Whale within Australian waters. Fin Whales are likely to be foraging in the Environmental Planning Area at similar time as Blue Whales, predominately occur between January to April. Sei Whale The Sei Whale is listed as vulnerable under the EPBC Act. Sei Whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. Sei Whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for Sei Whales in Australian waters. In Australia, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978, Bannister et al. 1996, Thiele et al. 2000, Chatto and Warneke 2000, Bannister 2008).

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Sightings of Sei Whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al. 2012), where opportunistic feeding has been observed between November and May (Gill et al. 2015). There are no BIAs for the Sei Whale within Australian waters. Sei Whales are likely to be foraging in the Environmental Planning Area at similar time as Blue Whales, predominately occur between January to April. Southern Right Whale The Southern Right Whale (*Eubalaena australis*) is listed as endangered under the EPBC Act. Southern Right Whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al. 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because Southern Right Whales have a slow rate of increase (7% per annum) compared to other marine mammals, their numbers remain low (IWC 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia, and New Zealand. Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996, DCCEEW 2022). They are distributed across thirteen primary aggregation areas along the southern coast of Australia. In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012). The peak period for Southern Right Whale mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. Calving females are known to have high site fidelity and a 3 to 4-year calving interval. Other population classes stay for shorter and variable periods undertaking coastal movements and departing the coast earlier than female-calf pairs (CoA 2012). The Environmental Planning Area overlaps the Southern Right Whale reproduction and migration BIAs (Appendix B12 MAP-REG-EPM-069).
Predicted Level of Risk
Marine mammals may be exposed to the chemicals in oil through: • Internal exposure by consuming oil or contaminated prey. • Inhaling volatile oil compounds when surfacing to breathe. • Dermal contact, by swimming in oil and having oil directly on the skin and body (NRDA 2012, Hook et al. 2016). The effects of this exposure include: • Maternal transfer of contaminants to embryos. • Hypothermia due to conductance changes in skin, resulting in metabolic shock (expected to be more problematic for non-cetaceans in colder waters). • Toxic effects and secondary organ dysfunction due to ingestion of oil. • Congested lungs. • Damaged airways. • Interstitial emphysema due to inhalation of oil droplets and vapour.

Marine Mammals
• Gastrointestinal ulceration and haemorrhaging due to ingestion of oil during grooming and feeding. • Eye and skin lesions from continuous exposure to oil. • Decreased body mass due to restricted diet. • Stress due to oil exposure and behavioural changes. Whales and Dolphins French-McCay (2009) identifies that a 10–25 µm oil thickness threshold has the potential to impart a lethal dose on marine species, however, they also estimate a probability of 0.1% mortality to cetaceans if they encounter these thresholds based on the proportion of the time spent at surface. Direct surface oil contact with hydrocarbons is considered to have little deleterious effect on whales, possibly due to the skin's effectiveness as a barrier to toxicity, as such effect of oil on cetacean skin is probably minor and temporary (Geraci & St Aubin 1988). Cetaceans in particular have mostly smooth skins with limited areas of pelage (hair covered skin) or rough surfaces such as barnacled skin. Oil tends to adhere to rough surfaces, hair, or calluses of animals, so contact with hydrocarbons by cetaceans is expected to cause only minor hydrocarbon adherence. The physical impacts from ingested hydrocarbon with subsequent lethal or sub-lethal impacts are both applicable to entrained oil. However, the susceptibility of cetaceans varies with feeding habits. Baleen whales (such as blue, fin, humpback and sei whales) are not particularly susceptible to ingestion of oil in the water column but are susceptible to oil at the sea surface as they feed by skimming the surface. Oil may stick to the baleen while they 'filter feed' near slicks. Sticky, tar-like residues are particularly likely to foul the baleen plates. The inhalation of oil droplets, vapours and fumes is a distinct possibility if whales surface in slicks to breathe. Exposure to hydrocarbons in this way could damage mucous membranes, damage airways, or even cause death. Toothed whales and dolphins may be susceptible to ingestion of dissolved and entrained oil as they gulp feed at depth. There are reports of declines in the health of individual pods of killer whales (a toothed whale species), though not the population as a whole, in Prince William Sound after the Exxon Valdez vessel spill (heavy oil) (Hook et al. 2016). It has been stated that pelagic species will avoid hydrocarbon, mainly because of its noxious odours, but this has not been proven. The strong attraction to specific areas for breeding or feeding (e.g., use of the Warrnambool coastline as a nursery area for southern right whales) may override any tendency for cetaceans to avoid the noxious presence of hydrocarbons. So weathered or tar-like oil residues can still present a problem by fouling baleen whales feeding systems. Dolphin populations from Barataria Bay, Louisiana, USA, which were exposed to prolonged and continuous oiling from the Macondo oil spill in 2010, had higher incidences of lung and kidney disease than those in the other urbanised environments (Hook et al. 2016). The spill may have also contributed to unusually high perinatal mortality in bottlenose dolphins (Hook et al. 2016). There is the potential for the survey to occur when blue, fin and sei whales are foraging in the areas If present, these species may be exposed to oil externally and via ingestion whilst feeding. If large quantities of zooplankton exposed to the spill were ingested, chronic toxicity impacts may occur. However, as oil exposure above low thresholds will only occur within a small area at the spill source and for ~24 hours biological consequences of physical contact with localised areas of low concentrations of hydrocarbons are unlikely to lead to any long-term population impacts, with temporary skin irritation and very light fouling/matting of baleen plates likely to occur. Southern Right Whales may also be present in the area of oil exposure and they and their calves could be exposed to oil. However, as oil exposure above low thresholds will only occur within a small area at the spill source and for ~ 24 hours biological consequences of physical contact with localised areas of low concentrations of hydrocarbons are unlikely to lead to any long-term population impacts. It is unlikely that highly mobile and transient species that are not undertaking biologically important behaviour would be affected by exposure to oil within the relatively small area of the Environmental Planning Area and that oil exposure above low thresholds will only occur within a small area at the spill source.

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The predicted levels of consequence to whales and dolphins from a 250 m3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur to whales undertaking biologically important behaviours (feeding, reproduction), though if consequences occurred, they are likely to only affect a small portion of the population due to the low spill volume and short duration of any exposure the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium. Pinnipeds Pinnipeds are vulnerable to sea surface exposures given they spend much of their time on or near the surface of the water as they need to surface every few minutes to breathe and regularly haul out on to beaches. Pinnipeds are also sensitive as they will stay near established colonies and haul-out areas, meaning they are less likely to practice avoidance behaviours. This is corroborated by Geraci & St. Aubin (1988) who suggest seals, sea- lions and fur-seals have been observed swimming in oil slicks during a number of documented spills. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. As a result of exposure to surface oils, pinnipeds, with their relatively large, protruding eyes are particularly vulnerable to effects such as irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Hook et al (2016) reports that seals appear not to be very sensitive to contact with oil, but instead to the toxic impacts from the inhalation of volatile components. For some pinnipeds, fur is an effective thermal barrier because it traps air and repels water. Petroleum stuck to fur reduces its insulative value by removing natural oils that waterproof the pelage. Consequently, the rate of heat transfer through fur seal pelts can double after oiling (Geraci & St. Aubin 1988), adding an energetic burden to the animal. Kooyman et al (1976) suggest that in fact, fouling of approximately one-third of the body surface resulted in 50% greater heat loss in fur seals immersed in water at various temperatures. Fur-seals are particularly vulnerable due to the likelihood of oil adhering to fur. Heavy oil coating and tar deposits on fur-seals may result in reduced swimming ability and lack of mobility out of the water. Davis and Anderson (1976) observed two Gray Seal pups drowning, their "flippers stuck to the sides of their bodies such that they were unable to swim". However, pinnipeds other than Fur-seals are less threatened by thermal effects of fouling, if at all. Oil has no effect on the relatively poor insulative capacity of sea-lion and bearded and ringed seal pelts; oiled Weddell seal samples show some increase in conductance (Oritsland 1975, Kooyman et al. 1976, 1977). ITOPF (2011) documents impacts on species that rely on fur to regulate their body temperature (such as fur-seals), demonstrating these species are most vulnerable to oil as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil. It is reported that most pinnipeds scratch themselves vigorously with their flippers and do not lick or groom themselves, so are less likely to ingest oil from skin surfaces (Geraci & St. Aubin 1988). However, mothers trying to clean an oiled pup may ingest oil. All pinnipeds examined to date have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt 1982, Addison and Brodie 1984, Addison et al. 1986). Ingested hydrocarbons can irritate or destroy epithelial cells that line the stomach and intestine, thereby affecting motility, digestion and absorption. However, pinnipeds have been found to have the enzyme systems necessary to convert absorbed hydrocarbons into polar metabolites, which can be excreted in urine (Engelhardt 1982, Addison & Brodie 1984, Addison et al. 1986). Geraci & St. Aubin (1988) suggest that a small phocid weighing 50 kg might have to ingest approximately 1 litre of oil to be at risk. Volkman et al (1994) report that benzene and naphthalene ingested by seals is quickly absorbed into the blood through the gut, causing acute stress, with damage to the liver considered likely. If ingested in large volumes, hydrocarbon, may not be completely metabolised, which may result in death. Breeding colonies (used to birth and nurse until pups are weaned) are particularly sensitive to hydrocarbon spills (Higgins & Gass 1993). Pinnipeds also appear to rely on scent to establish a motherpup bond (Sandegren 1970, Fogden 1971), and consequently oil-coated pups may not be recognisable to their mothers. This is only theorised, with studies and research indicating interaction between mothers and oiled pups were normal (Davis and Anderson 1976, Davies 1949, Shaughnessy & Chapman 1984).

Marine Mammals
The long-term Environmental Impact and Recovery report for the Iron Barren oil spill (in Tasmania, 1995) concluded that "The number of seal pups born at Tenth Island in 1995 was reduced when compared to previous years. There was a strong relationship between the productivity of the seal colonies and the proximity of the islands to the oil spill wherein the islands close to the spill showed reduced pup production and those islands more distant to the oil spill did not" (Tasmanian SMPC 1999). Australian sea-lions have 'naturally poor recovery abilities' due to 'unusual reproductive biology and life history' (TSSC 2005). Due to the extreme philopatry of females and limited dispersal of males between breeding colonies, the removal of only a few individuals annually may increase the likelihood of decline and potentially lead to the extinction of some of the smaller colonies. Extinction of breeding colonies has the potential to further reduce genetic diversity and the already limited genetic flow between colonies. This, in turn, may weaken the genetic resilience of the species and impact on its ability to cope with other natural or anthropogenic impacts. In addition, the extreme philopatry of females suggests that extinction of breeding colonies may lead to a contraction of the range of the species as re-colonisation of breeding sites via immigration is limited. For the reasons outlined above, small breeding colonies are under particular pressure of survival from even low levels of anthropogenic mortality. As highly mobile species, in general it is very unlikely that marine mammals will be constantly exposed to concentrations of hydrocarbons in the water column for continuous durations (e.g., >96 hours) that would lead to chronic toxicity effects. There is the potential for Lady Julia Percy Island and Cape Bridgewater to be exposed to oil above the low threshold levels, though unlikely for Reid Rocks due to the distance from the Operational Area. Thus, seals at Lady Julia Percy Island and Cape Bridgewater could be exposed to oil at levels that could result in some level of impact. As diesel is a light fuel and readily evaporates matting and heavy coating of fur is not predicted. Impacts from inhalation of vapours is more likely as the diesel evaporates resulting in irritations to mucous membranes. Ingestion and tainting of prey are less likely as pinnipeds have large foraging ranges and are less likely to be exposed to oil above low thresholds in the water column. The predicted level of consequence to pinnipeds from a 250 m3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur to breeding and haul out locations, though if consequences occurred, they are likely to only affect a small portion of the population due to the low spill volume and short duration of any exposure the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.11 Coastal Developments

Coastal Developments	
Sensitivity Rating	**High**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	

Local government areas within the Environmental Planning Area are detailed below.

Victoria

Mornington Peninsula Shire

Mornington Peninsula Shire coastal areas within the environmental planning area are St Andrews Beach, Rye, Blairgowrie, Sorrento, and Portsea. These towns are popular tourist areas with a variety of beaches and tourist attractions. The area was originally home to the Mayone-bulluk and Boonwurrung-Balluk clans and formed part of the Boonwurrung nation's territory prior to European settlement.

Greater Geelong City

Greater Geelong City coastal areas within the environmental planning area are St Leonards, Swan Bay, Point Lonsdale, Ocean Grove, Barwon Heads, Connewarre, and Breamlea. The largest of these towns is Ocean Grove with a population of 14,714 (ABS 2021). These towns are popular tourist areas with a variety of beaches and access to Port Phillip Bay.

Surf Coast Shore

Within the environmental planning area are the world-famous surfing beaches Bells Beach and Torquay Beach. In addition, the Great Ocean Road follows the coast from Anglesea past Lorne.

Colac Otway Shire

Within the environmental planning area, the Great Ocean Road follows the coast past Apollo Bay and then goes inland at Marengo. The Great Otway National Park coastal areas, including the Aire River outlet, which is a popular campaign area, are within the environmental planning area. The Apollo Bay Port is home to a local fishing industry and commercial fleet which employs more than 70 people and boasts 16 boats, including trawlers, crayfish, and charter boats (Colac Otway Shire 2023).

Corangamite Shire

The main Corangamite Shire coastal areas within the environmental planning area are Princetown and Port Campbell. The Great Ocean Road follows the coast within the shire and the Twelve Apostles Marine National Park abouts the coastal area. Port Campbell is one of the main ports for the Eastern Zone Rock Lobster Fishery (VFA 2023).

Moyne Shire

The main Corangamite Shire coastal areas within the environmental planning area are Peterborough, Warrnambool, and Port Fairy. The three towns are on the Great Ocean Road and are popular tourist areas for sightseeing, beaches and whale watching.

Coastal Developments
Glenelg Shire Within the Glenelg Shire the main coastal town is Portland which is the oldest European settlement in Victoria. In 2021, the population was 10,016 (ABS 2021). The Great South West Walk, a 250 km walking track, begins in Portland. Portland has become known as 'Tuna Town' because of its reliable tuna fishing and the importance of the species to the tourist economy (VFA 2023a). Portland harbour exists for commercial boats and ships that support export industries and doubles as a first-class boating facility. South Australia *District Council of Grant* The area along the South Australian coast of the environmental planning area is known as the limestone coast. The main town is Port MacDonnell, originally known as *Ngaranga,* which is the southernmost town in South Australia. The area was originally inhabited by the Bungandidj Aboriginal people. The 2021 Census reports that the locality of Port MacDonnell had a population of 859 (ABS 2021). Once a busy shipping port, the town now relies heavily on its fishing and summer tourism industries, particularly rock lobster harvest industry, proclaiming itself "Australia's Southern Rock Lobster Capital". Tasmania *King Island Council* King Island is at the western entrance to Bass Strait and is 64 km long by 27 km wide. The 2021 Census reports that the King Island had a population of 1,617 (ABS 2021). King Island was originally part of a land bridge linking Tasmania with the Australian mainland, which was submerged around 12,000 years ago due to rising sea levels. A human skeleton was discovered in a cave on the island in 1989, which was dated to approximately 14,000 years ago. However, previous examinations had revealed no "shell heaps, bones, charcoal or other remains which might indicate Aboriginal occupation", suggesting that the area was passed through by the ancestors of Aboriginal Tasmanians but not permanently inhabited (Sim 1990). The island is a popular tourist location and produces cheese, lobsters, kelp, and beef.
Predicted Level of Risk
Due to the distance to the South Australian and King Island coastal areas from the Operational Area (~130 km and ~ 70 km respectively) impacts to coastal areas above the low thresholds are not predicted. As the Operational Area is as close as ~7 km to the Victorian coast, there is the potential for diesel above the low threshold to be visible on the ocean surface in coastal waters and as a sheen on shoreline areas. Most of the diesel will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible. Visible nearshore and shoreline hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities this can have a knock-on effect to local businesses if beaches are required to be closed to allow for the clean-up of any oil. Due to the low volumes, light nature of marine diesel and substantial wave action with the nearshore area's impacts are likely to be short term and not require intrusive clean-up response. The predicted level of consequence to coastal developments from a 250 m^3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur areas nearshore of the Operational Area, though if consequences occurred, they are likely to only affect a small portion of the coastal area for a short duration (hours to days) due to the low spill volume and short duration of any exposure, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.12 Indigenous Culture

Indigenous Culture	
Sensitivity Rating	**High**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	
The information provided below has been sourced from publicly available information and from consultation undertaken in preparing the EP. The Environmental Planning Area overlaps King Island which was part of a land bridge linking Tasmania with the Australian Mainland and was submerged around 12,000 years ago with rising sea levels. While uninhabited at the time of European discovery by Captain Reed in 1799 the first Tasmanians were a very mobile people, especially by water. They had a wide-ranging territory, travelling in season for hunting, gathering and ceremonial purposes. They built and used several different types of seaworthy boats and research suggests that they passed through but did not permanently inhabit King Island (KIC 2023). The Environmental Planning Area overlaps with the following Registered Aboriginal parties in Victoria: Gunditjmirring Eastern Maar Wathaurung There are many landscapes within Gunditjmara Country – *Nyamat Mirring* (Sea Country), *Tungatt Mirring* (Stone Country), *Bocara Mirring* (River Country) and *Woorrowarook Mirring* (Forest Country) – connecting Gunditjmara Traditional Owners to Country through dreaming stories, language, oral histories, cultural law/lore and customs (GMTOAC 2023). Within the Environmental Planning Area, the following have been identified as key values and sensitivities in relation to First Nations. Deen Maar (Lady Julia Percy Island) is of cultural significance where ancestors leave the earth (GMTOAC 2023, Parks Victoria 2015). Eeling remains an important traditional, social, and economic practice among First Nations (EMAC 2015). See Section 6.7. Southern Right Whales (DCCEEW 2022a). See Section 0.	
Predicted Level of Risk	
Due to the distance to the South Australian and King Island coastal areas from the Operational Area (~130 km and ~ 70 km respectively) impacts to coastal areas above the low thresholds are not predicted. As the Operational Area is as close as ~7 km to the Victorian coast, there is the potential for diesel above	

Indigenous Culture
the low threshold to be visible on the ocean surface in coastal waters and as a sheen on shoreline areas. Most of the diesel will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible. Visible nearshore and shoreline hydrocarbons have the potential to reduce the visual amenity of the area but impacts to cultural values are not predicted due to the low volumes, light nature of marine diesel and substantial wave action with the nearshore areas impacts are likely to be short term and not require intrusive clean-up response. The predicted level of consequence to coastal developments from a 250 m^3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur areas nearshore of the Operational Area, though if consequences occurred, they are likely to only affect a small portion of the coastal area for a short duration (hours to days) due to the low spill volume and short duration of any exposure, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.13 Commercial Fisheries

Commercial Fisheries	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	

The Environmental Planning Area overlaps the following fisheries that have catch effort. A description of these fisheries is provided in the Regia MSS Commercial Fishery Review in Appendix B6.

Commonwealth:

- Bass Strait Central Zone Scallop Fishery
- Eastern Tuna and Billfish Fishery
- Small Pelagic Fishery (Western sub-area)
- Southern and Eastern Scalefish and Shark (SESS) Fishery SESSF following sectors:
  - Shark Gillnet and Hook
  - Scalefish Hook
  - Trawl – otter board
- Southern Squid Jig Fishery
- Western Tuna and Billfish Fishery

Victorian:

- Abalone
- Giant Crab
- Multi-species Ocean
- Octopus
- Rock Lobster
- Wrasse

Tasmanian:

Commercial Fisheries
• Abalone • Giant Crab • Octopus • Rock Lobster South Australian: • Abalone • Charter Boat • Giant Crab • Marine Scalefish Fishery • Rock Lobster
Predicted Level of Risk
Commercial fishing has the potential to be impacted through exclusion zones associated with the spill, the spill response and subsequent reduction in fishing effort. Exclusion zones may impede access to commercial fishing areas, for a short period of time, and nets and lines may become oiled. The impacts to commercial fishing from a public perception, however, may be much more significant and longer term than the spill itself. Fishing areas may be closed for fishing for shorter or longer periods because of the risks of the catch being tainted by oil. Concentrations of petroleum contaminants in fish and crustacean and mollusc tissues could pose a significant potential for adverse human health effects, and until these products have been cleared by the health authorities, they could be restricted for sale and human consumption. Toxicity in adult fish has been reported in response to crude oils, HFO and diesel (Holdway 2002, Shigenaka 2011). Uptake of hydrocarbons has been demonstrated in bony fish after exposure to water-accommodated fraction hydrocarbons of between 24 and 48 hours. Davis et al (2002) report detectable tainting of fish flesh after a 24-hour exposure at crude concentrations of 0.1 ppm, marine fuel oil concentrations of 0.33 ppm and diesel concentrations of 0.25 ppm. The majority of studies, either from laboratory trials or of fish collected after spill events (including the Hebei Spirit, Macondo, and Sea Empress) find evidence of elimination of PAHs in fish tissues returning to reference levels within two months of exposure (Challenger and Mauseth 2011, Davis et al. 2002, Gagnon & Rawson 2011, Gohlke et al. 2011, Jung 2011, Law 1997, Rawson et al. 2011). Should there be impacts to fish stocks associated with impacts to plankton life phase there is the potential for reduction in profits for commercial fisheries over a longer period of time, and potential for reduced fishing quotas or exclusion zones exclude fishing effort, associated with sustainable fisheries management. The Montara spill of a light gas condensate, (as the most recent [2009] example of a large hydrocarbon spill in Australian waters) occurred over an area fished by the Northern Demersal Scalefish Managed Fishery (with 11 licences held by 7 operators), with Goldband Snapper, Red Emperor, Saddletail Snapper and Yellow Spotted Rockcod being the key species fished (PTTEP 2013). As a precautionary measure, the WA Department of Fisheries advised the commercial fishing fleet to avoid fishing in oil-affected waters. Testing of fish caught in areas of visible oil slick (November 2009) found that there were no detectable petroleum hydrocarbons in fish muscle samples, suggesting fish were safe for human consumption. In the short-term, fish had metabolised petroleum hydrocarbons. Limited ill effects were detected in a small number of individual fish only (PTTEP 2013). No consistent effects of exposure on fish health could be detected within two weeks following the end of the well release. Follow up sampling in areas affected by the spill during 2010 and 2011 (PTTEP 2013) found negligible ongoing environmental impacts from the spill.

Commercial Fisheries
Similarly, the Macondo well blowout in the Gulf of Mexico (2010), began testing a month after the event showing levels of oil contamination residue in seafood consistently tested 100 to 1,000 times lower than safety thresholds established by the USA FDA, and every sample tested was found to be far below the FDA's safety threshold for dispersant compounds (BP 2015). FDA testing of oysters found oil contamination residues to be 10 to 100 times below safety thresholds (BP 2014). Sampling data shows that post-spill fish populations in the Gulf of Mexico since 2011 were generally consistent with pre-spill ranges and for many shellfish species, commercial landings in the Gulf of Mexico in 2011 were comparable to pre-spill levels. In 2012, shrimp (prawn) and blue crab landings were within 2.0% of 2007-09 landings. In the event of a MDO spill, a temporary fisheries closure may be put in place by the fishing authority or voluntarily by the fishers themselves. A temporary fisheries closure, combined with oil tainting of target species (actual or perceived), may lead to financial losses to fisheries and economic losses for individual licence holders. Fisheries closures and the flow on losses from the lack of income derived from these fisheries are likely to have short-term but potentially widespread socio-economic consequences, such as reduced employment in the fisheries and fisheries service industries, such as tackle and bait supplies, fuel, marine mechanical services, accommodation and so forth. Oiling of fishing vessel hull and fishing equipment is not predicted given the light nature of MDO and that surface oil is predicted to have evaporated or entrained with 24 hours. A spill event may result in a short-term fishing exclusion zone (days to weeks) being implemented by the appropriate fishing authority. Areas of moderate dissolved and high entrained exposure thresholds are expected to be very small as MDO is predicted to weather quickly and the area would return to pre-spill conditions rapidly. MDO is not predicted to accumulate among benthic sediments due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column, as such reducing impacts to habitats in 10 m depth, which are likely slower to recover. The predicted level of consequence to commercial fisheries from a 250 m^3 MDO spill is assessed as moderate as consequences could be longer lasting (> 30 days) if fishery closures and public perception of fishing tainting occur, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

6.14 Seaweed Industry

Seaweed Industry	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
The Australian seaweed industry is small: currently valued at an estimated GVP of AUD $3 million. Of this, the majority is from one company, Kelp Industries Pty Ltd on King Island in Tasmania, who hand collect plants cast bull kelp (*Durvillea pototorum*) on the beaches from predominantly the west coast of the island, predominantly for export to a large alginate manufacturer and for use in biofertiliser products (Australian Seaweed Institute 2023). Australia Bureau of Statistics (ABS) data shows seaweed exports from Australia are valued at $1.5 million for non-human consumption and it is assumed that this is almost entirely from Kelp Industries exports. Besides Kelp Industries, other seaweed collectors in Tasmania include Kelpomix and TasKelp. There are also licenses for wild harvest of the invasive species of *Undaria* in Tasmania (KaiHo Ocean Treasure) and some in Victoria (Australian Seaweed Institute 2023). The harvesting of native seaweed in Victorian marine waters is prohibited without a permit (s. 112(2) Fisheries Act 1995) and licences enabling seaweed aquaculture are not currently available in Victoria (VFA 2023b). While there are numerous research projects taking place or being planned, currently there are two projects in Tasmania (Australian Seaweed Institute 2023). The first, is a CRC-P project involving collaboration with Tassal, Spring Bay Seafoods and University of Tasmania (UTAS). This project aims to demonstrate the benefits of Kelps as part of an integrated multitrophic aquaculture approach. The second is a research collaboration between UTAS and Huon Aquaculture in Storm Bay that will also yield its first harvest in late 2020. The west coast of King Island where bull kelp is collected is within the Environmental Planning Area.	
Predicted Level of Risk	
Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – north America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. The study did not look at how this would affect the productivity of bull kelp. Bull kelp affect by oil would not be suitable for collection and processing which could result in a temporary closure to the industry and a perception of tainting of product. This could lead to financial losses to kelp collection and processing businesses. However, given the distance to King Island from the Operational Area oil exposure above low threshold levels are not predicted and thus impacts are unlikely to be a significant to seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate. Thus, the predicted level of consequence to seaweed industries from a 250 m^3 MDO spill is assessed as minor as exposure is likely to be below low thresholds and any consequences would be short-term (days to weeks), recoverable and affect a small portion of bull kelp, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.	

6.15 Marine Industries

Marine Industry	
Sensitivity Rating	**Medium**
Predicted Level of Risk	**Low**
Environmental Planning Area Existing Environment	
Marine industries identified within the Environmental Planning Area are: Defence A defence practice area is located within the Environmental Planning Area. There is also a number of potential unexploded ordnance areas, however, these are not predicted to be impacted by oil exposure and is not assessed further. Desalination Plant The Victorian Desalination Plant, located at Wonthaggi, is outside of the Environmental Planning Area. Offshore Energy Within the Environmental Planning Area there is the Beach Energy Otway Development consisting of subsea infrastructure and an unmanned platform and the Cooper Energy Casino Henry Netherby Development consisting of subsea infrastructure. During the Regia MSS design envelope (1 November 2023 to 31 October 2028) there is the potential for exploration and development activities such as infrastructure inspection, maintenance and repairs campaigns, seabed surveys, seismic surveys, drilling and infrastructure installation to be undertaken with vessels and drill rigs to support the ongoing energy supply of oil and gas and potentially renewables within the Otway Basin. Shipping The South East Marine Region is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania. Ports Australia provide statistics for port operations throughout Australia's main commercial ports. Based on the latest information (2021) the majority of commercial shipping traffic transiting to and from Victorian ports were container (3,682), general cargo (2,663), bulk liquid carriers (2,019), dry bulk (1,715), car carrier (1,342), bulk gas (220), other cargo (47) and livestock (9). Submarine cables INDIGO-Central submarine cable which at a depths greater than 100 m is not predicted to be affected by oil exposure and is not assessed further.	
Predicted Level of Risk	
Marine industries have the potential to be impacted through exclusion zones associated with the spill and the spill response. Exclusion zones may impede access to shipping lanes, defence practice areas and offshore energy infrastructure, for a short period of time. Oiling of vessel hulls or the Thylacine-A platform is not predicted given the light nature of MDO and that surface oil is predicted to have evaporated or entrained with 24 hours.	

Marine Industry
Thus, the predicted level of consequence to seaweed industries from a 250 m^3 MDO spill is assessed as minor as exposure is likely to be below low thresholds and any consequences would be short-term (days to weeks), recoverable and affect a small portion of marine industries, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of low.

6.16 Tourism including Diving and Recreational Fishing

Tourism including Diving and Recreational Fishing	
Sensitivity Rating	**High**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	
The coastal areas of the Environmental Planning Area offer a wide and diverse range for marine based tourism and recreational activities, including snorkelling, scuba diving, surfing, kayaking, whale, and wildlife watching, sailing and charter boat cruises. Popular tourist destinations in the Environmental Planning Area include Portland, Port Fairy, Warrnambool, the Great Ocean Road, Great Otway National Park, and King Island. The west coast of Victoria from Warrnambool to Portland is known as reliable spots to catch tuna, kingfish, and trevalla in areas such as Lawrence Rock, the North Shore, Lady Julia Percy Island, Killarney, The Crags, Minerva Reef, Julia Reef and the Horseshoe off Cape Bridgewater (VFA 2023a). May, June, and July are reliable months to find schools of bluefin tuna (VFA 2023c). The Arches Marine Sanctuary and Twelve Apostles Marine National are well known locally for excellent scuba diving sites (Parks Victoria 2006) Seal and Dolphin watching occur within Discovery Bay Marine National Park and Deen Maar (Lady Julia Percy Island).	
Predicted Level of Risk	
Due to the distance to the South Australian and King Island coastal areas from the Operational Area (~130 km and ~ 70 km respectively) impacts to coastal areas above the low thresholds are not predicted. As the Operational Area is as close as ~7 km to the Victorian coast, there is the potential for diesel above the low threshold to be visible on the ocean surface in coastal waters and as a sheen on shoreline areas. Most of the diesel will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible. Visible nearshore and shoreline hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. Due to the low volumes, light nature of marine diesel and substantial wave action with the nearshore areas impacts are likely to be short term and not require intrusive clean-up response. The predicted level of consequence to tourism and recreation from a 250 m^3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur in areas nearshore of the Operational, though if consequences occurred, they are likely to only affect a small portion of the coastal area for a short duration (hours to days) due to the low spill volume and short duration of any exposure, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.	

6.17 Protected Areas

Protected Areas	
Sensitivity Rating	**High**
Predicted Level of Risk	**Medium**
Environmental Planning Area Existing Environment	

There are no World Heritage Areas within the Environmental Planning Area.

The PMST Report for the Environmental Planning Area (Appendix B5) identified the following for protected areas.

National Heritage Places

Two places of National Heritage were identified in the Environmental Planning Area:

Great Ocean Road and Scenic Environs

Point Nepean Defence Sites and Quarantine Station Area

The Point Nepean Defence Sites and Quarantine Station Area is above the shoreline and hence would not be directly affected by oil. It is on the bay side of the Mornington Peninsula which is not predicted to be impacted by a spill.

The Great Ocean Road and Scenic Environs is above the shoreline and hence would not be directly affected by oil. However, the scenic environs could be impacts by surface or shoreline oil.

The Australian Heritage Council found the Great Ocean Road and its scenic environs road from Torquay to Allansford, a journey of 242 kms, as a place of outstanding national heritage significance. Constructed by workers, including more than 3000 returned servicemen, as a memorial to First World War servicemen, the Great Ocean Road is a significant reminder of the participation of Australian servicemen in the First World War, the Australian community's appreciation of their service, and the support provided for the welfare of servicemen and women upon returning to Australia.

The scenic environs include all views from the Great Ocean Road and Great Ocean Walk, including the Twelve Apostles, the Bay of Islands and Bay of Martyrs. The coastline from Lorne to Kennett River is among the world's most dramatic cliff and ocean scenery able to be viewed from a vehicle.

Along the length of the Great Ocean Road, the pullover points and lookouts beside or nearby the road provide travellers with spectacular views of the coastline, hinterland, and Bass Strait seascape, framed only by cliffs, lighthouses and unencumbered by intrusive built structures. The place is also listed for its; outstanding rocky coastline, dinosaur fossil sites, geomorphological monitoring sites, its association with the pioneering landscape architect Edna Walling, and for the significance of Bells Beach to surfing.

Commonwealth Heritage Places

Six places of National Heritage were identified in the Environmental Planning Area

Cape Northumberland Lighthouse SA (Historic, Listed place)

Cape Wickham Lighthouse TAS (Historic, Listed place)

Protected Areas
Fort Queenscliff VIC (Historic, Listed place)
Sorrento Post Office VIC (Historic, Listed place)
Swan Island Defence Precinct VIC (Historic, Listed place)
Swan Island and Naval Waters VIC (Natural, Listed place)
Only the Swan Island and Naval Waters includes coastal areas within the Environmental Planning Area and is described.
Swan Island is the largest emergent sand accumulation feature in Port Phillip Bay. The island, which has been built principally by wave actions rather than by aeolian forces, has played a major role in determining the pattern of sedimentation in Swan Bay and preserves geomorphological evidence of changing Quaternary sea levels. The eastern and northern shores of the eastern arm of Swan Island are of regional significance as an example of active coastal depositional and erosional processes (DCCEEW 2023c).
Swan Island and adjacent naval waters provide important habitat for 46 water bird species, of which 26 species are listed under the Japan-Australia and China-Australia migratory bird agreements, and 8 species are listed under the Bonn Convention on Migratory Species (DCCEEW 2023c). During the migration season Swan Bay supports internationally significant populations of the Eastern Curlew, Ruddy Turnstone, Red-necked Stint, Sharp-tailed Sandpiper, Curlew Sandpiper, and Grey Plover (DCCEEW 2023c). Nationally significant populations of the Greenshank, Pacific Golden Plover, Double-banded Plover, and Lesser Sand Plover also occur (DCCEEW 2023c). Sand Island is the most important high tide roosting area in Swan Bay and at high tide regularly supports half of the shorebirds in the Swan Bay - Mud Islands complex.
Ramsar Wetlands
Four Ramsar Wetlands were identified in the Environmental Planning Area.
Glenelg Estuary and Discovery Bay
Key features of the site (DCCEEW 2023d):
The Glenelg Estuary and Discovery Bay Ramsar Site is situated in western Victoria. It covers approximately 22,289 hectares and comprises portions of the Lower Glenelg National Park, the Discovery Bay Coastal Park and the Nelson Streamside Reserve. The Glenelg River estuary is the longest in the bioregion, extending 75 kilometres. The Ramsar site comprises three broad systems that support different wetland types: freshwater wetlands, the Glenelg Estuary and the beach and dune system. The site contains several regionally (and internationally) rare wetland types: intact fen peatlands and a humid dune slack system.
The site:
Supports the nationally vulnerable coastal saltmarsh ecological community and eight nationally / internationally listed threatened flora and fauna species.
Provides habitat for 95 waterbird species including 24 species listed under international agreements. Beach nesting birds such as Hooded Plover (Thinornis rubricollis) and Red-capped Plover (Charadrius ruficapillus) are regularly recorded nesting on the dunes of the Discovery Bay Coastal Park.
Supports 14 species of native fish which are diadromous, migrating between habitats for part of their lifecycle by providing food, spawning grounds and nurseries. It also acts as a migration path on which diadromous fishes of the region depend.
Provides habitat for obligate aquatic species in the permanent wetlands of the Long Swamp complex and Bridgewater Lakes when the surrounding landscape is dry and during drought conditions.
Supports > 1% of the population of the wetland dependent invertebrate species the Ancient Greenling (Hemiphlebia mirabilis) in the Baumea sedgelands.

Protected Areas
The area is popular for recreational and tourism activities, including sightseeing, walking, camping, and recreational fishing. Importantly, the Gunditjmara Indigenous people have a living association with the Ramsar site, which has great cultural significance for them, as it is part of their Koonang (sea) and Bocara Woorrowarook (river forest) country. Lavinia Key features of the site (DCCEEW 2023e): The Lavinia Ramsar site is located on the north-east coast of King Island, Tasmania. The boundary of the site forms the Lavinia State Reserve, with major wetlands in the reserve including the Sea Elephant River estuary area, Lake Martha Lavinia, Penny's Lagoon, and the Nook Swamps. The shifting sands of the Sea Elephant River's mouth have caused a large back-up of brackish water in the site, creating the saltmarsh which extends up to five kilometres inland. The present landscape is the result of several distinct periods of dune formation. The extensive Nook Swamps, which run roughly parallel to the coast, occupy a flat depression between the newer parallel dunes to the east of the site and the older dunes further inland. Water flows into the wetlands from the catchment through surface channels and groundwater and leaves mainly from the bar at the mouth of the Sea Elephant River and seepage through the young dune systems emerging as beach springs. The Lavinia State Reserve is one of the few largely unaltered areas of the island and contains much of the remaining native vegetation on King Island. The vegetation communities present on the site include Succulent Saline Herbland, Coastal Grass and Herbfield, Coastal Scrub and King Island Eucalyptus globulus Woodland. The freshwater areas of the Nook Swamps are dominated by swamp forest. Nook Swamps and the surrounding wetlands contain extensive peatlands. The site is an important refuge for a collection of regional and nationally threatened species, including the nationally endangered Orange-bellied Parrot. This parrot is heavily dependent upon the samphire plant, which occurs in the saltmarsh, for food during migration. They also roost at night in the trees and scrub surrounding the Sea Elephant River estuary. Several species of birds which use the reserve are rarely observed on the Tasmanian mainland, including the Dusky Moorhen, Nankeen Kestrel, Rufous Night Heron and the Golden-headed Cisticola. The site is currently used for conservation and recreation, including boating, fishing, camping and off-road driving. There are artefacts of Indigenous Australian occupation on King Island that date back to the last ice age when the island was connected to Tasmania and mainland Australia via the Bassian Plains. Piccaninnie Ponds Karst Key features of the site (DCCEEW 2023f): The Piccaninnie Ponds Karst Wetlands Ramsar Site is located in south-east South Australia, near Mount Gambier. It is an exceptional example of karst spring wetlands, with the largest and deepest of the springs reaching a depth of more than 110 m. The majority of the water comes from an unconfined regional aquifer and is consistently 14-15 degrees Celsius. The karst springs support unique macrophyte and algal associations, with macrophyte growth extending to 15 m below the surface as a result of exceptional water clarity. A number of different wetland types exist on the site, including a large area of peat fens. There are four distinct areas of the Ramsar site. Piccaninnie Ponds (also known as Main Ponds) consists of three interconnected bodies of water - First Pond, The Chasm and Turtle Pond - rounded by an area of shrub dominated swamp. Western Wetland consists of dense closed tea-tree and paperbark shrubland over shallow dark clay on limestone soils. Eastern Wetland includes the spring-fed Hammerhead Pond. Pick Swamp, on the extreme west of the site, includes areas of fen, marshes and sedgelands as well as the spring-fed Crescent Pond on peat soils.

Protected Areas
The system is an important remnant of an extensive system of wetlands that once occupied much of the south-east of South Australia. The major groundwater discharge points are Main Ponds, Hammerhead Pond and Crescent Pond. Water principally leaves the site via Outlet Creek and the Pick Swamp drain outlet, which connect the site to the sea. There are a number of fresh groundwater beach springs located on the site. The geomorphic and hydrological features of the site produce a complex and biologically diverse ecosystem which supports considerable biodiversity, including a significant number of species of national and/or international conservation value. These include the orange-bellied parrot, Australasian bittern and Yarra pygmy perch. The site attracts 20,000 visitors annually for cave diving, snorkelling, bushwalking, educational activities and birdwatching. The site also has spiritual and cultural value. The Traditional Owners of the land, the Bunganditj (Boandik) and local Indigenous people have a strong connection with the site. Traditionally the site provided a good source of food and fresh water, and evidence of previous occupation still exists. Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Key features of the site (DCCEEW 2023g): The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is located in the western portion of Port Phillip Bay, near the city of Geelong in Victoria. The site comprises six distinct areas that include Point Cook/Cheetham, Werribee/Avalon, Point Wilson/Limeburners Bay, Swan Bay, Mud Islands, and the Lake Connewarre Complex. The Ramsar site is a low-lying area and a natural discharge point for the rivers draining southern central Victoria. The tidal amplitude within the bay is reduced compared with Bass Strait due to the narrow opening of the Bay (Port Phillip Heads). Port Phillip Bay (Western Shoreline) and Bellarine Peninsula support a variety of wetland types ranging from shallow marine waters to seasonal freshwater swamps and extensive sewage ponds. Wetland areas include freshwater lakes, estuaries, some with White Mangrove, saltmarshes, intertidal mudflats and seagrass beds. The Ramsar site supports some plants species threatened in Victoria, such as Small Scurf-pea and Rare Bitter-bush. This Ramsar site is the sixth most important area in Australia for migratory waders and the most important in Victoria. Large numbers of bird species including Pied Oystercatchers, Banded Stilts, Red-necked Stint, Sharp-tailed Sandpiper, Fairy Tern, Australasian Shoveler, Red-necked Avocets, Blue-billed Duck, and Freckled Duck, have been recorded at the site. Furthermore, the Melbourne Water Corporation Sewage Farm and Western Treatment Plant at Werribee support many waterbirds on its retention ponds. Port Phillip Bay (Western Shoreline) and Bellarine Peninsula provides important habitat for threatened species such as the Little Tern and Striped Legless Lizard. In particular, large numbers of the nationally threatened Orange-bellied Parrot utilise Port Phillip Bay during the winter after their summer migration to Tasmania to breed. Swan Bay and Limeburners Lagoon are also valuable fish breeding grounds for many of the commercial species caught in Port Phillip Bay. There are a number of important indigenous sites within the wetlands, including burial sites, middens and artefacts, with the oldest midden in the area being at least 5000 years old. Currently over three million people live around Port Phillip Bay, which is used intensively for recreation, nature conservation, sewage treatment, aquaculture, fishing, and salt production. Nationally Important Wetlands Information on Nationally Important Wetlands is from the DCCEEW Directory of Important Wetlands. The following wetlands have a coastal intersect. Aire River and Lower Aire River The Aire River is located in south-western Victoria. The Aire River reach is of high value for its flora and fauna which is of national and state significance, particularly its large continuous stands of cool temperate rainforest. There are fourteen threatened flora species within the Aire reach and its associated corridor of which two are listed nationally.

Protected Areas
There are twenty-seven threatened fauna species within the Aire River reach and its associated corridor of which five are listed nationally. Significant fauna species in the reach are the Cape Barren Goose, Ground Parrot, Rufous Bristlebird, Eastern Barred Bandicoot, and the Australian Grayling. Social values are trout fishing, picnicking, camping, and scenic driving are. Hopetoun Falls Scenic reserve is the most popular area for sight-seeing along the reach. There are approximately eighteen archaeological sites in the area, most of which are Aboriginal shell middens. The area also contains the site of the 1848 Katabanuut Aboriginal massacre. Glenelg River and Estuary The Glenelg River reach begins at Dartmoor, on the southern side of the Grampians National Park, and flows through the Lower Glenelg National Park to the sea at Nelson, near the Discovery Bay Coastal Park. There are 25 threatened flora species found within the Glenelg River reach and its associated corridor of which ten are listed nationally. The river reach provides an important habitat link between the inland woodland environments and coastal environments. There are seventy-two threatened flora species found within the Glenelg River reach and its associated corridor of which 12 are listed nationally. The river was a source a food supplies for the Dhauwurd Wurrung Aboriginal Group. Shell middens and surface scatters as well as isolated artefacts and a scarred tree around the coastal dunes have been found just outside the river reach. The Princess Margaret Rose Caves are of significant historical values and are listed as an historic place of regional significance. Patterson's Canoe Camp recreation area is also of regional significance. Tourism in the river reach is increasing in Nelson and the caves. Other attractions are bushwalking such as the Great South West Walk, camping, sight-seeing, picnicking, canoeing, fishing, motor-boating, house-boating and water-skiing. Lavinia Nature Reserve – see Lavinia Ramsar Wetland Description above. Lower Merri River The Lower Merri River Wetlands consist of two connected wetlands developed in a swale between calcareous dune ridges and fed by the Merri River. Lower Merri River Wetland is of high value for its avifauna. There are large areas of Common Reed Phragmites australis with Spiky Club-sedge, saltmarsh and mudflats. Also, of high value for its geomorphology and are a well-preserved example of interdunal wetlands fed by a small drainage system. The wetlands are used for hunting, walking and bird watching. The Mahogany Trail follows the edge of these wetlands. The Mahogany Ship is reputed to be buried under sand dunes adjacent to Saltwater Swamp. Surface scatters exist at Kelly Swamp indicating a history of Aboriginal occupation. Princetown Wetlands These wetlands consist of swamps of varying salinity on the floodplains of the Gellibrand River and its tributary, the Serpentine (Latrobe) Creek. Wetlands types present are a deep freshwater marsh, semi- permanent saline marshes and a shallow freshwater marsh. The Princetown Wetlands have extensive beds of Common Reed (Phragmites australis) and meadows dominated by Beaded Glasswort which can support large numbers of waterbirds. The saltmarsh habitat surrounding these swamps is likely to be important for migration of the Orange-bellied Parrot. Australasian Bittern and Lewin's Rail have been recorded. Camping, fishing, boating, and duck hunting occur within the wetlands. Swan Bay Swan Bay is a shallow marine embayment partly enclosed by spits and barrier islands such as Swan Island. It is generally <2 m in depth, with 700-1,000 ha of mudflats exposed at low tide, and has extensive seagrass beds. The bay is fringed with saltmarsh including some extensive flats and there are some stands of remnant woodland. The bay is of high value for its avifauna and flora. It is very productive for birds, molluscs, and fish. The saltmarsh and intertidal seagrass meadows are regionally significant. The avifauna is particularly diverse, with 190 bird species recorded.

Protected Areas
Swan Bay is a high value wetland for its ecological, recreational, and educational features. Swan Bay is an unusual shallow embayment with a mixture of seagrass species which is relatively undisturbed and in good ecological condition. Australian Marine Parks Four Australian Marine Parks (AMPs) were identified in the Environmental Planning Area (Appendix B12 MAP-REG-EPM-078). Apollo The Apollo AMP is located off Apollo Bay on Victoria's west coast in waters 80 m to 120 m deep on the continental shelf. The reserve covers 1,184 km2 (DNP 2013). The reserve encompasses the continental shelf ecosystem of the major biological zone that extends from South Australia to the west of Tasmania. The area includes the Otway Depression, an undersea valley that joins the Bass Basin to the open ocean. Apollo AMP is a relatively shallow reserve with big waves and strong tidal flows; the rough seas provide habitats for fur seals and school sharks (DNP 2013). The major conservation values of the Apollo AMP (DNP 2013) are: Ecosystems, habitats, and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features: deep/hole/valley and shelf. Important migration area for blue, fin, sei and humpback whales. Important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. Cultural and heritage site - wreck of the MV City of Rayville. Franklin The Franklin AMP covers an area of 671 km2 west of the north-western corner of Tasmania and south-east of King Island (DNP 2013). At its northern end, the waters are only 40 m deep, and in much of the reserve the sea floor slopes gently and is covered by fine and coarse sediments. At the southern end of the reserve there is a valley where the water is up to 150 m deep. The major conservation values for the Franklin AMP (DNP 2013) are: Examples of ecosystems, habitats and communities associated with the Tasmanian Shelf Province and Western Bass Strait Shelf Transition and associated with sea-floor features shelf, deep/hole/valley, escarpment and plateau. Important foraging area for Shy Albatross, Short-tailed Shearwater, Australasian Gannet, Fairy Prion, Little Penguin, Common Diving petrel, Black-faced Cormorant and Silver Gull. Black Pyramid Rock, 6 km north of the reserve supports the largest breeding colony of the Australasian gannet in Tasmania, and one of only eight breeding sites for this species in Australia. White shark also forages in the reserve. Nelson The Nelson AMP spans the deepwater ecosystems (greater than 3,000 m depth) extending from South Australia to the west of Tasmania (DNP 2013). The reserve spans a range of geological features including plateaus, knolls, canyons and the abyssal plain (a large area of extremely flat or gently sloping ocean floor just offshore from the continent). The knoll features provide a rocky substrate above the abyssal plain. Little is known about the benthic biodiversity of this reserve; however, marine mammals are known to occur here.

Protected Areas
The major conservation values of the Nelson AMP (DNP 2013) are: Examples of ecosystems, habitats and communities associated with the West Tasmanian Transition and associated with the seafloor features including the abyssal plain/deep ocean floor, canyon, knoll/abyssal hill, plateau, and slope. Important migration area for Blue, Fin, Humpback and Sei whales. Zeehan The Zeehan AMP covers an area of 19,897 km2 to the west and south-west of King Island in Commonwealth waters surrounding north-western Tasmania (DNP 2013). It covers a broad depth range from the shallow continental shelf depth of 50 m to the abyssal plain which is over 3,000 m deep. The reserve spans the continental shelf, continental slope and deeper water ecosystems of the major biological zone that extends from South Australia to the west of Tasmania. Four submarine canyons incise the continental slope, extending from the shelf edge to the abyssal plains. A rich community made up of large sponges and other permanently attached or fixed invertebrates is present on the continental shelf, including Giant Crab. Concentrations of larval Blue Wahoo and Ocean Perch demonstrate the role of the area as a nursery ground. Rocky limestone banks provide important seabed habitats for a variety of commercial fish and crustacean species including the Giant Crab. The area is also a foraging area for a variety of seabirds such as Fairy Prion, Shy Albatross, Silver Gull, and Short Tail Shearwater (DNP 2013). The major conservation values for the Zeehan AMP (DNP 2013) are: Examples of ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features: abyssal plain/deep ocean floor, canyon, deep/hole/valley, knoll/abyssal hill, shelf and slope. Important migration area for Blue and Humpback whales. Important foraging habitat for Black-browed, Shy and Wandering albatrosses, and Great-winged and Cape Petrels. Victorian Marine Parks and Sanctuaries Four Victorian Marine National Parks (Appendix B12 MAP-REG-EPM-079) and six Marine Sanctuaries were identified in the Environmental Planning Area. In addition, two Conservation Parks, two Wildlife Reserves and three National Parks were identified as having coastal areas within the Environmental Planning Area. The Narrwong Coastal Reserve and Yambuck Coastal Reserve are long stretches of beach between Narrawong and Porty Fairy, however, no information on the reserves could be found. Barwon Bluff Marine Sanctuary Barwon Bluff Marine Sanctuary (17 ha) is located at Barwon Heads, approximately 100 km south-west of Melbourne. The Barwon Bluff Marine Sanctuary Management Plan (Parks Victoria 2007a) identifies the environmental, cultural and social values as: Intertidal reef platforms with a high diversity of invertebrate fauna and flora. Subtidal reefs that support diverse and abundant flora, including kelps, other brown algae, and green and red algae. Calcarenite and basalt reefs extending from The Bluff that are of regional geological significance. Intertidal habitats that support resident and migratory shorebirds, including threatened species. Subtidal habitats that support sedentary and mobile fish and are also used by migratory marine mammals.

Protected Areas
Marine habitats and species that are of scientific interest and valuable for marine education.
Underwater recreation, including visits to subtidal communities that are easily accessible from the shore.
Coastal vistas, seascapes and underwater scenery.
Important landmark and area for gathering fish and shellfish for the Wathaurong people.
Strong historic and ongoing connection with marine education.
Remnants from the Earl of Charlemont, a heritage-listed shipwreck.
Bay of Islands Conservation Park
This coastal park has outstanding ocean views and geological features and covers an extensive area of the coastline (~32 km in length and 950 ha), stretching east from Warrnambool to Peterborough. Sheer cliffs and rock stacks dominate the bays, and the heathlands contain wildflowers. Beaches are accessible at some points (Parks Victoria 1998).
This park protects the terrestrial environment above the low water mark of this coastline. This Coastal Park is managed under the Port Campbell National Park and Bay of Islands Coastal Park Management Plan (Parks Victoria 1998).
Discovery Bay Marine National Park and Coastal Park
The Discovery Bay Marine National Park is situated 20 km west of Portland and covering 2,770 ha. It covers part of the largest coastal basalt formation in western Victoria. In deep water (30 – 60 m) there are low reefs from ancient shorelines or dunes. There is a rich diversity of marine life within this park due to the cold, nutrient rich waters of the area. The deep calcarenite reefs support diverse sponge gardens whilst the shallower reefs support the brown alga Ecklonia radiata. The offshore waters support a diverse array of invertebrates including southern rock lobster, black-lip abalone, and gorgonians. The waters also support great white sharks and blue whales during the summer breeding season. The Discovery Bay Marine National Park abuts the Discovery Bay Coastal Park which are managed via the Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (Parks Victoria 2015). The Plan describes some key values of the Discovery Bay Marine National Park and Coastal Park, namely:
Important shorebird habitat for migratory species listed under international agreements.
Two Important Bird Areas, Lawrence Rocks Wildlife Reserve, which consists of two rocky islets off the coast from Portland with a resident Australasian Gannett population, and the Discovery Bay Coast through to Picaninnie Ponds in South Australia with resident populations of Australasian Bittern, Hooded Plover, Rufous Bristlebird and Striated Fieldwren, and non-breeding Orange-bellied Parrot.
The Bonney Coast, which extends from Robe in South Australia to Discovery Bay, is a productive area because of a nutrient rich cold water upwelling, known as the Bonney Upwelling. This high productivity provides an important feeding ground for seabirds, fur seals and whales. It also greatly influences primary productivity and maintains commercially important fisheries species such as Blacklip Abalone and Southern Rock Lobster. The continental shelf and the Bonney Upwelling draws close to the coast near the township of Portland, and this makes the area a highly significant recreational fishery for Southern Bluefin Tuna.
Subtidal Reefs with six key natural assets – Brown macroalgae dominated beds, large mobile fish including sharks and rays, motile macroinvertebrates, Giant Kelp Forest communities, sessile invertebrate dominated communities such as thick growths of sponges, ascidians, bryozoans and gorgonians, and mixed red algae sessile invertebrate dominated communities.
Great Otway National Park

Protected Areas
The Great Otway National Park (103,185 ha) is located near Cape Otway and stretches from the low water mark inland on an intermittent basis from Princetown to Apollo Bay (approximately 100 km). Landscapes within the park are characterised by tall forests and hilly terrain extending to the sea with cliffs, steep and rocky coasts, coastal terraces, landslips, dunes and bluffs, beaches and river mouths. There is a concentration of archaeological sites along the coast, coastal rivers and reefs. The park contains many sites of international and national geological and geomorphological significance including Dinosaur Cove (internationally significant dinosaur fossil site), Lion Headland and Moonlight Head to Milanesia Beach (internationally significant coastal geology and fossils). The park provides habitats for the conservation of the Rufous Bristlebird, Hooded Plover, White-bellied Sea Eagle, Fairy Tern, Caspian Tern and Lewin's Rail and native fish such as the Australian Grayling. The park contains significant Aboriginal cultural sites adjacent to rivers, streams and the coastline including over 100 registered archaeological sites, particularly shell middens along the coast, as well as non-physical aspects such as massacre sites, song lines, family links and stories. The park also contains four sites listed on the Victorian Heritage Register including the Cape Otway Light Station and several shipwreck features along the coast (Parks Victoria and DSE 2009). This park protects the terrestrial environment above the low water mark of this coastline. The Park is protected under the Great Otway National Park and Otway Forest Park Management Plan (Parks Victoria and DSE 2009) and relevant values are: Large area of essentially unmodified coastline, linking the land to marine ecosystems and marine national parks. Diverse range of lifestyle and recreation opportunities for communities adjacent to the parks – for local permanent residents and holiday homeowners Regionally, nationally and internationally. Significant tourist attractions, close to access routes and accommodation, such as spectacular coastal scenery along the Great Ocean Road, access to beautiful beaches, clifftop lookouts, picnic areas, historic sites, waterfalls and walking tracks such as the Great Ocean Walk. Basis for continued growth of nature-based tourism associated with the parks and the region, providing economic opportunities for accommodation providers, food and services providers, and recreation, tourism and education operators. Lady Julia Percy Island Wildlife Reserve Lady Julia Percy Island is off the coast of Victoria 22 km south-west of Port Fairy. It is one of the two largest breeding sites for the Australian fur seal species in Australia (DCCEEW 2023h) and provides habitat to migratory seabirds. Lawrence Rocks Wildlife Reserve Lawrence Rocks Wildlife Reserve consists of two small islets about 6.8 ha and 1.5 ha in area that lie about 2 km offshore from Point Danger and about 6 km south-east of Portland in western Victoria (BirdLife International 2023). The islets are composed of basaltic and tuff rock. The habitat on the islets consists of exposed rock and some patches of exotic grasses and native and exotic herbs. The Australasian Gannet breeds on both islets in the IBA. Lawrence Rocks supports a small population of the Australian Fur Seal. BirdLife International have deemed Lawrence Rocks an Important Bird Area (BirdLife International 2023). Marengo Reefs Marine Sanctuary The Marengo Reefs Marine Sanctuary (12 ha) is in Victorian State waters near Marengo and Apollo Bay, which are on the Great Ocean Road, approximately 220 km south-west of Melbourne. The sanctuary protects two small reefs and a wide variety of microhabitats. Protected conditions on the leeward side of the reefs are unusual on this high wave energy coastline and allow for dense growths of bull kelps and other seaweed. There is an abundance of soft corals, sponges, and other marine invertebrates, and over 56 species of fish have been recorded in and around the sanctuary. Seals rest on the outer island of the reef and there are two shipwrecks (the Grange and Woolamai) in the sanctuary (Parks Victoria 2007).

Protected Areas
The Marengo Reefs Marine Sanctuary Management Plan (Parks Victoria 2007) identifies the environmental, cultural and social values as:
Subtidal soft sediments, subtidal rocky reefs and intertidal reefs.
High diversity of algal, invertebrate and fish species.
Australian fur seal haul out area.
Evidence of a long history of Indigenous use, including many Indigenous places and objects nearby.
Wrecks of coastal and international trade vessels in the vicinity of the sanctuary.
Spectacular underwater scenery for snorkelling and scuba diving.
Intertidal areas for exploring rock pools.
Opportunities for a range of aquatic recreational activities including seal watching.
Merri Marine Sanctuary
The Merri Marine Sanctuary is on the Victorian south-west coast near Warrnambool, approximately 260 km west of Melbourne. Merri Reefs Marine Sanctuary (25 ha) is located at the mouth of the Merri River, west of Warrnambool Harbour. Merri Marine Sanctuary contains a mixture of habitats, including intertidal reef, sand, shallow reef and rocky overhang. These areas provide a nursery for many fish species and a habitat for many algae species, hardy invertebrates and shorebirds. Bottlenose dolphins and fur seals are regular visitors to the shore (Parks Victoria 2007c).
The Sanctuary is protected with the Merri Marine Sanctuary Management Plan (Parks Victoria, 2007c) identifies the environmental, cultural and social values as:
Culturally significant to indigenous communities that have a long association with the area.
Merri River, wetlands and islands and headlands provide a variety of habitats.
Provision of nursery for many fish species and habitat for algal species, hardy invertebrates and shorebirds.
Mornington Peninsula National Park
Mornington Peninsula National Park is situated about 70 km south of Melbourne. Mornington Peninsula National Park runs along the coast from Point Nepean, at the western tip of the Mornington Peninsula, to Bushrangers Bay, where it turns inland along the Main Creek valley, still as a narrow band, until it joins the more expansive Greens Bush section of the Park. This park protects the terrestrial environment above the low water mark of this coastline. The Park is managed under the Mornington Peninsula National Park and Arthurs Seat State Park Management Plan, which has identified the key environmental, social and cultural values as (Parks Victoria 2016):
Largest and most significant remaining areas of native vegetation on the Mornington Peninsula. Numerous sites and features of geomorphic significance, particularly along the coast (cliffed calcarenite coast sandy forelands and basalt shore platforms).
Only representation in the Victorian conservation reserve system of four land systems formed within the Southern Victorian Coastal Plains and the Southern Victorian Uplands.
Many significant native plants and vegetation communities, especially in Greens Bush and former McKellar Flora Reserve, and the most extensive remnant coastal grassy forest habitat on the Mornington Peninsula.
Highly scenic landscape values along the ocean coast and at Port Phillip heads and the prominent landscape feature of Arthurs Seat.

Protected Areas
Many significant fauna species, including populations of the nationally significant hooded plover, over 30 species of State significance and many species of regional significance. High quality marine and intertidal habitats, with some pristine areas within Point Nepean. Nationally significant and fascinating historic sites at Point Nepean. Historic Seawinds Gardens in Arthurs Seat State Park. One of the highest recorded densities of Aboriginal archaeological sites along the Victorian Coast South Channel Fort is an important component of the historic fortification defence system of Port Phillip (and an important bird nesting and roosting site). Spectacular scenery and popular surf beaches associated with a wild and rugged coastline. Local and regional economic benefits. Intensively used recreational nodes, e.g. at Portsea, Sorrento, Cape Schanck and Arthurs Seat. Point Addis Marine National Park, Point Danger Marine Sanctuary and Eagle Rock Marine Sanctuary The three protected areas are managed under the Management Plan for Point Addis Marine National Park, Point Danger Marine Sanctuary and Eagle Rock Marine Sanctuary (Parks Victoria 2005). Point Addis Marine National Park lies east of Anglesea and covers 4,600 hectares. The park protects representative samples of subtidal soft sediments, subtidal rocky reef, rhodolith beds and intertidal rocky reef habitats. The park also provides habitat for a range of invertebrates, fish, algae, birds and wildlife. The world-famous surfing destination of Bells Beach is within the park. Point Danger Marine Sanctuary is 20 km south-west of Geelong, close to the township of Torquay and nearby Jan Juc and covers 25 ha. It extends from the high-water mark at Point Danger offshore for approximately 600 m east and 400 m south, encompassing an offshore rock platform. Eagle Rock Marine Sanctuary is about 40 km south-west of Geelong, close to Aireys Inlet and covers 17 ha. The sanctuary extends from high water mark around Split Point between Castle Rock and Sentinel Rock. It extends offshore for about 300 m and includes Eagle Rock and Table Rock. The main habitats protected by the sanctuary include intertidal and subtidal soft sediment, intertidal and subtidal reefs, and the water column. The management plan identifies the following environmental, cultural, and social values for the parks and sanctuaries: Sandy beaches, subtidal soft sediments, subtidal rocky reefs, rhodolith beds and intertidal reefs. High diversity of algal, invertebrate and fish species. High diversity of sea slugs (opisthobranchs) and other invertebrate communities within Point Danger Marine Sanctuary. Evidence of a long history of Indigenous use, including many Indigenous places and objects adjacent to the park and sanctuaries near dunes, headlands, estuaries and creeks. Surf breaks, including those at Bells Beach, which are culturally important to many people associated with surfing. Coastal seascapes of significance for many who live in the area or visit.

Protected Areas
Recreational and tourism values
Spectacular underwater scenery for snorkelling and scuba diving.
Intertidal areas for exploring rock pools.
Opportunities for a range of recreational activities.
Spectacular seascape complementing well-known visitor experiences on the Great Ocean Road.
Port Campbell National Park
Port Campbell National Park is slightly west of Twelve Apostles Marine National Park and 10 km east of Warrnambool. The park is 1,750 ha that presents an extraordinary collection of wave-sculptured rock formations. Port Campbell National Park is home to various fauna such as the little penguin, short-tailed shearwater, and various whale species (Parks Victoria 1998).
Port Phillip Heads Marine National Park
Port Phillip Heads Marine National Park is an area of 35.8 km2 that is located at the southern end of Port Phillip Bay. Many areas within the Port Phillip Heads Marine National Park are popular for a range of recreational activities. The habitats that are found within the park are seagrass beds, sheltered intertidal mudflats, intertidal sandy beaches and rocky shores, subtidal soft substrate and rocky reefs. The bay has a high diversity and abundance of marine flora and fauna that provides a migratory site for wader birds (Visit Victoria 2019). The land adjacent to the Port Phillip Heads Marine National Park is within the Port Nepean National Park.
Twelve Apostles Marine National Park and The Arches Marine Sanctuary
The Twelve Apostles Marine Park is managed in conjunction with the Arches Marine Sanctuary under the Twelve Apostles Marine National Park and The Arches Marine Sanctuary Management Plan (Parks Victoria 2006).
The Twelve Apostles Marine National Park (7,500 ha) is located south-east of Port Campbell between Broken Head and Pebble Point and extends offshore 3 nautical miles to the limit of Victorian waters (Parks Victoria 2006).
The area is representative of the Otway Bioregion and is characterised by a submarine network of towering canyons, caves, arches, and walls with a large variety of seaweed and sponge gardens plus resident schools of reef fish. The park contains areas of calcarenite reef supporting the highest diversity of intertidal and sub-tidal invertebrates found on that rock type in Victoria (Parks Victoria 2006).
The Arches Marine Sanctuary (45 ha) is approximately 600 m offshore from Port Campbell. It has a spectacular dive site of limestone formations, rocky arches, and canyons. The sanctuary is also ecologically significant, supporting habitats such as kelp forests and a diverse range of sessile invertebrates on the arches and canyons. These habitats support schools of reef fish, seals and a range of invertebrates such as lobster, abalone and sea urchins.
The Twelve Apostles Marine Park is managed in conjunction with the Arches Marine Sanctuary under the Management Plan for Twelve Apostles Marine National Park and The Arches Marine Sanctuary (Parks Victoria 2006b) and is classified as IUCN II. The Plan describes the key environmental, cultural, and social values as:
Unique limestone rock formations, including the Twelve Apostles.
Range of marine habitats representative of the Otway marine bioregion.
Indigenous culture based on spiritual connection to sea country and a history of marine resource use.
Wreck of the Loch Ard (shipwreck).

Protected Areas
Underwater limestone formations of arches and canyons.
Diverse range of encrusting invertebrates.
Spectacular dive sites.
South Australian Marine and Coastal Conservation Parks
Lower South East Marine Park
The Lower South East Marine Park Management Plan 2012 (DEWNR 2012) details the following values:
High diversity of plants and animals, including blue whales, due to the influence of the Bonney coast upwelling, an ocean current that supplies nutrient-rich water to the area.
Diverse range of habitats ranging from high-energy sandy beaches and freshwater springs, various reef types (shore platforms, fringing and limestone),
Kelp forests and algal communities and is strongly influenced by natural processes such as the Bonney coast upwelling.
Spring lakes such as Ewen Ponds and Piccaninnie Ponds (both Wetlands of National Importance) emerge from the beaches and are unusual in South Australia.
Habitat for several threatened or potentially threatened species that require freshwater and marine environments during their lifecycle, including the pouched lamprey, short-headed lamprey and shortfinned eel.
Feeding and resting grounds for migratory and resident shorebirds.
Recreational activities including fishing, diving and snorkelling.
Commercial fisheries including the Southern Zone Abalone Fishery, the Southern Zone Rock Lobster Fishery, the Marine Scalefish Fishery, the Charter Fishery and the Miscellaneous Giant Crab Fishery.
Buandig Aboriginal people have traditional associations with areas of the marine park.
Douglas Point Conservation Park
Douglas Point Conservation Park provides scenic views of the coastline and is home to a rare daisy that is only found in three other sites in Australia. The coastal park features areas of exposed limestone, sea cliffs, small sandy beaches and dense coastal vegetation, and provides for fishing, diving and bushwalking. The park is managed under the Douglas Point Conservation Park Management Plan (DEH 2003).
Values of the park (DEH 2003) are:
The only reserved population of Sand Ixodia in Australia.
Conserves vulnerable (SA) Rufous Bristlebird and rare (SA) Beautiful Firetail, regionally uncommon coast velvet-bush and drooping velvet-bush.
Nationally endangered Orange-bellied Parrot recorded in the Park.
The Park is located within the traditional lands of the Boandik people. The remains of scattered middens are evidence of Aboriginal habitation in the past.
Shipwrecks.
Nene Valley Conservation Park

Protected Areas
Nene Valley Conservation Park preserves an area of vegetation typical of sandy coasts in the south-east of South Australia. This vegetation complex has suffered through the effects of clearing and grazing throughout much of its former range.
Piccaninnie Ponds Conservation Park
The Piccaninnie Pond covers an area of 8.64 km2, that has a wide diversity of fauna and flora with 60 bird species and six vegetation communities. Other vegetation found within the park includes reeds, sedge swamp, open heath and tussock grassland.
Tasmanian Marine and Coastal Parks and Reserves
Black Pyramid Rock Nature Reserve
Black Pyramid Rock Nature Reserve, situated of Hunter Island has a land mass of 40 ha. Black Pyramid Rock was proclaimed a Wildlife Sanctuary on 30 June 1964 due to it being the largest known breeding ground for Australasian gannets in Australia (DPIWE 2020). The Nature Reserve is managed under the Small Bass Strait Island Reserves Draft Management Plan (DPIWE 2020).
Cape Wickham State Reserve
The Cape Wickham State Reserve is on the northern tip of King Island and contains Cape Wickham lighthouse and the gravesites of the crew of Loch Leven, a ship that was wrecked nearby. It is designated as IUCN Category V which is a protected landscape/seascape.
Christmas Island Nature Reserve
Christmas Island is located off the west coast of King Island. It is designated IUCN 1a which is a strict nature reserve, which allows minimal human use. It is a BIA for both breeding and foraging for the little penguin (Commonwealth of Australia, 2015a). It is also a known nesting site of the Little Tern. Christmas Island Nature Reserve is a priority site for management under the King Island Biodiversity Management Plan (TSS 2012).
Councillor Island Nature Reserve
Councillor Island Nature Reserve is a 10.53 ha granite reserve east of Tasmania approximately 2.5 km off the mainland coastline of Tasmania within the Bass Strait. The island forms part of the King Island Important Bird Area because of its importance for breeding seabirds and waders.
Disappointment Bay State Reserve
The Disappointment Bay State Reserve is located on the north coast of King Island near Cape Wickham.
Lavinia State Reserve
Lavinia State Reserve is located on the north-east coast of King Island. The reserve contains a number of rare birds, including the endangered orange-bellied parrot (DELWP 2016). It includes the Lavinia Ramsar site and two freshwater lakes. Lavinia Beach is a popular location for surfing and fishing. The Lavinia Nature Reserve (Ramsar Site) Management Plan draft (2000) is not available online. The Sea Elephant Estuary which is within the Lavinia State Reserve is a priority site for management under the King Island Biodiversity Management Plan (TSS 2012).
Reid Rock Nature Reserve
Reid Rocks are situated approximately 21.5 km east-south-east of Stokes Point at the southern extremity of King Island in western Bass Strait. The main islet is approximately 500 m long and rises to 13 m above sea level. Reid Rocks became a Nature Reserve on 5 April 1978 due to their importance as an Australian fur seal breeding colony (DPIWE 2020). The Nature Reserve is managed under the Small Bass Strait Island Reserves Draft Management Plan (DPIWE 2020).

Protected Areas
Seal Rock State Reserve Seal Rock State Reserve is located on the south-east coast of King Island. Species and vegetation communities are seabird rookeries, shining dogwood, triggerplants and coastal complex on King Island. Seal Rock State Reserve is a priority site for management under the King Island Biodiversity Management Plan (TSS 2012).
Predicted Level of Risk
Due to the distance to the South Australian and King Island coastal areas from the Operational Area (~130 km and ~ 70 km respectively) impacts to coastal areas above the low thresholds are not predicted. As the Operational Area is as close as ~7 to the Victorian coast, there is the potential for diesel above the low threshold to be visible on the ocean surface in coastal waters and as a sheen on shoreline areas. Most of the diesel will be concentrated along the high tide mark while the lower/upper parts are often untouched (IPIECA 1995) and expected to be visible. Visible nearshore and shoreline hydrocarbons have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. Due to the low volumes, light nature of marine diesel and substantial wave action with the nearshore areas impacts are likely to be short term and not require intrusive clean-up response. The predicted level of consequence to protected areas and their values from a 250 m3 MDO spill is assessed as moderate as exposure to oil above low thresholds could occur in protected areas nearshore of the Operational Area, though if consequences occurred, they are likely to only affect a small portion of coastal areas or marine areas for a short duration (hours to days) due to the low spill volume and short duration of any exposure, the likelihood is assessed as rare (based on the absence of any reported seismic vessel collisions in Australia) resulting in a predicted level of risk of medium.

7 Predicted Levels of Risk

Circumstances resulting in a loss of containment of MDO such as a vessel collision and subsequent fuel tank rupture) are low probability events in open ocean areas without restricted navigation. Though shipping activity is relatively high within the Operational Area, modern navigational aids assist in reducing the likelihood of a collision event.

There have been no vessel collisions during a seismic survey in Australia. While undertaking the survey the seismic and support vessels will be moving at a slow speed of up to 10 km/hr and the seismic vessel will always have at least one vessel with it to observe and respond to any vessels that come to close to the seismic vessel, thereby further reducing the risk of collision with third-party vessels. Therefore, the likelihood of a vessel collision resulting in a loss of a full tank of MDO is rare.

8 Comparison of Predicted Level of Risk with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Risk	Predicted Level of Risk Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	Impact result in temporary / reversible, small scale, and/or low intensity environmental damage.	A vessel oil spill is not predicted to occur but if it occurred impacts would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel.	Yes
	The impact assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government management plans, recovery plans and conservation advice were used to inform the risk assessment. A vessel oil spill is not predicted. There is high confidence in the prediction of risks from a vessel oil spill.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1 of this document.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	A vessel oil spill is not predicted to occur but if it occurred risks would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	A vessel oil spill is not predicted to occur but if it occurred risks would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	A vessel oil spill is not predicted to occur but if it occurred impacts would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	A vessel oil spill is not predicted to occur but if it occurred impacts would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel.	Yes

Defined Acceptable Level		Predicted Level of Risk	Predicted Level of Risk Below Defined Acceptable level?
Category	**Level**		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce the risk of a vessel oil spill.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted consequence ranges from Minor to Moderate depending on the report with the likelihood of rare as a vessel collision would only occur in exceptional circumstance. Thus, the risk level ranges from Low to Medium.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the risk.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	Some relevant persons reported finding oily residues and tar balls on beach walks along the Otway coastline. This information has been included in this risk assessment and is expected given the hydrocarbon prone geology of the area. From relevant person consultation objections and claims have been made regarding: Impacts to beaches and shorebird nesting areas. This risks assessment shows that impacts to beaches and shorebird nesting area would be temporary / reversible, small scale, and/or low intensity environmental damage due to the low volumes and light nature of marine diesel. Balls of crude oil along beaches and how these will be disposed. Diesel being a light fuel is not prone to forming crude oil balls. Notification to the DNP in the event of oil/gas pollution incidences which occur within a marine park or are likely to pose a risk to a marine park as soon as possible. This requirement is covered in the Regia MSS Implementation Strategy and Oil Pollution Emergency Plan.	Yes
	The views of public have been considered in the impact and risk assessment.	To date there has been no views from the public in relation to a vessel oil spill.	Yes

9 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental risks will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#02: Consultation Management System	CGG will implement the Consultation Management System to ensure that pre and during survey communications will be undertaken so that other marine users know when, where and how the Regia MSS will be undertaken so they can undertake their activities in a manner that avoids any interactions or can engage with CGG so that both parties can plan activities in a manner that minimises potential displacement to each party.	Yes
	A simultaneous operations plan will be developed if the seismic vessels or any equipment will enter the 500 m Petroleum Safety Zone of the Thylacine-A platform.	Yes
M#05: CGG Marine Assurance System	Project vessels, as part of the CGG contracting process, will undergo OVID-style inspections to verify the validity and compliance of certificates required by COLREGS, the Navigation Act, SOLAS and various Marine Orders, and the presence of a vessel bunkering procedure and a Shipboard Oil Pollution Emergency Plan (SOPEP), tailored to the vessel's class and operational requirements.	Yes
	CGG Marine Assurance System will ensure vessel materials or equipment that have the potential for spill overboard are within contained/bunded areas.	Yes
	CGG Marine Assurance System will ensure vessels have a bunkering procedure that at a minimum details: Use of certified equipment with checked integrity including dry-break couplings. No bunkering within 50 km of a Commonwealth or State marine parks. Transfer process (e.g. safety, communication, monitoring, inventory, emergency shut down, spill response and incident reporting).	Yes
	CGG Marine Assurance System will ensure vessels have a documented Preventative Maintenance System (PMS) that provides a status on the maintenance of equipment as per the manufacturer's specification for maintenance procedures.	Yes
M#07: Adjustment Protocol	An adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Other titleholders in the region will be invited to participate in the review, update, and implementation of the adjustment process.	Yes
M#08: Oil Spill Response Plans	CGG will have a NOPSEMA accepted Oil Pollution Emergency Plan (OPEP) and Oil Spill Monitoring Plan (OSMP). Under the OPGGS (Environmental) Regulations, NOPSEMA require that a petroleum activity (Regia MSS) have an accepted OPEP and OSMP in place before the activity commences. In the event of a vessel loss of containment, the OPEP and OSMP will be implemented.	Yes

10 Conclusion

This chapter predicts the levels of risk to environmental receptors within the Environment Planning Area of the Regia MSS. The survey vessels and support vessels will carry an inventory of oils and fuel and though it is unlikely that a spill will occur during operations the risk is part of carrying out the activity. A summary of the outcomes of the risk assessment is provided in Table D4-10-1.

Table D4-10-1: Summary of Risk Assessment Outcome for Accidental Release of Fuel

Receptor	Sensitivity	Consequence	Likelihood	Predicted Level of Risk
Water Quality	Medium	Minor	Rare	Low
Sediment Quality	Low	Minor	Rare	Low
Benthic Assemblages	Medium	Moderate	Rare	Medium
Coastal Habitats & Communities	Medium	Moderate	Rare	Medium
Plankton	Low	Minor	Rare	Low
Invertebrates	Low	Minor	Rare	Low
Fish	Low	Minor	Rare	Low
Birds	Medium – seabirds	Minor	Rare	Low – seabirds, aquatic birds
	High – aquatic birds, shorebirds	Moderate	Rare	Medium - Shorebirds
Marine Reptiles	Medium	Minor	Rare	Low
Marine Mammals	Medium	Moderate	Rare	Medium
Coastal Developments	High	Moderate	Rare	Medium
Indigenous Culture	High	Moderate	Rare	Medium
Commercial Fisheries	Medium	Moderate	Rare	Medium
Seaweed Industry	Medium	Minor	Rare	Low
Marine Industries	Medium	Minor	Rare	Low
Tourism (inc. Diving and Recreational Fishing	High	Moderate	Rare	Medium
Protected Areas	High	Moderate	Rare	Medium

11 Recommendations

As demonstrated in this risk assessment, the predicted level of risk to each receptor has either been assessed as medium or low. The predicted levels of risk are clearly below the pre-defined acceptable levels of risk and the mitigation and management measures in place provide reliable prevention to have confidence in the predicted likelihood levels, thus there are no further recommendations.

12 Document Control

Date	Revision	Update
6 July 2023	A	Draft prepared for initial comment
23 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Updated following public comment and rerun of the PMST search.**

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Annex 1: Legislative and Other Requirements Relevant to Accidental Release of Fuel

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Commonwealth Legislation			
Australian Maritime Safety Authority Act 1990	The act establishes the Australian Maritime Safety Authority (AMSA), which is responsible for ensuring the safety of vessels and seafarers.	Vessels are required to implement safety requirements as per the Navigation Act and applicable marine orders. AMSA is the designated Control Agency for oil spills from vessels in Commonwealth waters.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
AMSA Advisory note for the offshore petroleum industry on environmental plans and oil pollution emergency plans	As of 2021, AMSA will no longer be entering into any direct agreements with Titleholders for support with oil spill preparedness and response into the future. AMSA will continue to fulfil its obligations under the National Plan for Maritime Environmental Emergencies for non-ship source pollution incidents on the formal request from the respective Offshore Petroleum Incident Controller/s.	In the event of an oil spill from a vessel associated with the Regia MSS, AMSA is the Control Agency with CGG providing support and resources as directed by AMSA.	This requirement is met by the implementation of M#08: Oil Spill Response Plans where the NOPSEMA Accepted OPEP details the role of the vessel operator, CGG and AMSA in the event of an oil spill.
Marine Order 21 (Safety and Emergency Arrangements)	The marine order provides guidance on the safety and emergency arrangements for vessels.	Vessels are required to have safety and emergency arrangements dealing with life-saving appliances and arrangements, safety of navigation and special measures to enhance maritime safety in accordance with the marine order.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.

Marine Order 27 (Safety of Navigation and Radio Equipment)	The marine order provides guidance on the prevention of collisions between vessels.	Vessels are required to have navigation and radio equipment that meets the marine order requirements.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 30 (Prevention of Collisions)	The marine order provides guidance on the prevention of collisions between vessels.	Vessels are required to have onboard navigation, radar equipment, and lighting that meets the International Rules for Preventing Collisions at Sea (COLREGs).	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 31 SOLAS and non-SOLAS certification	The marine order provides guidance on the survey, certification, and maintenance of certificates for regulated Australian vessels and certification of foreign vessels.	Vessels are required to have in date certification in accordance with AMSA MO 31: SOLAS and non-SOLAS certification.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 70 (Seafarer Certification)	The marine order provides guidance on the certification of seafarers.	Vessel crew are required to be certified and trained as per the marine order requirements	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 71 (Masters and Deck Officers)	The marine order provides guidance on the certification and training of masters and deck officers for vessels.		
Marine Order 72 (Engineer Officers)	The marine order provides guidance on the certification and training of engineer officers for vessels.		
Marine Order 91 - Marine pollution prevention - oil	Marine Order 91 sets out the requirements for the prevention of marine pollution by oil from ships in Australian	Vessels are required to have a Shipboard Marine Pollution Emergency Plan (SMPEP) or Shipboard Oil Pollution Emergency Plan (SOPEP) (according to class) developed based upon the Guidelines for the	This requirement is met by the implementation of M#05: CGG Marine

	waters. The order establishes procedures for reporting, investigating, and responding to pollution incidents, as well as measures for the clean-up and disposal of spilled pollutants. It also sets out the requirements for pollution emergency plans, contingency planning, and pollution response equipment and training.	Development of Shipboard Oil Pollution Emergency Plans and approved by AMSA.	Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 93 - Marine pollution prevention - noxious liquid substances	Marine Order 93 sets out the requirements for the prevention of marine pollution from liquids and chemicals in Australian waters, including measures to prevent spills, leaks, and discharges of noxious liquids from ships. The order establishes procedures for reporting, investigating, and responding to noxious liquid pollution incidents, as well as measures for the clean-up and disposal of spilled noxious liquids. It also sets out the requirements for noxious liquids pollution emergency plans, contingency planning, and pollution response equipment and training.	Vessels are required to prevent spills to the marine environment.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
Marine Order 94—Marine pollution prevention – packaged harmful substances	Marine Order 94 sets out the requirements for the prevention of marine pollution from packaged harmful substances in Australian waters, including management of harmful substances in packaged form, washing substances overboard and notifying and reporting an incident.	Vessels are required to prevent spills to the marine environment.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.

National Plan for Maritime Emergencies (AMSA 2020)	The National Plan implements Australia's obligations under the International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969; United Nations Convention on the Law of the Sea, 1982; the International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990; and the Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 with respect to the management of maritime environmental emergencies.	CGG is required to have an Oil Pollution Emergency Plan (OPEP), accepted by NOPSEMA before the Regia MSS can commence.	This requirement is met by the implementation of M#08: Oil Spill Response Plans.
Navigation Act 2012	Australian implementation of the International Regulations for Preventing Collisions at Sea.	Vessels are required to implement navigation requirements as detailed in the Act and associated marine orders.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.
NOPSEMA Petroleum activities and Australian Marine Parks Guidance Note	The purpose of this guidance note is to provide guidance on the key management arrangements and requirements that are relevant to petroleum and greenhouse gas activities that may affect Australian Marine Parks (AMPs). The intent is to assist titleholders in preparing EPs that comply with regulatory requirements.	The Regia MSS EP should evaluate how the activity impacts and risks to AMPs will be of an acceptable level and reduced to as low as reasonably practicable (ALARP). There needs to be a clear demonstration that the activity will not be inconsistent with the relevant marine park management plan. When making a case to demonstrate how these requirements are met and to define the acceptable levels of environmental impact and risk, titleholders should have regard to context such as marine park and zone objectives, the marine park values including the representativeness of relevant natural values, and any claims and/or objections made by the DNP during consultation	This requirement is met by this risk assessment that shows that risks to AMPs from a 250 m^3 MDO spill are predicted to be of an acceptable level short due to the low spill volume and short duration (hours to days) of any exposure.
		In the South-east marine park network oil pollution response, environmental monitoring and remediation activities are allowable under existing authorisations (class approvals) in IUCN category VI	This requirement is met by the Regia MSS EP which must be accepted

		zones, when undertaken in accordance with an EP accepted under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (Environment Regulations).	by NOPSEMA prior to the activity commencing.
		The DNP should be made aware of oil spills which occur within AMPs, or are likely to impact marine parks, as soon as possible.	This requirement is met by the implementation of M#08: Oil Spill Response Plans where the NOPSEMA Accepted OPEP details reporting requirements to the DNP in the event of an oil spill. The Regia MSS Implementation Strategy (Appendix B3) also details reporting requirements to the DNP in the event of an oil spill.
Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008	The Protection of the Sea (Civil Liability for Bunker Oil Pollution Damage) Act 2008 is a Commonwealth legislation that provides for civil liability and compensation for damages caused by oil spills from ships' bunkers in Australian waters. The act establishes a regime for the liability of the shipowner and the right to compensation of the affected parties, including the cost of clean-up and restoration of the environment. The act also provides for the limitation of liability of the shipowner in certain circumstances.	Places liability on vessel owner for pollution damage caused by loss of bunker fuel.	NA – as vessels will not be carrying bunker fuel.
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	The act regulates the prevention of pollution from ships, which may be associated with the transportation of personnel	Vessels greater than 400 gross tonnes and above to have pollution emergency plans.	This requirement is met by the implementation of M#05: CGG Marine Assurance System which will verify that vessels have a pollution

	and equipment during seismic surveys.		emergency plans tailored to the vessel's class and operational requirements.
Victorian Legislation			
Emergency Management Act 2013	This act provides for the management of emergencies, including natural disasters and other incidents that threaten public safety, health, or welfare. It establishes a framework for emergency management at the federal, state, and local levels, and sets out the roles and responsibilities of emergency management agencies.	CGG is required to have an Oil Pollution Emergency Plan (OPEP), accepted by NOPSEMA before the Regia MSS can commence.	This requirement is met by the implementation of M#08: Oil Spill Response Plans where the NOPSEMA Accepted OPEP details the role of the vessel operator, CGG, AMSA and the Victorian Combat Agency in the event of an oil spill posing a risk to Victorian waters.
Pollution of Waters by Oil and Noxious Substances Act 1986 (POWBONS)	This act provides measures for preventing, controlling, and cleaning up pollution caused by oil and other noxious substances in Australian waters. It aims to reduce the risk of damage to the environment and protect public health and safety.	Requires mandatory reporting of marine pollution incidents that could pose a risk to Victorian waters.	This requirement is met by the implementation of M#08: Oil Spill Response Plans where the NOPSEMA Accepted OPEP details reporting requirements in the event of an oil spill. The Regia MSS Implementation Strategy (Appendix B3) also details reporting requirements in the event of an oil spill.
Tasmanian Legislation			
EPA Tasmania – Offshore Petroleum Industry Guidance Note	The purpose of the guidance note is to inform Offshore Petroleum Titleholders (Petroleum Titleholders) of the Tasmanian emergency management arrangements in respect to Marine Oil Pollution emergencies in State waters. The guidance note outlines Petroleum Titleholders obligations under those arrangements and the	CGG is required to have an Oil Pollution Emergency Plan (OPEP), accepted by NOPSEMA before the Regia MSS can commence. For any Pollution emergency, it is an expectation that the Petroleum Titleholder will conduct initial response actions in State waters as necessary in accordance with their OPEP/OSCP and continue to manage those operations until incident control can be established by EPA Tasmania.	This requirement is met by the implementation of M#08: Oil Spill Response Plans where the NOPSEMA Accepted OPEP details the role of the vessel operator, CGG, AMSA and the Tasmanian EPA in the event of an oil spill posing a risk to Tasmanian waters.

	Department of Primary Industry Parks Water and Environment – EPA Tasmania (EPA) expectations.		
Marine-related Incidents (MARPOL Implementation) Act 2020	Under the Act, the Tasmanian EPA is responsible for preparedness for and responding to oil and chemical spills in Tasmania.	CGG is required to have an Oil Pollution Emergency Plan (OPEP), accepted by NOPSEMA before the Regia MSS can commence.	
Guidance Material			
Environmental Management in the Upstream Oil and Gas Industry (IOGP-IPIECA, 2020)	The primary focus of this report is on managing the risk from potential impacts to the natural environment during exploration and production of oil and gas.	Of relevance are: • Ensure all facilities/infrastructure has the appropriate navigation lighting and all facilities/infrastructure and subsea infrastructure is gazetted and included on navigational charts. • Issue a 'Notice to Mariners' through the relevant government agencies, detailing the area of operations. • Ensure all vessels adhere to International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders to minimise the likelihood of an oil spill. • M#02: Consultation Management System which details notification requirements to the AHO and AMSA and to relevant stakeholders as required.
Birds			
Wildlife Conservation Plan for Seabirds (CoA 2020a)	The plan aims to provide a national framework for the research and management of listed marine and migratory seabirds and to outline national activities to support the conservation of listed	Fuel spills are identified as a threat with the following actions relevant: • Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System

	seabirds in Australia and beyond. Threatened species are not covered by the plan and receive separate, approved conservation advice and, in some cases, a recovery plan which sets out what should be done to stop the decline and support the recovery of the species.	• Ensure all areas of important habitat for seabirds are considered appropriately and consistently in the development assessment process.	which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)	The plan provides a framework to guide the conservation of migratory shorebirds and their habitat in Australia and, in recognition of their migratory habits, outlines national activities to support their appreciation and conservation throughout the East Asian-Australasian Flyway (EAAF).	The conservation plan identifies that migratory shorebirds are not directly affected by oil spills, but important habitat may be affected with the following action relevant to an oil spill: • Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes. • Enhance contingency plans to prevent and/or respond to environmental emergencies that have an impact on seabirds and their habitats. The conservation plan refers to the EPBC Act Policy Statement 3.21 Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act Listed Migratory Shorebird Species (CoA 2017).	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and

			NOPSEMA Accepted OSMP to monitor for any potential impacts.
EPBC Act Policy Statement 3.21—Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act Listed Migratory Shorebird Species (CoA 2017)	The purpose of this policy statement is to assist proponents in avoiding, assessing, and mitigating significant impacts on migratory shorebirds listed under the EPBC Act. This policy statement is a key action under the Wildlife Conservation Plan for Migratory Shorebirds.	Thresholds of significance impacts on migratory shorebirds relevant to an oil spill are: • Degradation of habitat leading to a substantial reduction in migratory shorebird numbers. • Increased disturbance leading to a substantial reduction in migratory shorebird numbers. • Direct mortality of birds leading to a substantial reduction in migratory shorebird numbers. The guidelines details that defining substantial reduction is made on a case-by-case basis. Factors to consider include: • The number of migratory shorebirds historically using an area (based on surveys and historical data). • Likely resultant changes in bird numbers and species diversity. • Alterations to the value, quality, geographic extent of the area (for example, will the area still be classed as important habitat). • The function and role of the area (roosting, foraging) and likely changes in ecology and hydrology. • The regional and local context of the area. • The nature, extent, duration and timing of impacts, their likelihood and consequence.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
National Recovery Plan for Albatrosses and Petrels (CoA 2022)	The recovery plan provides a national strategy to guide the activities of government, industry, research organisations, and other stakeholders in the protection, conservation and management of listed threatened albatross and petrel species. The plan replaces the previous plan adopted in 2011.	Fuel spills are identified as a threat in the recovery plan with the action to minimise the effects of pollution.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution

			Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
Conservation Advice *Botaurus poiciloptilus* Australasian Bittern (TSSC 2019a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies wetland pollution as a threat.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and

			NOPSEMA Accepted OSMP to monitor for any potential impacts.
National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the long-term viability of the species, and the parties that will undertake those actions.	The recovery plan identifies oil spills as a threat. No actions relevant to oil spills were identified. The coastline and islands around Western Port and Port Phillip Bay are known Fairy Tern breeding locations and are significant to future recovery in Victoria. https://portphillipwesternport.rcs.vic.gov.au/prospectus/a-lifeline-for-fairy-terns/	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPaC 2011)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies oil spills, particularly in Victoria, where the close proximity of oil facilities poses a risk of oil spills that may affect the species' breeding habitat with the action of: • Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills, such as the breeding colonies in Victoria.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution

			Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Limosa limosa* (Black-tailed Godwit) (DCCEEW 2024i)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Black-tailed Godwit throughout Australia (including habitat predicted to become habitat critical to survival in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Pluvialis squatarola* (Grey Plover) (DCCEEW 2024h	Conservation advice guide recovery planning and identify actions required for	Conservation advice identifies chronic and acute pollution as a threat.	• M#05: CGG Marine Assurance System which ensures

	conservation and recovery of the threatened species or ecological community.		compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (DSEWPaC 2013)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (CoA 2022a)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in the wild, and the parties that will undertake those actions.	The recovery plan identifies oil spills as a threat.	NA
Conservation Advice for *Limosa lapponica baueri* Bar-tailed Godwit (Western Alaskan) (DCCEEW 2024b)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Alaskan Bar-tailed Godwit throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with

		providing major foraging opportunities as identified by species experts, local studies and site managers	Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)	Eligible for listing as vulnerable under the EPBC Act.	Listing advice does not identify oil spills as a threat.	NA
Conservation Advice for *Xenus cinereus* (Terek Sandpiper) (DCCEEW 2024g)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies chronic and acute pollution as a threat.	• M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted

			OSMP to monitor for any potential impacts.
Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Common Greenshank throughout Australia (including habitat predicted to become habitat critical to the survival of the species in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	• M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for Ardenna grisea (Sooty Shearwater) (DCCEEW 2023i)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
Conservation Advice for *Gallinago hardwickii* (Latham's Snipe) (DCCEEW 2024d)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
Conservation Advice *Halobaena caerulea* Blue Petrel (TSS 2015)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of	Conservation advice does not identify oil spills as a threat.	NA

	the threatened species or ecological community.		
Conservation Advice for *Calidris ferruginea* Curlew Sandpiper (DCCEEW 2023m)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Curlew Sandpiper throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of far Eastern Curlew throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to

			minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice *Pachyptila turtur subantarctica* fairy prion (southern) (TSSC.2015e)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Ruddy Turnstone throughout Australia (including habitat predicted to become habitat critical to survival in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies and site managers.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted

			OSMP to monitor for any potential impacts.
Commonwealth Listing Advice on *Ardenna carneipes* (Flesh-footed Shearwater) (TSSC 2014)	Assessed as ineligible for listing.	Listing advice does not identify oil spills as a threat.	NA
Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)	Constitutes the formal Commonwealth and New South Wales recovery plan for Gould's Petrel. It identifies the actions to be taken to ensure the long-term viability of the Gould's Petrel in nature and the parties who will carry these out.	Recovery plan identifies oceanic oil spills as a threat. No actions relevant to oil spills were identified.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Sharp-tailed Sandpiper throughout Australia (including habitat predicted to become habitat critical to survival in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with

		providing major foraging opportunities as identified by species experts, local studies and site managers	Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice for *Calidris tenuirostris* (Great Knot) (DCCEEW 2024f)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Great Knot throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted

			OSMP to monitor for any potential impacts.
Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover) (DCCEEW 2023o)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	• Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Greater Sand Plover throughout Australia (including habitat predicted to become habitat critical in the future because of climate change). • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Approved Conservation Advice for *Thalassarche chrysostoma* (Grey-headed Albatross) (DEWHA 2009)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
Conservation Advice *Charadrius mongolus* Lesser Sand Plover (TSSC 2016)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies habitat loss and degradation from pollution as a threat. Actions relevant to oil spills are: • Incorporate requirements for lesser sand plover into coastal planning and management.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of

			contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (western Pacific)) (TSSC 2002)	Advice is that it is ineligible for listing as conservation dependent.	Listing advice does not identify oil spills as a threat.	NA
Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)	Assessed as ineligible for listing.	Listing advice does not identify oil spills as a threat.	NA
Commonwealth Listing Advice on *Neophema chrysogaster* Orange-bellied Parrot (TSSC 2006)	TSSC recommends that the list referred to in section 178 of the EPBC Act be amended by transferring from the endangered category to the critically endangered category.	Listing advice does not identify oil spills as a threat.	NA
National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)	The recovery plan outlines the long-term strategy, and short-term objectives and actions, for the recovery of the Orange-bellied Parrot.	Recovery plan does not identify oil spills as a threat.	NA
Conservation Advice *Pedionomus torquatus* Plains-wanderer (DoE 2015a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of	Conservation advice does not identify oil spills as a threat.	NA

	the threatened species or ecological community.		
National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*) (DoE and SA DEWNR 2016)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species long-term viability in nature, and the parties that will undertake those actions.	The recovery plan does not identify oil spills as a threat.	NA
Conservation Advice for *Calidris canutus* Red Knot (DCCEEW 2024)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies threat to wetlands or intertidal habitat and loss of marine benthic food sources from oil spills. Relevant actions include: • Minimise further loss of habitat critical to the survival of Red Knot throughout Australia (including habitat predicted to become habitat critical in the future because of climate change) • Ensure that future development projects avoid any activities that disproportionately affect the upper tidal flats and/or areas providing major foraging opportunities as identified by species experts, local studies, and site managers.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice *Thalassarche cauta* Shy Albatross (TSS 2020)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat but does have the following action: • Where feasible, population monitoring programmes also monitor, in a standardised manner, the incidence of oiled birds at the nest.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System

			which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice *Pterodroma mollis* Soft-plumaged Petrel (TSS 2015a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
Commonwealth Listing Advice on *Macronectes giganteus* (Southern Giant-Petrel) (TSSC 2001a)	Recommends that the species be listed as Endangered under the EPBC Act	Listing advice does not identify oil spills as a threat.	NA
Conservation Advice *Lathamus discolor* Swift Parrot (TSSC 2016a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros 2011)	The plan considers the conservation requirements of the species across its range, identifies the actions to be taken to ensure its long-term viability in nature and the	The recovery plan does not identify oil spill as a threat.	NA

	parties who will undertake these actions.		
Conservation Advice *Hirundapus caudacutus* White-throated Needletail (TSSC 2019)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
Fish			
Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spills as a threat.	NA
Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015)	Recommends that the species be listed in the conservation dependent category under the EPBC Act.	Listing advice does not identify oil spills as a threat.	NA
National Recovery Plan for the Dwarf Galaxias (*Galaxiella pusilla*) (Saddlier et al. 2010)	The long-term objective of recovery plan is to minimise the probability of extinction and ensure long-term survival of Dwarf Galaxias in the wild and to increase the probability of important population becoming self-sustaining in the long term.	The recovery plan does not identify oil spills as a threat.	NA
Conservation Advice for *Galaxiella pusilla* (Dwarf Galaxias) (DCCEEW 2023j)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
Commonwealth Listing Advice on *Rexea solandri*. Threatened Species Scientific Committee (TSSC 2009)	Recommends listing as conservation dependent.	The recovery plan does not identify oil spills as a threat.	NA
Commonwealth Listing Advice on *Thunnus maccoyii*	Recommends listing as conservation dependent.	Listing advice does not identify oil spills as a threat.	NA

(Southern Bluefin Tuna) (TSSC 2010)			
Conservation Advice for *Nannoperca obscura* (Yarra Pygmy Perch) (DCCEEW 2023k)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
National Recovery Plan for the Yarra Pygmy Perch (*Nannoperca obscura*) (Sadler and Hammer 2010)	Recommends listing as conservation dependent.	The recovery plan does not identify oil spills as a threat.	NA
Sharks			
Commonwealth Listing Advice on *Centrophorus zeehaani* (southern dogfish) (TSSC 2013a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Does not identify oil pollution as a threat.	NA
Commonwealth Listing Advice on *Galeorhinus galeus* (TSSC 2009a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Does not identify oil pollution as a threat.	NA
Listing Advice *Isurus oxyrinchus* shortfin mako shark (TSSC) (2014)	Recommends as not listing.	Listing advice does not identify oil spill as a threat.	NA
Recovery Plan for the White Shark (*Carcharodon carcharias*). (DSEWPaC 2013b)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in nature and the parties that will undertake those actions.	The recovery plan does not identify oil spill as a threat.	NA
Threatened Ecological Communities			

Conservation Advice for Giant Kelp Marine Forests of South East Australia (TSSC 2012)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Does not identify oil pollution as a threat.	NA
Conservation Advice Subtropical and Temperate Coastal Saltmarsh. Threatened Species Scientific Committee (TSSC 2013)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	The conservation advice identifies coastal saltmarsh as important habitat in all oil spill contingency planning at national and State levels and monitor the application of protocols on the management of spills involving saltmarshes.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Approved Conservation Advice (including Listing Advice) for the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community (DoEE 2018a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Does not identify oil pollution as a threat.	NA
Turtles			

Recovery Plan for Marine Turtles (DoEE 2017)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.	Oil spills are identified as a threat in the recovery plan with the action of: • Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to the survival. • Manage anthropogenic activities in Biologically Important Areas to ensure that biologically important behaviour can continue. • Ensure spill risk strategies and response programs adequately include management for marine turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts. Turtle nesting habitat, seagrass meadows or coral reefs were not identified to occur within the Environmental Planning Area.
Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle) *(*DEWHA 2008)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify oil spill as a threat.	NA
Pinnipeds			
Conservation Advice *Neophoca*	Conservation advice guide recovery planning and identify	Conservation advice identifies oil spill as a threat with the action of:	This requirement is met by this risk assessment

***cinerea* Australian Sea Lion (TSSC 2020b)**	actions required for conservation and recovery of the threatened species or ecological community.	• Investigate and mitigate other potential threats to Australian Sea Lion populations, including pollution.	and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC. 2013a)	The overarching objective of this recovery plan is to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: • Improving the population status, leading to future removal of the Australian sea lion from the threatened species list of the EPBC Act.	Recovery plan identifies oil spill as a threat with the action of: • Improve the understanding of—and where necessary mitigate—the threat posed to Australian sea lion populations by oil spills: implement jurisdictional oil spill response strategies as required.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill.

	• Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future		• M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Whales			
Conservation Management Plan for the Blue Whale (DoE 2015c)	The long-term recovery objective for Blue Whales is to minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list.	Conservation management plan identifies oil spills as a threat with an action of: • Creation and/or updating of an oil spill response plan.	This requirement is met by this risk assessment and the implementation of: • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies pollution (persistent toxic pollutants) as a threat. No actions relevant to oil spills were identified.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with

			the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)	Recommends removal as a threaten species but remain a Matter of National Environmental Significance under the EPBC Act as a listed Migratory Species.	Listing advice identifies pollution as a threat. No actions relevant to oil spills were identified.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Advice *Balaenoptera borealis* sei whale (TSSC 2015c)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies pollution (persistent toxic pollutants) as a threat. No actions relevant to oil spills were identified.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with

			Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted OSMP to monitor for any potential impacts.
Conservation Management Plan for the Southern Right Whale (CoA 2012) **Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)**	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Conservation management plan identifies oil spills as a threat. No actions relevant to oil spills were identified.	This requirement is met by this risk assessment and the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act, MARPOL, COLREGS, Marine Orders and Vessel Pollution Emergency Plan to minimise the likelihood of an oil spill. • M#08: Oil Spill Response Plans with the NOPSEMA Accepted OPEP to minimise the effects of an oil spill and NOPSEMA Accepted

			OSMP to monitor for any potential impacts.
Marine Protected Areas			
Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (Parks Victoria 2015)	The Ngootyoong Gunditj Ngootyoong Mara South West Management Plan is a strategic guide for managing and protecting over 130 parks, reserves and Indigenous Protected Areas in south-west Victoria. It takes a multiple park planning approach within a geographic landscape and covers over 116 000 hectares.	Strategies within the plan relevant to oil spill are: • Work collaboratively to implement marine emergency contingency plans and arrangements with controlling agencies including for marine pollution, cetacean strandings and wildlife management. • Work with Port of Portland on marine pollution responses within the park and adjacent waters and maintain communications with the petroleum industry and relevant agencies with respect to petroleum activities near the park. • Report and respond to oil spills in and near the park in accordance with the Portland Region Marine Pollution Contingency Plan.	This requirement is met by the implementation of: M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Vessel Pollution Emergency Plan and M#08: Oil Spill Response Plans, the NOPSEMA Accepted OPEP as these plans detail reporting requirements and will be implemented to respond to an oil spill.
Twelve Apostles Marine National Park and The Arches Marine Sanctuary Management Plan (Parks Victoria 2006b).	The plan provides the basis for the future management of Twelve Apostles Marine National Park and The Arches Marine Sanctuary	Marine pollution, especially oil spills, is a significant threat to natural values, aesthetics, and public safety. Response to pollution at sea is guided by the National Plan to Combat Pollution of the Sea by Oil and other Noxious and Hazardous substances (AMSA 1998). In Victorian waters the Victorian Marine Pollution Contingency Plan (VICPLAN) (MSV 2002) outlines broad response arrangements to a potential oil or chemical spill. Under this plan, the park and sanctuary are within the Port of Portland Region. Actions relevant to oil spills are: • In accordance with the Portland Region Marine Pollution Contingency Plan, report oil spills in and near the planning area, and respond accordingly.	This requirement is met by the implementation of: • M#05: CGG Marine Assurance System which ensures compliance of contract vessels with Vessel Pollution Emergency Plan and M#08: Oil Spill Response Plans, the NOPSEMA Accepted OPEP as these plans detail reporting requirements and will be implemented to respond to an oil spill.

Annex 2: Loss of Containment Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Fish							
Australian Grayling	Species or species habitat known to occur within area	Vulnerable				None identified	Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)
Blue Warehou	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015)
Eastern Dwarf Galaxias, Dwarf Galaxias	Species or species habitat known to occur within area	Endangered				None identified	National Recovery Plan for the Dwarf Galaxias (*Galaxiella pusilla*) (Saddlier et al. 2010) Conservation Advice for *Galaxiella pusilla* (Dwarf Galaxias) (DCCEEW 2023j)
Eastern Gemfish	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Rexea solandri* (TSSC 2009)
Orange Roughy, Deep-sea Perch, Red Roughy	Species or species habitat likely to occur within area	Conservation Dependent				None identified	None identified
Southern Bluefin Tuna	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna) (TSSC 2010)
Yarra Pygmy Perch	Species or species habitat known to occur within area	Endangered				None identified	National Recovery Plan for the Yarra Pygmy Perch (*Nannoperca obscura*) (Sadler and Hammer 2010) Conservation Advice for *Nannoperca obscura* (Yarra Pygmy Perch) (DCCEEW 2023k)
Sharks							
Little Gulper Shark	Species or species habitat likely to occur within area	Conservation Dependent (listed as *Centrophorus zeehaani)*				None identified	Commonwealth Listing Advice on *Centrophorus zeeha* (southern dogfish) (TSSC 2013)
Porbeagle, Mackerel Shark	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Species or species habitat likely to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Galeorhinus galeus (*TSSC 2009a)
Shortfin Mako, Mako Shark	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Isurus oxyrinchus* shortfin mako shark (TSSC 2014)
White Shark, Great White Shark	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		Distribution and foraging	Recovery Plan for the White Shark (*Carcharodon carcharias*). (DSEWPaC 2013b)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Syngnathidae							
Australian Smooth Pipefish, Smooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Brushtail Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Bullneck Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Common Seadragon, Weedy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Deepbody Pipefish, Deep-bodied Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Hairy Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Halfbanded Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Javelin Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Knifesnout Pipefish, Knife-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Leafy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Mollison's Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Mother-of-pearl Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Port Phillip Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Pugnose Pipefish, Pug-nosed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Red Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Ringback Pipefish, Ring-backed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Robust Pipehorse, Robust Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Sawtooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Short-head Seahorse, Short-snouted Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spiny Pipehorse, Australian Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spotted Pipefish, Gulf Pipefish, Peacock Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Trawl Pipefish, Bass Strait Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Tucker's Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Seabirds							
Antipodean Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Australasian Gannet	Breeding known to occur within area				Listed	Foraging: year round 40 km buffer around coast off Portland	Wildlife Conservation Plan for Seabirds (CoA 2020a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)
Blue Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice *Halobaena caerulea* Blue Petrel (TSS 2015)
Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Campbell Albatross, Campbell Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Common Diving-Petrel	Breeding known to occur within area				Listed	Foraging: year round Breeding: July – January Buffer around Tasmania and Victoria	None identified
Fairy Prion	Species or species habitat known to occur within area	Vulnerable			Listed	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Fairy Prion (southern)	Species or species habitat known to occur within area	Vulnerable				None identified	Conservation Advice *Pachyptila turtur subantarctica* fairy prion (southern) (TSSC 2015)
Flesh-footed Shearwater, Fleshy-footed Shearwater	Species or species habitat known to occur within area		Migratory	Migratory Marine Birds	Listed (as *Puffinus carneipes*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Commonwealth Listing Advice on *Ardenna carneipes* (Flesh-footed Shearwater) (TSSC 2014)
Gould's Petrel, Australian Gould's Petrel	Species or species habitat may occur within area	Endangered				None identified	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)
Greater Crested Tern	Breeding known to occur within area		Migratory	Migratory Wetlands Species	Listed (as *Sterna bergii*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Grey-headed Albatross	Species or species habitat may occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Approved Conservation Advice for *Thalassarche chrysostoma* (Grey-headed Albatross) (DEWHA 2009)
Indian Yellow-nosed Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Most of the South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Little Penguin	Breeding known to occur within area				Listed	Breeding and foraging BIAs occur at Black Pyramid, Christmas Island and Councillor Island	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Northern Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable			Listed (as *Thalassarche sp. nov.)*	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Northern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)
Northern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Salvin's Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Short-tailed Shearwater	Breeding known to occur within area		Migratory	Migratory Marine Birds	Listed (as *Puffinus tenuirostris*)	Foraging Breeding Buffer around Tasmania including Bass Strait	None identified
Shy Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)) Conservation Advice *Thalassarche cauta* Shy Albatross (TSS 2020)
Silver Gull	Breeding known to occur within area				Listed (as *Larus novaehollandiae*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Soft-plumaged Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice *Pterodroma Mollis* Soft-plumaged Petrel (TSS 2015a)
Sooty Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Sooty Shearwater	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed (as *Puffinus griseus*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)
Southern Giant-Petrel, Southern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on *Macronectes giganteus* (Southern Giant-Petrel) (TSSC 2001a)
Southern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wandering Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wedge-tailed Shearwater			Migratory Marine Birds	Migratory Marine Birds	Listed	Foraging: Breeding: August - May 160 km around breeding area on Mutton Bird Island	Wildlife Conservation Plan for Seabirds (CoA 2020a)
White-bellied Sea-Eagle	Breeding known to occur within area				Listed	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian)	Species or species habitat likely to occur within area	Vulnerable				None identified	Lord Howe Island Biodiversity Management Plan (DECC 2007) – not relevant to Environmental Planning Area
White-capped Albatross	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Shorebird							
Australasian Bittern	Species or species habitat known to occur within area	Endangered				None identified	Conservation Advice *Botaurus poiciloptilus* Australasian Bittern. Threatened Species Scientific Committee (TSSC 2019a)
Australian Fairy Tern	Species or species habitat known to occur within area	Vulnerable				None identified	Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPaC. 2011) National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)
Australian Painted Snipe	Species or species habitat known to occur within area	Endangered			Listed - overfly marine area (as *Rostratula benghalensis (sensu lato*))	None identified	Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (DSEWPaC 2013) National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (CoA 2022a)
Bar-tailed Godwit	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Black-eared Cuckoo	Species or species habitat known to occur within area				Listed - overfly marine area (as *Chrysococcyx osculans*)	None identified	None identified
Black-faced Cormorant	Breeding known to occur within area				Listed	Breeding Foraging	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Black-faced Monarch	Species or species habitat may occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified
Black-tailed Godwit	Roosting known to occur within area	Endangered	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	Conservation Advice for *Limosa limosa* (Black-tailed Godwit) (DCCEEW 2024i) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Blue-winged Parrot	Species or species habitat known to occur within area	Vulnerable			Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)
Cape Gannet	Breeding known to occur within area				Listed	None identified	None identified

Common Name	**Presence**	**Threatened Category**	**Migratory Status**	**Migratory Category**	**Marine Status**	**Biologically Important Area**	**Management Plan Conservation Advice Listing Advice**
Cattle Egret	Species or species habitat may occur within area				Listed - overfly marine area (as *Ardea ibis*)	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Common Greenshank, Greenshank	Species or species habitat known to occur within area	Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Common Noddy	Species or species habitat likely to occur within area		Migratory	Migratory Marine Birds	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Common Sandpiper	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Curlew Sandpiper	Species or species habitat known to occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DCCEEW 2023m)
Double-banded Plover	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed – overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Eastern Curlew, Far Eastern Curlew	Species or species habitat known to occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)
Hooded Plover, Hooded Dotterel	Species or species habitat known to occur within area				Listed - overfly marine area (as *Thinornis rubricollis)*	None identified	None identified
Fork-tailed Swift	Species or species habitat likely to occur within area		Migratory	Migratory Marine Birds	Listed - overfly marine area	None identified	None identified
Great Knot	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Calidris tenuirostris* (great knot) (DCCEEW 2024f) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Brown Skua	Species or species habitat may occur within area				Listed (as *Catharacta skua*)	None identified	None identified
Greater Sand Plover, Large Sand Plover	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Charadrius leschenaultii* (Greater Sand Plover) (DCCEEW 2023o) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Grey Plover	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Pluvialis squatarola* (Grey Plover) (DCCEEW 2024h) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Grey-tailed Tattler	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed (as *Heteroscelus brevipes*)	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Hooded Plover, Hooded Dotterel	Species or species habitat known to occur within area				Listed - overfly marine area (as *Thinornis rubricollis)*	None identified	None identified
Latham's Snipe, Japanese Snipe	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Gallinago hardwickii* (Latham's snipe) (DCCEEW 2024d) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Lesser Sand Plover, Mongolian Plover	Roosting known to occur within area	Endangered	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice *Charadrius mongolus* Lesser Sand Plover (TSSC 2016c) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Little Curlew, Little Whimbrel	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Little Tern	Species or species habitat may occur within area		Migratory	Migratory Marine Birds	Listed (as *Sterna albifrons*)	None identified	Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (Western Pacific)) (TSSC 2002) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Magpie Goose	Species or species habitat may occur within area				Listed - overfly marine area	None identified	None identified
Marsh Sandpiper, Little Greenshank	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Species or species habitat known to occur within area	Endangered				None identified	Conservation Advice for Limosa lapponica baueri Bar-tailed Godwit (western Alaskan) (DCCEEW 2024b)
Orange-bellied Parrot	Species or species habitat known to occur within area	Critically Endangered			Listed - overfly marine area	None identified	Commonwealth Listing Advice on *Neophema chrysogaster* (TSSC 2006). National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)
Osprey	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Pacific Golden Plover	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Pectoral Sandpiper	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Pied Stilt, Black-winged Stilt	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Pin-tailed Snipe	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Plains-wanderer	Species or species habitat likely to occur within area	Critically Endangered				None identified	Conservation Advice *Pedionomus torquatus* Plains-wanderer (DoE 2015a) National Recovery Plan for the Plains-wanderer (*Pedionomus*

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
							torquatus) (DoE and SA DEWNR 2016)
Rainbow Bee-eater	Species or species habitat may occur within area				Listed - overfly marine area	None identified	None identified
Red Knot, Knot	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice *Calidris canutus* Red Knot (DCCEEW 2024) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Red-capped Plover	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Red-necked Avocet	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Red-necked Phalarope	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Red-necked Stint	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Ruddy Turnstone	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Rufous Fantail	Species or species habitat known to occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified
Sanderling	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	None identified
Satin Flycatcher	Breeding known to occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Sharp-tailed Sandpiper	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)
Swift Parrot	Species or species habitat likely to occur within area	Critically Endangered			Listed - overfly marine area	None identified	National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros 2011) Conservation Advice *Lathamus discolor* Swift Parrot (TSSC 2016a)
Swinhoe's Snipe	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Terek Sandpiper	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Xenus cinereus* (Terek Sandpiper) (DCCEEW 2024g) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Whimbrel	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
White-throated Needletail	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	Conservation Advice *Hirundapus caudacutus* White-throated Needletail (TSSC 2019)
Wood Sandpiper	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Yellow Wagtail	Species or species habitat may occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified
Turtles							
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*) (*DEWHA 2008)
Loggerhead Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Dolphins							
Bottlenose Dolphin	Species or species habitat may occur within area						None identified
Common Dolphin, Short-beaked Common Dolphin	Species or species habitat may occur within area						None identified
Dusky Dolphin	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species			None identified
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Species or species habitat likely to occur within area						None identified
Risso's Dolphin, Grampus	Species or species habitat may occur within area						None identified
Southern Right Whale Dolphin	Species or species habitat may occur within area						None identified
Whales							

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Andrew's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Antarctic Minke Whale, Dark-shoulder Minke Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Arnoux's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blainville's Beaked Whale, Dense-beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blue Whale	Foraging, feeding or related behaviour known to occur within area	Endangered	Migratory	Migratory Marine Species		Foraging (annual high use area)	Conservation Management Plan for the Blue Whale (DoE 2015c)
Cuvier's Beaked Whale, Goose-beaked Whale	Species or species habitat may occur within area					None identified	None identified
Dwarf Sperm Whale	Species or species habitat may occur within area					None identified	None identified
False Killer Whale	Species or species habitat likely to occur within area					None identified	None identified
Fin Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)
Gray's Beaked Whale, Scamperdown Whale	Species or species habitat may occur within area					None identified	None identified
Hector's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Humpback Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Killer Whale, Orca	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Long-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Minke Whale	Species or species habitat may occur within area					None identified	None identified
Pygmy Right Whale	Foraging, feeding or related behaviour likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Pygmy Sperm Whale	Species or species habitat may occur within area					None identified	None identified
Sei Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera borealis* sei whale (TSSC 2015c)
Shepherd's Beaked Whale, Tasman Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Short-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Southern Bottlenose Whale	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale	Breeding known to occur within area	Endangered	Migratory (as Balaena glacialis australis)	Migratory Marine Species		Reproduction and Migration BIAs	Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)
Sperm Whale	Species or species habitat may occur within area		Migratory	Migratory Marine Species		None identified	None identified
Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
True's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Pinnipeds							
Australian Fur-seal, Australo-African Fur-seal	Breeding known to occur within area				Listed	None identified	None identified
Australian Sea-lion, Australian Sea Lion	Species or species habitat known to occur within area	Endangered			Listed	None identified	Conservation Advice *Neophoca cinerea* Australian Sea Lion (TSSC 2020b) Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC. 2013a)
Long-nosed Fur-seal, New Zealand Fur-seal	Species or species habitat may occur within area				Listed	None identified	None identified

Impact Assessment Physical Presence

Appendix E1: REG-EP-020-E1

Rev 2

May 2024

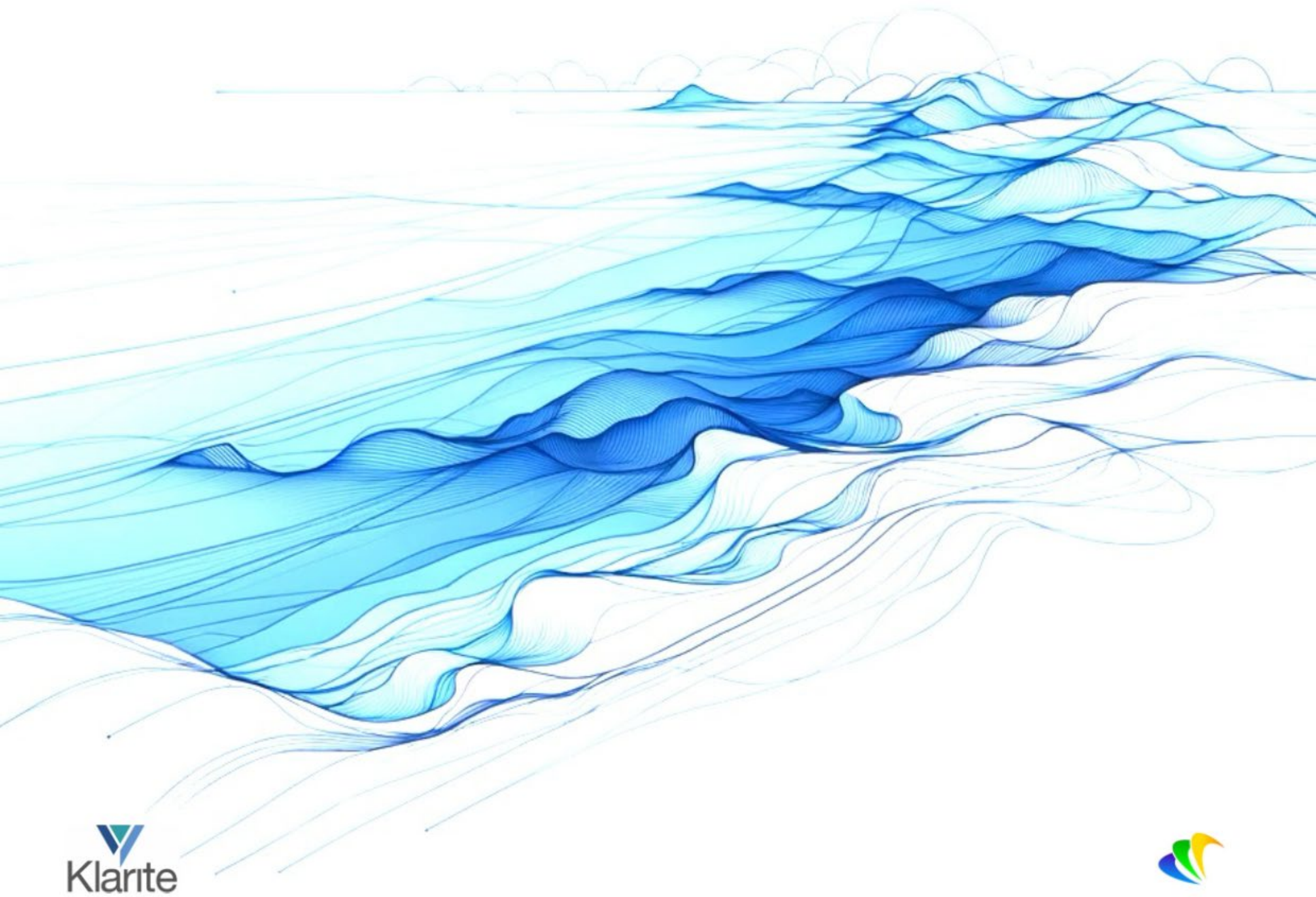

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (**Regia MSS**) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (**PEIRA**) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Commercial Fisheries Analysis Report (Appendix B6)
2. Cultural Heritage Assessment Report (Appendix B10)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (**EP**) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E1-2-1 shows feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E1-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E1-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E1-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E1-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Objection through an online survey to seismic surveying due to impacts on SRW and Traditional Owner values.	74	CGG provided information and sought further feedback.
An email received detailing seismic blasting should not occur within 20 km of the vicinity of these beaches at any time of the year. These beaches (and others) are utilised all year round by members of our community.	95	CGG will implement a 145 dB threshold exceedance limit at popular beaches.
A response to the interactive map stating no disruption to SRW calving grounds and First Nations values of them.	164	CGG have agreed to implement the following measures: Exclusion of SRW reproductive BIA - adopted. Exclusion of SRW BIA+15 km buffer while SRW present - adopted. Policy Statement 2.1 measures, plus others - adopted. Fauna Management Plan - adopted.
Email received regarding "other fishermen that have been displaced by your operations moving into the area I am working in resulting in reduced catch rates".	226	Compensation protocol to be adopted with CPUE adjustment calculation method.
Email received from fishing association requesting the need to understand the overlap of the survey with historical fishing activities.	172	CGG will implement an activity limitation of no acquisition beyond 200 m depth contour.
Members of the public raised an objection regarding the negative impact on marine life and climate	166, 405, 406, 408, 409, 412, 414	CGG will implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Compensation protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.

Objection raised by Marine Parks regarding the spatial avoidance of fishing grounds and, or temporal avoidance of fishing seasons.	232	CGG will implement a 50m exclusion zone ss this is protective for abalone divers, abalone, and other recreational marine users.
Concern raised at a community session regarding the fur seal colony on Deen Maar.	97	CGG will implement a 17 km buffer around Deen Maar. Project vessels will not traverse between Lady Percy Julia Island / Deen Maar and the mainland.
A member of the public raised a concern through the interactive map regarding the impact of seismic blasts on fur seal colony in Deen Maar and about the sacred importance of Deen Maar for the indigenous community.	222	

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E1-2-2 shows how this feedback has been incorporated into the environmental assessments.

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).

3 Aspect – Physical Presence of Vessels and Towed Equipment

3.1 How the Aspect Occurs

The physical presence of the survey vessel with the towed sound source and streamers and the support vessels operating in marine waters may interfere with other marine users' activities.

The aspect does not cover the risk of a vessel collision with other marine users as this is assessed in the Accidental Release of Fuel section.

3.2 Extent and Duration of the Aspect

Duration: 90 days

Extent: Operational Area

The extent of the area where the physical presence of vessels and towed equipment will occur is within the Operational Area and the impact could occur while the activity is undertaken.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to the physical presence of vessels and towed equipment.

4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for the physical presence of vessels and towed equipment for the following environmental components:

- Commercial fishing and aquaculture
- Indigenous culture
- Marine industries
- Diving
- Marine tourism
- Recreational fishing

The PEIRA did not identify any environment components that were ranked as having a negligible level of effect and are not required to be assessed further in this section.

Via relevant person consultation the Department of Defence has confirmed the Operational Area is located outside of any Defence Training Areas and restricted airspace thus no impact is predicted from the physical presence of vessels and towed equipment, and they are not assessed further in this section.

Based on relevant person consultation, an activity limitation (M#01) has been put in place where no seismic acquisition will be undertaken in water depths shallower than 50 m to reduce impacts to commercial and recreational fishers, surfers, swimmers, and coastal users. As recreational diving and diving for commercial fisheries takes place in water depths less than 50 m no impact is predicted from the physical presence of vessels and towed equipment, and they are not assessed further in this section.

The limited manoeuvrability of the seismic survey vessel while towing the source array and streamers means that other marine user may have to avoid the immediate vicinity of the seismic survey vessel and towed equipment. In addition, commercial fishing vessels may be asked to remove fishing gear such as traps and lines to avoid interaction with the seismic survey vessel and towed equipment.

5 Description of the Existing Environment that May be Affected by the Activity

As detailed in the Section Extent and Duration of the Aspect, the Operational Area has been adopted as the extent of the area where other marine users' activities may be affected by the physical presence of vessels and towed equipment associated with the Regia MSS.

Other marine users identified within Section 0, are described in this section.

5.1.1 Commercial Fishing and Aquaculture

A review of commercial fisheries was undertaken identify Commonwealth and State (Victorian, Tasmanian, and South Australian) fisheries that fish or potentially fish within the Operational Area and is available in Appendix B6: Commercial Fisheries Analysis Report.

The review identified the following commercial fisheries that have catch effort, and hence are likely to be fish within the Operational Area:

- Commonwealth
    - Bass Strait Central Zone Scallop Fishery
    - Eastern Tuna and Billfish Fishery
    - Small Pelagic Fishery
    - Southern and Eastern Scalefish and Shark Fishery following sectors:
    - Shark Hook Sub-Sector

  - Shark Gillnet Sub-sector
  - Trawl – otter board
  - Southern Squid Jig Fishery
  - Western Tuna and Billfish Fishery
- Victorian:
  - Giant Crab
  - Multi-species Ocean
  - Octopus
  - Southern Rock Lobster
  - Wrasse
- Tasmania: No fisheries identified.

A summary of these fisheries is provided in Table E1-5-1 with further details in Appendix B6: Commercial Fisheries Analysis Report.

Table E1-5-1: Summary of Level of Fishing Activity within the Operational Area

Fishery	**Level of Activity within the Operational Area**	**Summary**
Commonwealth Fisheries		
Bass Strait Central Zone Scallop Fishery	The Operational Area overlaps a small area of the fishery where there has been > 5 fishers during 2010 to 2020.	Low
Eastern Tuna and Billfish Fishery	The Operational Area overlaps the fishery where there has been > 5 fishers during 2010 to 2020.	Low
Small Pelagic Fishery (Western sub-area)	The Operational Area overlaps a small area of the fishery where there has been > 5 fishers during 2010 to 2020.	Low
Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Hook Sub-sector	The Operational Area overlaps the fishery where there has been > 5 fishers during 2010 to 2020.	Low
Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Gillnet Sub-sector	The Operational Area overlaps the fishery where there has been a high level of fishing intensity during 2010 to 2020.	High
Southern and Eastern Scalefish and Shark Fishery (SESSF) - Commonwealth Trawl Sector	The Operational Area overlaps the fishery where there has been a high level of fishing intensity during 2010 to 2020.	High
Southern and Eastern Scalefish and Shark Fishery (SESSF) - Commonwealth Trawl Sector, Danish Seine Sub-sector	The Operational Area overlaps the fishery where there has been > 5 fishers during 2010 to 2020.	Low
Southern and Eastern Scalefish and Shark Fishery (SESSF) -Scalefish Hook Sector	The Operational Area overlaps the fishery where there has been a low level of fishing intensity during 2010 to 2020.	Low
Southern Squid Jig Fishery	The Operational Area overlaps the fishery where there has been a high level of fishing intensity during 2010 to 2020.	High
Western Tuna and Billfish Fishery	The Operational Area overlaps a small area of the fishery where there has been > 5 fishers during 2010 to 2020.	Low

Fishery	Level of Activity within the Operational Area	Summary
Victorian Fisheries		
Giant Crab Fishery	During 2011 to 2021 the maximum number of vessels that fished within the Operational Area was three and the maximum days per year was 24.	Low
Multispecies Ocean Fisheries – Ocean General	During 2011 to 2021 the maximum number of vessels that fished within the Operational Area was five and the maximum days per year was 40.	Low
Octopus Fishery	During 2020 to 2021 the maximum number of vessels that fished within the Operational Area was one and the maximum days per year was one.	Low
Rock Lobster Fishery	During 2011 to 2021 the maximum number of vessels that fished within the Operational Area was ten and the maximum days per year was 316.	High
Wrasse (Ocean) Fishery	During 2011 – 2021 the maximum number of vessels that fished within the Operational Area was three and the maximum days per year was 100. Activity was within a small number of grids (four) within the Operational Area.	Low

5.1.2 Indigenous Culture

Biosis Pty Ltd (**Biosis**) was commissioned by ConocoPhillips to undertake a cultural heritage desktop assessment for the proposed resource exploration in Bass Strait. ConocoPhillips and Biosis gave permission for CGG to utilise this report given the overlap of the study area with the Regia MSS. The report is provided as part of this EP at Appendix B10, and a short summary is included in this document.

The purpose of the report was to explore cultural heritage and cultural heritage landscapes to understand Country, and Sea Country within and surrounding the project area to provide the project a grounding in Aboriginal cultural heritage. The report describes the known cultural environment, include a brief ethnohistory and history, and detailed results of register searches.

The study area includes the proposed permit areas (the location of the exploration zone(s)), where surveys may occur. In general, the permit areas are located south of Port Fairy and the Great Otway National Park, and west of King Island. The study area consists of a large geographical area which is based on stochastic modelling of oil spills, generating a statistical area where impacts may occur under many eventualities.

Due to the significant size of the study area, it is broken into three areas:

1. Primary Stakeholder area (Victoria) – the area directly surrounding the proposed permit areas and adjacent coastlines.
2. Secondary Stakeholder area – the wider area affected by the modelling of oil spills.
3. Primary Stakeholder area (Tasmania) – North and Northwest Tasmania and the Bass Strait islands.

Within the study area, along the Victorian coast, there are 5636 registered Aboriginal places with the most common site types being shell middens, artefact scatters and Low-Density Artefact Distributions (**LDADs**). Shell middens are typically found along the coastline, whereas artefact scatters, while also being found along the coast, are varied, and move inland following freshwater sources, likely to be indicative of past inland-coastal travel routes. LDADs are also typically found further inland than shell middens and artefact scatters, indicative of widespread use of the landscape in the past, rather than concentrations and repeated patterning.

The study concludes that there is a high likelihood for Aboriginal cultural heritage material to be present within the areas subject to potential impact.

CGG notes that the report identifies many cultural sites at coastal areas that will not be affected by the Regia MSS. Rather, the spiritual values and cultural sensitivities are the more likely values and sensitivities affected. The Operational Area is adjacent to Eastern Maar and Gunditjmara Native Title determinations (Appendix B12 MAP-REG-EPM-076). Native Title has not been identified to occur within the operational area.

Appendix B10 provides a description of the cultural heritage values and sensitivities, noting that not all of these will be affected by the Regia MSS. Further research about spiritual connections of First Nations peoples to Sea Country was undertaken during the search for relevant persons. The outcome of this further research is available to NOPSEMA in the sensitive information part of the EP (Appendix C3).

5.1.3 Marine Industries

Marine industries within the Operational Area that could be impacted by the physical presence of the survey vessel and towed equipment are the offshore energy and shipping.

5.1.3.1 Offshore Energy

Within the Operational Area is the Beach Energy Otway Development consisting of subsea infrastructure and the Thylacine-A unmanned platform and the Cooper Energy Casino Henry Netherby Development consisting of subsea infrastructure (Appendix B12 MAP-REG-EPM-082). During the Regia MSS design envelope (1 November 2023 to 31 October 2028) there is the potential for exploration and development activities such as infrastructure inspection, maintenance and repairs campaigns, seabed surveys, seismic surveys, drilling, and infrastructure installation to be undertaken with vessels and drill rigs to support the ongoing energy supply of oil and gas and potentially renewables within the Otway Basin.

5.1.3.2 Shipping

The South East Marine Region is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes. Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania. Ports Australia provide statistics for port operations throughout Australia's main commercial ports. Based on the latest information (2021) the majority of commercial shipping traffic transiting to and from Victorian ports were container (3,682), general cargo (2,663), bulk liquid carriers (2,019), dry bulk (1,715), car carrier (1,342), bulk gas (220), other cargo (47) and livestock (9).

5.1.4 Marine Tourism

No areas of marine tourism were identified within the Operational Area. Areas where marine tourism occur such as Deen Maar (Lady Julia Percy Island), Australian Marine Parks, Victorian Marine Parks, and Sanctuaries are outside of the Operational Area.

From relevant person consultation undertaken during preparation of the EP, a low level of fishing tour operators (one) was identified to occur within Operational Area.

5.1.5 Recreational Fishing

Recreational fishing from vessels including fishing tour operators, may occur within the Operational Area.

Several fishing tour operators operate from coastal towns such as Port Fairy, Warrnambool, Portland, and Port Campbell that fish in offshore waters for species such as Blue Fin Tuna, Shark (Gummy, School and Mako), Yellowtail Kingfish and reef species including Snapper, Morwong, Nannygai.

From relevant person consultation undertaken during preparation of the EP, a low level of fishing tour operators (one) was identified to occur within Operational Area.

6 Predicted Levels of Impact

6.1.1 Changes to the functions, interests, or activities of other users

The limited manoeuvrability of the seismic survey vessel while towing the source array and streamers means that other marine user may have to avoid the immediate vicinity of the seismic survey vessel and towed equipment.

For vessels that are transiting through the area, such as shipping, they may be required to move around the seismic vessel when the streamers are deployed. This could result in a detour of 10 km and take approximately 16 minutes for a vessel travelling at 20 knots (38 km/hr). However, avoidance of slow-moving vessels or obstacles are normal practice for shipping vessels and impacts can be avoided by Notification to Mariners (M#02) that alert ships to slow moving vessels or obstacles such as the survey vessel.

Areas such as Deen Maar (Lady Julia Percy Island) that hold deep and significant cultural association for Traditional Owners are outside of the Operational Area and hence no impact is predicted from the physical presence of the survey and support vessel. Indigenous fishing has not been identified within the Operational Area and hence no impact is predicted from the physical presence of the survey and support vessel. Impacts to cultural values associated with Sea Country are also not predicted from the physical presence of the survey and support vessel.

Recreation and tourism could be affected by restricted access to an area where recreational fishing or fishing tours occur. Most vessel recreational fishing and fishing tours are day tours with no overnight stays. If a recreational fisher or fishing tour operator plans to fish within the Operational Area an area may need to be avoided for a short period of time (hours) while acquisition occurs in the area. From relevant person consultation undertaken during preparation of the EP, a low level of fishing tour operators (one to date) has been identified to occur within Operational Area. Impacts to recreational and fishing tour operators can be minimised via notifications and lookaheads (M#02) as part of planning and undertaking the Regia MSS.

The Beach Energy Otway Development and Cooper Energy Casino Henry Netherby Development are within the Operational Area. Impacts could occur if these companies are undertaking exploration or development activities during the Regia MSS. To ensure impacts to Beach and Cooper and CGG are minimised, planning between the companies is ongoing and, in the event, activities are planned to occur at the same time in the same area a Simultaneous Operations Plan (M#02) will be developed.

As detailed in Commercial Fishery Analysis Report (Appendix B6) and summarised in Table E1-5-1 there are several Commonwealth and Victorian commercial fisheries that have fishing effort within the Operational Area. Most of the activity is low level (> 5 vessels) except for the Victorian Rock Lobster Fishery and Commonwealth Southern and Eastern Scalefish and Shark Fishery Commonwealth Shark Gillnet Sub-sector and Commonwealth Trawl Sector, and Southern Squid Jig Fishery. Commercial fishers may be impacted by having to avoid an area of the Operational Area while acquisition occurs. This may be for hours or days depending on the fishing location within the acquisition area and the type of fishing equipment used, as fishers using pots, nets and traps may need to avoid an area for longer than trawling and squid jigging where the fishing vessel is moving. There is also a risk that fishing equipment such as pots, nets and traps can become entangled with the seismic survey equipment.

The predicted level of effect to the functions, interests, or activities of other marine users from the physical presence of the survey vessel and towed equipment and the support vessels is assessed as moderate as there may be displacement, however impacts are temporary and, in most cases, avoidable based on:

- Pre-survey communications prior to the start of the survey, with daily lookahead information provided during the survey. CGG will work proactively and collaboratively with other marine users so that both parties can plan activities in a manner that minimises potential displacement to each party (M#02).
- When the seismic vessel has equipment deployed it will typically move along pre-determined survey lines in a racetrack pattern at a constant speed of ~ 3-6 knots (~ 5.5 to

11 km/hr) (M#01) that will be communicated to other marine users so they can proactively avoid the area.

- The survey lines are planned to be acquired as three racetracks thus, other marine users would at the worst case, be displaced from a third of the Acquisition Area at a time.
- No marine tourism or diving has been identified to occur within the Operational Area.
- Shipping deviations are predicted to be minor and have a negligible impact on travel times or fuel use. Deviations are normal practice and impacts can be avoided by Notification to Mariners (CM#02) that alert ships to slow moving vessels or obstacles such as the survey vessel.
- Impacts to Indigenous culture and values are not predicted from the presence of the vessels and equipment.
- A low level of fishing tour operators (one to date) has been identified to occur within Operational Area.
- Commercial fishing effort within the Operational Area is of a low level (< 5 vessels) except for the Victorian Rock Lobster Fishery and Commonwealth Southern and Eastern Scalefish and Shark Fishery Commonwealth Shark Gillnet Sub-sector and Commonwealth Trawl Sector, and Southern Squid Jig Fishery.
- CGG will implement an adjustment protocol (M#07) in the event displacement cannot be avoided and there is a financial loss to the marine user.

The uncertainty level for impact of the physical presence of the survey vessel to the functions, interests and activities of other marine users is assessed as low based on:

- Extensive relevant person consultation was undertaken during the preparation of the EP to identify other marine users that may be present within the Operational Area.
- CGG will communicate with marine users prior to and during the survey to ensure other marine users can undertake their activities in a manner that avoids any interactions or can engage with CGG so that both parties can plan activities in a manner that minimises potential displacement to each party.
- There is no predicted impact to marine tourism, divers, or indigenous culture values.
- CGC will implement a compensation process in the event displacement cannot be avoided and there is a financial loss to the marine user.

The predicted level of impact based on the effect (moderate) and uncertainty (low) is assessed as medium. For marine users the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in the Comparison of Predicted Level and Defined Acceptable Level. The mitigation and management measures detailed in the Identification of Mitigation and Management Measures and Demonstration of ALARP provide sufficient confidence in the predicted effect levels.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
Principles of ESD	Impact result in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts are temporary, reversible, and small-scale.	Yes
	The impact assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government data were used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts to marine users.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Not applicable.	NA
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Not applicable.	NA
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Not applicable.	NA
Economic	Affected persons will not be worse off as a result of the activity.	Predicted impacts are temporary and in most cases avoidable. A compensation process will be implemented in the event displacement cannot be avoided and there is a financial loss to the marine user.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Impacts to cultural features including cultural values, traditions, or practices, are not predicted.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is moderate.	Yes

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons as per the stakeholder feedback of: Ensure continued liaison with the Australian Hydrographic Service (AHS) for Notices to Mariners (NOTMAR), ensure that the AHS is notified three weeks prior to the actual commencement of activities. This information is critical to maritime safety and reduces negative impacts on other maritime users. This is addressed by M#02: Consultation Management System. CCG have adopted an adjustment protocol that will ensure that no fisher will be worse off as a result of the Regia MSS and that reasonable, evidence-based claims will be paid. M#07 will be adopted to reflect the arrangements that will give effect to the adjustment protocol. See Section 8 Identification of Mitigation and Management Measures and Demonstration of ALARP, for detailed information on the measure identified.	Yes
	The views of public have been considered in the impact and risk assessment.	No public comments have been received in relation to the physical presence of the vessels and equipment in relation to impacts to marine users.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measures	**Justification**	**Adopted**
M#05: CGG Marine Assurance System	Vessel will adhere to the requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea (SOLAS) as implemented in Commonwealth Waters through the Navigation Act 2012 and associated Marine Orders 21 Safety and Emergency Arrangements, 30 Prevention of Collisions and 31 SOLAS and non-SOLAS certification including: Appropriate lighting, navigation, and communication to inform other users. Use of radar and 24/7 watch. It is a legislative requirement for vessels to comply with the Navigation Act and Marine Orders. The CGG Marine Assurance System ensure compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.	Yes
	Streamer tail buoys will be used to mark ends of the streamers so that they can be detected by other vessels.	Yes
M#02: Consultation Management System	CGG will implement the Consultation Management System to ensure that pre and during survey communications will be undertaken so that other marine users know when, where and how the Regia MSS will be undertaken so they can undertake their activities in a manner that avoids any interactions or can engage with CGG so that both parties can plan activities in a manner that minimises potential displacement to each party.	Yes
M#07: Adjustment Protocol	An adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Other titleholders in the region will be invited to participate in the review, update, and implementation of the adjustment process.	Yes

Measures assessed and not adopted.

Measure	**Justification**	**Adopted**
Seasonal timing of the survey to avoid peak fishing seasons.	Fishing activities within the Operational Area occur all year round except for: Giant crab closed seasons are: Male: 15 September to 15 November to protect males during moult. Female: 1 June to 15 November to protect females while breeding and in berry (with eggs attached). Rock lobster closed seasons. The closed season for female rock lobsters is from 1 June to 15 November and is designed to protect females in berry (with eggs attached) during the spawning period. The closed season for male rock lobsters is from 15 September to 15 November and is designed to protect males during the moulting period when soft shells increase their vulnerability. The survey is not being undertaken during this time to avoid overlapping the period when southern right whales are within the reproductive BIA (May-November).	No

Measure	Justification	Adopted
	With the other measures in place impacts to commercial fishers can be managed to ensure that fishers are not displaced from their fishing areas or where this cannot be avoided there is no financial loss.	

9 Conclusions

This impact assessment has demonstrated that the effect of the physical presence of the survey vessels and towed equipment to marine users has a:

- **Predicted level of effect of moderate.**
- **An uncertainty of low.**
- **Predicted level of impact of medium.**

10 Recommendations

As demonstrated in this impact assessment the predicted level of impact level is medium. The predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels, thus there are no further recommendations.

11 Document Control

Table 2 - Revision history

Date	Revision	Update
20 June 2023	A	Draft prepared for initial comment
30 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA

12 References

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Annex 1: Legislative and Other Requirements Relevant to Physical Presence

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Fisheries Management Act 1991	The Fisheries Management Act 1991 establishes the legislative framework for the sustainable use and conservation of fisheries resources, and for the management of fishing activities by commercial, recreational, and Indigenous fishers.	Commercial and recreational fishing occur within the Operational Area. No indigenous fishing has been identified to occur within the Operational Area.	This impact assessment and identified measures details that CGG will work collaboratively with other marine users to avoid displacing them from their activities. In the event displacement cannot be avoided and there is a financial loss to the marine user a compensation process will be implemented.
Native Title Act 1993	The main objects of this Act are: to provide for the recognition and protection of native title; and to establish ways in which future dealings affecting native title may proceed and to set standards for those dealings; and to establish a mechanism for determining claims to native title; and to provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title.	Native Title has not been identified to occur within the Operational Area.	Consultation has been undertaken with First Nations Registered Aboriginal Parties.
Offshore Petroleum and Greenhouse Gas Storage Act 2006	The act provides a regulatory framework for offshore petroleum and greenhouse gas storage activities, which includes seismic surveys.	Section 280 requires that a person carrying on activities in an offshore area under the permit, lease, licence, authority or consent must carry on those activities in a manner that does not interfere with navigation or fishing (among others) to a greater extent than is necessary for the reasonable exercise of the rights	This impact assessment and identified measures details that CGG will work collaboratively with other marine users to avoid displacing them from their activities. In the event displacement cannot be avoided and there is a financial loss to the marine user a compensation process will be implemented.
Environmental Management in the Upstream Oil and Gas Industry (IOGP-IPIECA, 2020)	The primary focus of this report is on managing the risk from potential impacts to the natural	Of relevance are: Develop exclusion zones in consultation with key stakeholders, including local fishing	These requirements have been met by:

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
	environment during exploration and production of oil and gas.	communities; raise awareness of exclusion zones with all stakeholders. Issue a 'Notice to Mariners' through the relevant government agencies, detailing the area of operations. Ensure all vessels adhere to International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels. Optimise vessel use to ensure the number of vessels required and length of time that vessels are on site is as low as practicable.	The following exclusions zones have been put in place based on consultation with relevant persons: No acquisition in water depths less than 40 m to avoid displacement of divers and other nearshore recreational marine users. No acquisition within 17 km of Deen Maar which will avoid displacement of marine tourism operators. [Distance updated in response to Activity Limitation 11 and Matter F17] M#02: Pre and During Survey Communications includes notification to Australian Hydrographic Service who issue Notices to Mariners. M#04: CGG Marine Assurance System ensure compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders. The survey designed has been optimised to ensure the most effective survey design to limit the time the vessels are on site.
International Association of Geophysical Contractors (IAGC) Environment Manual for Worldwide Geophysical Operations (2013)	Provides the industry with information for conducting geophysical field operations in an environmentally sensitive manner.	Of relevance is: Section 8.4 (Travel – water travel) – maintain a lookout for, and establish communications with local fishing boats, tourist diving vessels, etc, where possible to minimise interruption with their operations and equipment.	These requirements have been met by: M#04: Support Vessel where at least one vessel will accompany the survey vessel to identify other marine users and fishing equipment in the area. M#02: Pre and During Survey Communications which includes establishing communications with other marine users to minimise interruption with their operations and equipment.

Impact Assessment
Underwater Sound: Plankton

Appendix E2: REG-EP-021-E2

Rev 2

May 2024

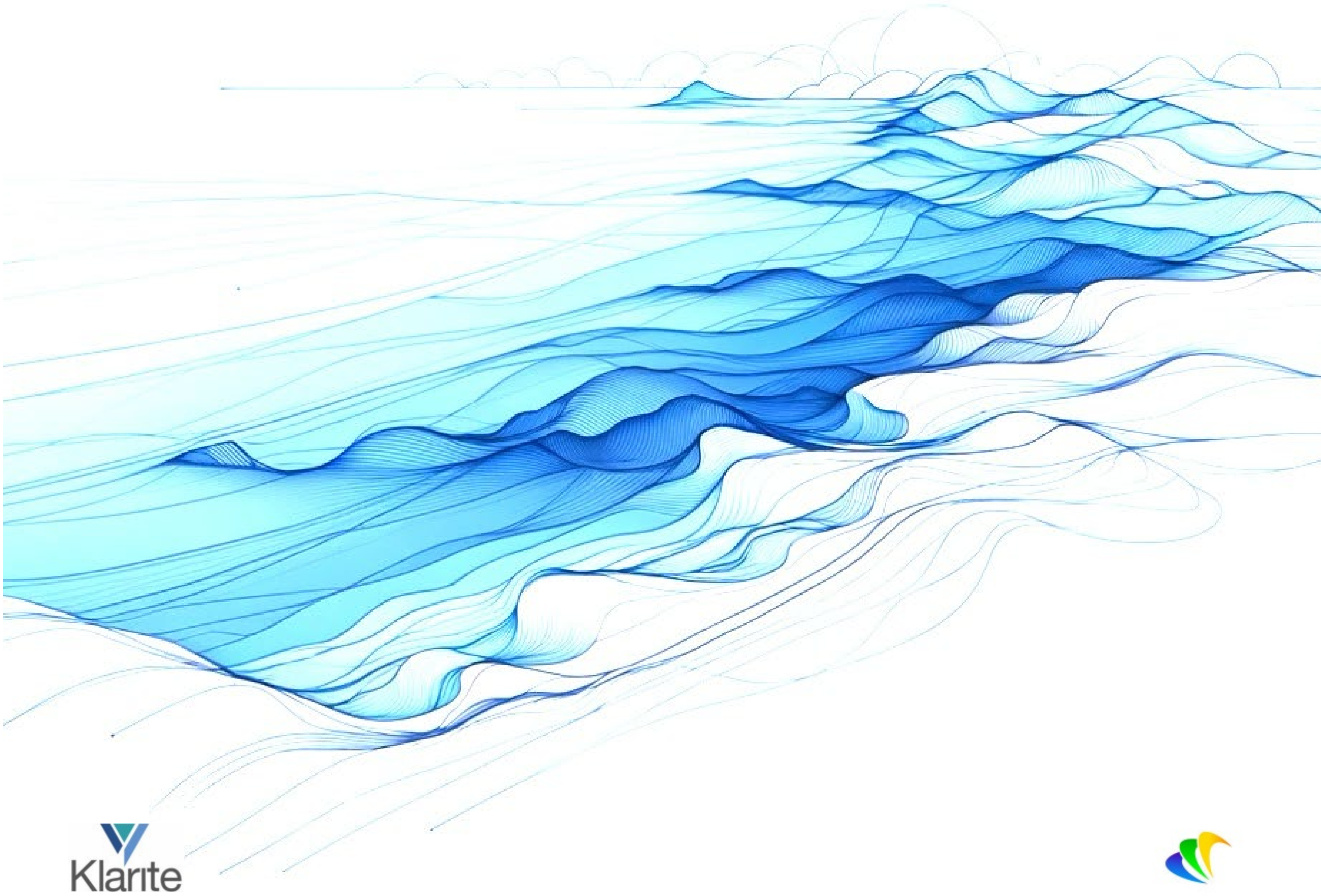

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (**Regia MSS**) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (**PEIRA**) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7)
2. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (**EP**) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E2-2-1 shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E2-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E2-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E2-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E2-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Feedback from a community session on the impact of seismic blasting on penguins and their food supply	135	CGG included an assessment of zooplankton and food supply in impact assessment.
Email received detailing the negative impact on marine life and climate	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Compensation protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E2-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E2-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Unacceptable impacts and risks to Marine Parks and protected areas	E01	CGG has considered these claims and has updated figures in Appendix B12 to include distances from operational and activity action zone areas to marine parks, reserves, and KEFs thereby providing further context of separation distances; and has calculated the percentage overlap of the Regia Operational Area with Bonney Coast Upwelling KEF.
Matter: Awareness of, and impacts on marine flora	E09	CGG has considered these claims and has added Section 4.4 to include information relevant to marine flora.
Matter: Risks to seaweed	E10	CGG has considered these claims and has added Section 4.4 to include information relevant to risks to seaweed.
Matter: Impacts on planktonic seaweed	E10 & FN06	CGG has considered these claims and has added Section 4.4 to include information relevant to impacts on planktonic seaweed.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

An overview of underwater sound and studies relevant to seismic is in Appendix B8.

Continuous underwater acoustic emissions are generated by the survey and support vessels and helicopters. Underwater acoustic emissions from vessels are generated by thrusters, engines, and propellers. Underwater acoustic emissions from helicopters are generated via the engine and rotors.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area + 230 m based on the furthest distance to modelled sound effect criteria. [Updated in response to Matter: F17]

The seismic source will only be active in the Active Source Area.

Continuous Sound

Duration: 90 days

Extent: Operational Area

The survey and support vessels and helicopters will be active in the Operational Area for the duration of the survey undertaking support activities and acquisition.

3.3 Legislative and Other Requirements

No legislative or other requirements applicable to plankton and underwater sound were identified.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for plankton.

There is no scientific information on the potential for underwater sound impacts on phytoplankton and no cause-effect pathway has been established. Thus, the impact assessment focuses on impacts to zooplankton from seismic sound emissions.

In addition, there is no scientific information on the potential for continuous underwater sound impacts to plankton and no cause-effect pathway has been established. Thus, the impact assessment focuses on impacts from impulsive (seismic) underwater sound to zooplankton.

From relevant person consultation, commercial fishers have raised concerns in relation to impacts to commercial fish and invertebrate spawning and recruitment. The assessment of impacts to commercial fish and invertebrate spawning and recruitment is covered by species in the underwater sound Impact assessment sections for invertebrates and fish.

From relevant person consultation, concerns have been raised in relation to impacts to zooplankton, particularly the copepod *Nyctiphanes australis*, generally called krill, which is an important component of the upwelling and productivity systems within the Survey Operational Area. These concerns are assessed in this section.

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (**JASCO**) to undertake a numerical modelling study of underwater sound levels associated with the initial Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including plankton.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Two modelling reports were procured, one in the preparation phase of the EP (Koessler et al. 2023) and which is available in Appendix B7a and a second iteration during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m. The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria.

4 Description of the Existing Environment that may be Affected by the Activity

Plankton is a collective term for marine organisms that are unable to swim against a current. This group is diverse and includes phytoplankton (plants) and zooplankton (animals).

Plankton is a key component in oceanic food chains and supports nearly all marine life and is the dominant biomass of marine ecosystems (CSIRO 2015). The carrying capacity of marine ecosystems (the biomass of fish resources) and recruitment of individual stocks is strongly related to plankton abundance, timing, and composition.

Plankton communities are highly diverse, with members from almost all phyla. Phytoplankton are the [plant] base of this community, capturing energy through photosynthesis while drifting with the ocean currents. They are grazed by zooplankton which are comprised of meroplankton which spend only the early part of their lives in the plankton (e.g. larval stages of jellyfish, molluscs, invertebrates, and fish) and holoplankton, such as copepods, chaetognaths and salps, which spend their entire life as zooplankton (White 2018).

The small sizes, short lifespans and high abundances of zooplankton enables fast rates of production and turnover of populations. It is advantageous to grow and multiply quickly to maximise access to phytoplankton resources when they become available (White 2018). Zooplankton are the key trophic link converting primary production into a food source for fish, such as sardines, which in turn are consumed by top predators such as tuna, shark and dolphins.

Watson and Chaloupka (1982) reported a high diversity of zooplankton in eastern and central Bass Strait, with over 170 species recorded while Kimmerer and McKinnon (1984) reported only 80 species in their surveys of western and central Bass Strait.

CSIRO's Australian Ocean Data Network which is a primary resource for marine science data does not contain any data collection points within the Active Source Area. The closest data points, located south of Wilson's Promontory, show that zooplankton samples taken at these sites from 2011-2020 contained copepods, appendicularians, chaetognaths, decapods, thaliaceans, cladocerans, amphipods, cirripedes and mysids with copepods the most abundant group in the samples. Surveys of the Eastern Great Australian Bight also highlighted the dominance of copepods in the zooplankton community (Van Ruth & Ward 2009).

4.1 Krill - *Nyctiphanes australis*

Nyctiphanes australis is a common endemic coastal species of krill in southern Australian waters and plays an important role in the ecological significance of upwelling events in the area (e.g. the Bonney Coast Upwelling). *N. australis* is one of the most important dietary items for Pygmy Blue Whales, Jack Mackerel, Short-tailed Shearwater, Fairy Prion, Australian Salmon, Skipjack Tuna and Tiger Flathead among other abundant fish and seabirds (Nicol and Endo 1997).

The latitudinal range of *N. australis* in Australian waters extends from 31ºS–44ºS latitude to 132ºE–156ºE longitude, reaching their highest abundances in shallow waters of the continental shelf, predominantly during night-time vertical migrations (Hosie 1982). This vertical migration pattern is more evident during summer than winter (July to September), when *N. australis* becomes relatively scarce in the upper water column, even during the night. In southeastern Tasmania, highest abundances are found in summer between the surface and 40 m during the night and 30–100 m during the day; however, it is not rare to observe large numbers swimming ("swarming") at the surface during daytime (Lagos 2021, Gill 2002).

N. australis has one of the highest production-to-biomass ratios, including moulting and egg production, among all krill genera, about 10 times higher than values found for the Antarctic krill species, *Euphausia superba* (Lagos 2021). Production of *N. australis* ranges from 78.3–84.8 mg m^{-3} y^{-1} (Ritz & Hosie1982). It also has the fastest growth rate of the *Nyctiphanes spp.* at 40 d (Haywood & Burns 2003 in Lagos 2021).

As detailed in Butler et al. (2002) *N. australis* live ~ 1 year, reach sexual maturity at 3-4 months, with a maximum length of 20 mm and weight of 40 mg and are known to be omnivorous. The species broods its eggs until they hatch rather than spawning them directly into the water column. There is continuous maturation of ova, with an individual female capable of releasing a total of 1100 eggs in a lifetime, which are deposited as a series of batches into a pair of external ovisacs, every 30 days (Hosie 1982).

There is a main peak of spawning from early spring to late autumn, but reproduction continues through all months with as many as three generations produced each year. Continuous reproduction through the year coupled with a high growth rate means that *N. australis* has very high productivity (UTAS 2003). Gill and Morris (2003) noted that surface swarms of *N. australis* were sighted in all months that aerial surveys have been conducted except September, when no surveys were conducted. Sighting covered shelf waters from near King Island to waters 50 km west of Robe, SA.

4.2 Upwelling and Productivity

Upwelling refers to physical processes that lift or entrain subsurface water into the eutrophic zone, where it can trigger autotrophic phytoplankton production if nutrient limitation is overcome (Shute et al. 2022). Phytoplankton are the food source underpinning the trophic structure and flow of energy through marine food webs as they are consumed respectively by zooplankton and these in turn are consumed by larger and larger predators (CoA 2015a).

Each year during summer, a number of well-described coastal upwelling centres develop along Australia's southern coastline off the Bonney coast (Lewis, 1981, Schahinger 1987), the southern tip of the Eyre Peninsula (Kämpf et al. 2004), and the west coast Tasmanian shelf (Kämpf 2015). Upwelling also occurs along the Otway Shelf between Portland and King Island (where the Regia MSS will be undertaken). However, upwelling along the Otway Shelf is primarily sub-surface, with only a narrow band of surface upwelling inshore during strong upwelling events (Levings and Gill 2010). These sub-areas of upwelling are recognised as components of a unified upwelling system extending from the eastern Great Australian Bight to western Bass Strait/west coast Tasmania and are referred to as the Great Southern Australian Upwelling System (GSACUS) (Kämpf 2004, 2015).

The GSACUS is active during autumn and summer, driving simultaneous upwelling along the Bonney and Otway Coasts (Levings and Gill 2010). Cool upwelled water from depths of 200-400 m is nutrient rich, enhances subsequent upwelling events and leads to phytoplankton growth in the region (Rogers et al. 2013).

4.3 Bonney Coast Upwelling Key Ecological Feature

The Bonney Coast Upwelling (BCU) occurs between Cape Jaffa, South Australia and Portland, Victoria (DCCEEW 2023). It is a productivity hotspot, with high densities of zooplankton including the coastal krill (*N. australis)* which is an important food source for fish, birds and whales.

The BCU is driven by the frequent south-easterly winds which are the result of southern migration of the subtropical ridge (Nieblas et al. 2009, Schahinger 1987), during the austral summer. The upwelling occurs via Ekman dynamics, where the ocean surface experiences a steady wind stress resulting in a net transport of water at right angles to the left of the wind direction which brings cold, nutrient rich water to the sea surface.

The Bonney Coast Upwelling has been shown to follow a clear temporal pattern. When the upwelling season starts during late spring and early summer (November and December), the influence of the BCU was found to be often restricted to the coast. During the mid-summer and early autumn (January to March) when the upwelling is the strongest, the upwelling influence often extends to the shelf break before retreating in April (Huang and Wang 2019).

Gill et al (2011) states that the Bonney Coast Upwelling generally starts in the eastern part of the Great Australian Bight and spreads eastwards to the Otway Basin. At the height of the upwelling during February and March, its area of influence often exceeds 12,000 km^2, while its sea surface temperature anomaly often exceeds 1°C, and its chlorophyll-a concentrations are often >1.5 times adjacent areas (Huang and Wang 2019).

The BCU is one of only two identified seasonal feeding areas for blue whales in Australian coastal waters and is one of 12 known blue whale feeding aggregation areas globally. Sightings of Sei whales and Fin whales in the upwelling indicate this is potentially an important feeding ground for these species also (Gill et al. 2015, Morrice et al. 2004).

The BCU is regionally important as it supports the lucrative local fishing and tourism industry off the Otway towns such as Portland, which annually holds an Upwelling Festival in late October/early November to celebrate the abundance of the Bonney Upwelling, and to begin the summer fishing season (Glenelg Shire 2023).

The Bonney Coast Upwelling is defined as a Key Ecological Feature as it is an area of enhanced pelagic productivity and has high aggregations of marine life (DCCEEW 2023). In addition to whales, many endangered and listed species frequent the area, possibly also relying on the abundance of krill that provide a food source to many seabirds and fish. The high productivity of the Bonney Coast Upwelling is also capitalised on by other higher predator species such as little penguins and Australian fur seals feeding on baitfish (DCCEEW 2023).

The Regia Operational Area overlaps the eastern end of Bonney Coast Upwelling Key Ecological Feature by 1.21 % (Appendix B12 MAP-REG-EPM-003). The Regia Active Source Area does not overlap this KEF. [Paragraph updated in response to Matter E01].

4.4 Marine Flora

In Australia, shallow (<30 m) temperate reefs are defined largely by the distribution of Ecklonia radiata kelp forests, which span more than 8000 km of coastline from the subtropical waters of northern New South Wales down the east coast of mainland Australia, around Tasmania, along Australia's southern coastline and north as far as Kalbarri in Western Australia (Bennet et al 2015). Most of Australia's kelp-dominated temperate reefs lie within the 'coastal zone' under state jurisdiction (3 nautical miles or 5.5 km from shore) (Bennett et al 2015). On the south and west coasts of Australia, E. radiata forests typically occur in mosaics of mixed species with large canopy-forming fucoids (e.g. Cystophora spp., Scytothalia dorycarpa), covering most of the rocky reefs.

Timing of reproduction is variable across its distribution range with seasonal peaks in Western Australia and more continuous reproduction of sori and zoospores in Tasmania. Water temperature is the key driver of reproductive timing but is also influenced by other variables such as wave action. Once E. radiata zoospores are released, they have the ability to swim for at least 24 h (although they often do so for only 1–2 h), until they settle onto the substratum and germinate into male or female gametophytes. Ecklonia radiata can disperse via three modes; zoospores, sperm and detached fertile drift material. Population genetic studies on E. radiata using neutral microsatellite markers (Dolman & Coleman 2009, reported in Wernberg et al 2019) have identified that genetic structure around the Australian continent is weak, suggesting widespread gene flow that is mediated by the strength and direction of prevailing ocean boundary currents. Such strong connectivity should imbue considerable resilience on this species; however climate change is operating at such a large scale that warming temperatures are negatively affecting kelp across its entire range.

Due to the depths associated with the acquisition area, with no discharge of the sound source at full power to occur in water depths less than 50 m, impacts on larger plants and nearshore planktonic phases arising from the activities associated with the Regia MSS are not anticipated. There is no scientific information on the potential for noise-induced effect in macroalgae and no functional cause-effect relationship has been established. Therefore, impacts from acoustic disturbance on macroalgae/ marine flora, or associated cultural values has not been considered further.

It is understood there is potential for kelp in shallower, more coastal areas to be impacted in the highly unlikely event of a marine oil spill, and a detailed description of kelp, its cultural and seaweed industry value, and risks to kelp associated with a spill are detailed in EP Appendix D4 (Accidental Release of Fuel), in Sections 6.3 (Benthic Assemblages), 6.14 (Seaweed Industry) and 6.17 (Protected Areas).

[Section added in response to Matters: E09, E10 and FN06].

5 Sound Effect Criteria

Sound exposure guidelines for eggs and larvae have been established by the American National Standards Institute (ANSI) accredited report of Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014). The sound exposure guidelines from Popper et al. (2014) are based on references and studies on potential impacts of noise emissions on fish eggs and larvae prior to 2014. Results presented in Day et al. (2016b) for embryonic lobsters and Fields et al. (2019) for copepods align with those presented in Popper et al. (2014), which is that mortality and sub-lethal injury are limited to within tens of metres of seismic sources. Additionally, the Popper et al. (2014) sound exposure guidelines are extrapolated from simulated pile driving signals which have a more rapid rise time and greater potential for trauma than pulses from a seismic source.

For eggs and larvae, the sound exposure guidelines provide sound exposure metrics for:

- Mortality and potential mortal injury.

Within these sound exposure guidelines, there was insufficient data to make a quantitative guideline for:

- Recoverable injury
- Temporary threshold shift (TTS) in hearing
- Behaviour
- Masking

For these impacts, a subjective approach of ‘relative risk’ (low, moderate, and high) is used to assess risk at three distances from the seismic source (near - tens of metres, intermediate - hundreds of metres, and far - thousands of metres) as detailed in Table E2-51-.

The sound exposure guidelines and predicted maximum distances from the acoustic modelling are detailed in Table E2-51- for mortality and potential mortal injury.

Table E2-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Plankton

	Mortality/Potential Mortal Injury		**Recoverable Injury and TTS**		**Behavioural**	
Threshold Criteria	Few studies to base criteria on, however, Popper et al. (2014) provides acoustic criteria extrapolated from simulated pile driving signals which have a more rapid rise time and greater potential for trauma than pulses from a seismic source. Popper et al. (2014) does not recommend a timeframe for cumulative sound exposure levels and thus 24 hrs has been used as is current industry practice.		There are currently no acoustic criteria for plankton, fish and invertebrate eggs or larvae, however, a scale of relative risk is provided in Popper et al. (2014). The scale assumes that larvae have similar sensitivity to sound as juvenile and adult fish, and that recoverable injury and TTS are possible.		There are currently no acoustic criteria for plankton, fish and invertebrate eggs or larvae, however, a scale of relative risk is provided in Popper et al. (2014). The scale assumes that a behavioural response is possible.	
Relevance of thresholds adopted	Popper et al. (2014) has been used as this cites many of the current references and studies on potential impacts of noise emissions on fish eggs and larvae, and when compared to other studies the threshold levels are similar to those proposed, e.g., Day et al. (2016a and 2016b) and Fields et al. (2019). Popper et al. (2014) suggests that injury to larvae resulting from seismic impulses may occur for sound exposures above 207 dB PK or above 210 dB SELcum. However, Popper et al. (2014) suggest that recoverable injury and TTS is likely within tens of metres of a seismic source, which is generally less than the distance associated with their proposed mortal injury threshold, hence there is some discrepancy. The threshold proposed for mortal injury is derived from pile driving impacts to fish and is likely to be conservative. The body of literature indicates that mortality and sub-lethal injury are limited to within tens of metres of seismic sources. Masking is identified as low at near, intermediate, and far distances.					
Sound exposure guideline	**Per pulse**	**SELcum**	**Proximity to sound source**	**Relative risk**	**Proximity to sound source**	**Relative risk**
	207 dB PK	210 dB SELcum	Near – tens of metres	Moderate	Near (tens of metres)	Moderate
			Intermediate – hundreds of metres Far – thousands of metres	Low	Intermediate – hundreds of metres Far – thousands of metres	Low
Modelled Distance	230 m[1]	7-120 m[1]	NA	NA	NA	NA

1: Sound modelling updated in response to Matter: F17.

6 Predicted Levels of Impact

As detailed from the underwater sound and studies relevant to seismic surveys (see the Regia MSS Seismic Studies Summary available in Appendix B8), mortality and injury to plankton has been identified from seismic source sound emissions within proximity to the seismic source. This can have direct impacts to plankton including krill, and fish and invertebrate larvae and indirect impacts to receptors that feed on plankton and recruitment of fish and invertebrate species.

The extent of the area of impact is predicted to be a maximum of 230 m from the sound source during survey acquisition (Table E2-51-).

The predicted effect level on these species is assessed as minor, meaning impacts to plankton are predicted but they will be localised and temporary, with the system having the capacity to recover from the impact in a timescale of days to months given the following:

- Phytoplankton and zooplankton biomass in the oceans varies significantly at spatial scales ranging from hundreds of metres to hundreds of kilometres, and temporal scales of hours, days, seasons and inter-annually, due to tidal and large-scale currents, bathymetry, temperature, salinity, water chemistry parameters and other environmental factors (Gibbons & Hutchings 1996; Holliday et al. 1987; McKinnon et al. 2008; Pearce et al. 2000; Sutton & Beckley 2017). Thus, plankton will be spatially and temporally variable throughout the seismic survey and it follows that predicted impacts will not be ubiquitous to all plankton present within the Active Source Area.

- No impacts to phytoplankton are predicted so they will remain available for zooplankton and other fauna to graze on.

- Zooplankton do not have hearing structures (although they can sense pressure changes) and their bodies are generally the same density as the surrounding water so sudden pressure changes associated with seismic activity are presumed to not cause physical damage (Parry & Gason 2006).

- The Working Group on the Effects of Sound on Fish and Turtles (Popper et al. 2014) detailed (a) there is a low relative risk of plankton experiencing masking impacts at all distances from the seismic source (b) a moderate risk of recoverable injury from TTS behavioural impacts near (tens of metres) to the seismic source (c) a low risk of TTS impacts at intermediate or far distances from the seismic source (Table E2-51).

- Any potential mortality or permanent injury effects to plankton must be assessed in the context of natural mortality rates. Mortality and/or mortal injury impacts to plankton assemblages (including fish eggs and larvae) resulting from seismic surveys are likely to be inconsequential relative to natural daily mortality rates, which can range from 11.6% (average minimum) to 59.8% (average maximum) as reported by Tang et al. (2014). Mean mortality rates for marine fish larvae have been assessed as equivalent to 21.3% per day (Houde and Zastrow 1993). In the experiment undertaken by McCauley et al. (2017) zooplankton mortality rate background levels were 19%. Thus, predicted impacts to zooplankton from the seismic survey are likely to be well within natural mortality rates.

- Sætre and Ona (1996) calculated that under a 'worst-case' scenario, the number of larvae killed during a typical seismic survey was 0.45% of the total population, and they concluded that mortality rates caused by exposure to the seismic source were so low compared to natural mortality that the impact from seismic surveys must be regarded as insignificant.

- Zooplankton have rapid recovery rates given their life-history characteristics as described earlier (e.g Huntley and Lopez 1992, Richardson et al 2017). Richardson et al. (2017) modelled the spatial and temporal impact of a seismic survey on zooplankton on the

North-West Shelf from a large-scale seismic survey, considering the mortality estimates of McCauley et al. (2017), and accounting for typical growth rates, natural mortality rates, and the ocean circulation in the region. Their results illustrated:

- Simulations that included ocean circulation showed that the impact of the seismic survey on zooplankton biomass was greatest in the Survey Region where 22% of the zooplankton biomass was removed, while declines moving to the Survey Region + 15 km were 14% of the zooplankton biomass was removed, and when moving out to the Survey Region + 150 km only 2% of the zooplankton biomass was removed. There was no discernible regional-level effect on the entire Northwest Shelf Bioregion. The time to recovery (to 95% of the original level) for the Survey Region was 39 days (38-42 days) after the start of the survey and 3 days (2-6 days) after the end of the survey.
- Simulations with no ocean circulation showed a much greater impact of the seismic survey on relative zooplankton biomass with 35% of the zooplankton biomass removed for the Survey Region, 22% for the Survey Region + 15 km and 3% for the Survey Region + 150 km. Nevertheless, there was still no discernible effect on the entire Northwest Shelf Bioregion. The time to recovery for the Survey Region from the start of the survey was 64 days (49-100 days) and from the end of the survey was 26 days.

- Though the modelling by Richardson et al. (2017) was done for the North-West Shelf the outcomes provide a reasonable proxy as to the impact and recovery of plankton to a seismic survey in the Otway. Average current speeds within the Otway are within those for the North-West Shelf with the maximum Otway current speed higher than for the Northwest Shelf[1]. Water temperatures are colder in the Otway but during upwellings there is significantly more nutrients to fuel plankton growth. Applying predicted impacts from the Richardson et al. (2017) modelling to a seismic survey in the Otway could result in a loss of zooplankton biomass ranging from 22 – 35% with recovery within 3 to 26 days from the end of the survey. Even under the worst-case scenario of no ocean circulation mortality rates for the whole survey fall within the daily mortality rates of 11.6% (average minimum) to 59.8% (average maximum) as empirically derived by Tang et al. (2014).
- Based on an effect range of 200 m it is estimated ~2% of the zooplankton, including krill, present within the Regia Active Source Area and less than 0.2% of zooplankton present in the Otway bioregion would be impacted per day. This is significantly less than zooplankton daily mortality rates of 11.6% (average minimum) reported by Tang et al (2014).
- From a bioregional perspective, the area where zooplankton may be impacted (assessed on the most conservative areal basis) is localised within the Active Source Area and represents <1% of the Otway bioregion. In addition, there are no recorded significant upwelling zones within the Active Source Area.
- Richardson et al (2017) notes that zooplankton communities can begin to recover in number during a seismic survey, such that a continuous decline in zooplankton throughout the seismic survey is unlikely and parts of the Active Source Area would be replenished with zooplankton as the survey progresses.
- Predicted impacts to zooplankton, including krill, do not remove them from the food web and as such the nutrients and energy they contain are retained within the ecosystem. Even after plankton die, their carcasses remain in the water column for several days where they

[1] RPS (2019) details for Otway monthly average surface current speed was 0.16 to 0.25 m/s, maximum surface current speed ranged between 0.60 m/s and 1.22 m/s, and sea surface temperatures ranged from 13.3°C to 18°C. RPS (2019a) details for Scarborough on the North-West Shelf monthly average surface current speed was 0.4 to 0.26 m/s, maximum surface current speed was ~0.70 m/s, and sea surface temperatures ranged from 15°C to 29°C.

remain available for scavengers before any remaining carcasses sink to the seafloor to be consumed by opportunistic benthic organisms (Kirillin et al. 2012, Tang et al. 2014, Dubovskaya et al. 2015). Thus, tangible impacts to primary production and ecosystem function are not predicted.

- While the upwelling season provides the greatest concentration of krill in a defined area, krill swarms are nevertheless prevalent throughout the year and over a broad area as detailed by Gill and Morris (2003) who noted that surface swarms of *N. australis* were sighted in all months that aerial surveys were conducted and that sightings covered shelf waters from near King Island to waters 50 km west of Robe, SA. *N. australis'* main peak of spawning is from early spring to late autumn, but reproduction continues through all months with as many as three generations produced each year (UTAS 2023). Continuous reproduction throughout the year coupled with high growth rates results in very high productivity which confers high levels of resilience to any disturbances.
- The area of predicted impact overlaps the pygmy blue whale high density foraging BIA. Seasonal aggregation for feeding is associated with the timing of the Great Southern Australian Upwelling System, specifically the Bonney Coast Upwelling and the presence of high concentrations of *N. australis* (Australian Krill). Krill is also an important dietary item for other fauna such as Jack Mackerel, Short-tailed Shearwater, Fairy Prion, Australian Salmon, Skipjack Tuna and Tiger Flathead (Nicol and Endo 1997).
- Mortality or mortal injury effects to krill will be confined to the active seismic area. As noted previously effects will be patchy, and relative to the scale of the foraging grounds and the spatial extent of the upwelling the scale of any impacts will be minor. The upwelling is providing an extremely concentrated food source for the food chain which is effectively super-charging the productivity rates of zooplankton and krill, and by extension increasing their resilience to disturbance. It is an unrealistic assumption that the density of food (e.g krill) and the density of feeding animals is completely filling this niche and therefore any changes will tip the system into an alternate state. Any potential changes to plankton populations will not have any measurable effect on the ability of pygmy blue whales and other species being able to feed on them. Any impacts to krill are likely to be within natural mortalities rates thus not effecting the availability of krill for foraging.
- In Summary, impacts to the Bonney Coast Upwelling KEF and the broader Great Southern Australian Upwelling System, that the Regia MSS overlaps, and the role these upwellings play in ecosystem function and productivity, are not predicted as:
    - An activity limitation has been adopted whereby the seismic source will not be discharged within the Bonney Coast Upwelling KEF (M#01).
    - Impacts to the physical upwelling process are not predicted.
    - Impacts to phytoplankton are not predicted and thus they are available to be grazed on by zooplankton and other fauna that increase productivity in the area.
    - Levels of mortality or mortal injury effects to zooplankton will be subsumed by higher natural mortality rates. Plankton communities are patchy in time and space and also highly productive which confers powerful rates of recovery in response to any disturbances not just seismic. Hence, continuous declines of zooplankton throughout the duration of the seismic survey is not anticipated.
    - Mortal injury effects to zooplankton, including krill, will not confer any disadvantage to feeding marine fauna as they will remain available within the water column.

The uncertainty level for impact to plankton is assessed as low based on:

- There are multiple published studies on seismic sound effects to plankton.

- The impact assessment used all available literature and used peer-reviewed published literature to validate report data where possible.
- There are peer reviewed sound effect criteria for fish eggs and larvae.
- There are several published studies on zooplankton and krill that are relevant to the Otway region.
- The body of peer reviewed literature indicates that mortality and sub-lethal injury are limited to within tens of metres of seismic sources.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low. For plankton the predicted level of impact is beneath levels of perception and/or within normal bounds of variation. Good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts to zooplankton are temporary, reversible, small-scale, and within natural variations in mortality.	Yes
	The impact and risk assessment process are based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	No EPBC Act Management Plans and Recovery Plans were identified relevant to plankton.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to zooplankton are temporary, reversible, small-scale, and within natural variations in mortality.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	As predicted impacts to zooplankton are temporary, reversible, small-scale, and within natural variations in mortality, impacts to primary production and ecosystem function are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	As predicted impacts to zooplankton are temporary, reversible, small-scale, and within natural variations in mortality, impacts to economic receptors are not predicted.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or	As predicted impacts to zooplankton are temporary, reversible, small-scale, and within natural variations in mortality, impacts to cultural receptors are not predicted.	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
	practices, will be temporary / reversible, small scale, and/or low intensity.		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in Section 8.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/ consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation the following objections and claims have been made: Impact of the survey on the Bonney Upwelling. The impacts of the noise on marine ecosystems, can kill zooplankton. Seismic blasting will kill zooplankton which have a fundamental role for ecological integrity as food for krill and subsequently krill are food for whales. Impacts to zooplankton and the Bonney Coast Upwelling and the role they both plays in ecosystem function and productivity is not predicted as: • Impacts to phytoplankton are not predicted. • Mortality or mortal injury effects to zooplankton are within natural mortality rates and zooplankton communities can begin to recover during the seismic survey such that a continuous decline in zooplankton throughout the duration of the seismic survey is not anticipated and parts of the survey area would be replenished as the survey progressed. • Mortality or mortal injury effects to zooplankton, including krill, does not impact on marine fauna being able to feed on them as they will still be available within the water column.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#01: Activity Limitation	Data acquisition will follow a 130 orientation, aligning with the modelled approach to minimise environmental impact. Richardson et al (2017) recommends that to reduced impacts to plankton that a seismic survey run perpendicular to prevailing currents, minimising the duration of exposure of plankton to seismic source, as plankton will be moving away from the seismic source not with it. The survey lines have been developed in an east-west orientation to obtain the greatest efficiency to reduce the number of days of acquisition to as low as possible. The Bonney Coast Upwelling occurs along the Bonney coast between Cape Jaffa, South Australia and Portland, Victoria. It displays seasonal and annual variation driven by the prevailing south-easterly winds (DEECCW 2023). These winds drive ocean currents to the north-west along the coast. Thus, the east-west lines though not perpendicular to the currents do not follow the currents therefore minimising the duration of exposure of plankton to seismic source. As impacts to plankton have been assessed as temporary, reversible, small-scale, and within natural variations in mortality they are of an acceptable level. Changing the acquisition line orientation will significantly increase the number of days of acquisition, having an increased impact on other receptors for a limited increased environmental benefit.	Yes
M#01: Activity Limitation	There will be no discharge of the sound source within the Bonney Upwelling KEF. There will be no discharge of the sound source in January, February, March. The Bonney Upwelling is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March.	Yes

9 Conclusions

This impact assessment has demonstrated that the effect of underwater sound to plankton has a:

- **Predicted level of effect of minor.**
- **An uncertainty of low.**
- **Predicted level of impact of low.**

10 Recommendations

While there is extensive literature about the effects of seismic on plankton there has been a high level of concern throughout the consultations with relevant persons, particularly about the importance of biodiversity increases associated with the summer upwelling events. It is recommended that CGG undertake additional assessment looking at the effects of the activity on plankton and spawning in the context of the upwelling events. This assessment is detailed in the Acceptable Levels Assessment (Appendix F3).

11 Document Control

Table E2-2 - Revisions History

Date	Revision	Update
6 July 2023	A	Draft prepared for initial comment.
23 August 2023	B	Update based on comments and relevant person feedback.
11 Sept 2023	0	Approved for release on Regia MSS website.
20 Dec 2023	1	EP submission to NOPSEMA.
14 May 2024	**2**	**Review and update following public comment**

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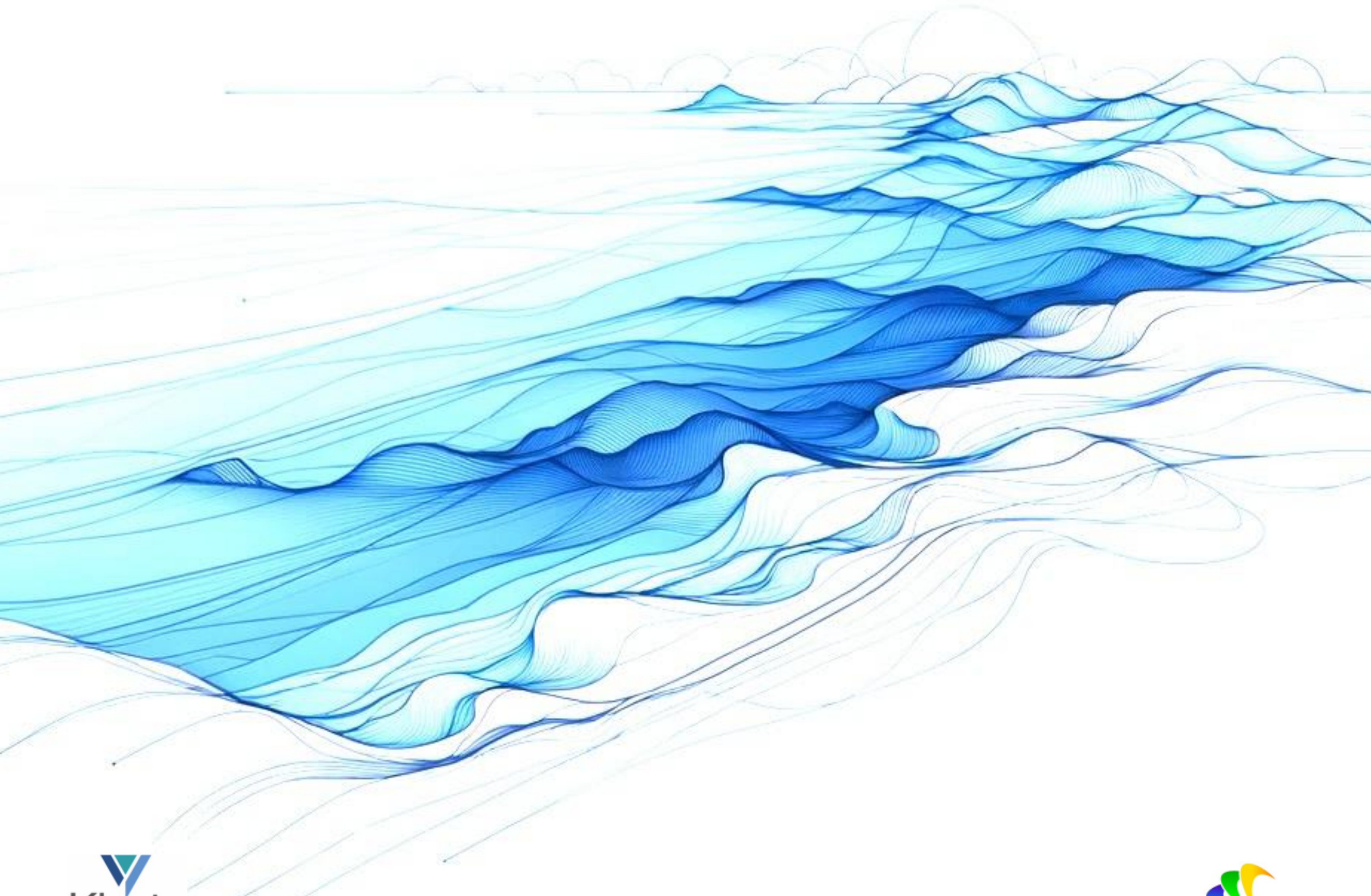
REGIA
Marine Seismic Survey

Impact Assessment Underwater Sound: Fish

Appendix E3: REG-EP-022-E3

Rev 2

May 2024



Klarite

Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7)
2. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E3-2-1able E3-21 shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E3-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E3-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E3-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E3-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Email received detailing the negative impact on marine life and climate	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Adjustment protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.
Received from a fisher concerned about the impacts on shark fishery (displacement) and request to table a compensation document.	170	CGG agreed that an adjustment protocol will be implemented.
During group commercial fishers meeting, concerns were raised about sustainability/fishability of immediate and adjacent areas directly after seismic activity.	254	CGG agreed that there will be an activity limitation of no acquisition beyond 200 m depth contour. Adjustment Protocol
Fishing associations suggested a requirement to put a commercial fishing compensation protocol in place for trawl and gillnet fishers.	175	CGG agreed a compensation protocol will be implemented (subject to further input from fishers)
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.
Email received regarding the interference with Orange Roughy Research Program	213	CGG have agreed there will be a sail line plan put in place.

Objections and Claims	Feedback ID	Measure adopted because of consultation
Email received regarding losing craypots due to being cut off by your vessels during transit.	227	CGG have agreed a compensation protocol to be adopted with a loss of gear clause will be implemented.
During in person meeting relevant person stated concerns that fishers might be affected by the activities	248, 264	CGG have agreed a compensation protocol to be adopted with a tailored protocol method for commercial Abalone divers. CGG will develop a SIMOPS plan with divers who may be affected
During online meeting concerns were raised of the potential adverse effects of the project on Sharks and other marine species.	99	Detailed information regarding the project and relevant documents concerning the activity and its impact on marine species was provided.
Email and in person meeting: concern of displacement and requesting compensation	57, 244, 252	CGG agreed that an adjustment protocol will be implemented and where appropriate measures in place to minimise displacement

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E3-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E3-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Additional information to support impact assessment for fish	F03	CGG has reassessed and referenced literature in Section 4, which clarifies that there is no evidence of significant spawning aggregations occurring within the proposed Regia MSS area for the following species: Blue Warehou, Orange Roughy, Gulper Shark, School Shark, Australian Sardine, Blue Grenadies, Blue-eye Trevalla, Elephant Fish, Gummy Shark, Pink Ling, and Tiger Flathead.
Matter: Impacts of underwater sound on elasmobranchs	F07	CGG has considered these claims and is satisfied that the concerns raised were adequately addressed but has include reference to activity limitation M#01 and it's mitigating effect against potential impacts to sharks and rays in EP Appendix E3, Section 8.
Matter: Impacts of underwater sound on white sharks	F08	CGG has considered these claims and is satisfied that the concerns raised were adequately addressed but has include additional information on the White Shark BIA and activity limitation M#01, and it's mitigating effect against potential impacts to White Sharks, in EP Appendix E3, Sections 6.3 and 8.

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

Continuous underwater acoustic emissions are generated by the survey and support vessels and helicopters. Underwater acoustic emissions from vessels are generated by thrusters, engines, and propellers. Underwater acoustic emissions from helicopters are generated via the engine and rotors.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area + 60 m to 8.35 km based on the furthest distance to modelled sound effect criteria. [Updated in response to Matter: F17]

Seismic acquisition where the seismic source will be active will occur for up to 60 days within the Active Source area.

Continuous Sound

Duration: 90 days

Extent: Operational Area +1.6 km

The survey and support vessels and helicopters will be active in the Operational Area for the duration of the survey undertaking support activities and acquisition.

The extent (1.6.km) of vessel sound that may impact marine receptors is based on the assessment of vessel and helicopter sound.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to underwater sound and species that may be affected by underwater sound, and how the requirements will be met.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Fish including eels and sharks.

In addition, indirect impacts to the following were identified via relevant person consultation:

- Commercial fisheries and fishing tour operators

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling study of underwater sound levels associated with the initial Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including fish.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Two modelling reports were commissioned, one in the preparation phase of the EP (Koessler et al. 2023) and which is available in Appendix B7a and a second iteration during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m. The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria.

4 Description of the Existing Environment that may be Affected by the Activity

To identify fish species that may be present within the area affected by underwater sound a PMST search was undertaken using the Active Source Area with an 8 km buffer based on a furthest distance to a sound effect criterion of 8.35 km (Table E3-5-1able E3-51). The PMST Report is available in Appendix B5. Annex 1 provides details on these protected fish species and relevant conservation advice or management plans.

The PMST Report identified the Eastern Dwarf Galaxias and Yarra Pygmy Perch as occurring in the area affected by underwater sound. The Dwarf Galaxias is a freshwater species (Saddler et al. 2010). The Yarra Pygmy Perch occurs in lakes, ponds, and slow flowing rivers (Saddlier and Hammer 2010). No impact from underwater sound is therefore predicted to impact freshwater area so these species are not discussed further.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. Conservation Advice has also been updated for several species and subsequent changes have been made to Annex 1 (Legislative and Other Requirements Relevant to Underwater Sound and Fish) and Annex 2 (Underwater Acoustic Sensitive Species). Changes relevant to the assessment of underwater sound and fish:

- Changes to presence of:
    - *Thunnus maccoyii* (Southern Bluefin Tuna) is now Known (Species or species habitat known to occur within area).

[Section added in response to Matters: I16 and I17].

In addition, a review was undertaken of commercial fisheries that are active in the area to identify what fisheries targeted species may be present in the Active Source Area. Also, via stakeholder consultation concerns were raised in relation to the potential impact of seismic sound on eels.

4.1 Protected Species

4.1.1 Australian Grayling (Prototroctes maraena)

The Australian Grayling is a small to medium-sized, slender, silvery fish with soft-rayed fins lacking any spines. It is endemic to south-eastern Australia, including Victoria, Tasmania, and New South Wales, and is a migratory species that inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults (Backhouse et al. 2008). Australian Grayling generally migrates downstream to the lower freshwater reaches of rivers to spawn, usually over a two-week period, typically from late-summer to mid-winter (TSSC 2021). Fecundity of the Australian Grayling varies between 25 000 and 68 000 eggs, with an average of 47 000 eggs (TSSC 2021). Eggs hatch between 10 and 20 days after being laid. Larvae emerge at 6.5 mm in length, are buoyant, and while they are free swimming, they are typically swept downstream into marine habitats by river flow (TSSC 2021). A lack of genetic diversity between Australian Grayling collected from coastal rivers in Victoria suggested that a single population occurs in Victoria, as larvae are most likely dispersed during the marine stage of their life cycle (TSSC 2021).

4.1.2 Blue Warehou (Seriolella brama)

The Blue Warehou is a medium-sized, deep-bodied fish, reaching a maximum total length of 90 cm and a maximum weight of 7 kg (TSSC 2015). Globally, the Blue Warehou is confined to Australian and New Zealand waters predominantly in coastal shelf, upper continental slope, and seamount waters offshore from New South Wales, Tasmania, Victoria and South Australia (TSSC 2015). It is nevertheless a highly mobile species that is genetically well-connected over its range. [Paragraph updated in response to Matter: F03]

Blue Warehou is a bentho-pelagic species that inhabits continental shelf and slope waters. Adults can be found at depths from 50 - 300 m. Blue Warehou is a schooling fish and usually aggregates close to the seabed. Juveniles can sometimes be found schooling close to the surface in estuaries, often in association with jellyfish (AFMA 2023).

Spawning occurs during winter and early spring. Larval sampling has found that the major spawning locations are along the west coast of Tasmania (Bruce et al 2001). On average female's spawn around three times per season, producing 430,000 – 1,350,000 eggs per spawning event depending on their body size (AFMA 2023). [Paragraph updated in response to Matter: F03]

Blue Warehou is a target species for the Southern and Eastern Scalefish and Shark Fishery and Tasmania Scalefish Fishery.

4.1.3 Little Gulper Shark (Centrophorus uyato)

The Little Gulper Shark is listed as Conservation Dependent. Gulper Sharks are targeted by the Southern and Eastern Scalefish and Shark Fishery, but are mostly taken as bycatch in the trawl fishery. They are endemic to Australia, occupying demersal habitats on the upper-slope of the southern continental shelf, between 180 m to 900 m (Williams et al. 2012). There are likely to be three distinct stocks of Gulper Shark:

- An eastern stock along the east coast of Australia down to eastern Tasmania.
- A central stock from western Tasmania through the Great Australian Bight.
- A western stock from the western Great Australian Bight, south Western Australia.

Gulper Sharks have life history characteristics that make them vulnerable to overfishing, which is the biggest driver of declines in this species. These include slow growth, late age-at-maturity, low fecundity, and low natural mortality (TSSC 2013a). Young are born live, and reproduction is continuous and non-seasonal (TSSC 2013a). Estimated foraging range for Gulper sharks is up to 50 nm based on acoustic telemetry data (Williams et al. 2012). They undertake day-night migrations across their depth range from relatively deep day time residence depths (1000 m) to shallower night time feeding depths (to 200 m) (Williams et al. 2012). [Section update in response to response to Matter: F03]

4.1.4 Orange Roughy (Hoplostethus atlanticus)

Orange Roughy are a deepwater species that inhabits waters over steep continental slopes and ocean ridges. They are usually found dispersed over rough bottoms and steeps at depths of 700 - 1400 m (AFMA 2023a). Orange Roughy form dense spawning aggregations in winter, with non-spawning aggregations occurring sporadically in summer and autumn. Aggregations usually occur from 5-10 metres above the seabed, with some extending over 50 metres in height from the sea floor. Aggregations are usually associated with submerged hills or pinnacles. Excluding substantial migrations to spawning grounds, Orange Roughy are a relatively sedentary species (AFMA 2023a).

Orange Roughy reach reproductive maturity at 27-32 years of age. Spawning aggregations form between mid-July and late August. Adult males appear to spawn over a 1–2-week period, with females spawning for up to 1 week. Females produce 10 000-90 000 eggs in a single spawning event each season. The eggs float to the surface after fertilisation before sinking again to hatch close to the sea floor. Hatching is thought to occur 10-20 days after fertilisation. It is likely that females do not spawn every year (AFMA 2023a).

The Orange Roughy is a demersal fish targeted by the Southern and Eastern Scalefish and Shark Fishery. They are widely distributed throughout the world and form dense spawning and feeding aggregations on or near topographic features such as seamounts, canyons, and plateaus (DCCEEW

2023). No spawning or feeding aggregation areas have been identified in the Operational Area, with their major spawning locations located on the east coast of Tasmania (Knucky & Smith 1997). [Paragraph updated in response to Matter: F03]

4.1.5 School Shark (Galeorhinus galeus)

The following is from AFMA 2023.

School Shark are a temperate demersal species found on the continental shelf and slope. They can be found to depths of 550 m, and often move up into the water column at night. School shark segregate into schools according to size and sex (AFMA 2023). Size generally increases from inshore to offshore. Pups and juveniles aggregate in shallower 'nursery' waters during the spring and summer. School Shark undertake long migrations of up to 1400 km along the southern coast of Australia, which are thought to be associated with homing to natal mating and pupping grounds.

School Shark are a target species for the Southern and Eastern Scalefish and Shark Fishery, but are also taken as bycatch in the trawl fishery.

School Shark is listed as Conservation Dependent. It appears to have undergone a significant reduction in numbers as a result of commercial fishing in southeastern Australian waters (TSSC 2009a). School Sharks move extensively throughout the waters of southern Australia. School Shark is primarily a deep water demersal (bottom-dwelling) species, although individuals have been recorded undertaking daily vertical migrations, remaining at depths of around 500 m during the day and moving up to around 100 m at night (McLoughlin, 2007). Females and juveniles utilise inshore coastal areas around Victoria, Tasmania, and parts of South Australia for nursery areas (Pogonoski et al., 2002). Birth occurs in early summer after a gestation period of 12 months. Pups are born in shallow bays and estuaries (AFMA 2024).

School Sharks are highly migratory, with individual migrations of up to 1400 km recorded in southern Australia. These migrations appear to be associated with reproduction (Last and Stevens 1994). However, while extensive migrations within regions have been recorded, studies of different global populations indicate that each region hosts a genetically distinct population. Within regions, it is suspected that there may be localised subpopulations (TSSC 2009a).

4.1.6 Southern Bluefin Tuna (Thunnus maccoyii)

Southern Bluefin Tuna can grow to 225 cm in length and 200 kg in weight (TSSC 2010). They are a highly migratory species that occurs globally in waters between 30°S and 50°S. In Australian waters, they range from northern Western Australia, around the southern region of the continent, to northern New South Wales (TSSC 2010). Southern Bluefin Tuna forms a single widely distributed population in the southern, temperate oceans, but with a single known spawning ground in the Indian Ocean, between Java and northern Western Australia (TSSC 2010). Southern Bluefin Tuna are known to be among the fastest ocean swimmers in the world and can travel in speed bursts of up to 70 km/hr while feeding (TSSC 2010).

Southern Bluefin Tuna are a target species for the Southern Bluefin Tuna Fishery and in Australian waters, they are found mainly in the Great Australian Bight (AFMA 2023b) where they are most commonly caught during the summer months (December to April). They are also caught off the New South Wales coastline during winter (AFMA 2023b).

Southern Bluefin Tuna is not commercially caught in the Operational Area. It is sometimes caught recreationally off Victoria.

4.1.7 Syngnathids

Most of the listed marine ray-finned fish species identified in the PMST report are syngnathids, which includes seahorses and their relatives (sea dragon, pipehorse and pipefish). The majority of these species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Fishes of Australia, 2015). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as sargassum.

4.1.8 White Shark (Carcharodon carcharias)

The White Shark is listed as Vulnerable. White Sharks are long-lived, living for 30 years or more (Bruce 2008), and are found throughout temperate and sub-tropical regions in the northern and southern hemispheres (Last & Stephens 2009). The species is also commonly found in inshore waters in the vicinity of islands, and often near seal colonies (Malcolm et al. 2001). The White Shark foraging BIA within the area that may be impacted by underwater sound above the behavioural threshold for sharks, is centred on Lady Julia Percy Island which is a known seal breeding colony (Appendix B12 MAP-REG-EPM-077). The Operational Area also overlaps the distribution BIA that covers Australian waters from Barrow Island/Montebello Islands, WA to Yeppoon/Swains Reef, Qld (Appendix B12 MAP-REG-EPM-077).

4.1.9 Eels (Anguilla spp.)

The Short-finned Eel (*Anguilla australis australis*) and the Long-finned Eel (*A. reinhardtii*) both occur naturally within Victoria and are the target species of the Victorian Eel Fishery. The Eels have differing but overlapping distributions east and south of the Great Dividing Range in estuarine and freshwater catchments (VFA 2023) (Figure E3-4-1igure E3-41).

The Short-finned Eel is widespread across the southern parts of the Victoria and occurs occasionally in northern streams draining into the Murray River, while the Long-finned Eel is found within southeast parts of Victoria only (VFA 2023). Both species spend the majority of their life cycle in fresh water or estuaries before travelling to the ocean to spawn once before dying (VFA 2023). The Operational Area or area potentially impact by underwater sound does not overlap habitat associated with the Long-finned Eel (Figure E3-41-) and hence is not discussed further.

Both species migrate to the ocean once matured; male short-finned eels generally mature at 8-12 years of age, whilst females mature at 10-20 years. Migration occurs during late summer to autumn (VFA 2023a). Spawning is thought to occur in the vicinity of the Coral Sea, although no precise spawning location for either species has been identified. Eggs are thought to be pelagic and hatch after about two days. Larvae are transported southwards along the east coast of Australia where they metamorphose into glass eels and swim into coastal bays and estuaries (VFA 2023). Most Short-finned glass eels migrate in the winter and spring, although glass eels may continue to arrive anytime throughout the year (VFA 2017).

The distributions of Short-finned Eels are extensive from subtropical Queensland to western Victoria, Tasmania, and New Zealand (VFA 2023).

Koster et al (2021) tracked the Short-finned Eel spawning migration for the first time in Australia. Sixteen eels were collected and tagged from the Hopkins and Fitzroy River estuaries as they migrated from the river mouths outwards to the Southern Ocean over a sandbar in 2019. They were then released at either Warrnambool Harbour, Hopkins mouth beach or Killarney beach. Of the 16 tags twelve returned data. The results showed that the Short-finned eels exhibit diel vertical migration, where they travel in the top layers of water during the night and travel further down in the water column during the day (Koster et al. 2021). Of the small number of eels that made the entire journey to the spawning location their last movements were recorded in the Coral Sea. Many of the eels (about 30%) migrations were cut short due to predation, suspected by sharks, tuna, or other marine mammals.

Short-finned Eel is listed as ‘near threatened’ on the IUCN red list, with barriers to riverine movement and freshwater habitat loss being key threats. Additionally changes in ocean currents, primary production, and thermal regimes may also affect eel migration, spawning success, and recruitment

(Koster et al. 2021). The long-finned eel is listed as 'least concern' by the IUCN. Short-finned Eel is not listed under the EPBC Act and is fished by the Victorian Eel Fishery.

Victorian Eel Fishery

Both the Long-finned and Short-finned Eel are the target species for the Victorian eel fishery. The first commercial catches of eel were recorded in 1914, and up until 1950 eel was primarily fished for bait. Export of frozen Short-finned eel to Europe began in the 1960s (VFA 2023a). Eel are harvested in Victorian coastal river basins south of the Great Dividing Range using fyke nets, with a maximum of 18 licences allowed in Victoria. Certain waterways are closed to fishing to allow for eels to escape and spawn (VFA 2023a). Short-finned Eels are the most abundant and the most keenly targeted eel species in Victoria, productivity from the fishery is highly susceptible to short and long term and seasonal environmental variations, particularly drought (VFA 2017).

The eel fishery comprises both a wild catch sector and a culture (stock enhanced) sector. The culture sector has developed strategies for growth consistent with the species life cycle by translocating juvenile eels from other parts of Victoria into lakes and impoundments (culture waters) in western inland Victoria where they continue to grow (VFA 2017). Fishing for glass eels has been of limited success due to the highly variable abundance in Victoria. Most of Victoria's eel catch is taken by commercial fishers and is comprised of adult eels during different stages of their migration.

First Nations Connection to Eels

Eels were, and continue to be, an important resource for certain First Nation communities. Their use for communal gatherings and for barter and trade was extensive in pre-colonial times. Today, eel remains a popular food for community events (VFA 2017). Short-finned Eels in particular hold a cultural significance to First Nations people. For example, the Gunditjmara people of south-western Victoria built and used sophisticated aquaculture systems throughout the Budj Bim Cultural Landscape to exploit eel migrations at least 7,000 years ago. These systems are outside of the area that may be affected by underwater sound.

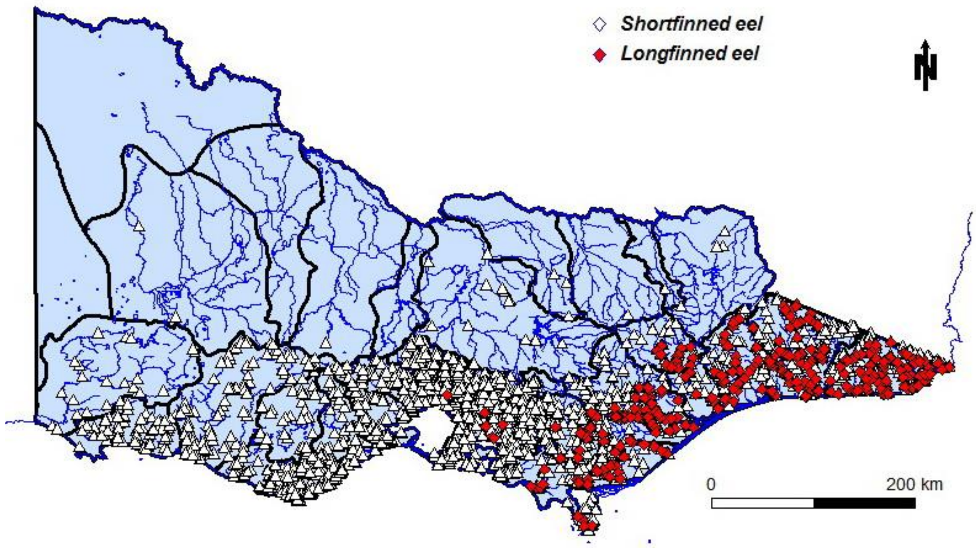


Figure E3-4-1: Distribution of Long-finned and Short-finned Eels in Victoria (VFA 2017)

4.2 Commercial Fish Species

The following commercial fish species were identified from the Commercial Fisheries Analysis Report available in Appendix B6 based on the commercial fisheries which have catch effort within the Operational Area.

4.2.1 Albacore Tuna (Thunnus alalunga)

The following is from AFMA 2023c.

Albacore Tuna is a highly migratory species, swimming continuously over large distances. They are found commonly in eastern Australian waters, but they are also found in the waters of other countries within the Pacific and Indian Oceans. In Australia, Albacore Tuna are caught anywhere along the east coast and is a targeted species by fishers in the Eastern Tuna and Billfish Fishery.

Though Albacore tuna is not commercially caught in the Operational Area it is sometimes caught recreationally off Victoria.

4.2.2 Australian Sardine (Sardinops sagax)

The following is from AFMA 2023d ((https://www.afma.gov.au/species/australian-sardine)).

Australian Sardine is found primarily in temperate waters throughout the eastern Pacific Ocean. They are a coastal species that can usually be found from inshore waters to the edge of the continental shelf, down to depths of about 200 m. Australian Sardine is often found in large schools. Feeding is thought to mainly occur during the day.

There are four recognised sub-populations centred on South Western Australia, Eastern Australia, South Eastern Australia and Southern Australia. The major fishing grounds are located in South Australia. Stocks are considered sustainable. Spawning occurs during spring-summer in the southern part of its range, and in summer-autumn in the northern part. It was previously thought that Australian Sardine only spawn once or twice in a season, but research on similar species suggests that they may spawn multiple times. Females produce 10 000-45 000 eggs per spawning event depending on their body size.

Australian Sardine is a target species for the Small Pelagic Fishery and the Southern and Eastern Scalefish and Shark Fishery. [Section updated in response to Matter: F03]

4.2.3 Bigeye Tuna (Thunnus obesus)

The following is from AFMA 2023e.

Bigeye Tuna is a highly migratory species, swimming continuously over large distances. They are found commonly in eastern Australian waters, but they are also found in the waters of other countries within the Pacific and Indian Oceans.

In Australia, Bigeye Tuna is caught anywhere along both the east and west coasts and is a targeted species by fishers in both the Eastern Tuna and Billfish Fishery and the Western Tuna and Billfish Fishery.

Bigeye Tuna is a tropical tuna species and prefers warmer oceanic waters and is not likely to be present in the Otway area of the Operational Area.

4.2.4 Blue Grenadier (Macruronus novaezelandiae)

The following is from AFMA 2023f.

Blue Grenadier is a deepwater species that occurs on the continental slope. They can be found at depths of 200 - 700 m. Juveniles often occur in shallower bays and inlets. Blue Grenadier aggregate near the seabed during the day and move up into the water column at night. Spawning occurs in winter and early spring. The main spawning ground for blue grenadier is on the west coast of Tasmania. Females release about 1 million eggs in a single spawning event.

Blue Grenadier is a target species for the Southern and Eastern Scalefish and Shark Fishery. Catch rates in Australia are highest off the west coast of Tasmania on the shelf slope during winter where the species aggregates to spawn, and this region has been confirmed as a major spawning ground for the species (Gunn et al. 1989, and Bulman et al. 1999). [Paragraph updated in response to Matter: F03]

4.2.5 Blue Mackerel (Scomber australasicus)

The following is from AFMA 2023g.

Blue Mackerel are a schooling pelagic species that occurs in tropical and temperate waters of the Pacific Ocean. They can be found to depths of 200 m over the continental shelf, although juveniles inhabit inshore waters and shallower waters. Blue Mackerel tend to school by size, as well as with other fish such as jack mackerels. Feeding is thought to occur during the day.

Blue Mackerel reach reproductive maturity at about 3 years of age. Spawning occurs in spring and summer in outer continental shelf waters off northern New South Wales and southern Queensland.

Fishing for Blue Mackerel in the Small Pelagic Fishery has historically been focused off southeast NSW, eastern Tasmania, and South Australia. These areas are outside of the Operational Area.

4.2.6 Blue-eye Trevalla

The following is from AFMA 2023h.

The Blue-eye Trevallas are stout-bodied fish with a blunt snout and small scales. The Blue-eye Trevallas are benthic species that are associated with rocky ground on continental slopes often found in continental shelf and upper slope waters at depths from 100-600 m and on seamounts and undersea features. They generally remain close to the seabed during the day and move up into the water column at night. Spawning occurs in summer and autumn. Mature fish are thought to move into shallower waters and aggregate over specific areas for spawning. Most spawning activity occurs in waters from central New South Wales to north-eastern Tasmania (AFMA 2024). [Reference added in response to Matter: F03]

Blue-eye Trevallas are a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.7 Broadbill Swordfish (Xiphias gladius)

The following is from AFMA 2023i.

Broadbill Swordfish is an oceanic species and is caught worldwide throughout tropical, temperate, and occasionally cold waters. They are commonly found in eastern Australian waters, but they are also found in the waters of other countries within the Pacific and Indian Oceans.

In Australia, Broadbill Swordfish are caught anywhere along both the east and west coasts and it is a targeted species by fishers in both the Eastern Tuna and Billfish Fishery and the Western Tuna and Billfish Fishery.

Broadbill Swordfish are not commercially caught in the Operational Area.

4.2.8 Eastern School Whiting (Sillago flindersi)

The following is from AFMA 2023j.

Eastern School Whiting is a benthic species found from shallow tidal flats down to depths of 180 m on the continental shelf. They are usually associated with sandy substrates. Juveniles tend to be found in shallower waters than adults.

Spawning is regionally variable and occurs from October to March in the eastern Bass Strait, late summer in Tasmania, and during winter in northern New South Wales. Females spawn twice each year in deeper waters. Females produce 30 000-110 000 eggs per spawning season depending on their body size.

Eastern School Whiting is a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.9 Elephant Fish

The following is from AFMA 2023k.

Elephant Fish are the common name for Ghost Shark (*Callorhinchus mili) and* Spookfish *(Harriotta haeckeli and H. raleighana)*

Ghost Sharks are often found in shallow bays and large estuaries, but also to depths of 200 m on the continental shelf. Juveniles inhabit shallow coastal waters for about three years and gradually move into deeper water as they mature. Ghost Sharks appear to school by gender.

Spookfish are a deepwater species that occurs on the continental slope. They can be found in depths of 380-2600 m. *H haeckeli* are generally found in deeper water than *H. raleighana*. Little is known about the habitat of spookfish. Adults and juveniles probably occupy different habitats.

Ghost Sharks are oviparous (lay eggs) and it is presumed that spookfish do as well.

Elephant Fish have a broad distribution across much of southern Australia, but actual biological stock structure is unknown. The species is caught in relatively low quantities in NSW, Victoria and Tasmania. In Victoria, Elephant Fish were historically landed in low to moderate quantities by commercial bay and inlet fisheries, particularly in Western Port Bay (WPB). Females move inshore to lay pairs of leathery egg cases on sandy or muddy bottoms (AFMA 2024). [Paragraph added in response to Matter: F03]

Elephant Fish is a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.10 Gummy Shark (Mustelus antarcticus)

The following is from AFMA 2023l (https://www.fish.gov.au/report/301-Gummy-Shark-2020))

Gummy Sharks are a demersal species that inhabits the continental shelf from the near shore region to depths of 80 - 350 m. They remain either on or near the seabed. Newborn and juvenile Gummy Sharks aggregate in many areas across southern Australia, while young and adult gummy sharks are more widely distributed. Gummy Shark are considered a single genetic stock across their entire range from Bunbury, WA to Jervis Bay, NSW, with 3 sub-stocks centred on Bass Strait, Tasmania and Southern Australia. Gummy Sharks are oviparous (lay eggs).

Gummy Sharks are a target species for the Southern and Eastern Scalefish and Shark Fishery where catches have remained stable for many years. [Section in response to Matter: F03]

4.2.11 Jack Mackerel (Trachurus declivus and T. murphyi)

The following is from AFMA 2023m.

Jack Mackerel are a pelagic schooling species found around the southeast and southern coasts of Australia over the continental shelf and outer shelf margin. They are commonly found at depths of 20 - 300 m. Jack Mackerel school by size. Juveniles tend to be found in shallower waters than adults. Feeding is thought to occur both during the day and at night.

Spawning occurs during late spring to early summer. Spawning begins off the southeast coast of Australia and moves progressively southwards over the summer.

Fishing for Jack Mackerel in the Small Pelagic Fishery has historically focused on the area of waters off South East NSW, Eastern Tasmania and South Australia.

4.2.12 Pink Ling (Genypterus blacodes)

The following is from AFMA 2023n.

Pink Ling are a demersal species that inhabits the continental shelf and slope. They can be found at depths of 20 - 1000 m. Juveniles tend to occur in shallower waters than adults. Pink Ling occur over a variety of substrates, from rock ground to soft sand and mud in which they burrow. Aside with some movement associated with spawning, pink ling are thought to be relatively sedentary.

Spawning occurs over an extended period during late winter and spring. Pink Ling are thought to be serial spawners, with egg batches being released in a floating gelatinous mass in each spawning event. Females produce about 333 000 eggs per spawning event depending on body size.

Spawning aggregations have been reported by commercial fishers off Strahan, Tasmania, Lakes Entrance Victoria, and Gabo Island NSW (Bruce et al 2002). [Sentence added in response to Matter: F03]

Pink Ling is a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.13 Ribaldo (Mora moro)

The following is from AFMA 2023o.

Ribaldo are a temperate deepwater species that occurs on the continental shelf. They can be found near the seafloor at depths of 450 - 2500 m and it appears to be most common at depths of 500-1000 metres. Ribaldo are associated with sea mounts and rough sea beds. Juveniles may be pelagic.

Spawning occurs in winter and early spring. Ribaldo are not thought to form large spawning aggregations.

Ribaldo is a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.14 Sawsharks (Pristiophorus cirratus and P. nudipinnis)

The following is from AFMA 2023p.

Sawsharks are a common demersal species that inhabits the continental shelf and upper slope. They can be found in depths to 300 m. Sawsharks are sometimes found in large schools or feeding aggregations. Sawsharks are oviparous (lay eggs).

Sawsharks are a target species for the Southern and Eastern Scalefish and Shark Fishery.

4.2.15 Striped Marlin (Kajikia audax)

The following is from AFMA 2023q.

Striped Marlin is an oceanic species caught worldwide throughout tropical, temperate, and occasionally cold waters. They are found commonly in eastern Australian waters, but they are also found in the waters of other countries within the Pacific and Indian Oceans.

In Australia, Striped Marlin are caught anywhere along both the east and west coasts and is a targeted species by fishers in both the Eastern Tuna and Billfish Fishery and the Western Tuna and Billfish Fishery.

Though Striped Marlin is not commercially caught in the Operational Area it is sometimes caught recreationally off Victoria.

4.2.16 Tiger Flathead (Platycephalus richardsoni)

The following is from AFMA 2023r ((https://www.fish.gov.au/report/325-Tiger-Flathead-2020).)

Tiger Flathead are a demersal species that is found at depths of 10 - 400 m. Juveniles inhabit shallow waters of the continental shelf and move into the deeper outer shelf zone as they reach maturity. They are not an active species and normally rest in areas of mud and sand on the seabed during the day and move into the water column at night to feed. There is evidence that mature fish migrate to shallower waters prior to the spawning period. Spawning occurs over an extended period from spring to autumn, with some variation on the timing of spawning depending on location. Females produce 1.5-2.5 million eggs per spawning season.

Tiger Flathead is a target species for the Southern and Eastern Scalefish and Shark Fishery. The southern Australian population is considered sustainable under current fishing effort. [Section updated in response to Matter: F03]

4.2.17 Yellowfin Tuna (Thunnus albacares)

The following is from AFMA 2023s.

Yellowfin Tuna is a highly migratory species, swimming continuously over large distances. They are usually found in eastern and western Australian waters but are also found in the waters of other countries within the Pacific and Indian Oceans.

Spawning occurs throughout the year in tropical waters and seasonally in subtropical waters. The peak spawning period in the southern hemisphere occurs in summer. In tropical waters females spawn almost daily. Spawning occurs almost entirely at night. Females can produce over 0.2-8 million eggs per spawning event depending on their body size.

In Australia, Yellowfin Tuna are caught along both the east and west coasts and is a targeted species by fishers in both the Eastern Tuna and Billfish Fishery and the Western Tuna and Billfish Fishery.

Though Yellowfin Tuna is not commercially caught in the Regia MSS area it is sometimes caught recreationally off Victoria.

4.2.18 Wrasse (multiple species)

The following is from (VFA 2023).

The Victorian Wrasse (Ocean) Fishery targets Bluethroat Wrasse and Purple Wrasse, also called Saddled Wrasse (*N. fucicola*). Small catches of Rosy Wrasse, Senator Wrasse and Southern Maori Wrasse are also caught.

Wrasse inhabit depths up to 160 m where individuals tend to remain close to a home reef and are territorial. They are relatively long lived and have a relatively long larval period (Bluethroat Wrasse: 44 to 66 days; Purple Wrasse: 40 to 87 days) leading to potentially wide dispersal that can repopulate depleted areas. The two species are thought to interbreed to produce hybrids.

5 Sound Effect Criteria

Although hearing ranges and sensitivities vary substantially between species (Ladich and Fay 2013), all fish species tested to date can detect sound and vibration to some degree (Dale et al. 2015). Fishes have developed two sensory mechanisms for detecting, localising, and interpreting underwater sounds and vibrations: the inner ear, which is tuned to sound pressure detection, and the lateral line system, which allows a fish to detect vibration and water flow. Inter-specific variations in hearing range and sensitivity result from the different adaptations in these systems for perceiving sound pressure and particle motion information (Popper and Fay 2011).

Based on their morphology, Popper et al. (2014) classified fishes into three categories comprising:

- Fishes with swim bladders whose hearing does not directly involve the swim bladder or other gas volumes.
- Fishes whose hearing does directly involve a swim bladder or other gas volume.
- Fishes without a swim bladder that can sink and settle on the substrate when inactive.

The Popper et al. (2014) classifications can be assigned to the following families or species of commercial fish species common in Australian waters:

- Fishes with swim bladders or other gas volumes, but whose hearing does not directly involve the swim bladder, e.g. snappers, emperors, groupers and rock cods (Lutjanids and Lethrinids such as *Pristipomoides* spp., *Lethrinus* spp., *Lutjanus* spp., and family Serranidae), and some species of tuna (*Thunnus* sp.) (Tavolga and Wodinsky 1963, Higgs et al. 2006, Braun and Grande 2008, Engineering-Environmental Management Inc. 2008, United States Department of the Navy 2008, Caiger et al. 2012, Bertrand and Josse 2000, Song et al. 2006).
- Fishes whose hearing does directly involve a swim bladder or other gas volume e.g., family Clupeidae (herrings, sardines, pilchards and shads) and some Haemulidae (grunters and sweetlips) (Nedwell et al. 2004, Braun and Grande 2008, Popper et al. 2014). Eels are included in this group (Jerko et al 1989).
- Fishes without a swim bladder (e.g., mackerel, Scomberomorus spp., some species of tuna, Thunnus sp. and sharks) (Casper et al. 2012, Popper et al. 2014, Carroll et al. 2017).

The most relevant metric for perceiving underwater sound for most fish species is particle motion (Popper and Hawkins 2019, Popper et al. 2019) but, except for few species (Popper and Fay 2011, Popper et al. 2014), there is an almost complete lack of relevant data on particle motion sensitivity in fishes (Popper and Hawkins 2019).

Most fish species detect sounds from below 50 Hz up to 500-1500 Hz. A smaller number of species can detect sounds to over 3 kHz, while a very few species can detect sounds to well over 100 kHz. The critical issue for understanding whether an anthropogenic sound affects hearing is whether it is within the hearing frequency range of a fish and loud enough to be detectable above threshold. For this impact assessment, it is assumed that all fishes can detect signals below 500 Hz and therefore can 'hear' the seismic source.

Sound exposure guidelines for fish have been established by the American National Standards Institute (ANSI) accredited report of Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014). The sound exposure guidelines from Popper et al. (2014) are based on the presence or absence of a swim bladder and ancillary structures which determines the level of susceptibility of fishes to injurious effects from exposure to intense sound. Accordingly, different exposure guidelines were developed for fishes without a swim bladder, fishes with a swim bladder not involved in perception of acoustic signals and fishes that use their swim bladders for hearing.

For fish, the sound exposure guidelines provide sound exposure metrics for:

- Mortality and potential mortal injury
- Recoverable injury
- Temporary threshold shift (TTS) in hearing

Within these sound exposure guidelines, there were insufficient data to make a quantitative guideline for:

- Behaviour
- Masking

For these impacts, a subjective approach of ‘relative risk' (low, moderate, and high) is used to assess risk at three distances from the seismic source (near - tens of metres, intermediate - hundreds of metres, and far - thousands of metres) as detailed in TTable E3-5-1able E3-51.

The sound exposure guidelines and predicted maximum distances from the acoustic modelling are detailed in Table E3-5-1able E3-51.

Further information on studies in relation to seismic acoustic emission impacts to fishes is provided in the Regia MSS Seismic Studies Summary available in Appendix B8.

Table E3-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Fish

	Mortality/Potential Mortal Injury	Recoverable Injury	TTS
Threshold Criteria	No studies to date have demonstrated direct mortality of adult fish in response to seismic emissions, even at close proximity (within 1–7 m; DFO 2004, Boeger et al. 2006, Popper et al. 2014). Carroll et al. (2017) concludes that "*For fish, there are few data on the physical effects of seismic airguns (e.g., mortality, barotrauma), and of these none have shown mortality*." Though mortality or mortal injury of fish from seismic sources has not been demonstrated it is industry practice to apply the Popper et al. (2014) exposure guidelines as part of the impact assessment process.	The effects of change in pressure (barotrauma – resulting in tissue injury) can result in injury. Recoverable injuries include fin hematomas, capillary dilation, and loss of sensory hair cells. Full recovery from these injuries is possible (Popper et al. 2014).	TTS is a temporary reduction in hearing sensitivity caused by exposure to intense sound. After termination of a sound that causes TTS, normal hearing ability returns over a period that is variable, depending on many factors, including the intensity and duration of sound exposure (Popper et al. 2014). Sound exposure guidelines proposed in Popper et al. (2014) use a cumulative sound exposure level (SELcum) for TTS. Popper et al. (2014) summarises that in all TTS studies considered, fish that showed TTS recovered to normal hearing levels within 18–24 hours. Due to this, a period of accumulation of 24 hours has been applied in this assessment for SEL, which is the same to that applied for marine mammals in Southall et al. (2007) and NMFS (2016).
	Popper et al. (2014) proposes a dual criterion of PK and SEL24hr for mortality or potential mortal injury and recoverable injury. For the impact assessment the furthest distance to the criteria is be used. For this impact assessment, the period of 24 hrs is applied to the SELcum metric.		
Relevance of thresholds adopted	Based on the literature review presented in Appendix A, and the indicator commercial species that are present within the CSEP OA (pelagic and demersal fish), Popper et al. (2014) has been adopted as relevant to set the threshold criteria. This American National Standards Institute (ANSI) accredited report by the Working Group on the Effects of Sound on Fish and Turtles undertook a review of experimental findings of sound on fishes, presenting thresholds for mortality, recoverable injury, and TTS in 2014, and is adopted by industry in Australia for the basis of impact assessment.		

	Mortality/Potential Mortal Injury		**Recoverable Injury**		**TTS**	
Group I: Fish with no swim bladder - mackerel, Scomberomorus spp., some species of tuna, Thunnus sp. and sharks						
Sound exposure guideline	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**
	213 dB PK	219 dB SELcum	213 dB PK	216 dB SELcum	NA	186 dB SELcum
Modelled Distance	Water column: 60-90 [1] m Seafloor: Not reached to 113 m	60 m[1]	Water column: 60-90 m[1] Seafloor: Not reached to 113[1] m	60[1] m	NA	8.35 [1] km
Group II: Fish with swim bladder not involved in hearing - snappers, emperors, groupers and rock cods and some species of tuna						
Sound exposure guideline	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**
	207 dB PK	210 dB SELcum	207 dB PK	203 dB SELcum	NA	186 dB SELcum
Modelled Distance	Water column: 230 m[1] Seafloor: 124 – 197[1] m	70[1] m	Water column: 230 m[1] Seafloor: 124 – 197[1] m	70 - 120[1] m	NA	8.35 [1]km
Group: III Fish with swim bladder involved in hearing - herrings, sardines, pilchards, grunters, sweetlips, eels						
Sound exposure guideline	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**	**Per pulse**	**SELcum**
	207 dB PK	207 dB SELcum	207 dB PK	203 dB SELcum	NA	186 dB SELcum
Modelled Distance	Water column: 230 m[1] Seafloor: 124 – 197[1] m	70 m[1]	Water column: 230 m[1] Seafloor: 124 – 197[1] m	70 – 120 [1] m	NA	8.35 [1]km

1: Sound modelling updated in response to Matter: F17

6 Predicted Levels of Impact

As detailed from the underwater sound and studies relevant to seismic surveys (see Regia MSS Seismic Studies Summary available in Appendix B8), mortality and injury to fish are not predicted based on the received sound levels to these species.

6.1 Mortality and Potential Mortal Injury and Recoverable Injury

As detailed in Table E3-5-1 maximum modelled distance to sound effect criteria for mortality/potential mortal injury and recoverable injury is 60 – 230 m. The predicted effect level on these species is assessed as minor as impacts while predicted to have some effect on fish, are not considered significant or at a level to affect the population given the following:

- Mortality of fish (both immediate and delayed) is not predicted based on lack of documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions (DFO 2004; Boeger et al. 2006; Popper et al. 2014; Popper et al. 2016; Carroll et al. 2017; Popper and Hawkins 2019).
- Injury impacts may occur if the seismic array commences at full power adjacent to fish. However, the implementation of M#03: Fauna Management System requires the seismic source to be slowly ramped up to full power over 30 minutes. This would allow demersal and pelagic species to move away from the source before it is at full power. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04].
- Site-attached fish species are species that rely on the benthic habitat and demonstrate a very high degree of site fidelity to the extent that they are unlikely or unable to flee an approaching seismic source and are likely to remain and/or seek refuge within habitat structures. However, impacts to site-attached fish were studied by Woodside at Scott Reef during the Maxima 3D MSS activities (Miller and Cripps 2013) and no lethal or sub-lethal effects on fish were experienced nor any significant decreases in the diversity and abundance of fish after the seismic survey, compared with the long-term temporal trend before the survey.
- Commercially targeted fishes within the area of impact that are generally considered site attached include a range of commercially targeted species such as Blue-eye Trevalla, Eastern School Whiting, flathead, Gummy Shark, Orange Roughy, Pink Ling, Ribaldo and Sawsharks. Examination and testing of seismic effects on commercial catches of fish, (including flathead and shark species), in the Gippsland Basin region found little evidence for changes induced by seismic surveys for 12 species (Bruce et al. 2018).
- National Recovery Plans and Conservation List Advice for EPBC Act list and migratory for species do not identify underwater sound as a threat to the recovery of fish species.

The uncertainty level for impact to fish causing mortality and potential mortal injury and recoverable injury from seismic sound is assessed as <u>low</u> based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- There is a significant body of published studies that demonstrate no cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low thus good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.

6.2 Temporary Threshold Shift

As detailed in E3-5-1 maximum modelled distance to sound effect criteria for temporary threshold shift (TTS) is 8.35 km.

The predicted effect level to these species is assessed as minor as impacts are predicted to have some effect on fish, but the effect is not considered significant or at a level to affect the population given the following:

- The Popper et al. (2005) study that informed the Popper et al. (2014) TTS sound exposure guideline, was done using a static source (airgun array) and static receptors (fish in cages at 13-17 m from the array) and is therefore not representative of a marine seismic survey which is a moving source. On this basis, the Popper et al (2005) study represents a worst-case scenario as the source is fixed and not moving (i.e. fish received five pulses of identical intensity over five minutes) and nor are the fish.
- Since the Popper et al. (2014) TTS sound exposure guidelines were developed Professor Popper has provided feedback on the appropriateness of using a 24-hour period to assess SELcum and the potential for TTS and other effects associated with SELcum (Popper 2018). The review considered the potential impacts of cumulative seismic noise from the proposed Santos Bethany 3D seismic survey on fish, including TTS effects, and length of time for recovery and the applicability of a SEL24h metric. Though this information was based on another survey it is applicable to the Regia MSS as the premise for the modelling was a racetrack that bought the vessel back to a similar starting point within 24 hours, thus receiving the closest shots within a 24-hour period. The review noted:
    - It is highly unlikely that there would be physical damage to fishes as a result of the survey unless the animals are very close to the source (perhaps within a few meters).
    - If TTS does take place, the duration of exposure to the most intense sounds that could result in TTS will be over just a few hours. Thus, accumulation of energy over longer periods than a few hours is probably not appropriate.
    - If TTS takes place, its level is likely to be sufficiently low that it will not be possible to easily differentiate it from normal variations in hearing sensitivity. Even if fishes do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses.
    - If TTS takes place, its level is likely to be sufficiently low that it will not be possible to easily differentiate it from normal variations in hearing sensitivity. Even if fishes do show some TTS, recovery will start as soon as the most intense sounds end, and recovery is likely to even occur, to a limited degree, between seismic pulses. Based on very limited data, recovery within 24 hours (or less) is very likely.
    - Little is known about the behavioural implications of TTS in fishes in the wild. However, since the TTS is likely very transitory, the uncertainty of it having a significant impact on fish fitness and survival is very low.
- As detailed above, Popper et al. (2005) reports that fish showing a TTS recovered to normal hearing levels within 18-24 hours, thus any hearing loss and subsequent decrease in fitness would be temporary with recovery taking place in a relatively short timeframe after the seismic source has moved away from the exposed fish, and the sound levels are reduced. Based on this, the potential for impacts to individuals' fitness and survival is limited and impacts to fish community structures are not predicted.

The uncertainty level for impact to fish causing TTS from seismic sound is assessed as medium based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- Published studies show TTS impacts to fish are short lived (up to hours), however there is limited published studies on the effects of seismic sound on fish specifically in the Otway region.
- An absence of long-term monitoring data of the effects of seismic on fish in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For fish the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.3 Change in Behaviour

There are currently no quantitative exposure guidelines or criteria for behaviour or masking for fish for impulsive sounds. The Working Group on the Effects of Sound on Fish and Turtles (Popper et al. 2014) found that there was insufficient data available and instead applied a subjective approach using 'relative risk' to assess risk at three distances from the source. These are:

- Behavioural response: high at near (within tens of metres) and intermediate (hundreds of metres) distances from the seismic source and moderate at distances far (thousands of metres) from the source.
- Masking: low at near (within tens of metres) and intermediate (hundreds of metres) distances from the seismic source and moderate at distances far (thousands of metres) from the source.

Thus, the extent of the area of impact is predicted to be within thousands of metres of the seismic source. The predicted effect level to these species is assessed as minor because while the impacts are predicted to have some effect on fish, the effects are not considered significant or at a level high enough to affect the population given the following:

- Meekan et al. (2021) undertook a large-scale experiment that quantified the impacts of exposure of an assemblage of tropical demersal emperors, snappers and groupers targeted by commercial fisheries to a commercial-scale seismic source on the North West Shelf off Western Australia. They did not identify any short-term (days) or long-term (months) effects of exposure on the composition, abundance, size structure, behaviour, or movement of fishes at any exposure sites.
- Shark species are highly vagrant and naturally cover large distances. As such, short-term exposures from the transient seismic source are expected to result in localised behavioural responses and movements of sharks. Research by Bruce et al. (2018), which tagged two commercially targeted shark species (Broadnose Shark and School Shark) and monitored their movements in response to a seismic survey in Australian waters noted that both control sharks and exposed sharks moved freely in and out of the study area which did not indicate any changes in behaviour or distribution because of seismic sound exposure.
- The White Shark foraging BIA within the area that may be impacted by underwater sound above the behavioural threshold for sharks, is centred on Lady Julia Percy Island / Deen Maar which is a known seal breeding colony. The sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar (M#01 Activity Limitation) which will significantly reduce the potential impacts of underwater sound on White Shark behaviour near the foraging BIA. [Point added in response to Matter F08 and F17]
- The fishes' awareness of the sound and any resultant behavioural responses may be limited to a few hours as the seismic source approaches from several kilometres away and passes, while significant behavioural responses (startle or avoidance) are more likely to be limited to a short period (less than an hour) when the seismic source passes close by. As the seismic source will be transient (i.e., continuously moving) during seismic data acquisition, demersal fishes will only be exposed to significant sound levels for a relatively short period of time as the seismic survey vessel passes nearby before sailing away again.
- Impacts to site-attached fish were studied by Woodside at Scott Reef during the Maxima 3DMSS activities (Miller and Cripps 2013) and they determined that there was a lack of significant impacts to fish species considered sensitive because of their site-fidelity requirements (i.e., being restricted to reef habitat and unable move far when the seismic sound approaches) based on the following:
    - Behavioural responses were observed at close range with general movement from the water column to the seabed, however normal feeding behaviour returned within 20 minutes of the survey vessel passing and when the vessel was beyond 1.5 km.

  - No significant decreases in the diversity and abundance of fish after the seismic survey were detected compared with the long-term temporal trend before the survey.
- Any behavioural impacts are likely to be short-lived and fish would return to normal behaviours once the vessel has moved away based on research by Miller and Cripps (2013) and Wardle et al. (2001). Behavioural impacts to pelagic fish species are possible but would be temporary, localised, and unlikely to impact at a population level.
- Limited data on biochemical stress indicators in fishes exposed to seismic sound indicate there may not be any discernible change (e.g., McCauley et al. 2000, 2003). However, if fishes were to experience stress because of sound exposure, levels may return to normal within 72 hours (Santulli et al. 1999).

The uncertainty level for impact to fish causing a change in behaviour from seismic sound is assessed as medium based on:

- Published studies show behavioural impacts to fish are too short lived and fish return to normal behaviour once the vessel has moved away (in some cases within 20 minutes). While there are limited published studies on the effects of seismic sound on fish behaviour specifically in the Otway region there is no reason to expect different behaviour of similar species from different locations.
- An absence of long-term monitoring data of the effects of seismic on fish in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For fish the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.4 Change in Commercial Catch

As detailed in the review of Commercial Fisheries (available in Appendix B6) the Operational Area overlaps the following fisheries where there is a low level of fishing effort from 2010 - 2020:

- Eastern Tuna and Billfish Fishery
- Small Pelagic Fishery
- Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Hook Sector and Scalefish Hook Sector
- Western Tuna and Billfish Fishery

The main fisheries where there has been a significant fishing effort from 2010 – 2020 are:

- Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Net Sub-sector
- Southern and Eastern Scalefish and Shark Fishery (SESSF) - Commonwealth Trawl Sector
- Multispecies Ocean Fisheries – Ocean General
- Wrasse (Ocean) Fishery

Impacts to commercial catch rates can occur if fish are disturbed by the seismic survey and move away from traditional fishing areas. However, once the source passes, fish will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04]. Impacts to fish eggs and larvae from seismic surveys also has the potential to affect fisheries yield and spawning stock in subsequent years.

The predicted effect level to these species is assessed as minor based on impacts to commercial fish species are predicted to have some effect but the effect is not considered to be distinguishable from annual variability in recruitment and catch rates given the following:

- The following commercial fish species do not spawn within the Operational Area, thus impacts to spawning behaviour and egg dispersal are not predicted:

- Most spawning activity for Blue-eye Trevalla occurs in waters from central New South Wales to north-eastern Tasmania (AFMA 2023h).
- Blue Mackerel spawning occurs in spring and summer in outer continental shelf waters off northern New South Wales and southern Queensland (AFMA 2023g).
- Eastern School Whiting spawn in the eastern Bass Strait, Tasmania, and New South Wales (AFMA 2023j).
- Orange Roughy form dense spawning and feeding aggregations on or near topographic features such as seamounts, canyons, and plateaus (DCCEEW 2023). No spawning or feeding aggregation areas have been identified in the Operational Area. In addition, the Regia MSS will apply a survey limitation such that the seismic survey will not be activated within the West Tasmanian Canyons Key Ecological Feature (KEF) where features such as seamounts, canyons, and plateaus may be present.
- Jack Mackerel spawn off the southeast coast of Australia moving progressively southwards over the summer (AFMA 2023m).
- Southern Bluefin Tuna spawn in the Indian Ocean, between Java and northern Western Australia. forming on single global population (TSSC 2010). Though Southern Bluefin Tuna is not commercially caught in the Operational Area it is sometimes caught recreationally off Victoria.
- Yellowfin Tuna spawn throughout the year in tropical waters and seasonally in subtropical waters (AFMA 2023s). Though Yellowfin Tuna is not commercially caught in the Operational Area it is sometimes caught recreationally off Victoria.

- Spawning occurs over months and is not limited to a single event, with females releasing large numbers of eggs (as detailed below) to balance high natural daily mortality rates up to ~60% as reported by Tang et al. (2014). Predicted impacts to eggs and larva from the seismic survey are therefore predicted to be well within natural mortality rates, as detailed in the impact assessment section for plankton (Appendix E2).
  - Blue warehou females produce 430 000-1 350 000 eggs per spawning event depending on their body size (AFMA 2023).
  - Australian Sardine females produce 10 000-45 000 eggs per spawning event depending on their body size (AFMA 2023d).
  - Blue Grenadier females release about 1 million eggs in a single spawning event (AFMA 2023f).
  - Pink Ling are thought to be serial spawners, with egg batches being released in a floating gelatinous mass in each spawning event. Females produce about 333 000 eggs per spawning event depending on body size (AFMA 2023n).
  - Tiger Flathead spawning occurs over an extended period from spring to autumn, with some variation on the timing of spawning depending on location. Females produce 1.5-2.5 million eggs per spawning season (AFMA 2023r).
- For commercial fish species that spawn or potentially spawn within the Operational Area, the distribution of eggs and larvae will be over a large area as species identified are not restricted in their habitat and spawning areas. Thus, fish eggs and larvae will be spatially and temporally variable throughout the Operational Area. Thus, predicted impacts will not occur to all fish eggs and larvae if spawning overlaps when the seismic survey is being undertaken.
- The serial, broadcast spawning strategies of the commercial fish species, by their very nature, offsets potential high natural egg and larvae mortality because of predation or other environmental factors and thereby spreads the risk or potential opportunity for larval settlement over large areas and long timeframes. Subsequent recruitment of fishes to the adult stock also occurs over extended timeframes and is ongoing. Therefore, in comparison, the short-term and localised impacts to spawning because of a seismic

survey would have impacts many orders of magnitude smaller than regional scale environmental/climatic events that would affect entire stocks.

- As detailed in the Regia MSS Seismic Studies Summary, available in Appendix B8, field and desk-top studies on the effects of marine seismic surveys on commercial catch rates have shown highly variable outcomes, ranging from positive effects, no effect, short-term temporary effects (days) and longer-term effects (up to 200 days). The most relevant studies to commercial fisheries in Victorian waters are:
  - Catch studies undertaken as part of a marine seismic survey in the Gippsland Basin found no clear evidence of adverse effects on scallops, fish or commercial catch rates (Przeslawski et al. 2016a; Bruce et al. 2018).
  - Preliminary results from three phases of a four-phase study to investigate the effects of a 3D marine seismic survey in eastern Bass Strait on Danish Seine catch rates (Fishwell Consulting 2020) found negative impact of seismic acquisition on whiting catch rates up to ~100 days following the survey and on flathead rates up to ~200 days.
  - A study by CSIRO and Geoscience Australia (Thomson et al. 2014) examined fisheries catches (10 species of interest) and catch rates for potential effects from 183 seismic surveys undertaken in the Gippsland Basin (Bass Strait). They found no clear or consistent relationships between seismic surveys and subsequent fisheries catch rates and that if effects occurred, they could not be distinguished from inter-annual changes in stock size or availability to fishing gear resulting from other dynamics.
  - Haddon (2017) investigated the effect of the 2015 seismic survey in the Gippsland Basin on deepwater flathead catches and concluded that the significant drop in catch per unit effort was very likely negatively influenced by the seismic survey. However, Haddon (2017) went on to add that the seismic survey did not appear to have had a lasting impact on deepwater flathead catch per unit effort, which returned to typical values in the first month following the seismic survey.

The uncertainty level for impact to fish causing a change in behaviour from seismic sound is assessed as <u>medium</u> based on:

- There have been several field and desktop studies suggesting short term but recoverable effects of seismic surveys on commercial catch.
- Mortality of fish (both immediate and delayed) is not predicted based on no documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions.
- An absence of long-term monitoring data of the effects of seismic on fish in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For fish the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.5 Impacts to Eels

Adult Short-finned Eels are likely to migrate through the Operational Area during January to May (Gooley et al. 1998) and Short-finned glass eels during April to October (Gooley et al. 1998), although glass eels may continue to arrive anytime throughout the year (FRDC 2023).

The predicted effect level to these species is assessed as minor as impacts are predicted to have some effect on eels, but the effect is not considered significant or at a level to affect the population given the following:

- Mortality of eels (both immediate and delayed) is not predicted based on no documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions (DFO 2004; Boeger et al. 2006; Popper et al. 2014; Popper et al. 2016; Carroll et al. 2017; Popper and Hawkins 2019).

- Injury impacts may occur if the seismic array commences at full power adjacent to migrating eels. However, the implementation of M#03: Fauna Management System requires the seismic source to be slowly ramped up to full power over 30 minutes. This would allow eels to move away from the source before it is at full power. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04]. As detailed below adult Short-finned Eels have been tracked swimming at average speeds of 30.8 ± 7.3 km/day up to 80 km/day so it is feasible that they can swim away from a sound source. Glass eels, which are between 50-60 mm in length, actively swim toward and into the embayments and estuaries of the eastern Australian continent (VFA 2017). Though they are unlikely to achieve speeds reached be adult eels they can actively swim away from the sound source.
- Adult Short-finned Eels tagged and released from Hopkins River Mouth, Killarney Beach and Warrnambool Harbour, locations in shore of the Operational Area showed that they migrated to access deep water via two main routes: directly east via Bass Strait or south-east around Tasmania (Koster et al 2021). While migrating through the shelf area where the Operational Area is located adult eels achieved an average speed of 30.8 ± 7.3 km/day with one eel swimming at 80 km/day (Koster et al 2021). Thus, temporary impact to hearing from cumulative exposure to the sound source are not predicted as migrating eels will not be moving through the area where the sound source will be active at a rate that does not exposure them to cumulative impacts.
- Since 2011 the Victorian Eel Fishery annual catch has continued to vary, averaging 58 t per year with a low of 36 t in 2016–17 and a high the following year of 84 t (FRDC 2023). Commercial fishing is generally confined to lower and estuarine reaches of waters that are open to fishing and predominantly targets migrating eels (FRDC 2023). Thus, even with a level of biomass averaging 58 t per year and predominantly of migrating eels, the fishery is assessed as sustainable, and that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired (FRDC 2023). Impacts to adult eels from the seismic survey are not predicted to result in mortality and impediment to migration for spawning thus stock and recruitment would not be affected.

  Eels are a relatively long-lived fish, maturing at 8 to 20+ years of age (VFA 2017) thus recruitment of eels to the adult stock occurs over extended timeframes and is ongoing. In comparison, the short-term and localised impacts to glass eels because of a seismic survey would have impacts many orders of magnitude smaller than regional scale environmental/climatic events that would affect entire stocks.

The uncertainty level for impact to eels from seismic sound is assessed as <u>medium</u> based on:

- Migrating eels will not be moving through the area where the sound source will be active at a rate that does not exposure them to cumulative impacts.
- Mortality of fish (both immediate and delayed) is not predicted based on no documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions.
- An absence of long-term monitoring data of the effects of seismic on eels in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as <u>medium</u>. For fish the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts to EPBC Act listed fish species are temporary / reversible and small scale behavioural response or recoverable temporary threshold shift. Predicted impacts to fish are low intensity damage at populations levels and within current accepted levels of impact to these species as applied to the commercial fishing industry.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	No EPBC Act Management Plans and Recovery Plans identified for fish identified underwater sound as a threat and no actions relevant to the seismic survey were identified.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to fish are low intensity damage at populations levels and within current accepted levels of impact to these species as applied to the commercial fishing industry.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off because of the activity.	Via stakeholder consultation commercial fishers have raised concerns in relation to seismic impacts to commercial fisheries and control measure M#07: Adjustment Protocol, will be implemented to ensure that affected fishers will not be worse off because of the activity.	Yes

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Via consultation, impacts to the Budj Bim Cultural Landscape World Heritage Area eel traps and *kooyang* (Short-finned Eel) from the seismic survey has been raised. The eel traps are protected under the World Heritage Area listing, the eels themselves are not. No impacts to the World Heritage Area are predicted. The predicted impacts to eels are low intensity at a populations level and within current accepted levels of impact to these eel species as applied to the commercial fishing industry.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation the following objections and claims have been made: Commercial fishers and some other marine users have raised concerns about the impacts to fish populations and the long-term effects of seismic on the sustainability of the fisheries. The impacts of the Regia MSS have been assessed and the predicted levels of impact to each commercial fish species are all sub-lethal and mostly behavioural. There is no evidence of reduced fecundity nor developmental effects in any fish species, so long-term effects over multiple fishing seasons are not predicted. his has been communicated to the individuals who raised these concerns.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#01: Activity Limitation	The seismic source will not be operated within the West Tasmania Canyons Key Ecological Feature (KEF). This is protective for fish species associated with this KEF.	Yes
M#01: Activity Limitation	The sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar, which will significantly reduce potential impacts of underwater sound on sharks and rays in general, and White Shark behaviour near the foraging BIA. [Row added in response to Matters: F07 F08, and F17]	Yes
M#01: Activity Limitation	The MSS acquisition lines will be acquired working from shallow to deep if the survey period is during the April to June period, as was suggested by the ASBTA (Event ID 4370). If the survey period is between September to November, lines will be acquired working from deep to shallow to mitigate interactions with Blue Whales who might traverse the intended MSS area as they move towards their summer feeding grounds..	
M#03: Fauna Management System	The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For demersal and pelagic fish species including eels, they would move away from the source before it is at full power, providing them a level of protection. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04].	Yes
M#07: Adjustment Protocol	An adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Other titleholders in the region will be invited to participate in the review, update, and implementation of the adjustment process.	Yes

9 Conclusions

The conclusion of the effects of seismic sound to fish is summarised below.

Potential Impact	Predicted Level of Effect	Uncertainty	Predicted Level of Impact
Mortality and Potential Mortal Injury and Recoverable Injury	Minor	Low	Low
Temporary Threshold Shift	Minor	Medium	Medium
Change in Behaviour	Minor	Medium	Medium
Change in Commercial Catch	Minor	Medium	Medium

10 Recommendations

While there is extensive literature about the effects of seismic on fish there has been a high level of concern throughout consultation with relevant persons, particularly about the importance of commercially important species. It is recommended that CGG undertake additional assessment looking at the effects of the activity on commercially important fish species. This assessment is detailed in the Acceptable Levels Assessment (Appendix F3).

11 Document Control

Date	Revision	Update
6 August 2023	A	Draft prepared for initial comment
29 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Review and update following public comment**

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Annex 1: Legislative and Other Requirements Relevant to Underwater Sound and Fish

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify underwater sound as a threat.	NA
National Recovery Plan for the Australian Grayling *Prototroctes maraena* (Backhouse et al. 2008).	The overall objective of recovery is to minimise the probability of extinction of the Australian Grayling in the wild, and to increase the probability of important populations becoming self-sustaining in the long term.	Recovery plan does not identify underwater sound as a threat.	NA
Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015d)	Recommends that the species be listed in the conservation dependent category under the EPBC Act.	Listing advice does not identify underwater sound as a threat.	NA
National Recovery Plan for the Dwarf Galaxias (*Galaxiella pusilla*) (Saddlier et al. 2010)	The long-term objective of recovery plan is to minimise the probability of extinction and ensure long-term survival of Dwarf Galaxias in the wild and to increase the probability of important population becoming self-sustaining in the long term.	Recovery plan does not identify underwater sound as a threat.	NA
Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna) (TSSC 2010)	Recommends listing as conservation dependent.	Listing advice does not identify underwater sound as a threat.	NA
National Recovery Plan for the Yarra Pygmy Perch (*Nannoperca obscura*) (Sadler and Hammer 2010)	The long-term objective of recovery is to minimise the probability of extinction and ensure long-term survival of Yarra Pygmy Perch in the wild and to increase the probability of important populations becoming self-sustaining in the long term.	Recovery plan does not identify underwater sound as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Commonwealth Listing Advice on *Centrophorus zeehaani* (southern dogfish) (TSSC 2013a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Listing advice does not identify underwater sound as a threat.	NA
Commonwealth Listing Advice on *Galeorhinus galeus (*TSSC 2009a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Listing advice does not identify underwater sound as a threat.	NA
Recovery Plan for the White Shark (*Carcharodon carcharias*). (DSEWPaC 2013b)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in nature and the parties that will undertake those actions.	Recovery plan does not identify underwater sound as a threat.	NA

Annex 2: Underwater Acoustic Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Fish							
Australian Grayling	Species or species habitat known to occur within area	Vulnerable				None identified	Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)
Blue Warehou	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015)
Eastern Dwarf Galaxias, Dwarf Galaxias	Species or species habitat known to occur within area	Vulnerable				None identified	National Recovery Plan for the Dwarf Galaxias (*Galaxiella pusilla*) (Saddlier et al. 2010)
Orange Roughy, Deep-sea Perch, Red Roughy	Species or species habitat likely to occur within area	Conservation Dependent				None identified	None identified
Southern Bluefin Tuna	Species or species habitat likely to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna) (TSSC 2010)
Yarra Pygmy Perch	Species or species habitat known to occur within area	Vulnerable				None identified	National Recovery Plan for the Yarra Pygmy Perch (*Nannoperca obscura*) (Sadler and Hammer 2010)
Sygnathids							
Australian Smooth Pipefish, Smooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Brushtail Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Common Seadragon, Weedy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Deepbody Pipefish, Deep-bodied Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Hairy Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Halfbanded Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Javelin Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Knifesnout Pipefish, Knife-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Leafy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Mother-of-pearl Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Port Phillip Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Pugnose Pipefish, Pug-nosed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Red Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Ringback Pipefish, Ring-backed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Robust Pipehorse, Robust Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Sawtooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Short-head Seahorse, Short-snouted Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spiny Pipehorse, Australian Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spotted Pipefish, Gulf Pipefish, Peacock Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Tucker's Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Sharks							
Little Gulper Shark	Species or species habitat likely to occur within area	Conservation Dependent (listed as *Centrophorus zeehaani)*					Commonwealth Listing Advice on *Centrophorus zeeha* (southern dogfish) (TSSC 2013)
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	Species or species habitat may occur within area	Conservation Dependent					Commonwealth Listing Advice on *Galeorhinus galeus (*TSSC 2009a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
White Shark, Great White Shark	Foraging, feeding, or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		Distribution Foraging	Recovery Plan for the White Shark (*Carcharodon carcharias*). (DSEWPaC 2013b)

Marine Seismic Survey

Impact Assessment
Underwater Sound: Invertebrates

Appendix E4: REG-EP-023-E4

Rev 2

May 2024

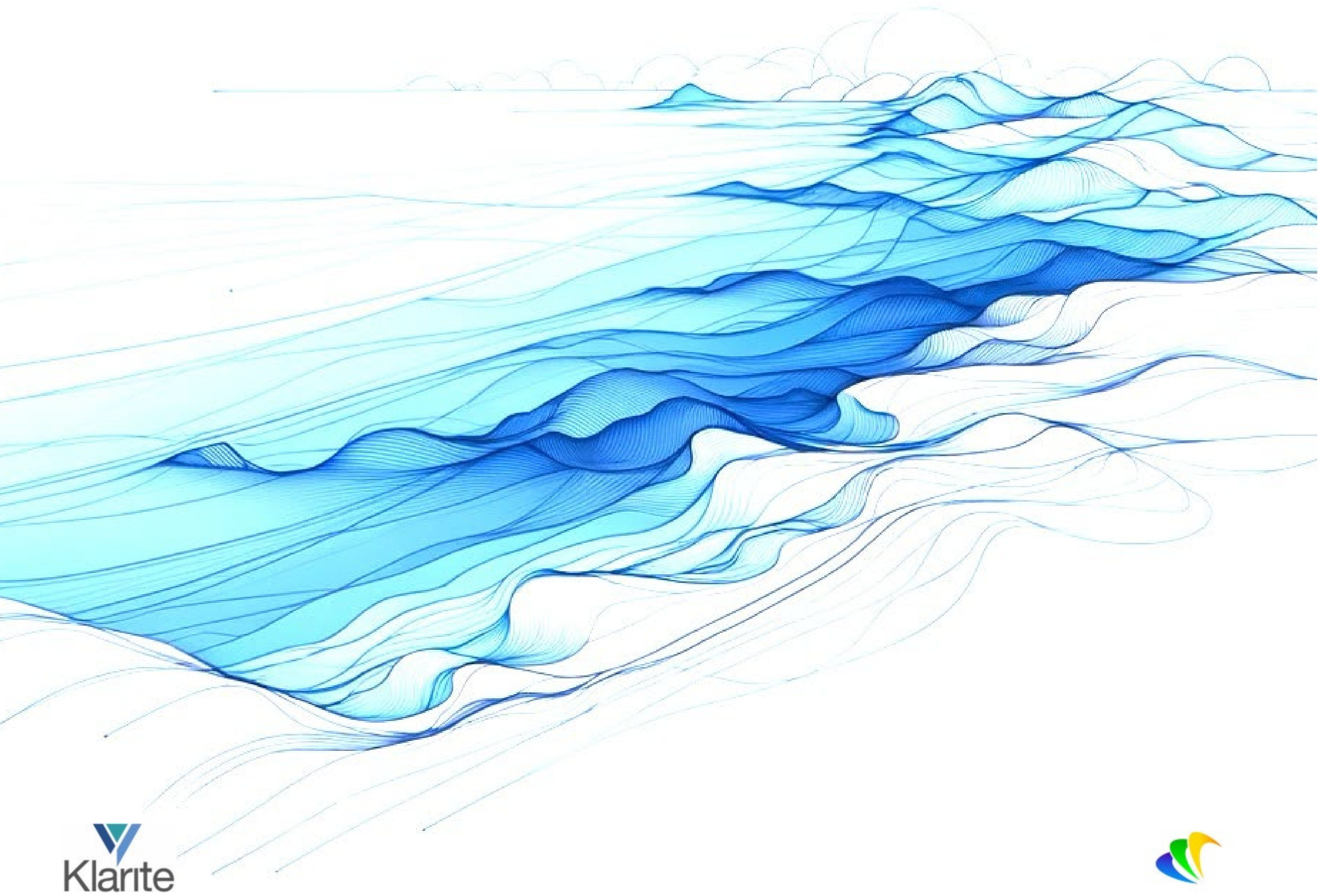

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Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7)
2. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E4-21 -shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E4-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E4-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E4-2-1able E4-21 shows how this feedback has been incorporated into the environmental assessments.

Table E4-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Received from the interactive regarding impacts to abalone industry.	128	CGG have included information on effects on bivalves to be included in impact assessment.
Relevant person from a community session cited studies regarding harm to scallops and shellfish	132	CGG included the paper mentioned in the impact assessment noting that scallops are not commercially fished in this area indicating an absence of commercial quantities.
Email received detailing the negative impact on marine life and climate.	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Compensation protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.
Received from the interactive regarding concern for effects to abalone.	174	The initial assessment adopted 40 m, which was superseded by 50 m depth contour activity limitation.
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan.	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.
Email received concerning Giant Crab and Southern Rock Lobster habitat within the canyon	233	CGG agreed to the following activity limitation: No acquisition within the West Tasmania Canyons KEF.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E4-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E4-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

For an overview of underwater sound and studies relevant to seismic surveys see the Seismic Sound Studies Report (Appendix B8).

Continuous underwater acoustic emissions are generated by the survey and support vessels and helicopters. Underwater acoustic emissions from vessels are generated by thrusters, engines, and propellers. Underwater acoustic emissions from helicopters are generated via the engine and rotors.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area + 4 - 702 m based on the furthest distance to modelled sound effect criteria. [Updated in response to Matter: F17]

Seismic acquisition where the seismic source will be active will occur for up to 60 days within the Active Source area.

Continuous Sound

Duration: 90 days

Extent: Operational Area

The survey and support vessels and helicopters will be active in the Operational Area for the duration of the survey undertaking support activities and acquisition.

3.3 Legislative and Other Requirements

No legislative or other requirements applicable to invertebrates and underwater sound were identified.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Invertebrates

Invertebrates were identified as a feature of the West Tasmanian Canyons Key Ecological Feature (KEF) which the previous Activity Planning Area overlapped. An assessment of impacts to invertebrates within this KEF was included in this document when first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. However, since then the Active Source Area has been defined and is ~20 km from the West Tasmanian Canyons KEF (Appendix B12 MAP-REG-EPM-004) thus impacts to invertebrates are not predicted within the KEF based on the furthest distance to the modelled sound effect criteria for invertebrates is between maximum 4 - 702 m from the Active Source Area.

Invertebrates were identified as a value of the Twelve Apostles Marine National Park which was adjacent to the previous Activity Planning Area. Since then, the Operational and Active Source Areas have been defined which included a 5 km buffer from the Operational Area Twelve Apostles Marine National Park (Appendix B12 MAP-REG-EPM-047). The Active Source Area is ~25 km Twelve Apostles

Marine National Park (Appendix B12 MAP-REG-EPM-047) thus impacts to invertebrates are not predicted within the park based on the furthest distance to the modelled sound effect criteria for invertebrates is between maximum 4 – 702 m from the Active Source Area.

There is no scientific information on the potential for continuous underwater sound impacts to invertebrates and no cause-effect pathway has been established. Thus, the impact assessment focuses on impacts from impulsive (seismic) underwater sound to invertebrates.

From relevant person consultation, commercial fishers have raised concerns in relation to impacts to commercial invertebrate species including spawning and recruitment. These concerns are assessed in this section.

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling study of underwater sound levels associated with the initial Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including plankton.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Two modelling reports were procured, one in the preparation phase of the EP (Koessler et al. 2023) and which is available in Appendix B7a and a second iteration during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m. The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria

4 Description of the Existing Environment that may be Affected by the Activity

Marine invertebrates consist of:

- Crustaceans such as crabs and rock lobsters.
- Molluscs such as bivalves (abalone, clams, mussels, and scallops), gastropods (sea snails/trochus, sea slugs and nudibranchs) and cephalopods (squid and octopus).
- Hard and soft corals.

Marine invertebrates not only represent the largest proportion of marine biomass and are indicators of ocean health, but many species also have important socio-economic values (Solé et al. 2023).

4.1 Invertebrates - General

Studies by the Museum of Victoria found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions (Wilson and Poore 1987). This is supported by studies in the region.

Studies for the Beach Otway Gas Development that is in the eastern part of the Regia Operational Area identified the following:

- A video survey of the seabed at selected sites along proposed offshore pipeline routes for the Otway Gas Development was undertaken during 2003 (Beach Energy 2022) and found:
  - Substrate in water depths between 82 and 66 m were predominantly low-profile limestone with an incomplete sand veneer that supported a low to medium density, sponge dominated filter feeding community. Fish and other motile organisms were uncommon.
  - In shallower depths of between 63 and 30 m, the video surveys showed a rippled, sand or sand/pebble substrate with minor sponge dominated benthic communities. The epibenthic organisms were generally attached to outcropping or sub-outcropping limestone pavements. Only in waters shallower than approximately 20 m, was an area of significant, high-profile reef and associated high density macroalgae dominated epibenthos encountered.
- A drop camera survey at the seabed for the next phase of the Otway Gas Development was undertaken from November 2019 to January 2020 and ranged in water depths from 70 to 104 m (Beach Energy 2022) and found:
  - Percent cover of epifauna ranged from 0 to 80% of the sample photograph for all samples but on average the percent cover was typically no more than 37%. Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant.
  - The general impression of the seafloor was of an unmodified marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges) that provided microhabitat for a range of macrofauna such as amphipods, isopods, polychaete worms and molluscs.
  - There was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.

- Epibiota on the seabed in the area surveyed was representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates. No species or ecological communities listed as threatened under the *Environmental Protection and Biodiversity Conservation Act* 1999 (the EPBC Act) were observed.

Studies for the proposed pipeline for the Cooper Energy Casino, Henry, Netherby Development (Cooper Energy 2017) that is in the eastern part of the Regia Operational Area, identified that in water depths from 20 – 70 m much of the seabed to ~ 60 m water depth was sand or fine gravel. No epifauna were observed in these large tracts of sand and the biological component was likely to be primarily in-faunal or pelagic. Beyond 60 m water depth, the seabed was characterised by concreted outcroppings with very low relief and structural complexity separated by gullies of sand or fine gravel. Survey footage indicated that this broad flat area has a sparse cover of filter-feeding epifauna dominated by sponges and also probably hydrozoans, bryozoans and algae.

4.2 Invertebrates – Commercial Species

Based on the review of commercial fisheries within the Regia MSS Operational Area (Appendix B6), the fisheries in Table E4-41- have been identified as having catch effort for invertebrate species within the Operational Area.

Based on stakeholder consultation CGG has implemented an operational constraint where the seismic source will not be operated in water depths less than 50 m, thus impacts to abalone and other sessile invertebrates in these water depths are not predicted.

Table E4-4-1: Commercial Invertebrate Fisheries with Catch Effort within the Regia MSS Operational Area

Jurisdiction	Fishery	Species	Note
Commonwealth	Southern Squid Jig Fishery	Gould's squid (arrow squid)	The Operational Area overlaps the Southern Squid Jig Fishery and Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Squid maximum fished area and where there has been fishing intensity during 2010 – 2020.
Victoria	Giant Crab Fishery	Giant crab	The Operational Area overlaps the area actively fished by the Giant Crab Fishery.
Victoria	Octopus Fishery	Pale octopus Maori octopus Gloomy octopus	The Operational Area overlaps the area where there has been one vessel with a maximum fishing day of one since the fishery commence in 2020. Currently octopus fishing in the Western Zone, which overlaps the Operational Area is via exploratory, temporary permits.
Victoria	Rock Lobster Fishery	Southern rock lobster	The Operational Area overlaps the area actively fished by the Rock Lobster Fishery.

4.2.1 Giant Crab

Giant Crab (*Pseudocarcinus gigas)* occurs in southern Australian waters between central New South Wales to southern Western Australia, including Tasmania. Giant crabs inhabit the continental slope at approximately 200 m depth and are most abundant along the narrow band of the shelf edge (VFA 2023b).

The stock of Giant Crabs distributed along the Victorian coast is part of a larger, genetically homogenous population that is endemic to southern Australia and maintained through widespread larval dispersion (VFA 2010). There has been little Giant Crab fishing in the Eastern Zone so the stocks in that zone are considered to be close to their natural state.

Giant Crabs are slow moving carnivores that feed primarily on sedentary benthic species such as starfish and on carrion. Growth of Giant Crabs is relatively slow; females and males taking approximately seven years and four to five years, respectively, to reach the legal minimum length of 150 mm (VFA 2010). The inter-moult period is one of the longest of the crab species and can be up to fifteen years for mature females (VFA 2010).

Female Giant Crabs are highly fecund and their ability to store sperm gives them the ability to fertilise their eggs over several successive breeding seasons. Eggs are released during autumn and incubated by the female until the following spring when they are released in the shallower depths of the shoulder of the continental slope (VFA 2010).

While there is little scientific data on the population, stock status records show the species to be sustainable throughout Western Australia, South Australia and Victoria but depleted in the Tasmania region (FRDC 2020).

Harvesting of the species has been undertaken for decades, though total allowable catch has been decreasing in Victoria significantly since 2011 from 25 tonnes to 10 tonnes by 2020 (VFA 2023b). Aspects of the species' biology (e.g., long-lived, slow-growing) and life-history characteristics make the species vulnerable to overfishing. The Victorian fishery stock status is listed as 'sustainable' while the Tasmania stock status is listed as 'depleted' based on percentage of egg production relative to unfished level.

Both the Victorian and Tasmanian fisheries recognise the importance of the breeding season with closures in effect from 1 June to 15 November for females while they are breeding and in berry. The Victorian fishery also closes between 15 September to 15 November to protect males during moult, while Tasmania remains open all year round for males.

4.2.2 Gould's Squid

The following is from AFMA (2023):

Gould's squid (*Nototodarus gouldi*) is a commercially important species that inhabits temperate and subtropical waters of Australia and New Zealand. They can be found in estuaries and pelagic environments to depths of 825 m but are most abundant over the continental shelf at depths of 50-200 m. Larvae and juveniles are often found in shallow coastal waters. Gould's squid aggregate near the seabed during the day and move into the water column at night to feed.

Gould's squid reach reproductive maturity at an age of 6-9 months. They spawn throughout the year, with 2-3 peaks in spawning activity. Females mate before they are fully mature, with sperm bundles ('spermatophores') from the male being stored in buccal pouches around the mouth. It is not known how long spermatophores are retained before fertilisation occurs. Eggs are fertilised as they pass the buccal pouch and are released in a free-floating jelly-like mass. Each egg mass can contain several thousand eggs, although reproduction is highly variable depending on environmental conditions. Hatching occurs 1-2 months after fertilisation. Gould's squid die shortly after spawning.

Gould's squid feed on crustaceans, fish and cephalopods at night and are in turn prey for birds, large fish, sharks, and marine mammals (O'Sullivan and Cullen 1983).

The species is commercially fished using jigging by the Southern Squid Jig Fishery and is incidental catch for the Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector. Fishing mortality and biomass are classed as not overfished.

4.2.3 Octopus

The Pale Octopus is a benthic species with no pelagic stage in its development. It has a depth range of 7–275 m and is found from the Great Australian Bight around Tasmania to southern New South Wales (Leporati et al. 2008a, 2008b). It has a single reproductive episode where the females stay with their eggs until they hatch, shortly after which they die. Leporati et al. (2008a, 2008b) details that Pale Octopus have a maximum life span of ~18 months and that peak-spawning season is around late summer and early autumn.

The Gloomy Octopus is unlikely to be present in the Operational Area as it is found throughout Subtropical eastern Australia and northern New Zealand (Australian Museum 2023).

Maori Octopus is the largest octopod in Australasia and can exceed an arm span of 3 m and mass of 10 kg (Lalas 2008). They live in the benthic zone in soft-sediment and rubble habitats from depths of 0-549 m and will sometimes forage in nearby hard-reef habitats but are less common at the fringes between reefal and soft sediment habitats (Animalia 2023).

Currently, only exploratory fishing for octopus is occurring in the western zone that overlaps the Operational Area with Pale Octopus classified as an undefined stock (FRDC 2020a).

4.2.4 Southern Rock Lobster

The Southern Rock Lobster (*Jasus edwardsii*) is found on coastal reefs from the south-west coast of Western Australia to the south coast of New South Wales, including Tasmania and the New Zealand coastline. Southern Rock Lobsters have extensive larval dispersal and can be found to depths of 150 metres, with most of the catch coming from inshore waters less than 100 metres deep (VFA 2017).

As the species is distributed continuously across southern Australia, the population is considered to be a single biological stock (VFA 2023, Bruce et al. 2007, Ovenden et al. 1992). Bruce (2007) detailed that with the exception of southwest Western Australia, all regions receive more pueruli from outside their own boundaries than from self-recruitment.

In Victoria, the abundance of Southern Rock Lobster decreases from west to east reflecting a decreasing area of suitable rocky reef habitat (VFA 2017). Most adult Southern Rock Lobster remain within the same region (moving less than 1 km), though some tagged Southern Rock Lobster have moved more than 80 km between inshore and offshore reefs (SRL 2023). In the Otway Bioregion, Southern Rock Lobster habitat occurs as patchy, discontinuous low-profile reef running parallel to the coast.

The life cycle of the Southern Rock Lobster is complex. After mating in April to July (SRL 2023), fertilised eggs (from 100,000 up to 1,000,000 per female) are carried under the tail of the female for approximately 4-6 months before being released, typically between September and November (VFA 2017). Larval release occurs across the southern continental shelf, which is a high-current area, facilitating dispersal.

Once released, Southern Rock Lobster larvae (phyllosoma) live in the plankton and undergo 11 developmental stages over a period of between 12 and 24 months (Hartmann et al. 2013; SRL 2023). This stage is spent far out to sea beyond the continental shelf where ocean currents can carry phyllosoma hundreds or even thousands of kilometres from where they were released by the female lobster.

At the end of this developmental phase, phyllosoma larvae moult and metamorphose into a puerulus larvae (a transparent miniature version of the adult), still living in the water column but not feeding (SRL 2023). Successful metamorphosis from the final stage phyllosoma to puerulus stage occurs offshore but close to the continental shelf (Curtin University 2009). The puerulus swim inshore at night to settle onto reef habitat in depths from 50 m to the intertidal zone (Booth et al. 1991) where they moult into pigmented juvenile lobsters (SRL 2023).

This settlement of puerulus is very important and is monitored using specifically designed collectors placed in many locations around southern Australia. Only a very small number of the eggs released actually reach the stage of settling as puerulus, and very few of these puerulus survive to become adults (SRL 2023). From the millions of larvae annually produced by each adult lobster, only two on average survive to become adult lobsters (SRL 2023a). By measuring the annual settlement of puerulus, fisheries scientists gain an indicator of future stock levels.

Bruce et al. (2007) reported data for state-maintained puerulus collector sites, which indicates that most puerulus settlement in Portland occurs June through September, tapering off in October.

Southern Rock Lobster grow by moulting or shedding their exoskeleton. The frequency of the moulting cycle declines with age from five per year for newly settled juveniles to once per year for mature adults (VFA 2017). Males grow faster and larger than females, reaching 160 mm in carapace length after ten years. Females generally reach 120 mm in the same period. Growth rates also vary spatially, with growth faster in the east than in the west (VFA 2017). It can take between three and ten years for Southern Rock Lobsters to reach commercial fishing size (SRL 2023).

Adult Southern Rock Lobster are carnivorous and feed mostly at night on a variety of bottom dwelling invertebrates such as molluscs, crustaceans, and echinoderms. The main predators of Southern Rock Lobster are octopus, sharks, and reef fish such as wrasse and ling (SRL 2023).

The latest stock status determination for the Southern Rock Lobster across South Australia, Tasmania, Victoria, and Western Australia details that it is sustainable (FRDC 2021). The 2021/22 Victorian Rock Lobster Fishery Stock Assessment Report (VFA 2023) details the that the egg production for the Western Zone, which the Operational Area overlaps, has been relatively consistent at 23-24% in the last seven years, in 2021/22 egg production was lower at 22.0% but still above the 20% limit reference point. Overall, the stock indicators in the Western Zone continue to show improvement.

The Victorian and Tasmanian Southern Rock Lobster Fisheries close between 1 June and 15 November to protect females in berry (with eggs attached) during the spawning period and between 15 September and 15 November to protect males during the moulting period when soft shells increase their vulnerability (VFA 2023a).

5 Sound Effect Criteria

No published sound effect criteria currently exist to enable an evaluation of potential impacts to invertebrates. The sound effect criteria adopted for the assessment of sound impacts to invertebrates are based on the studies in relation to seismic acoustic emission impacts to invertebrates provided in the Seismic Sound Studies Report (Appendix B8).

The sound effect criteria and predicted maximum distances from the acoustic modelling are detailed in Table E4-5-1.

The acoustic modelling is available in Appendix B7.

Table E4-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Invertebrates

Crustaceans – Recoverable Injury	
Threshold Criteria	Crustaceans are the most studied group in terms of the range of metrics investigated, including catch rates and physical, behavioural, and physiological effects (Carroll et al. 2017). No threshold criteria currently exist for acoustic impacts from seismic exposure to crustaceans. Though particle motion is likely the mechanism of impacts for invertebrates rather than sound pressure it is not clear what level of particle motion relates to an effect. Thus, for this assessment sound pressure metrics are used to be able to compare to published study results that use the sound pressure metrics of PK-PK. As Payne et al. (2008) identified no effects on righting time in lobster at 202 dB re 1 µPa (PK-PK), and Day et al. (2016a) found effects at 209 dB re 1 µPa (PK-PK), the level of 202 dB re 1 µPa (PK-PK) has been applied in this assessment as a precautionary threshold to determine potential impacts. To inform the assessment of potential effects on crustaceans the PK-PK sound level at the seafloor was estimated at all modelled sites and compared to assessment criteria of 202 dB re 1 µPa (PK-PK).
Sound exposure guideline	202 dB PK-PK
Modelled Distance	702 [1] m at 60 m water depth to 638[1] m at 170 m water depth
Bivalves – Mortality/Mortal Injury	
Threshold Criteria	No threshold criteria currently exist for acoustic impacts from seismic exposure to bivalves. Particle motion is likely the mechanism of impact for bivalves rather than sound pressure though it is not clear what level of particle motion relates to an effect. Particle motion is seen as a more relevant criteria for assessment of bivalves as they spend most of the time in the seabed sediments rather than the water column. To assess the potential impacts associated with the seismic survey, particle motion has been assessed, specifically particle acceleration and velocity, and the results compared to those presented in Day et al. (2016b). The maximum particle acceleration assessed for scallops was 37.57 ms^{-2}.
Sound exposure guideline	37.57 ms^{-2}
Modelled Distance	4[1] m in 50 m water depth, and not reached in >60 m water depth
Cephalopods – Startle Response	
Threshold Criteria	There are currently no peer-reviewed acoustic criteria for noise impacts and hence the 162 dB SEL per-pulse for squid is used based on the inking and startle response from Fewtrell and McCauley 2012).
Sound effect criteria	162 dB SEL
Modelled Distance	4.81[1] km
Coral - Mortality/Mortal Injury	

Threshold Criteria	There are currently no peer-reviewed acoustic criteria for noise impacts and hence the 226 dB PK received levels at which no impacts to coral were identified (Heyward et al. 2018) are used.
Sound effect criteria	226 dB PK
Modelled Distance	Not reached[1]

1: Sound modelling updated in response to Matter: F17

6 Predicted Levels of Impact

As detailed from the underwater sound and studies relevant to seismic surveys, provided in the Seismic Sound Studies Report (Appendix B8), mortality and injury to invertebrates are not predicted based on the received sounds levels to these species.

No impacts to corals are predicted based on the modelled distance to sound effect criteria for corals is 3 m and the minimum water depth for the Regia MSS is 50 m.

6.1.1 Giant Crab

Giant Crab are likely to be present in the deeper waters (>200 m) of the Operational Area which overlaps areas where Giant Crab are caught by the Victorian Giant Crab Fishery. The Operational Area does not overlap the Tasmanian Giant Crab Fishery.

The extent of the area of impact is predicted to be 702 m at 60 m water depth to 638 m at 170 m water depth based on the distance to the no effect criteria from Payne et al. (2008) (Table 2).

The predicted effect level to this species is assessed as minor as impacts are predicted to have some effect on Giant Crab, but the effect is not considered significant or at a level to affect the population given the following:

- Available scientific literature has demonstrated no direct mortality of crabs from exposure to seismic sounds (Morris et al. 2017, Christian et al. 2003, Christian et al. 2004, DFO 2004).
- Sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes are documented in rock lobsters at received levels of 209 dB re 1 µPa (PK-PK) (Day et al. 2016a) and could also occur in Giant Crab. Based on the distances from the seismic source that these levels would be reached it is possible that some individual Giant Crabs will incur a reduction in fitness. However, it is unlikely that this would occur to all Giant Crabs present within the Active Source Area, therefore, impacts at a population level due to reduced fitness are unlikely.
- A range of studies have exposed female crabs bearing eggs to seismic sound, with no reports of acute or chronic mortality in the adult lobsters and no mortality of embryos (Christian et al. 2003, DFO 2004, Pearson et. al 1994). Day et al. (2016a, 2016b) also reported that exposures equivalent to approximately 205 dB re 1 µPa (PK) did not impact the condition or development of eggs carried by female lobsters, or the size or morphology of the larvae once hatched. Therefore, potential exposure of berried females to the seismic source is unlikely to result in any mortalities to adult females in addition to natural or fishing mortalities and, therefore, no reduction in the adult spawning biomass.
- No change to development rate in exposed fertilised crab eggs/embryos is predicted compared with unexposed eggs/embryos based on Payne et al. 2008, Christian et al 2003, DFO 2004 and Pearson et al. 1994. Therefore, impacts at a population level due to reduced recruitment would be unlikely as impacts to larvae and eggs were not observed.
- At received noise levels of 209 – 212 dB re 1 µPa (PK-PK) (Day et al. 2016a) impacts to rock lobster embryonic development were not observed with hatched larvae found to be unaffected in terms of egg development, the number of hatch larvae, larval dry mass and energy content and larval competency (i.e., survival in adverse conditions) thus recruitment should be unaffected (Day et al. 2016a). Though a different species, the study results align with the outcomes of the studies on fertilised crab eggs/embryos compared with unexposed eggs/embryos based on Payne et al. (2008), Christian et al (2003), DFO (2004) and Pearson et al. (1994). Further supporting that impacts at a population level due

to reduced recruitment would be unlikely as impacts to larvae and eggs were not observed.

- The stock of Giant Crabs distributed along the Victorian coast is part of a larger, genetically homogenous population that is endemic to southern Australia and maintained through widespread larval dispersion (VFA 2010).

The uncertainty level for impact to Giant Crab from seismic sound is assessed as medium based on:

- There are no published sound effect criteria for acoustic impacts from seismic exposure to crustaceans.
- In the absence of a published sound effect criteria for acoustic impacts from seismic exposure to crustaceans no effects on righting time in lobster at 202 dB re 1 μPa (PK-PK) from Payne et al. (2008) was applied in this assessment as a precautionary threshold to determine potential impacts.
- There are limited published studies on the effects of seismic on Giant Crab, none of which are specific to the species in the Otway region.
- An absence of long-term monitoring data of the effects of seismic exposure on Giant Crab in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For Giant Crab the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in the Comparison of Predicted Level and Defined Acceptable Level. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.1.2 Molluscs

Molluscs may be present within the Operational Area. No commercial fishing for molluscs such as scallops or abalone were identified within the Operational Area. However, based on communication of concerns from Abalone Fishers a separate assessment on abalone has been added to Appendix F3: Acceptability Assessment. The predicted levels of impact as reported for Molluscs as a group are nevertheless the same for Abalone specifically.

As detailed in Table E4-51- the maximum modelled distance to sound effect criteria for molluscs is 4 m in 50 m water depth, and not reached in >60 m water depth.

The predicted effect level to this species is assessed as negligible as impacts to molluscs are predicted to have little or no effect on the environment or the affected species, populations, or ecosystems based on:

- CGG has implemented an operational constraint where the seismic source will not be operated in water depths less than 50 m, thus impacts to abalone and other molluscs in these water depths are not predicted.
- At 50 m water depth the distance to the sound effect criteria for molluscs is 4 m and at water depths > 60 m the sound effect criteria for molluscs is not reached. Thus, impact to mollusc species on the seafloor are not predicted.

The uncertainty level for impact to molluscs from seismic sound is assessed as medium based on:

- There are no published sound effect criteria for acoustic impacts from seismic exposure to molluscs.
- There are several published studies on the effects of seismic on molluscs, none of which are specific to the species in the Otway region.

- An absence of long-term monitoring data of the effects of seismic on molluscs in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (negligible) and uncertainty (medium) is assessed as medium. For molluscs the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in the Comparison of Predicted Level and Defined Acceptable Level. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.1.3 Southern Rock Lobster

The Operational Area overlaps where Southern Rock Lobster are likely to be present in waters up to 150 m, and the nearshore waters where the majority of catch for the Victorian Rock Lobster Fishery occurs. The Operational Area does not overlap the Tasmanian Rock Lobster Fishery.

The extent of impact to Southern Rock Lobsters is predicted to be within 702 m from the seismic source to the seafloor. The extent of impact to larvae is predicted to be within 230 m from the seismic source (see Appendix E2 Underwater Sound – Plankton) for on how this distance has been determined.

The duration of the predicted physical and physiological impacts to individuals:

- May be permanent in some adults directly below the sound source.
- May be recoverable in puerulus and is permanent in juvenile life-stages.

The duration of the predicted impacts to the SRL population are uncertain due to potential increased vulnerability to predators and increased intermoult period arising from the possible impacts to individuals. However, given fishery recruitment is largely unimpeded by the Regia MSS, the duration of population level impact is expected to be limited to juveniles in the current cohort.

The predicted effect level to this species is assessed as minor as impacts are predicted to have some effect on Southern Rock Lobster, but the effect is not considered significant or at a level to affect the population given the following:

- Scientific literature has demonstrated no direct mortality of lobsters including eggs, puerulus, juvenile, and adults, proximate to the seismic source (Day et al. 2016a, Payne et al. 2008, Day et al. 2021). The Day et al (2016 and 2021) assessments are considered conservative given the water depths in the Operational Area and the protection afforded by typical habitat features such as holes, crevices, or rocky dens within structurally complex reef habitats in nearshore area where most Southern Rock Lobsters would be present. Scientific studies have detected impacts in shallower water depths, and as scientific literature identifies, behavioural and physiological responses in crustaceans are likely to be related to particle motion effects, located close to the operating array, rather than pressure effects (Carroll et al. 2017).
- Southern Rock Lobster population is sustainably fished meaning that the population is not vulnerable to mortal effects to large portions of the adult populations.
- A single seismic survey has a negligible impact on larval supply by comparisons with the size of the larval populations (McCauley et al. 2000) and recruitment into or out of the area is unlikely to be impaired.
- Pueruli are likely to use a range of orientation cues to locate suitable settlement areas (Hinojosa et al. 2016), reducing the potential impact of increased ambient sound on the ability to locate suitable settlement areas.

- The impact assessment has evaluated impacts from underwater sound on Southern Rock Lobster stocks, including at key life stages based on contemporary scientific literature.
- Conservative thresholds have been adopted and given the small spatial overlap with likely Southern Rock Lobster habitat, the potential for impact at the population level is negligible, localised, and recoverable.
- The Southern Rock Lobster population is highly recoverable shown by the overlaps with the Victorian Rock Lobster Fishing Area which have removed their full quota or close to their quota since quotas were introduced, which was a combined Total Allowable Commercial Catch (TACC) of 286 tonnes of the adult population in 2019/20.
- The Southern Rock Lobster population is resilient to mortal effects because the population is a connected, broadly distributed stock across the whole of southern Australia in water depths from 0 m to 400 m.
- The predicted physical and physiological effects to individuals are unlikely to affect the current population, or future populations, because of the high resilience of the species to more severe impacts.
- Despite the uncertainty in the duration of population level effects, the extent of impacts is ecologically insignificant in comparison to any of the analysed areas.
- This assessment is considered highly conservative given that:
  - Puerulus larvae settle onto reef habitat in shallow waters (50 m to the intertidal zone) not present within the operational area; and
  - Juveniles are normally found in isolated holes and crevices, with larger juveniles and sub-adults residing in large aggregations inside rocky dens within structurally complex reef habitats and are not typically exposed at the seafloor.

The uncertainty level for impact to Southern Rock Lobster from seismic sound is assessed as <u>medium</u> based on:

- There are no published sound effect criteria for acoustic impacts from seismic exposure to crustaceans.
- In the absence of a published sound effect criteria for acoustic impacts from seismic exposure to crustaceans no effects on righting time in lobster at 202 dB re 1 µPa (PK-PK) from Payne et al. (2008) was applied in this assessment as a precautionary threshold to determine potential impacts.
- There are limited published studies on the effects of seismic on Southern Rock Lobster, none of which are specific to the species in the Otway region.
- An absence of long-term monitoring data of the effects of seismic exposure on Southern Rock Lobster in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For Southern Rock Lobster the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in the Comparison of Predicted Level and Defined Acceptable Level. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.1.4 Octopus and Squid

The extent of the area of impact is predicted to be a maximum of 4.81 km from the sound source during survey acquisition (Table E4-) which would result in a startle response.

The predicted effect level to this species is assessed as negligible based on impacts to octopus and squid are predicted to have little or no effect on the environment or the affected species, populations, or ecosystems. The impact will be localised and temporary, and octopus and squid have the capacity to recover from the impact without significant harm based on:

- Impacts are limited to behavioural startle response and potentially inking.
- Fewtrell and McCauley (2012) detailed that caged squid exposed to an air gun signal displayed a significant decrease in alarm responses in the second exposure to the air gun noise when compared with the first, supporting general habituation to the sound.
- Mortality or physiological damage to cephalopods is not predicted.
- Octopus and squid may be injured if the seismic source commences operation at full power immediately next to the species. With controls adopted, octopus and squid which are mobile can move away from areas where sound levels might have the capacity to cause physiological damage. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05].

The uncertainty level for impact to octopus and squid from seismic sound is assessed as <u>medium</u> based on:

- There are no published sound effect criteria for acoustic impacts from seismic exposure to octopus and squid.
- In the absence of a published sound effect criteria for acoustic impacts from seismic exposure to octopus and squid, the inking and startle response received level from Fewtrell and McCauley (2012) was used which provides a conservative assessment as the study was undertaken on caged squid which could not move away from the air gun.
- There are no published sound effect criteria for acoustic impacts from seismic exposure to crustaceans.
- In the absence of a published sound effect criteria for acoustic impacts from seismic exposure to crustaceans no effects on righting time in lobster at 202 dB re 1 μPa (PK-PK) from Payne et al. (2008) was applied in this assessment as a precautionary threshold to determine potential impacts.
- There are several published studies on the effects of seismic on crustaceans, including studies on southern rock lobsters.

The predicted level of impact based on the effect (negligible) and uncertainty (medium) is assessed as <u>low</u> thus good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Of the invertebrates known to be present within the Operational Area and predicted to be impacted by seismic sound, individual Southern Rock Lobster may suffer permanent injury, individual Giant Crab may suffer similarly but this is uncertain and impacts to molluscs are not predicted and impacts to octopus and squid and predicted to be behavioural only. Whilst the severity may be irreversible for individual Southern Rock Lobsters and Giant Crabs the extent and duration at population levels are negligible because the effects are sub-lethal, do not affect fecundity, and the population is resilient to >30% biomass removal annually from fishing. The impact to molluscs, octopus, and squid is predicted to be negligible.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	No EPBC Act Management Plans and Recovery Plans were identified relevant to invertebrates.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to molluscs, octopus, and squid are temporary, reversible, and small-scale. Predicted impacts to Giant Crab and Southern Rock Lobster are low intensity damage at populations levels and within current accepted levels of impact to these species as applied to the commercial fishing industry.	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Through consultation commercial fishers have raised concerns in relation to seismic impacts to commercial fisheries and control measure M#07: Adjustment Protocol, will be implemented to ensure that affected fishers will not be worse off because of the activity.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	From consultation to date no cultural features including cultural values, traditions, or practices have been identified associated with invertebrates that may be impacted.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation the following objections and claims have been made:	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
	The views of public have been considered in the impact and risk assessment.	Some fishers have raised a claim that they will be worse off because of the activity either through direct displacement, loss of gear, through knock-on effects, or through long-term effects to stock levels. A compensation process will be adopted to pay reasonable, evidence-based claims. Local businesses and interested individuals have claimed unacceptable levels of impact to fish stocks and the ripple effects that this would have to the coastal developments of the Otway. Local businesses once removed from the fisher (i.e., fish markets or point of sale handlers) will be able to submit claims under the compensation process.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#01: Activity Limitation	No discharge of the sound source within the West Tasmania Canyons (KEF). This is protective for invertebrate species associated with this KEF.	Yes
	No discharge of the sound source at full power in water depths of less than 50 m. This is protective for immobile or short ranging invertebrate species that are more likely to be present in water depth < 50 m.	Yes
M#03: Fauna Management System	The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For mobile species such as octopus and squid they would move away from the source before it is at full power, providing them a level of protection. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05].	Yes
M#07: Adjustment Protocol	An adjustment process will be implemented if a commercial fisher has a financial loss due to the Regia MSS. The adjustment process will be developed in consultation with the fishery associations that represent the commercial fishers that fish within the Operational Area. Other titleholders in the region will be invited to participate in the review, update, and implementation of the adjustment process.	Yes

9 Conclusions

The conclusion of the effects of seismic sound to invertebrates is summarised below.

Invertebrates	Predicted Level of Effect	Uncertainty	Predicted Level of Impact
Giant Crab	Minor	Medium	Medium
Molluscs	Negligible	Medium	Medium
Southern Rock Lobster	Minor	Medium	Medium
Octopus and Squid	Negligible	Medium	Low

10 Recommendations

While there is extensive literature about the effects of seismic on invertebrates there has been a high level of concern throughout the consultations with relevant persons, particularly about the effect of seismic sound on the spawning of commercially important species. It is recommended that CGG undertake additional assessment looking at the effects of the activity on commercially important invertebrate species. This assessment is detailed in the Acceptable Levels Assessment (Appendix F3).

11 Document Control

Date	Revision	Update
20 July 2023	A	Draft prepared for initial comment
30 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA

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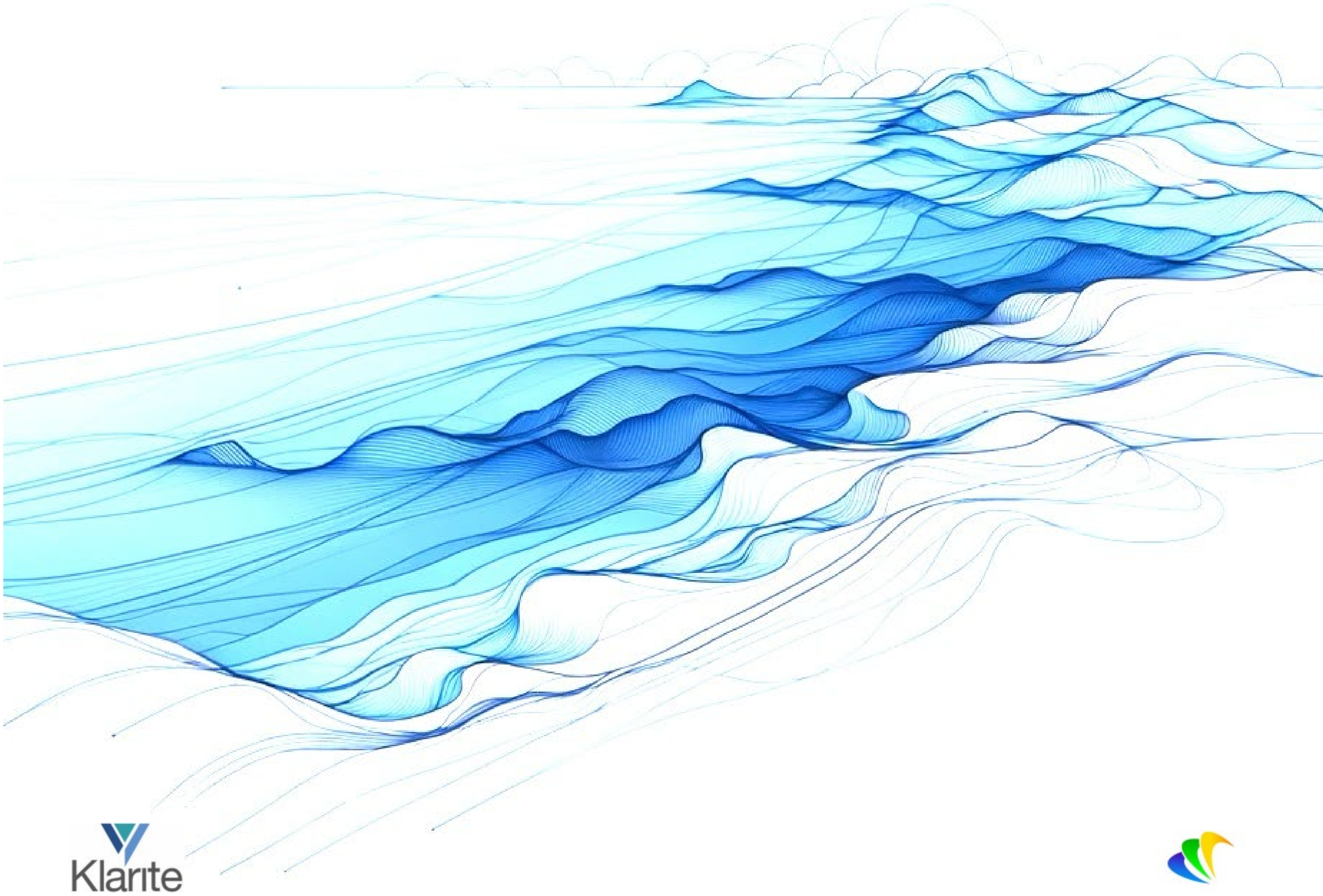
REGIA
Marine Seismic Survey

Impact Assessment Underwater Sound: Birds

Appendix E5: REG-EP-024-E5

Rev 2

May 2024



Klarite

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7)
2. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E5-21- shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E5-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E5-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E5-21 shows how this feedback has been incorporated into the environmental assessments.

Table E5-21 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Behavioural disturbance impacts to Little Penguin colony at Middle Island resulting in further distance to forage and impacting breeding success as the Middle Island population has been significantly reduced to due to fox predation.	247	The seismic source will be reduced to the low power setting if foraging birds are within 500 m of the source. Full power can commence when the seismic source is > 500 m from any foraging birds.
Relevant person has stated concerns and points of consideration regarding the Fairy penguin colony through the interactive map.	130	CGG agreed to implement the following measures: Inclusion of specific section in the impact assessments. MMO could also spot for seabird activity which would indicate a food source for Little Penguins. The seismic source will be reduced to the low power setting if foraging birds are within 500 m of the source. Full power can commence when the seismic source is > 500 m from any foraging birds. This will ensure that foraging birds are not startled by the seismic source and can continue to forage once the vessel has moved passed
Feedback from a community session on the impact of seismic blasting on penguins and their food supply	135	CGG included an assessment of zooplankton and food supply in impact assessment.
Email received detailing the negative impact on marine life and climate	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Compensation protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.

Objections and Claims	Feedback ID	Measure adopted because of consultation
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Key Biodiversity Area with four bird species listed for recovery plans under the Australian Government's Threatened Species Strategy. Decisions to be consistent with the federal government's Threatened Species Recovery Plan.	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.
Instant feedback received containing concern of negative impacts on seabirds	191, 196, 423	CGG agreed to implement the following measures: Policy statement 2.1 measures. Seismic source reduced to low power if flocks of foraging birds are observed by MMO within 500 m of the source, power can commence when >500 m from flocks of foraging birds OPEP protection priority
Negative effects on seabirds 'fitness to forage	192	CGG agreed to implement the following measures: MMO instruction to monitor for seabird aggregations along sail line
Interactive map comment containing objections and queries regarding the potential effects on the endangered hooded plovers and its habitat.	205	CGG agreed to implement the following measures: Light management plan including minimum lighting and shrouds. OPEP with priority protection areas.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E5-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E5-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Acknowledgement of breeding colonies	B07	EP Appendix E5 Section 4.7 has been updated to include specific mention of the Short-tailed Shearwater.
Matter: Underwater sound impacts on shearwaters	B08	Information has been added to EP Appendix E5 Section 4.7 regarding the shearwater colony on Griffiths Island, Victoria.

Matter: Impacts on prey species	B09	Information has been added to EP Appendix E5 Section 6.
Matter: Impacts to diving birds and their prey	B12	Information has been added to EP Appendix E5 Section 6.
Matter: Consideration of olfactory foraging in seabirds	B13	Information has been added to EP Appendix E5 Section 6.
Matter: Community level and cumulative impacts	B14	Information has been added to EP Appendix E5 Section 6.
Matter: Mitigating sound exposure impacts to seabirds	B15	Clarification has been provided in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds) that the acoustic source will be reduced to the low power setting if flocks of foraging birds are observed by the Marine Fauna Observer within 500 m of the source. Full power can commence when the seismic source is > 500 m from any flocks of foraging birds.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area + 10.4 to 77 km based on the furthest distance to modelled sound effect criteria. [Updated in response to Matter: F17]

Seismic acquisition where the seismic source will be active will occur for up to 60 days within the Active Source area.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to underwater sound and species that may be affected by underwater sound, and how the requirements will be met.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Diving birds and penguins.

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling study of underwater sound levels associated with the initial Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including penguins.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Two modelling reports were procured, one in the preparation phase of the EP (Koessler et al. 2023) and which is available in Appendix B7a and a second iteration during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m. The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria

4 Description of the Existing Environment that may be Affected by the Activity

To identify diving birds and penguins that may be present within the area affected by underwater sound a PMST search was undertaken using the Active Source Area with a 50 km buffer. Though the furthest distance to a sound effect criterion is 77 km the PMST search only allows a maximum buffer of 50 km (note: the furthest distance to a sound effect criteria was updated to Active Source Area + 10.4 to 77 km for the Little Penguin (Table E5-5-1) [Updated in response to Matter: F17]). The PMST report is available in Appendix B5.

To ensure all diving bird species with biologically important behaviours were identified a further review was undertaken of the Department of Climate Change, Energy, the Environment and Water National Conservation Values Atlas (NCVA). Only diving birds with breeding or foraging behaviour are reported in this section as they are likely to dive underwater whilst foraging and be exposed to underwater sound. Breeding was also used as many breeding birds also forage to feed themselves and young.

A summary of the birds identified from the PMST report and review of the NCVA is provided in Annex 2 of this document along with any relevant conservation advice or management plans.

The area above the sound effect criteria for diving birds overlaps the following marine protected areas that identified foraging birds as a value:

- Apollo Australian Marine Park for which one of the values are important foraging area for Black-browed and Shy albatross, Australasian Gannet, Short-tailed Shearwater, and Crested Tern.
- Zeehan Australian Marine Park for which one of the values are important foraging areas for Black-browed, Wandering and Shy albatrosses, and Great-winged and Cape Petrels.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. There are no changes to protected matters for diving birds [Section added in response to Matters: I16 and I17].

These species are described below.

4.1 Albatrosses and Petrels

Eleven albatross and six petrel species are identified as having foraging, feeding or related behaviour and/or BIAs within the area potentially affected by underwater sound (Annex 2). These BIAs cover either most or all the South-east Marine Region (CoA 2015a). In addition, the Common Diving-petrel breeds on Lady Julia Percy Island which is within the area potentially affected by underwater sound.

Albatrosses and petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (CoA 2022). Albatross and petrel species exhibit a broad range of diets and foraging behaviours, and hence at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is those waters south of 25o where many species spend much of their foraging time (CoA 2022).

Albatrosses have a widespread distribution throughout the southern hemisphere. They feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP 2020). Albatrosses are colonial, usually nesting on isolated islands and foraging across oceans in the winter months with most observations along the edge of the continental shelf (CoA 2022).

Petrels are oceanic and have a widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between 40°S and 60°S. Petrel species feed on small fish, cephalopods (octopus, squid and cuttlefish) and crustaceans along the edge of the continental shelf and open waters (CoA 2022).

4.2 Black-faced Cormorant

The Black-faced Cormorant was identified as breeding known to occur within the area potentially affected by underwater sound (Annex 2). This species is found along the coast of Tasmania and Victoria with two independent populations one on the coast of southern Western Australia, the other on the coasts of South Australia (del Hoyo et al. 1992). Breeding usually occurs on rocky islands, but also on stacks, slopes, and sea cliffs in colonies of up to 2,500 individuals (del Hoyo et al. 1992). It feeds in coastal waters, sometimes in sheltered places such as bays and islets and can be found entering rivers along the coast (CoA 2020a) and thus is unlikely to feed within the area potentially affected by underwater sound.

4.3 Crested Tern

Crested Terns are medium sized, slender terns that are widely distributed. They are commonly found in near-coastal environments and estuaries, but also inhabit lakes and rivers inland (GSA 2023). They dive from heights of five to eight metres when foraging but only penetrate a few centimetres below the surface of the water (GSA 2023). Their diet includes small fish such as Sardines, Australian Anchovies and Leatherjackets (GSA 2023).

4.4 Gannets

The Australasian Gannet was identified as breeding known to occur and an aggregation BIA within the area potentially affected by underwater sound (Annex 2). The BIA is a 40 km buffer around Portland (Point Danger) where the Australasian Gannet breeds between July and March.

The Australasian Gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers (CoA 2015a).

The Cape Gannet was identified as breeding known to occur within the area potentially affected by underwater sound (Annex 2). There is limited information on where this breeding location but it is likely that it is also at Point Danger (Portland) based on Pizzey (2007) that details that several birds have occasionally been found breeding on offshore Australian islands, together with Australasian Gannets, although the Cape species is never represented by more than a few pairs.

4.5 Little Penguin

The Little Penguin was identified as breeding known to occur within the area potentially affected by underwater sound (Annex 2). Within this area breeding occurs on Lady Julia Percy Island and Middle Island.

The Little Penguin is the smallest penguin species and is endemic to Australia and New Zealand. In Australia, the species occurs from Western Australia (Carnac Island) to New South Wales (Broughton Island) and Tasmania. The distribution is not continuous, with sections of the southern coast of Australia without occurrence of breeding colonies (CoA 2020a).

The Little Penguin breeds during the austral autumn to summer months and are the only truly nocturnal penguin species on land; adults always arrive after dusk and leave before dawn (CoA 2020a).

This species is a generalist feeder, with large variability in diet amongst colonies and even between years at the same colony. They feed mainly on clupeids, such as anchovy and sardines, when feeding chicks, but they may also feed on krill and several species of cephalopods at all stages of breeding (CoA 2020a).

Hoskins et al. (2008) examined the foraging range and diving behaviour of the Little Penguin from three breeding colonies (Rabbit Island, Kanowna Island and Phillip Island) in central northern Bass Strait, during the chick-guard stage using electronic tags. Although there were large overall differences between individuals, the mean maximum foraging range (16.9 to 19.8 km) and mean total distance travelled (41.8 to 48.0 km) were similar between the 3 colonies, despite different bathymetric environments. Individuals from all three colonies selected foraging habitats within a narrow sea surface temperature (SST) range (16.0 to 16.4°C). While there were significant differences in mean dive depths (5.4 to 10.9 m) and mean durations (13.2 to 28.6 s) between the different colonies, the mean diving effort (vertical distance travelled: 936.3 to 964.3 m h–1) was similar. These findings suggest little penguins from the three colonies employ relatively similar foraging efforts yet are flexible in their foraging behaviours.

McCutcheon et al. (2011) used satellite telemetry to determine the at-sea movements and foraging range of 47 Little Penguins from Phillip Island, south-eastern Australia, during the winter non-breeding period. Individuals conducting single-day trips (72% of individuals) typically foraged 8–14 km from the colony, whereas individuals conducting longer trips (28%; 2–49 days) foraged either within Port Phillip Bay or in the coastal waters of western Bass Strait at maximum distances of 62–147 km from the colony. McCutcheon et al. (2011) noted that the results of this study indicate that Little Penguins remain within continental shelf waters no more than several hundred kilometres from the breeding colony during the non-breeding period, suggesting food availability is adequate within this region throughout the year.

4.6 Little Tern

The Little Tern was identified as breeding known to occur within the area potentially affected by underwater sound (Annex 2). Little Terns forage in shallow waters of estuaries, coastal lagoons, and lakes, frequently over channels next to spits and banks or entrances, and often close to breeding colonies (DCCEEW 2023). They also forage along open coasts, especially around bars off the entrances to rivers and lagoons, less often at sea, and usually within 50 m of shore (DCCEEW 2023). Little Terns are primarily diurnal, and feed by plunging in shallow water of channels and estuaries, or in surf on beaches, typically from 3–10 m above the surface though up to 13 m above water (DCCEEW 2023).

4.7 Shearwaters

The Short-tailed Shearwater was identified as breeding known to occur (Lady Julia Percy Island) and a foraging BIA to be present within the area potentially affected by underwater sound (Annex 2). The Short-tailed Shearwater migrates to the Northern hemisphere for the austral winter and generally only present in Australian waters from September to May. They are common in the South-east Marine Region and largely found on numerous islands off Victoria and Tasmania during breeding (Baker and Hamilton 2013, Skira et al. 1996). During breeding they conducts a bimodal feeding strategy, alternating short foraging trips to local waters with long foraging trips (up to 17 days) to the Polar Frontal Zone. Short trips allow greater chick provisioning at the sacrifice of body condition, which is then recovered in richer subantarctic waters. Diet includes fish particularly mycotphids, crustaceans and squid (Weimerskirch and Cherel 1998). During consultation breeding colonies were also identified on Middle Island and Griffiths Island [Event ID 2023], and they are of significant value to local communities. These are not identified as BIAs, likely due to a lower number of breeding pairs in comparison to other offshore islands. [Paragraph updated in response to Matter: B07 and B08].

The Wedge-tailed Shearwater was identified as having foraging and breeding BIA within the area potentially affected by underwater sound (Annex 2). The foraging and breeding BIA is associated with Muttonbird Island, however, a review of the DCCEEW Species Profile and Threats Database (SPRAT), Atlas of Living Australia and South-east Marine Region Profile did not provide any information on the Victorian Muttonbird Island Wedge-tailed Shearwater colony. The DCCEEW SPRAT profile does not show any locations for the Wedge-tailed Shearwater in Victoria, and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of Wedge-tail Shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border.

Movement patterns of the Wedge-tailed Shearwater are poorly known but populations at the northern and southern extremities of the known range are migratory, departing nests in early April to early May and spending the nonbreeding season in the tropics (DCCEEW 2023a). In Australia, Wedge-tailed Shearwaters have been observed feeding along the junction between inshore and offshore water masses. There is no detailed analysis of the diet of Australian adult Wedge-tailed Shearwater's, however tropical residing Wedge-tailed Shearwater birds are known to mostly consume fish, some cephalopods, insects, jellyfish and prawns (DCCEEW 2023a). Food is taken by contact-dipping, dipping, surface-seizing and, rarely, deep-plunging up to 2 m deep (DCCEEW 2023a).

4.8 Silver Gull

The Silver Gull was identified as breeding known to occur within the area potentially affected by underwater sound (Annex 2). The breeding area is between Port Fairy and Warrnambool (DCEEW 2023b). Sliver Gulls natural diet consists of insects, worms, fish, and crustaceans. They are not known to plunge dive and thus are unlikely to be affected by underwater sound.

5 Sound Effect Criteria

There are no regulatory thresholds for underwater sound for bird species. Thus, for assessing potential sound–induced impact of impulsive seismic source signals on diving birds, the least sensitive marine mammal hearing group, other carnivores in water (OCW), from Southall et al. (2019), is used as a proxy. This hearing group has been selected due to similar hearing sensitivity in the frequency band of underwater hearing for diving birds and otariid pinnipeds, which are included in the group. This provides a conservative approach, as otariids are considered more sensitive to underwater sound at higher frequencies than diving birds.

There are also no regulatory thresholds or criteria established to assess potential behavioural responses by diving birds to underwater sound. To allow for assessing the potential for such impacts, an onset criterion for behavioural responses of 120 dB re 1 µPa (SPL) for impulsive sources was used based on information from Sørensen et al. (2020)**.** They exposed gentoo penguins (*Pygoscelis papua*) in a controlled exposure experiment to underwater noise bursts (impulsive signals) and demonstrated that the animals show a graded reaction depending on received sound levels.

The sound exposure guidelines and predicted maximum distances from the acoustic modelling are detailed in Table E5-5-1.

Further information on studies in relation to seismic acoustic emission impacts to diving birds is provided in the Seismic Sound Studies Report (Appendix B8).

Table E5-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Diving Birds

	Permanent Threshold Shift		**Temporary Threshold Shift**		**Behaviour**
Sound exposure guideline	Per pulse	SEL_{cum}	Per pulse	SEL_{cum}	Per pulse
	232 dB PK	203 dB SEL_{cum}	226 dB PK	188 dB SEL_{cum}	120 dB SPL
Modelled Distance	Not reached	Not reached	30[1] m	50-60[1] m	10.4 to 77 [1] km

1: Sound modelling updated in response to Matter: F17.

6 Predicted Levels of Impact

There is very little known about the effects of intense underwater sound (i.e. seismic surveys) on marine birds. It is generally thought that noise produced from activities associated with seismic surveys may impact those species of birds that spend large quantities of time underwater, either swimming or plunge diving while foraging for food.

As detailed in Table E5-51- the criteria for permanent threshold shift (PTS) were not reached from the acoustic modelling. The criteria for temporary threshold shift (TTS) were only reached for the per pulse criteria out to 60 m from the acoustic modelling. The modelled distance to sound effect criteria for behavioural impacts ranged from 10.4 km to 77 km.

The predicted effect level to these species is assessed as minor as impacts are predicted to have some effect on birds, but the effect is not considered significant or at a level to affect the population given the following:

- Mortality and injury impacts are not predicted for birds. Though the TTS criteria was reached within 60 m of the source it would be highly unlikely for a diving bird or penguin to be within that distance of the source. As the seismic source will be slowly ramped up to full power over 30 minutes this further reduces the risk of a diving bird or penguin being close to the seismic source at full power.
- Impacts to diving birds and penguins would be limited to behavioural impacts which could range from startle response to moving away from the seismic survey to forage in other areas.
- Seabirds feed on multiple prey species and have widespread foraging areas. Indirect impacts including displacement of prey species such as fish will be limited to the proximity of the sound source. While displacement of some prey species may result in the displacement of these birds, this impact is localised, temporary and recoverable in any one location after the survey vessel moves past. Given their widespread foraging areas (ACAP 2020) and the small area possibly affected by prey displacement, seabirds are not expected to be impacted by reduced net foraging opportunities. [Paragraph has been added in response to Matters B09, B12, B13 and B14].
- Pichegru et al. (2017) who investigated the behavioural response of endangered African penguins and found that penguins foraging within 100 km of the active seismic operations showed a change of foraging direction during seismic periods, increasing their distance between their feeding area and the location of the seismic vessel from 77 km, compared to ca 65 km on average in the absence of seismic activity. The avoidance behaviour by penguins observed in this study may be explained by either a direct disturbance from the noise generated by the operation or a change in fish distribution during that period (possibly because of seismic activities). Small-scale acoustic fish surveys assessing distribution and abundance of small pelagic fish in Algoa Bay around both penguin colonies did not show a significant change in distribution and/or abundance of small pelagic fish in the region in March 2013 compared to a few months prior to or after the seismic operations. Therefore, African penguins likely relocated away from their traditional feeding zone to avoid the disturbance generated by the noise of the seismic vessels, rather than to follow their prey.

- The specific source used in the Pichegru et al. (2017) study had a total volume of 4,230 in^3 compared to the 2,820 in^3 proposed for the Regia MSS and with a difference of bathymetry would account for the smaller distances of 8.06 km to 52.1 km to the behavioural criteria for the Regia MSS.
- The African penguins quickly reverted to normal foraging behaviour after cessation of seismic activities during this study, which suggest a relatively short-term influence of seismic activity on these birds' behaviour and/or that of their prey.
- Increasing energy expenditure at sea to locate food can negatively affect penguins' reproductive output. However, Little Penguins have been shown to travel large distances during chick-guard stage with mean total distance travelled of 41.8 to 48.0 km (Hoskins et al. 2008) and during non-breeding periods at maximum distances of 62–147 km from the colony. Suggesting that changes in areas and distances is dependent on food source and that a temporary increase in foraging distances associated with a seismic survey is unlikely to have a significant impact on individual penguins or the population.

The uncertainty level for impact to birds from seismic sound is assessed as medium based on:

- There are no sound effect criteria for underwater sound for bird species.
- There are limited published studies on the effects of seismic on diving birds, with only one study relevant to penguins.
- An absence of long-term monitoring data of the effects of seismic on birds in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) is assessed as medium. For birds the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in the Comparison of Predicted Level and Defined Acceptable Level. The mitigation and management measures detailed in the Section 8 provide sufficient confidence in the predicted effect levels.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts to diving birds and penguins are temporary / reversible and small-scale behavioural response that are likely to be within natural variation of foraging behaviours.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	No EPBC Act Management Plans and Recovery Plans identified for birds identified underwater sound as a threat and no actions relevant to the seismic survey were identified.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to diving birds and penguins are temporary / reversible and small-scale behavioural response that are likely to be within natural variation of foraging behaviours.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Impacts to economic receptors are not predicted.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or	Impacts to cultural receptors are not predicted.	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
	practices, will be temporary / reversible, small scale, and/or low intensity.		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in Section 8.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation the following objections and claims have been made: Behavioural disturbance impacts to Little Penguin colony at Middle Island resulting in further distance to forage and impacting breeding success as the Middle Island population has been significantly reduced to due to fox predation.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#03: Fauna Management System	The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. For diving birds and penguins, they would move away from the source before it is at full power, providing them a level of protection. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05].	Yes
M#03: Fauna Management System	The seismic source will be reduced to the low power setting if flocks of foraging birds are observed by the Marine Fauna Observer within 500 m of the source. Full power can commence when the seismic source is > 500 m from flocks of foraging birds. This will ensure that flocks of foraging birds are not startled by the seismic source and can continue to forage once the vessel has moved passed. [Updated in response to Matter: B15]	Yes

9 Conclusions

This impact assessment has demonstrated that the effect of underwater sound to birds has a:

- **Predicted level of effect of minor.**
- **An uncertainty of medium.**
- **Predicted level of impact of medium.**

10 Recommendations

As demonstrated in this impact assessment the predicted level of impact level is medium. The predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels, thus there are no further recommendations.

11 Document Control

Date	Revision	Update
6 August 2023	A	Draft prepared for initial comment
28 August 2023	B	Update based on comments and relevant person feedback
12 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Updated after public comment and rerun of the PMST searches.**

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Annex 1: Legislative and Other Requirements Relevant to Underwater Sound and Birds

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Wildlife Conservation Plan for Seabirds (CoA 2020a)	The plan aims to provide a national framework for the research and management of listed marine and migratory seabirds and to outline national activities to support the conservation of listed seabirds in Australia and beyond. Threatened species are not covered by the plan and receive separate, approved conservation advice and, in some cases, a recovery plan which sets out what should be done to stop the decline and support the recovery of the species.	Underwater sound is not identified as a threat.	NA
National Recovery Plan for Albatrosses and Petrels (CoA 2022)	The recovery plan provides a national strategy to guide the activities of government, industry, research organisations, and other stakeholders in the protection, conservation and management of listed threatened albatross and petrel species. The plan replaces the previous plan adopted in 2011.	Underwater sound is not identified as a threat.	NA
Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)	Eligible for listing as vulnerable under the EPBC Act.	Underwater sound is not identified as a threat.	NA
Conservation Advice *Halobaena caerulea* Blue Petrel (TSS 2015)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Underwater sound is not identified as a threat.	NA
Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)	Constitutes the formal Commonwealth and New South Wales recovery plan for Gould's Petrel. It identifies the actions to be taken to ensure the long-term viability of the Gould's Petrel in nature and the parties who will carry these out.	Underwater sound is not identified as a threat.	NA
Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)	Assessed as ineligible for listing.	Underwater sound is not identified as a threat.	NA
Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (western Pacific)) (TSSC 2002)	Advice is that it is ineligible for listing as conservation dependent.	Underwater sound is not identified as a threat.	NA

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Conservation Advice *Thalassarche cauta* Shy Albatross (TSS 2020)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Underwater sound is not identified as a threat.	NA

Annex 2: Underwater Acoustic Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Antipodean Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Australasian Gannet	Breeding known to occur within area				Listed	Aggregation	None identified
Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)
Black-faced Cormorant	Breeding known to occur within area				Listed		Wildlife Conservation Plan for Seabirds (CoA 2020a)
Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Blue Petrel	Species or species habitat may occur within area	Vulnerable			Listed		Conservation Advice *Halobaena caerulea* Blue Petrel (TSS 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Campbell Albatross, Campbell Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Cape Gannet	Breeding known to occur within area				Listed		None identified
Common Diving-Petrel	Breeding known to occur within area				Listed	Breeding Foraging	None identified
Gould's Petrel, Australian Gould's Petrel	Species or species habitat may occur within area	Endangered					Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)
Little Penguin	Breeding known to occur within area				Listed		Wildlife Conservation Plan for Seabirds (CoA 2020a)
Little Tern	Breeding known to occur within area		Migratory	Migratory Marine Birds	Listed (as *Sterna albifrons*)		Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (western Pacific)) (TSSC 2002). Wildlife Conservation Plan for Seabirds (CoA 2020a)
Northern Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable			Listed (as *Thalassarche sp. nov.)*		National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	**Presence**	**Threatened Category**	**Migratory Status**	**Migratory Category**	**Marine Status**	**Biologically Important Area**	**Management Plan** **Conservation Advice** **Listing Advice**
Northern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)
Northern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Salvin's Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Short-tailed Shearwater	Breeding known to occur within area		Migratory	Migratory Marine Birds	Listed (as *Puffinus tenuirostris*)	Foraging	None identified
Shy Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	Foraging likely	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Conservation Advice *Thalassarche cauta* Shy Albatross (TSS 2020)
Silver Gull	Breeding known to occur within area				Listed (as *Larus novaehollandiae*)		Wildlife Conservation Plan for Seabirds (CoA 2020a)
Southern Giant-Petrel, Southern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	**Presence**	**Threatened Category**	**Migratory Status**	**Migratory Category**	**Marine Status**	**Biologically Important Area**	**Management Plan** **Conservation Advice** **Listing Advice**
Southern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wandering Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wedge-tailed Shearwater						Breeding Foraging	Wildlife Conservation Plan for Seabirds (CoA 2020a)
White-capped Albatross	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed		National Recovery Plan for Albatrosses and Petrels (CoA 2022)
White-faced Storm-petrel						Foraging	Wildlife Conservation Plan for Seabirds (CoA 2020a)

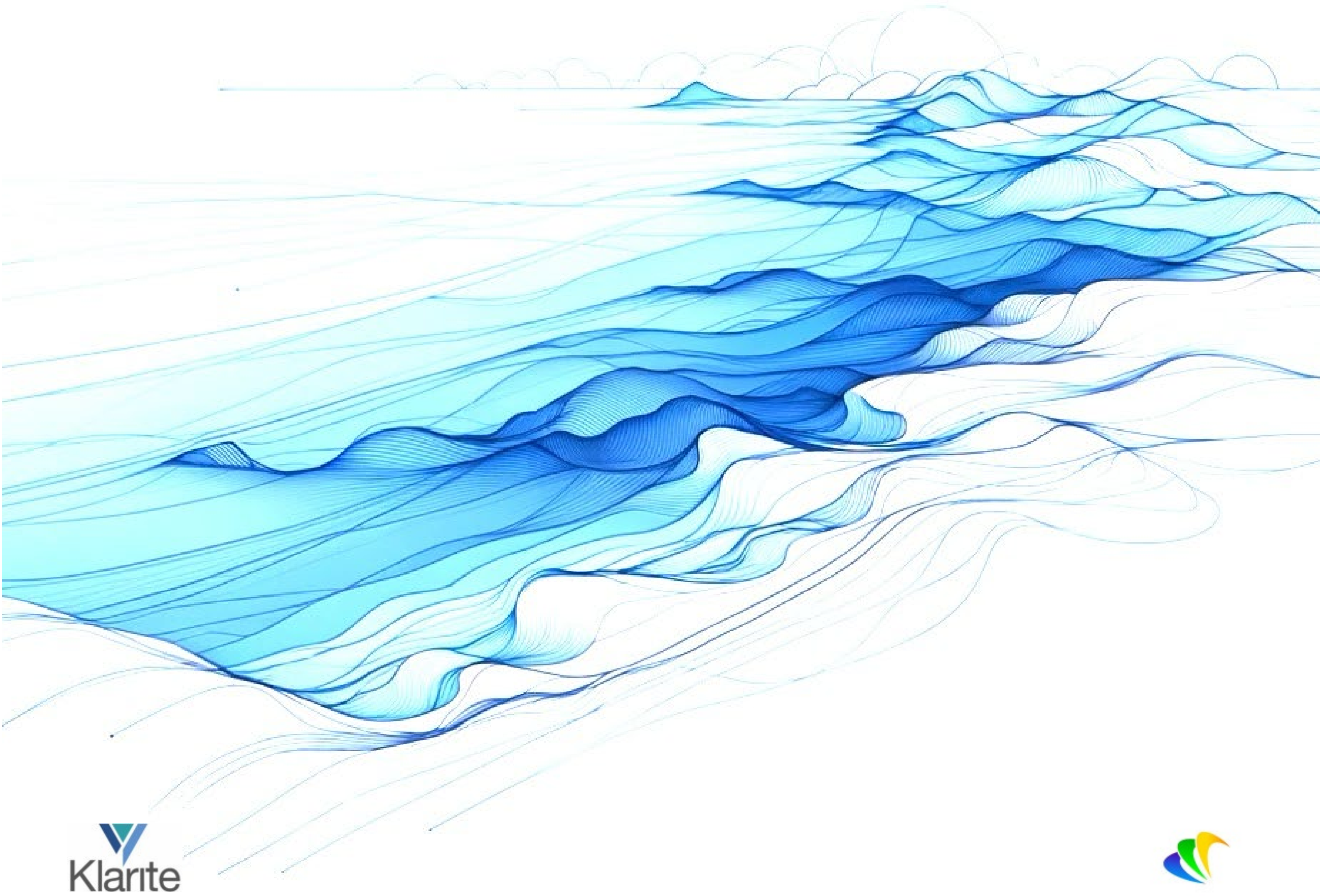
REGIA
Marine Seismic Survey

Impact Assessment Underwater Sound: Turtles

Appendix E6: REG-EP-025-E6

Rev 2

May 2024



Klarite

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment. This document also uses information in two preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7)
2. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

Up to 22 December 2023, there were no specific comments received on the content of the document. Table E6-21- shows the feedback received related to this environmental aspect.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E6-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E6-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E6-21- shows how this feedback has been incorporated into the environmental assessments.

Table E6-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Email received detailing the negative impact on marine life and climate**.**	166	CGG agreed to implement the following measures: Exclusion zones for shallower waters with higher biodiversity - adopted 50 m and shallower activity exclusion zone. Activity timing - avoid peak biodiversity in summer months (Jan/Feb/Mar) - adopted. Compensation protocol for commercial fishers - adopted. Policy Statement 2.1 measures, plus others.
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan.	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E6-2-2shows how this feedback has been incorporated into the environmental assessments.

Table E6-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Effectiveness of mitigation measures	E08	EP Appendices D2 and E5 have been updated to include existing mitigation and management measures that will reduce the likelihood of injury associated with vessel collision and underwater sound including M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure), which provides for marine turtles to move away from the activity before the airguns reach full power.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

Continuous underwater acoustic emissions are generated by the survey and support vessels and helicopters. Underwater acoustic emissions from vessels are generated by thrusters, engines, and propellers. Underwater acoustic emissions from helicopters are generated via the engine and rotors.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area + 40 m to 6.30 km based on the furthest distance to modelled sound effect criteria. [Updated in response to Matter: F17]

Seismic acquisition where the seismic source will be active will occur for up to 60 days within the Active Source area.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to underwater sound and turtles that may be affected by underwater sound, and how the requirements will be met.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Turtles

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling study of underwater sound levels associated with the initial Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including turtles.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area. Two modelling reports were procured, one in the preparation phase of the EP (Koessler et al. 2023) and which is available in Appendix B7a and a second iteration during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m. The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria Description of the Existing Environment that may be Affected by the Activity

To identify turtle species that may be present within the area affected by underwater sound a PMST search was undertaken using the Active Source Area with a 6 km buffer based on the furthest distance to a sound effect criterion is 6.30 km (Table E6-51-). The PMST Report is available in Appendix B5.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. There are no changes to protected matters information for species that may be impacted by underwater sound [Section added in response to Matters: I16 and I17].

The PMST Report identified three turtle species within the area potentially affected by underwater sound, Green (may occur), Leatherback (likely to occur) and Loggerhead turtle (likely to occur). No BIAs or habitat critical to the survival of the species were identified. Annex 1 provides details on these turtles species and relevant conservation advice or management plans.

The PMST Report identifies the Leatherback and Loggerhead turtles breeding likely to occur within the area potentially affected by underwater sound. However, this is not supported by other information sources:

Green Turtles nest, forage and migrate across tropical northern Australia. Green Turtles spend their first 5-10 years drifting on ocean currents. Green Turtles are predominantly found in Australian waters off the Northern Territory, Queensland, and Western Australian coastlines, with limited numbers in NSW, Victoria, and South Australia (DoEE 2017).

Small numbers of Leatherback Turtles nest on the Cobourg Peninsula (NT) and there are unconfirmed accounts of Leatherback Turtles nesting in Western Australia. Leatherback Turtles are more commonly found foraging in Australian waters along the east coast and in Bass Strait. The southern waters of Australia are one of five identified foraging sites (where area restricted behaviour occurs) for Leatherback Turtles (DoEE 2017). The region is an important feeding area for the Leatherback Turtle which is a pelagic feeder that is regularly found in the high latitudes of all oceans (DSEWPaC 2012). No major nesting has been recorded in Australia, but the species is regularly seen and known to forage in the waters of the South-east Marine Region (DSEWPaC 2012).

There are two genetically distinct stocks of Loggerhead Turtles nesting in Australia, one in Queensland (known as the south-west Pacific stock) and one in Western Australia. Loggerhead Turtles forage in all coastal states and the Northern Territory, but are uncommon in South Australia, Victoria, and Tasmania (DoEE 2017).

4 Sound Effect Criteria

Marine turtles are less sensitive to noise than marine mammals as they do not have an external hearing organ but can detect sound through bone-conducted vibration in the skull with their shell providing a receiving surface (Lenhardt et al. 1985). Morphological studies of green and loggerhead turtles (Ridgway et al. 1969; Wever 1978; Lenhardt et al. 1985) found that the turtle ear is like other reptile ears but has adaptations for underwater listening.

Sound exposure guidelines for turtles have been established by the American National Standards Institute (ANSI) accredited report of Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014).

Though mortality or potential mortal injury to turtles from seismic sound exposure has not been reported, Popper et al. (2014) provides exposure guidelines of >207 dB re 1 µPa PK or >210 dB re 1 µPa2.s SEL_{cum}. Popper et al. (2014) also defined semi-quantitative exposure criteria for potential hearing impairment (recoverable injury and TTS). Finneran et al. (2017) recently proposed thresholds of 232 dB re 1 µPa (PK) and of 226 dB re 1 µPa (PK) for PTS and TTS effects in turtles respectively. Therefore, the Popper et al. (2014) criteria for mortality/mortal injury may be conservative.

Finneran et al. (2017) identified 175 dB re 1 µPa SPL as the level at which marine turtles are expected to actively avoid seismic exposures. However, the Recovery Plan for Marine Turtles in Australia (DoEE 2017) acknowledges the 166 dB re1 µPa SPL reported by McCauley et al. (2000) as the level that may result in a behavioural response to marine turtles.

Further information on studies in relation to seismic acoustic emission impacts to turtles the Seismic Sound Studies Report (Appendix B8).

The sound exposure guidelines and predicted maximum distances from the acoustic modelling are detailed in Table E6-51-.

Table E6-4-1: Sound Exposure Guidelines and Predicted Maximum Distance for Turtles

	Mortality/Potential Mortal Injury		PTS and TTS		Behavioural
Threshold Criteria	Few studies to base criteria on, however, Popper et al. (2014) provides acoustic criteria for mortality and potential mortal injury. The criteria are based on pile driving and other impulsive sounds and do not represent the levels at which impacts will occur, but levels at which no impacts have been observed. They are therefore likely to be conservative.		A scale of relative risk is provided in Popper et al. (2014) for recoverable injury and TTS. The scale assumes that recoverable injury and TTS are possible. The relative risk is defined as High in the near field (tens of metres), and Low in the intermediate and far fields (hundreds to thousands of metres). Recent thresholds defined by Finneran et al. (2017) for PTS and TTS in marine turtles have been adopted.		There are currently no acoustic criteria for sea turtles, however, a scale of relative risk is provided below from Popper et al. (2014). The scale assumes that a behavioural response is possible. McCauley et al. (2000) reported that turtles behaved more erratically at 175 dB SPL and observed behavioural response in caged marine turtles at 166 dB re 1 µPa SPL, as referenced by NSF (2011) and in the Recovery Plan for Marine Turtles in Australia (DoEE 2017).
Relevance of thresholds adopted	There is limited information on marine turtle hearing. Most studies looking at the effect of seismic noise on marine turtles have focussed on behavioural responses given that physiological impacts are more difficult to observe in living animals. Exposure criteria developed by Popper et al. (2014) based on results from the Working Group on the Effects of Sound on Fish and Turtles as well as Finneran et al. (2017) has been adopted. These thresholds are within Australia as relevant threshold levels.				
Sound exposure guideline	**Per pulse**	**SELcum**	**Per Pulse**	**24 hr**	**Per Pulse**
	207 dB PK	210 dB SELcum	PTS: 232 dB PK TTS: 226 dB PK	PTS: 204 dB SEL24hr TTS: 189 dB SEL24hr	Behavioural response: 166 dB SPL Behavioural disturbance: 175 dB SPL
Distances	124 – 197[1] m	40[1] m	PTS: 40[1] m TTS: 70-80 m[1]	PTS: 70 m TTS: 60 m – 3.35 [1] km	Behavioural response: 1.49 – 6.30[1] km Behavioural disturbance: 0.80 – 2.38[1] km

1: Sound modelling updated in response to Matter: F17.

5 Predicted Levels of Impact

The predicted effect level to turtle species is assessed as minor as impacts are predicted to have some effect to turtles, but the effect is not considered significant or at a level to affect the population given the following:

- Mortality or mortal injury to turtles is considered highly unlikely based on no documented cases of mortality in turtles exposed to seismic source emissions under experimental or field operating conditions (Popper et al. 2016).
- As detailed in Table E6-51-, the per pulse (PK) exposure criteria for PTS and TTS are reached out to 40 and 80 m from the sound source, respectively. The cumulative exposure criteria for PTS is reached out to 70 m, TTS is reached out to 3.35 km, and behavioural response may occur out to 6.30 km. It is considered highly unlikely that a turtle would stay within the PTS and TTS effect distances for 24 hours as there are no BIAs or habitat critical to the survival of the species identified and thus turtles are likely to be transient in the area. [Section updated in response to Matter: F17]
- The Recovery Plan for Marine Turtles (DoEE 2017) identifies acute noise interference from anthropogenic noise sources, such as seismic surveys, as a low-risk threat to the stocks of marine turtles. Thus, population impacts from the seismic survey are not predicted.
- The Regia MSS is consistent with Recovery Plan for Marine Turtles (DoEE 2017) such that:
  - There is no important nesting habitat within or adjacent to the area that maybe affect by underwater sound.
  - Marine turtles will not be displaced from identified habitat critical to the survival from underwater sound.
  - Biologically important behaviours will not be impacted.

The uncertainty level for impact to turtles from seismic sound is assessed as low based on:

- There are long-term tagging studies of sea turtles in Australia, and there are no nesting habitats are BIAs identified within or adjacent to the area that may be affected by underwater sound.
- There has never been a documented mortality or mortal injury to turtles because of seismic source emissions.
- There are several published studies on the sound effect criteria of sea turtles.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low. For turtles the predicted levels of impact are beneath levels of perception and/or within normal bounds of variation. Good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.

6 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts to EPBC Act listed turtle species are temporary / reversible and small-scale behavioural response or recoverable temporary threshold shift. No impacts at a populations level are predicted.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1 of this document.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to EPBC Act listed turtle species are temporary / reversible and small-scale behavioural response or recoverable temporary threshold shift. No impacts at a populations level are predicted.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Impacts to economic features are not predicted.	Yes

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Impacts to cultural features are not predicted.	Yes
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation no objections and claims have been made regarding underwater sound and turtles. Though one relevant person raised awareness about the presence of marine turtles in the Otway region. This information was included in this impact assessment.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

7 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#03: Fauna Management System	The Fauna Management System includes the requirement from the EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales, where the seismic source is required to be slowly ramped up to full power over 30 minutes. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05]. The Recovery Plan for Marine Turtles (DoEE 2017) details that in accordance with the EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guidelines, all seismic survey vessels operating in Australian waters must undertake a soft start during surveys irrespective of location and time of year of the survey. Although these guidelines are specifically designed for interactions with cetaceans, the soft start provision may also afford protection for marine turtles.	Yes
M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure)	The soft-start procedure provides for marine turtles to move away from the activity before the airguns reach full power. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matters E08 and I05].	Yes

8 Conclusions

This impact assessment has demonstrated that the effect of underwater sound to turtles has a:

- **Predicted level of effect of minor.**
- **An uncertainty of low.**
- **Predicted level of impact of low.**

9 Recommendations

As demonstrated in this impact assessment the predicted level of impact level is low, thus, good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further recommendations being required, therefore there are no further recommendations.

10 Document Control

Table E6-2 - Revision History

Date	Revision	Update
12 July 2023	A	Draft prepared for initial comment
23 August 2023	B	Update based on comments and relevant person feedback
12 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
29 May 2024	**2**	**Updated following public comment and rerun of the PMST search.**

11 References

DoEE. 2017. Recovery Plan for Marine Turtles in Australia 2017 – 2027. Department of Environment and Energy. Commonwealth of Australia.

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DSEWPaC. 2012. Marine bioregional plan for the South-west Marine Region. Department of Sustainability, Environment, Water, Population and Communities.

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McCauley RD, Fewtrell J, Duncan AJ, Jenner C, Jenner M-N, Penrose JD, Prince RIT, Adhitya A, Murdoch J et al. 2000. *Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid*. Report Number R99-15. Prepared for Australian Petroleum Production Exploration Association by Centre for Maine Science and Technology, Western Australia. 198 pp. https://cmst.curtin.edu.au/wp-content/uploads/sites/4/2016/05/McCauley-et-al-Seismic-effects-2000.pdf.

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Ridgway SH, Wever EG, McCormick JG, Palin J and Anderson JH. 1969. Hearing in the giant sea turtle, *Chelonia mydas*. *Proceedings of the National Academy of Sciences* 64(3): 884-890. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC223317/pdf/pnas00113-0080.pdf.

Stephen T.J., V.E. Warren, S.C. Connell, M.W. Koessler and C.R. McPherson. 2024. Regia Marine Seismic Survey: Acoustic Modelling for Assessing Sound Exposures. Document 03301, Version 2.0. Technical report by JASCO Applied Sciences for Klarite Wever EG. 1978. The Reptile Ear: Its Structure and Function. Princeton University Press, Princeton, NJ.

Annex 1: Legislative and Other Requirements

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Recovery Plan for Marine Turtles (DoEE 2017)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.	The Recovery Plan identifies acute noise interference from anthropogenic noise sources, such as seismic surveys, as a low-risk threat to the stocks of marine turtles. Actions identified are: • A precautionary approach should be applied to seismic work, such that surveys planned to occur inside important internesting habitat should be scheduled outside the nesting season. • Manage anthropogenic activities to ensure marine turtles are not displaced from identified habitat critical to the survival. • Manage anthropogenic activities in Biologically Important Areas to ensure that biologically important behaviour can continue. • In accordance with the EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guidelines, all seismic survey vessels operating in Australian waters must undertake a soft start during surveys irrespective of location and time of year of the survey. Although these guidelines are specifically designed for interactions with cetaceans, the soft start provision may also afford protection for marine turtles.	No important internesting habitat is within or adjacent to the area that maybe affect by underwater sound. No habitat critical to the survival of marine turtles are within or adjacent to the area that may be affected by underwater sound. No Biologically Important Areas for turtles are within or adjacent to the area that may be affected by underwater sound. M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales will be implemented including soft starts.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*) (*DEWHA 2008)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify underwater sound as a threat.	NA

Annex 2: Underwater Acoustic Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle, Luth	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*)* *(*DEWHA 2008)
Loggerhead Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017)

Impact Assessment
Underwater Sound: Marine Mammals

Appendix E7: REG-EP-026-E7

Rev 2

May 2024

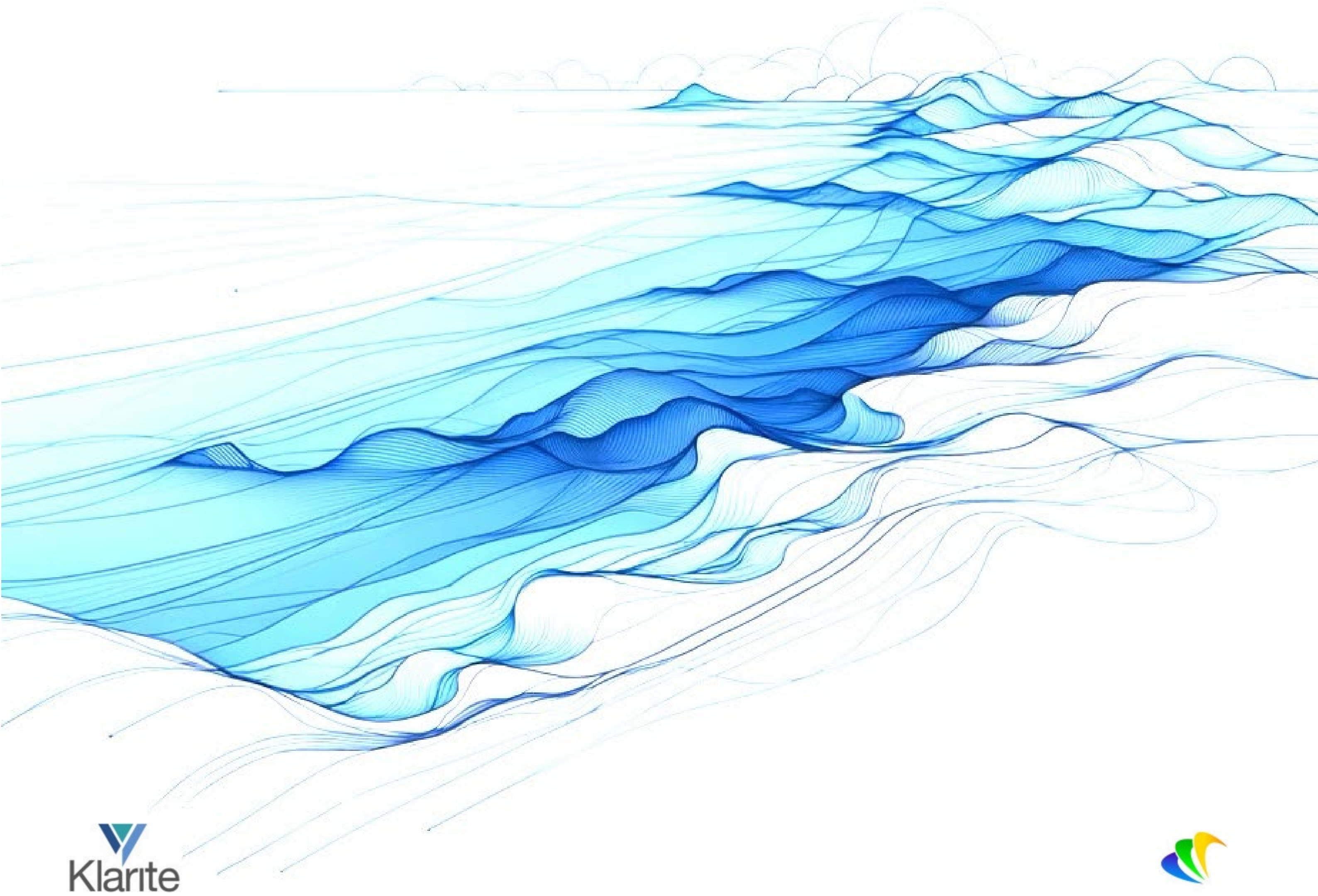

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect, underwater sound, between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment.

This analysis is based on information in three preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7a)
2. Sound Emissions Secondary Modelling Report (Appendix B7b)
3. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E7-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E7-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The feedback received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their insights on environmental values and sensitivities. Feedback was invited and Table E7-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E7-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Updated Measures
Objection raised regarding activities that may prevent or displace Pygmy Blue Whales or Southern Right Whales' use of BIAs.	48	CGG will implement the following measures: Whale Management Plan MFMOs PAM Operators
Objection raised by a member of the public through website regarding impacts on SRW and Traditional Owner values.	74	CGG provided information and sought further feedback.
Objection from Marine Parks suggesting the seismic array to operate at low power during line turns to minimise the risk of SRW and BW entering the zone of potential TTS or behavioural disturbance during shut down.	231	CGG have agreed to use low power during line turns.
Concern raised at a community session regarding the fur seal colony on Deen Maar.	97	CGG will implement a 10.3 km buffer around Deen Maar
A member of the public raised a concern through the interactive map regarding the impact of seismic blasts on fur seal colony in Deen Maar and also about the sacred importance of Deen Maar for the indigenous community.	222	CGG will implement the following measures: 10.3 km buffer around Deen Maar remains until it can be verified as appropriate through consultation with TO's. Install vessel movements limitation.
Concern raised through the interactive map about the protection of blue whales over southern right whales.	160	CGG agreed to implement the following measures: Policy Statement 2.1 measures, plus others. Exclusion of SRW reproductive BIA Temporal and spatial exclusion zones to protect both SRW and BW Fauna Management System
A response to the interactive map stating no disruption to SRW calving grounds and First Nations values of them	164	
Email received detailing the negative impact on marine life and climate	166	
Email received regarding concern about the welfare of whales that visit the area of the coast and bight.	53	
Objection through an online survey to seismic surveying due to impacts on SRW and Traditional Owner values.	44, 242	
Email received stating there was no mention of ceasing activities during whale	184	

sightings during testing and impacts of sustained noise on cetaceans		
Survey response concerned about impacts both reputational and physical to the region and the tourism industry because of whales	422	
Survey response stating unacceptable impact on whale nursey**202, 404**		
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email advised of additional whale species known to be present in the area	47	CGG will undertake a full environmental assessment
Received email from Marine Parks suggesting we identify a comprehensive suite of whale detection measures including regular aerial surveillance flights to identify presence / absence / species and direction of movement and PAMs to support the efficacy and reliability of shut down protocols for marine mammals.	230	CGG will produce a Whale Management Plan - including regular aerial surveillance flights.

2.2 Public Comment

The completed EP was published for public comment on the NOPSEMA website on 25 Jan 2024 for a 30-day period, closing 26 February 2024. Table E7-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E7-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Impacts on biologically important behaviours (foraging/ feeding, calving and migrating) and masking	M09	CGG has updated the information provided in EP Appendix E7 (Underwater Sound (Marine Mammals), in Section 6.1, 6.2 and 6.3.
Matter: Failure to consult with relevant persons	C07	CGG has considered these claims and the EP Appendix E7, 4.2 will be updated with the assessment of Southern Elephant Seals
Matter: Impacts on dolphins	M34	CGG has considered these claims and has updated EP Appendix EP Appendix E7, Section 6.2.

Matter: Research on impacts of anthropogenic noise on marine mammals.	M11	Updates have been made to EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) Section 6.5.
Matter: Mass strandings	M13	Updates have been made to EP Appendix E7 (Impact Assessment – Underwater Sound: Marine Mammals) Section 6.5.
Matter: Impacts to juvenile seals	M30	Updates have been made to EP Appendix E7 Section 6.4, Section 8) and EP Appendix F1 (Environmental Plan).
Matter: Displacement of Deen Maar and Portland seal colonies	M31	CGG has made updates to EP Appendix E 7 Sections 4.1, 6.4, 7, and 8.
Matter: Operational Buffer around Deen Maar	M32	CGG has made updates to EP Appendix E7 Sections 6.4, 7 and 8.
Matter: Insufficient mitigation measures for seals and sea lions	M33	CGG has made updates to EP Appendix E7 Sections 6.4, 7 and 8.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic sound source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

Continuous underwater acoustic emissions are generated by the survey and support vessels and helicopters. Underwater acoustic emissions from vessels are generated by thrusters, engines, and propellers. Underwater acoustic emissions from helicopters are generated via the engine and rotors.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area and area of sound propagation with which relevant sound effect criteria for marine mammals is exceeded as detailed in the impact assessment sections.

Seismic acquisition where the sound source will be active will occur for up to 60 days within the Active Source area.

Continuous Sound

Duration: 90 days

Extent: Operational Area

The survey and support vessels and helicopters will be active in the Operational Area for the duration of the survey undertaking support activities and acquisition.

3.3 Legislative and Other Requirements

Annex 1 in this document describes the legal and other requirements that apply to underwater sound and marine mammals that may be affected by underwater sound, and how the requirements will be met.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Marine mammals including whales, dolphins, seals, and sea lions.

Potential environmental impacts to marine mammals identified from the PEIRA are:

- Change in fauna behaviour.
- Change in hearing capacity.
- Change in physical condition.

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling studies of underwater sound levels associated with the Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including marine mammals.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area.

Two modelling reports were commissioned, one in the preparation phase of the EP (Koessler et al. 2023) available in Appendix B7a, and a secondary report during the public consultation phase (Stephen et al. 2024) available in Appendix B7b.

The second iteration of modelling undertaken specifically addressed an amended spatial survey layout, namely constraining sound source operation to water depths of no shallower than 50 m.

The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria.

Where cumulative sound exposure criteria were used, these were based on the conservative assumption that an individual remains within hearing range of the sound source for a continuous 24 hr period. For a more realistic assessment, JASCO's Animal Simulation Model Including Noise Exposure (JASMINE) was used to predict the exposure of 'animats' to underwater sound from the Regia MSS. JASMINE integrates the predicted sound field with biologically meaningful movement rules for each marine mammal species that results in an exposure history for each animat in the mode. For the Regia MSS, this modelling, called Animat modelling, was undertake for Pygmy Blue Whales and Southern Right Whales. The parameters used for forecasting realistic behaviours in JASMINE such as diving and foraging depth, swim speed, and surface times are determined from marine mammal studies. The modelling reports (Koessler et al. 2023 and Stephen et al. 2024) is available in Appendix B7a and B7b and provides information on JASMINE, the inputs used and the outputs from the modelling.

4 Description of the Existing Environment that may be Affected by the Activity

Marine mammals include whales, dolphins, and pinniped species (fur-seals and sea lions).

To identify marine mammals that may be present within the area affected by underwater sound, a PMST search was undertaken using the Active Source Area with a 44 km buffer based on the furthest distance to a sound effect criterion is 43.5 km (Table E7-51-). This distance was reduced in the secondary modelling report to 41.96 km because of changes to the sail line layout. Nevertheless, new PMST were run with a 44 km buffer zone as a precaution.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. There are no changes to protected matters information for species that may be impacted by underwater sound [Section added in response to Matters: I16 and I17].

The PMST Report (available in Appendix B5) identified the following for marine mammals:

- Blue, Fin and Sei whales with foraging, feeding or related behaviour known to occur within the area.
- Pygmy Right Whale foraging, feeding or related behaviour likely to occur within area.
- Pygmy Blue Whale foraging (annual high use area) BIA and known foraging area BIA.
- Southern Right Whale breeding known to occur within area.
- Humpback Whale known to occur in the area.
- Antarctic Minke Whale, False Killer Whale, and Killer Whale likely to occur within area.
- 14 whale species that may occur in the area.
- Australian Fur-seal breeding known to occur within area.
- New Zealand Fur-seal may occur in the area.
- Australian Sea-lion known to occur in the area.

Six dolphin species likely or may occur in the area. No dolphin species are threatened or have biologically important behaviour.

Annex 2 in this document provides a summary of the PMST Report and identifies any relevant conservation advice and management plans.

More information is provided on those species undertaking biologically important behaviour or are known to occur in the area affected by underwater sound.

4.1 Australian Fur-seal

The Australian Fur-seal is listed as migratory under the EPBC Act.

Australian Fur-seals (*Arctocephalus pusillus*) breed on islands of the Bass Strait but range throughout waters off the coasts of South Australia, Tasmania, Victoria and NSW. Numbers of this species are believed to be increasing as the population recovers from historic hunting (Hofmeyr et al. 2008). The species is endemic to south-eastern Australian waters.

In Victorian waters they breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland. In Tasmanian waters they breed on Reid Rocks. There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. Their preferred breeding habitat is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

Haul out sites with occasional pup births are located at Cape Bridgewater, at Moonlight Head, on various small islands off Wilsons Promontory and Marengo Reef near Apollo Bay. Australian Fur-seals are present in the region all year, with breeding taking place during November and December.

Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al. 2008, Hume et al. 2004, Arnould & Kirkwood 2007).

Lady Julia Percy Island is within the area that may be affected by underwater sound.

A study on the foraging behaviour of seals from the colony at Lady Julia Percy Island found that lactating Australian Fur-seals tended to search for prey south-east of their colony at 60-200 m depth (Arnould and Kirkwood, 2011). The Regia MSS Operational Area may therefore overlap foraging areas for the Australian Fur-seal. [Paragraph has been added in response to Matter M31].

4.2 Southern Elephant Seal

CGG has reviewed relevant literature including Conservation Advice for this species, and has noted the Southern Elephant Seal (Mirounga leonine) listed as Vulnerable under the EPBC Act, is a subantarctic species and, although some individuals have been recorded in coastal habitats, this species was not identified in the PMST search for this area. This species has a nearly circumpolar distribution and visits subantarctic islands to breed and to moult. There are two main populations found in Australian waters and the principal breeding colonies for these populations are located on Heard and Macquarie Islands (Shaughnessy 1999; McMahon et al. 2005). Southern Elephant Seals concentrate on the northern beaches of Macquarie Island, although colonies are scattered around the island (DEH 2003). In the Australian Antarctic Territory, small numbers of pups have been reported from Browning Peninsula and Peterson Island, near Casey station (Murray 1981 cited in Shaughnessy 1999), and there has been a well-frequented haul-out area at Vestfold Hills (Burton 1985). Off the coast of mainland Australia, several pups have been born and many animals recorded on Maatsuyker Island (located at the most southern end, off the south-west coast of Tasmania) (Shaughnessy 1999).

Given the likelihood of encountering this species during the Regia MSS is low, impacts to the species are not predicted and have not been assessed further. [Paragraph added in response to Matter C07].

4.3 Australian Sea Lion

The Australian Sea Lion is listed as endangered under the EPBC Act.

The Australian Sea Lion is the only endemic, and least abundant, pinniped that breeds in Australia (DSEWPaC 2013). All current breeding populations are located from the Abrolhos Islands (Western Australia) to the Pages Islands (South Australia). The Australian Sea Lion uses a variety of shoreline types but prefer the more sheltered side of islands and typically avoid rocky exposed coasts (Shaughnessy 1999).

The Australian Sea Lion is a specialised benthic forager, primarily feeding on the sea floor (DSEWPaC 2013). The Australian Sea Lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy 1999).

4.4 Blue Whale

The Blue Whale (*Balaenoptera musculus*) is listed as an endangered species under the EPBC Act. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the Pygmy Blue Whale (*B. m. brevicauda*) and the Antarctic Blue Whale (*B. m. intermedia*). The Otway region is an important migratory and foraging area for Blue Whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov 2012, McCauley et al. 2018, Gill et al. 2011). Underwater acoustic monitoring programs have detected Antarctic and Pygmy Blue Whale calls in the Otway Region (McCauley et al. 2018).

Annex 3 in this document provides a summary of aerial and acoustic monitoring studies focussed on Blue Whales in the Otway area.

The Blue Whale was extremely abundant until the early 20th century when they were hunted to near extinction. Approximately 341,830 Blue Whale takes were recorded by commercial whaling in the Antarctic and sub-Antarctic in the 20th century, of which 12,618 were identified as Pygmy Blue Whales (Branch et al. 2004). The current global population of Blue Whales is uncertain but is plausibly in the range of 10,000 to 25,000, corresponding to about 3-11% of the 1911 estimated population size (Reilly et al. 2008).

Important foraging grounds for Blue Whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015c). Pygmy Blue Whales then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015c).

The time and location of the appearance of Blue Whales in the east generally coincides with the upwelling of cold water in summer and autumn along this coast (the Bonney Upwelling) and the associated aggregations of krill that they feed on (Gill and Morrice 2003). The Bonney Upwelling generally starts in the eastern part of the Great Australian Bight in November or December and spreads eastwards to the Otway Basin around February as southward migration of the subtropical high-pressure cell creates upwelling favourable winds. Sighting data indicates that blue whales are seasonally distributed (Gill et al. 2011; McCauley et al. 2018).

The area that may be affected by underwater sound is within the Pygmy Blue Whale foraging (annual high use) BIA (Appendix B12 MAP-REG-EPM-068). Blue whales predominately occur in this area between January to April (DoE 2015c) though they have been recorded in the Otway area as early as October and as late as June.

4.5 Fin Whale

The Fin Whale is listed as vulnerable and migratory under the EPBC Act.

The Fin Whale is a cosmopolitan migratory species that is listed as vulnerable and occurs from polar to tropical waters but is rarely sighted in inshore waters. Fin Whales show well defined migratory movements between polar, temperate and tropical waters which are essentially north–south with little longitudinal dispersion.

While Australian Antarctic waters are important feeding grounds for Fin Whales, the species also feeds in the Bonney Upwelling during summer/autumn sometimes in the company of Blue and Sei Whales (DCCEEW 2023b). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat with the species feeding on planktonic crustacea, krill, some fish and cephalopods (DCCEEW 2023b). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed.

There are no BIAs for the Fin Whale within Australian waters. Fin Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April.

4.6 Humpback Whale

The Humpback Whale is listed as migratory under the EPBC Act. It is distributed in all oceans and due to its recovery from whaling has been removed as a threatened species under the EPBA Act (DAWE 2022a).

Humpback Whales are present around the Australian coast in winter and spring. Humpbacks undertake an annual migration between the summer feeding grounds in Antarctica to their winter breeding and calving grounds in northern tropical waters. Along the southeast coast of Australia, the northern migration starts in April and May while the southern migration peaks around November and December (DCCEEW 2023).

A discrete population of Humpback Whales have been observed to migrate along the west coast of Tasmania and through Bass Strait, and these animals may pass through the area that may be affected by underwater sound. The exact timing of the migration period varies between years in accordance with variations in water temperature, extent of sea ice, abundance of prey, and location of feeding grounds (DCCEEW 2023). Feeding occurs where there is a high krill density, and during the migration this primarily occurs in Southern Ocean waters south of 55°S (DCCEEW 2023).

Humpback Whales satellite-tagged off Australia's east coast were tracked during three austral summers in 2008/2009, 2009/2010 and 2010/2011 (Andrews-Goff et al. 2018). Of the thirty tagged humpbacks, 21 migrated south along the coastline across into Bass Strait during October. In November the whales then migrated along the east coast (12 whales) and west coast (1 whale) of Tasmania to Antarctic feeding grounds. The state space model used shows both search and transit behaviour revealing new temperate feeding grounds in Bass Strait, the east coast of Tasmania and in the eastern Tasman Sea.

There are no known feeding, resting or calving grounds for Humpback Whales in the area that may be affected by underwater, although feeding may occur opportunistically where sufficient krill density is present (CoA 2015).

4.7 Pygmy Right Whale

The Pygmy Right Whale is a little-studied baleen whale species that is found in temperate and sub-Antarctic waters in oceanic and inshore locations. The species, which has never been hunted commercially, is thought to have a circumpolar distribution in the Southern Hemisphere between about 30°S and 55°S. Distribution appears limited by the surface water temperature as they are almost always found in waters with temperatures ranging from 5° to 20°C (Baker 1985) and staying north of the Antarctic Convergence. There are few confirmed sightings of Pygmy Right Whales at sea (Reilly et al. 2008). The largest reported group was sighted (100+) just south-west of Portland in June 2007 (Gill et al. 2008).

Species distribution in Australia is found close to coastal upwellings and further offshore it appears that the Subtropical Convergence may be important for regulating distribution (Bannister et al. 1996). Key locations include south-east Tasmania, Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to upwelling habitats rich in marine life and zooplankton upon which it feeds (Bannister et al. 1996).

There are no BIAs for the Pygmy Right Whale within Australian waters. Pygmy Right Whale are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately between January to April.

4.8 Sei Whale

The Sei Whale is listed as vulnerable under the EPBC Act. Sei Whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. Sei Whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for Sei whales in Australian waters.

In Australia, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978; Bannister et al. 1996; Thiele et al. 2000; Chatto and Warneke 2000; Bannister 2008).

Sightings of Sei Whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al. 2012), where opportunistic feeding has been observed between November and May (Gill et al. 2015).

There are no BIAs for the Sei Whale within Australian waters. Sei Whales are likely to be foraging in the area that may be affected by underwater sound at similar time as Blue Whales, predominately occur between January to April.

4.9 Southern Right Whale

The Southern Right Whale (Eubalaena australis) is listed as endangered under the EPBC Act. Southern Right Whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al. 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because Southern Right Whales have a slow rate of increase (7% per annum) compared to other marine mammals, their numbers remain low (IWC 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia, and New Zealand.

Southern Right Whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al. 1996; DCCEEW 2022). They are distributed across thirteen primary aggregation areas along the southern coast of Australia. In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (CoA 2012). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (CoA 2012).

The peak period for Southern Right Whale mating is from mid-July through to August (CoA 2012). Pregnant females generally arrive during late May/early June and depart with calves in September to October however the general time of arrivals and departures varies on an inter-annual basis. Calving females are known to have high site fidelity and a 3 to 4-year calving interval. Other population classes stay for shorter and variable periods undertaking coastal movements and departing the coast earlier than female-calf pairs (CoA 2012).

The PMST Report identified that Southern Right Whale breeding is known to occur within area that may be affected by underwater sound, in addition the area where the sound effect criteria for SRW is reached is within the migration BIA and reproduction BIA (Appendix B12 MAP-REG-EPM-069).

5 Sound Effect Criteria

The potential impacts of underwater sound on marine mammals have been the subject of considerable research as detailed in the Regia MSS Seismic Studies Summary available in Appendix B8.

Marine mammals and especially cetaceans rely on sound for important life functions including individual recognition, socialising, detecting predators and prey, navigation, and reproduction (Weilgart 2007, Erbe et al. 2015, Erbe et al. 2018). Underwater sound can affect marine mammals in various ways including interfering with communication (masking), behavioural changes, a shift in the hearing threshold, physical damage, and stress (Erbe 2012, Rolland et al. 2012).

There are no defined sound effect criteria for mortality and potential mortal injury impacts for marine mammals. These effects are not predicted to occur as received sound levels are not of sufficient magnitude to cause mortality/potential mortal injury.

The sound exposure guidelines and predicted maximum distances from the acoustic modelling are detailed in Table E7-5-1.

Table E7-5-1: Sound Exposure Guidelines and Predicted Maximum Distance for Marine Mammals

	PTS		TTS		Behavioural
Threshold Criteria	NMFS finalised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing (NMFS 2016). The guidance describes injury criteria with new thresholds and frequency weighting functions for different hearing groups described by Finneran and Jenkins (2012). The latest revision to this work was published in 2018; with the criteria defined in NMFS (2018). The latest criteria are from Southall et al. (2019) which are applied.				For impulsive sounds, NMFS currently uses step function thresholds of 160 dB re 1 µPa SPL (unweighted) to assess and regulate sound-induced behavioural impacts for marine mammals (NOAA 2018, NOAA 2019). The threshold for impulsive sound is derived from the High-Energy Seismic Survey (HESS) panel (HESS 1999) report that, in turn, is based on the responses of migrating mysticete whales to airgun sounds (Malme et al. 1984). The HESS team recognised that behavioural responses to sound may occur at lower levels, but significant responses were only likely to occur above a SPL of 140 dB re 1 µPa. Southall et al. (2007) found varying responses for most marine mammals between a SPL of 140 and 180 dB re 1 µPa, consistent with the HESS (1999) report, but lack of convergence in the data prevented them from suggesting explicit step functions.
Relevance of thresholds adopted	The PTS and TTS thresholds are from NMFS (2018) and Southall et al. (2019) which is the most current, globally recognised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing. It is difficult to determine thresholds for behavioural response in individuals or groups of cetaceans (Southall et al. 2007, 2021). Often the way individuals or groups respond varies (Nowacek et al. 2004; Gomez et al. 2016; Southall et al. 2016, 2021) and is influenced by both biological and environmental factors such as age, sex, and activity at the time etc. The behavioural disturbance threshold criteria applied is the current NOAA (2019) criterion for marine mammals and which summates the most recent scientific literature on the impacts of sound on marine mammal hearing.				
Very-high-frequency (VHF) cetaceans - Porpoises, dwarf and pygmy sperm whales					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	202 dB PK	155 dB SEL_{24h}	196 dB PK	140 dB SEL_{24h}	160 dB SPL
Modelled Maximum Distance	220-410[1] m	70[1] m	400-820[1] m	190-350 [1] m	2.91-11.8[1] km
High-frequency (HF) cetaceans - Dolphins, beaked whales and sperm whales					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	230 dB PK	185 dB SEL_{24h}	224 dB PK	170 dB SEL_{24h}	160 dB SPL

	PTS		TTS		Behavioural
Modelled maximum Distance	Not reached	Not reached	Not reached	30-50[1] m	2.91-11.8[1] km
Low-frequency (LF) cetaceans – baleen whales					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	219 dB PK	183 dB SEL_{24h}	213 dB PK	168 dB SEL_{24h}	160 dB SPL
Modelled Maximum Distance	30[1] m	1-5.07[1] km	60 – 90[1] m	20.5-41.9 [1] km	2.91-11.8[1] km
Otariid Pinnipeds – sea lion, fur seals					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	232 dB PK	203 dB SEL_{24h}	226 dB PK	188 dB SEL_{24h}	160 dB SPL
Modelled Maximum Distance	Not reached	Not reached	30[1] m	50-60[1] m	2.91-11.8[1] km
***Blue Whales* – note the PTS and TTS 24 hr Cum and Behavioural distances are from Animat modelling**					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	219 dB PK	183 dB SEL_{24h}	213 dB PK	168 dB SEL_{24h}	160 dB SPL
Modelled Maximum Distance	30[1] m	330 – 1.98 km[1]	60 – 90[1] m	8.15-22.5 km[1]	6.40-9.83 [1] km
***Southern Right Whales* – note the PTS and TTS 24 hr Cum and Behavioural distances are from Animat modelling**					
Sound exposure guideline	**Per pulse**	**24 hr SEL**	**Per Pulse**	**24 hr SEL**	**Per Pulse**
	219 dB PK	183 dB SEL_{24h}	213 dB PK	168 dB SEL_{24h}	160 dB SPL
Modelled Maximum Distance	30[1] m	190m-1.4 [1] km	60 – 190[1] m	5.81 -14.2 [1] km	5.35 -9.51 [1] km

1: Sound modelling updated in response to Matter: F17 (Stephen et al. 2024).

6 Predicted Levels of Impact

The type and scale of the effect of seismic sound on cetaceans will depend on several factors. These include the level of exposure, the physical environment, the location of the animal in relation to the sound source, how long the animal is exposed to the sound, the exposure history, how often the sound repeats (repetition period) and the ambient sound level. The context of the exposure plays a critical and complex role in the way an animal might respond (Gomez et al. 2016; NMFS 2016).

6.1 Very-high-frequency Cetaceans

From the PMST it was identified that the Dwarf Sperm Whale and Pygmy Sperm Whale which are classed as very-high-frequency cetaceans (VHF) may occur within the area that may be affected by underwater sound.

The predicted effect level to these species is assessed as minor given that impacts are predicted to have some effect to VHF cetaceans, but the effect is not considered significant or at a level that may affect the population given the following:

- PTS and TTS per pulse effect criteria are reached between 410 – 820 m, thus the implementation of the EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic Activities and Whales for soft starts, where prior to acquisition commencing, the sound source power is ramped up over 30 minutes, will ensure no VHF cetaceans are within distances that PTS or TTS could occur. However, once the sound source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05].
- As the TTS per pulse effect criteria is reached up to 820 m, the EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic Activities and Whales recommended sound source shut down zone of 500 m will be extended to 2 km to account for any VHF cetaceans.
- The PTS 24hr cumulative effect criteria is reached within 70 m and the TTS 24hr cumulative effect criteria is reached within 190-350 m. It is not feasible that a cetacean would be within that distance of the moving vessel for 24 hrs, thus impacts are not predicted.
- Impacts to VHF cetaceans are limited to avoidance behaviour within an area between 2.91-11.8 km from the sound source depending on where in the Operational Area the survey is being undertaken. As VHF cetaceans are not dependent on any specific area within the area affected, impacts may occur to individuals but not at a level to reduce fitness.
- Dwarf Sperm Whales are found in open ocean habitats in temperate to tropical waters around the world with no recorded sightings or strandings off Victoria (DCCEEW 2023a). Pygmy Sperm Whales are also found in ocean habitats in temperate to tropical waters around the world and have been recorded in all states except NT, though as strandings (DCCEEW 2023q). The PMST identified that the Dwarf Sperm Whales and the Pygmy Sperm Whales may occur in the area, however, numbers are predicted to be low and as there are no BIAs these species are likely to be transient in the area affected by sound.
- Auditory masking of high-frequency and very high-frequency cetacean vocalisations is less likely as these species generally operate at higher frequencies than those generated by a seismic survey. [Paragraph added in response to Matter M09.]

The uncertainty level for impacts to VHF cetaceans is assessed as medium based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- Dwarf Sperm Whale and Pygmy Sperm Whale are not listed as threatened species.
- There is limited published data on noise studies specific to species.

- Biologically important areas within Australia are based on published data that routinely acknowledge the small sample sizes in the data.
- An absence of long-term monitoring data of the effects of seismic sound sources on very high frequency cetaceans in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) levels is assessed as medium. For VHF cetaceans the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.2 High-frequency Cetaceans

From the PMST it was identified that six dolphin and eight beaked whale species, which are classed as high-frequency cetaceans (HF) potentially occur within the area that may be affected by underwater sound.

The predicted level of impact to these species is assessed as minor given that impacts are predicted to have some effect to HF cetaceans, but the effect is not considered significant or at a level that may affect the population given the following:

- PTS and TTS per pulse effect criteria and PTS 24hr cumulative effect criteria are not reached.
- The TTS 24hr cumulative effect criteria is reached at up to 30-50 m from the sound source, however, itis not feasible that a cetacean would be within that distance of the moving survey vessel for 24 hrs, thus impacts are not predicted. [Paragraph updated in response to Matter M34].
- Impacts to HF cetaceans are limited to avoidance behaviour within between 2.91-11.8 km from the sound source depending on where in the Operational Area the survey is being undertaken. As HF cetaceans are not dependent on any specific area within the area affected impacts may occur to individuals but not at a level to reduce fitness.
- Auditory masking of high-frequency and very high-frequency cetacean vocalisations is less likely as these species generally operate at higher frequencies than those generated by a seismic survey. [Paragraph added in response to Matter M09.]

The uncertainty level for impact to HF cetaceans is assessed as medium based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- There is limited published data on noise studies specific to species.
- Biologically important areas within Australia are based on published data that routinely acknowledge the small sample sizes in the data.
- An absence of long-term monitoring data of the effects of seismic on high frequency cetaceans in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) levels is assessed as medium. For HF cetaceans the predicted level of impact is clearly below the predefined acceptable levels of impact as detailed in Section 7. The mitigation and management measures detailed in Section 8 provide sufficient confidence in the predicted effect levels.

6.3 Low-frequency Cetaceans

From the PMST Report it was identified that the following low-frequency cetaceans (LF) potentially occur within the area that may be affected by underwater sound:

- Long-finned Pilot Whale, Minke Whale, Short-finned Pilot Whale, and Sperm whale may occur.
- Antarctic Minke Whale, False Killer Whale, and Killer Whale likely to occur.

- Humpback Whale known to occur.
- Southern Right Whale breeding known to occur.
- Pygmy Right Whale foraging, feeding or related behaviour likely to occur.
- Blue Whale, Fin Whale, and Sei Whale foraging, feeding or related behaviour known to occur.

The predicted level of impact to these species is assessed as moderate given that impacts are predicted to potentially have a significant effect on low-frequency cetaceans (LF) species, or populations. The impact may require additional management measures based on:

- PTS and TTS per pulse effect criteria are reached between 30-90 m, thus the implementation of the EPBC Act Policy Statement 2.1 - Interaction between Offshore Seismic Activities and Whales for soft starts, where prior to acquisition commencing the sound source power is ramped up over 30 minutes and while acquisition is being undertaken the sound source will be shut down if a whale (except for Southern Right Whale and Blue Whale, see further down) is within 2 km of the sound source. This will ensure no LF cetaceans are within distances that per pulse PTS or TTS could occur. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I05].
- The PTS 24hr cumulative effect criterion is reached within 1-5.07km and the TTS 24hr cumulative effect criterion is reached within 20.5-41.9 km for LF cetaceans. This modelling assumes that a whale remains within this distance of the sound source for 24 hrs. This is not considered realistic for whales that are transient in the area or migrating (Humpback Whales). For whales undertaking biologically important behaviours such as Blue Whales (foraging) and Southern Right Whales (breeding) animat modelling was undertaken that considers the vessel and whale movements and provides a more realistic prediction of the area that may be affect by underwater sound.
- The predicted maximum distances to the PTS 24hr cumulative effect criterion, TTS 24hr cumulative effect criterion and behavioural effect criterion for Southern Right Whales is 1.4km, 14.2 km and 9.51km, respectively. To meet the action from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) of "Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance", CCG will implement the following activity limitation: The sound source will not be operated within 15 km of a Southern Right Whale Reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS. Furthermore, the shutdown zone for Southern Right Whales has been set to 15 km.
- The predicted maximum distances to the PTS 24hr cumulative effect criterion, TTS 24hr cumulative effect criterion and behavioural effect criterion for Blue Whales is 1.98 m, 22.5 km and 9.83 km, respectively. To meet the action from the Conservation Management Plan for the Blue Whale (DoE 2015c) of "Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury, and is not displaced from a foraging area", CGG will implement the following activity limitation: The sound source will only be operated in the Pygmy Blue Whale foraging BIA during April, May & June or September, October & November when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. The months of April, May & June or September, October & November were selected based on acoustic and aerial surveys focused on Blue Whales in the Otway region as detailed in Annex 3. Furthermore, the shutdown zone for Blue Whales has been set to 23 km.
- The PMST Reports identified foraging known to occur for the Fin and Sei whales. The conservation advice for both these whales (TSSC 2015b, TSSC 2015c) identify anthropogenic noise and acoustic disturbance as a minor consequence rating. The PMST Reports also identified Pygmy Right Whale foraging likely to occur. This species does not have a recovery plan or conservation advice. There is no information on foraging areas for Fin, Pygmy Right Whale or Sei whales off Victoria, though it is likely foraging occurs in the same areas identified as the foraging BIA for Blue Whales as they are often recorded

foraging in the same areas (Gill et al. 2008; Gill et al. 2015; McCauley et al 2018), therefore control measures applied to Blue Whales will ensure no PTS, TTS or behavioural disturbance to foraging Fin Pygmy Right or Sei whales.

- The sound generated by seismic surveys comprises low frequency pulses in the order of tens of milliseconds, occurring several seconds apart. At great distances from the seismic source, sound levels will be quieter, but transmission of the sound via multiple pathways (water, seabed) and reverberation mean that the pulse duration increases with distance. The sound frequencies that are emitted by seismic acoustic sources are broadband; however, most of the energy is concentrated between 0.1 kHz and 0.25 kHz. Consequently, the lowest frequency cetaceans are particularly affected since they have the most overlap with the frequencies of the seismic survey acoustic sources. As detailed in EP Appendix F3 (Acceptable Levels of Impact and Risk), Blue whale calls last up to 18 s and generally consist of three segments: a 9-s-long, 27-Hz tone, followed by a 1-s downsweep to 19 Hz and another, longer-lasting downsweep to 18 Hz (Širović et al 2004, Rankin et al 2005); and Antarctic blue whale source levels have been estimated to be between 188-191 decibels (Miller et al 2021). Given the short seismic pulse duration relative to the duration of marine mammal vocalisations (several seconds to several minutes or longer), marine mammals are likely to be able to detect calls in between seismic pulses (Wood et al., 2012).

  Further, several studies have documented compensation responses (anti-masking strategies) to anthropogenic underwater noise, including changes in vocalisation strength, frequency, and timing. (Erbe et al., 2016). For example, blue whales increased their calls (emitted during social encounters and feeding) when a seismic survey was operational in the area (Di lorio and Clark, 2010). Such adaptations have also been reported for humpback whales (McCauley et al., 1998; 2003b), right whales (Parks et al., 2007, 2011), killer whales (Holt et al., 2008), and bottlenose dolphins (van Ginkel et al., 2017). It is thought that increased calling enhances the probability that communication signals will be successfully received by conspecifics by reducing the effects of auditory masking.

  It is likely that marine mammals in the vicinity of the OA during the Regia MSS, particularly baleen whales, may be subject to some masking effects. The proposed survey timing, i.e. avoiding the peak productivity period for foraging blue whale and other species in the area will reduce the potential for behavioural impacts including interference with communication.

  Masking levels are difficult to predict, and no auditory thresholds exist for predicting masking effects on marine mammals (Erbe et al., 2016); however, as outlined above masking responses (e.g. changes in calling rates) have been documented to occur at relatively low exposure levels (i.e. lower than would elicit any behavioural response). Any masking effects will however cease at the completion of the survey and are highly unlikely to have detectable population level effects. [Paragraphs have been added in response to Matter M09.]

The uncertainty level for impact to LF cetaceans is assessed as high based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- There is limited published data on noise studies specific to species.
- The absence of direct hearing data for LF cetaceans continues to warrant substantial caution in attempting to predict their hearing capabilities and any potential susceptibility of their hearing to nose exposure (South et al. 2019).
- An absence of long-term monitoring data of the effects of seismic on low frequency cetaceans in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (moderate) and uncertainty (high) levels is assessed as high. For LF cetaceans the predicted level of impact is close or like the pre-defined acceptable levels and/or there is enough uncertainty to apply the precautionary principle.

6.4 Otariid Pinnipeds

From the PMST it was identified that within the area that may be affected by underwater sound the Australian Fur-seal breeds at Lady Julia Percy Island (Deen Maar), the New Zealand Fur-seal may occur in the area and the Australian Sea-lion is known to occur in the area.

The predicted level of impact to these species is assessed as minor given that impacts are predicted to have some effect to seals and sea lions, but the effect is not considered significant or at a level that may affect the population given the following:

- The effect criteria for PTS for these species was not reached.
- The effect criteria for TTS for these species was not reached for the per pulse criteria and was only reached at 60 m from the sound source for the 24 hr cumulative effect criteria. It is highly unlikely that a seal or sea lion would stay within 60 m of the sound source for up to 24 hr, thus TTS impacts are not predicted.
- Impacts to seals or sea lions are limited to avoidance behaviour within an area between 2.91km-11.8km depending on where in the Operational Area the survey is being undertaken. The Regia MSS Operational Area may overlap foraging areas for the Australian Fur-seal. [Paragraph updated in response to Matter M31]. As Australian Fur-seal may be potentially breeding on Lady Julia Percy Island while the seismic survey is undertaken a survey limitation will be put in place such that the sound source will not be activated within 11.8 km of the island. This will be implemented to ensure breeding seals are not disturbed. The survey limitation has been updated to reflect that the sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. Given that 11.8 km is the furthest distance to behavioural disturbance sound effect criteria for pinnipeds (seals), the increased protections afforded through the 17 km buffer are considered highly conservative to minimise disturbance of breeding seals. A 10.3km buffer from Deen Maar was initially applied to reduce risks and impacts to Australian Fur Seals to ALARP and an Acceptable level. This effect distance for pinnipeds was based on the initial modelling conducted for the activity (see Appendix b7a). The commissioning of subsequent modelling (see Appendix B7b Sound Emissions Secondary Modelling Report) has provided further insights relevant to the management of this species. The secondary modelling was undertaken in response to consultation with commercial divers [Event ID 3367 & Feedback ID 253] mainly to address constraining the sound source operation to water depths of no shallower than 50 m. Results from this work show that behavioural sound effect criteria for pinnipeds is now reached at a maximum of 11.8 km from the sound source. As the survey area is a minimum of 17km from the closest haul out site (Deen Maar), behavioural impacts to pinnipeds at this location are no longer predicted. [Paragraph updated in response to Matters M30, M31, M32, M33 and F17].

The uncertainty level for impact to pinnipeds is assessed as medium based on:

- The sound effect criteria used in the impact assessment have been published in peer reviewed journals.
- There is limited published data on noise studies specific to species.
- An absence of long-term monitoring data of the effects of seismic on pinnipeds in the presence of frequent seismic surveys, and other anthropogenic sound generating activities, in the region.

The predicted level of impact based on the effect (minor) and uncertainty (medium) levels is assessed as medium. For pinnipeds the predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels.

6.5 Cetacean Mass Strandings

While there has been considerable conjecture that the displacement of cetaceans from seismic surveys (as a consequence of avoidance) could result in stranding events, no solid evidence has yet been forthcoming to support this link. The most recent assessment of whale stranding patterns in

Victoria (Foord et al., 2019) makes no reference to seismic surveys, and found no seasonal stranding pattern. While Foord et al (2019) didn't specifically investigate the relationship between strandings and seismic surveys, seismic surveys typically occur over the summer months off the south coast of Australia; hence if causal links were present, some evidence of seasonal patterns would be expected.

Further to this, NOPSEMA (2019) states that "Evidence of mass whale stranding exists from six to seven million years ago, long before anthropogenic sound became a factor, and it is likely that any observable increase in occurrence [of stranding events] is due to greater visibility of previously inaccessible coastline." [Paragraph has been added in response to Matter M11 and M13].

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts to marine mammals with implemented controls are temporary / reversible and small-scale behavioural response or recoverable temporary threshold shift. No impacts at a populations level are predicted.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. Serious or irreversible environmental damage is not predicted. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature. There is medium confidence in the prediction of when foraging whales and Southern Right Whales are present in BIAs and thus monitoring will be undertaken to validate the presence and/or absence of whales.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1 of this this document.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to marine mammals with implemented controls are temporary / reversible and small-scale behavioural response or recoverable temporary threshold shift. No impacts at a populations level are predicted.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Impacts to economic features are not predicted.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Impacts to cultural features are not predicted. Via stakeholder consultation the cultural value of Deen Maar (Lady Julie Percy Island) has been raised, hence, an activity limitation (M#01) has been implemented such no acquisition (i.e. full power discharge of the sound source) within 17 km of Deen Maar. [Distance updated in response to Matters M31, M32, M33 and F17].	Yes

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor to moderate.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation objections and claims have been made regarding underwater sound and marine mammals. These have been addressed by changing the Regia MSS temporal and spatial boundaries to: Avoid the period when Blue Whale and other foraging whales are present in the Blue Whale foraging BIA in significant numbers. Not operating the sound source within 17 km of Deen Maar. Distance updated in response to Matters M31, M32, M33 and F17]. Not operating the sound source within 15 km of a Southern Right Whale Reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS to avoid impacts on breeding Southern Right Whales. 15 km is based on 114.2 km being the furthest distance modelled from the sound source within which the sound effect criterion for Southern Right Whales is exceeded. Further mitigation and management measures implemented because of relevant person consultation during the preparation of the EP: No discharge of the sound source in the Southern Right Whale reproduction BIA at any time.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted	Amendments
M#01: Activity Limitation	The sound source will not be discharged in the Southern Right Whale Reproduction BIA at any time.	Yes	
	No discharge of the sound source outside of the active source area except for when during line turns or if transiting between sail lines anywhere in the operational area when the sound source will be at low power.	Yes	
	The sound source will not be discharged within 17 km of Lady Percy Julia Island / Deen Maar. [Distance updated in response to Matters M31, M32, M33 and F17].	Yes	
	CGG has committed to not conducting the survey in the high productivity months of January-March which represents an important period when lactating females are alternating between feeding trips at sea and periods ashore to suckle their pups. [Section added in response to Matters M30 and M31].	Yes	
	If the survey period is between September to November, seismic survey lines will be acquired working from deep to shallow to mitigate interactions with Blue Whales who might traverse the intended MSS area as they move towards their summer feeding grounds.	Yes	
	The sound source will not be discharged in January, February, March. Pygmy Blue Whales and other foraging whales are associated with the Bonney Upwelling which is driven by spring-summer winds that blow from the south-east. It can vary from year to year but typically starts during November and December and retreats in April. Most consultations identified that the upwelling events and the associated increase in biodiversity in the area was a high priority. As a result, CGG will avoid the peak upwelling months of January, February, and March. Outside of these months low numbers of Pygmy Blue Whales and other foraging whales are in the Pygmy Blue Whale BIA off Otway based on acoustic and aerial surveys focused on Blue Whales in the Otway region as detailed in Appendix E7.	Yes	
	The sound source will only be discharged in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway.	Yes	

Measure	Justification	Adopted	Amendments
	CGG will implement an activity limitation where there will be no discharge of the sound source within 12 km of the Southern Right Whale Reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS. This buffer distance is based on secondary modelling showing that 11.6 km is the furthest distance from the sound source within which relevant sound effect criterion for Southern Right Whales is exceeded.	Yes	Based on the secondary modelling report, the activity limitation has been changed to 15 km as the secondary modelling report (Appendix B7b) predicts the TTS effect distance to be 14.2 km for southern right whales.
M#03: Fauna Management Plan	The Fauna Management Plan (Appendix G2) provides details about how the Regia MSS will be carried out in a manner by which the environmental impacts from underwater sound to marine fauna will be reduced to ALARP and be of an acceptable level. It details how the requirements of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans and EPBC Act Policy Statement 2.1 will be met and exceeded.	Yes	

9 Conclusions

The conclusion of the effects of seismic sound to marine mammals is summarised below.

Marine Mammal Group	**Predicted Level of Effect**	**Uncertainty**	**Predicted Level of Impact**
Very-high-frequency cetaceans	Minor	Medium	Medium
High-frequency cetaceans	Minor	Medium	Medium
Low-frequency cetaceans	Moderate	High	High
Otariid pinnipeds	Minor	Medium	Medium

10 Recommendations

While there is literature about the effects of seismic survey sound sources on marine mammals there has been a high level of concern expressed by relevant persons during consultation, particularly regarding the effects of seismic sound on Southern Right Whale and Pygmy Blue Whale. The concern is heightened as the area where relevant sound effect criteria may be exceeded overlaps with BIAs of both species. It is recommended that CGG undertake additional assessment looking at the effects of the activity and the level of uncertainty on the Southern Right Whale and Pygmy Blue Whale. This assessment is detailed in the Acceptable Levels Assessment (Appendix F3).

11 Document Control

Table E7-2 - Revision History

Date	Revision	Update
20 July 2023	A	Draft prepared for initial comment
30 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA
14 May 2024	**2**	**Updated following public comments, reruns of PMST searches, and additional modelling report.**

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Annex 1: Legislative and Other Requirements Relevant to Sound Emissions and Marine Mammals

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Pinnipeds			
Conservation Advice Neophoca cinerea Australian Sea Lion (TSSC 2020b)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies sound from seismic survey as a threat that may lead to avoidance behaviour and/or hearing threshold changes in pinnipeds and/or affect bony fish which pinnipeds feed on. Relevant actions are: Investigate and mitigate potential threats to Australian Sea Lion populations.	This requirement is met by this impact assessment and the implementation of the following measures: M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales (Soft-start Procedure) The adopted measures will be implemented and monitored as detailed in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.
Recovery Plan for the Australian Sea Lion (Neophoca cinerea) (DSEWPaC 2013)	The overarching objective of this recovery plan is to halt the decline and assist the recovery of the Australian sea lion throughout its range in Australian waters by increasing the total population size while maintaining the number and distribution of breeding colonies with a view to: Improving the population status, leading to future removal of the Australian sea lion from the threatened species list of the EPBC Act. Ensuring that anthropogenic activities do not hinder recovery in the near future, or impact on the conservation status of the species in the future	Recovery plan identifies sound as a threat with no specific actions.	NA
Whales			
Conservation Management Plan for the Blue Whale (DoE 2015c)	The long-term recovery objective for Blue Whales is to minimise anthropogenic threats to allow for their conservation status to improve so that they can be removed from the EPBC Act threatened species list.	Conservation management plan identifies anthropogenic underwater noise from seismic surveys as a threat with an action of: Anthropogenic noise in biologically important areas will be managed such that any blue whale	This requirement is met by this impact assessment and the implementation of the following measures: M#01: Activity Limitation – Blue Whales

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
		continues to utilise the area without injury, and is not displaced from a foraging area. EPBC Act Policy Statement 2.1—Interaction between offshore seismic exploration and whales is applied to all seismic surveys.	M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales The adopted measures will be implemented and monitored as detailed in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.
Guidance on key terms within the Blue Whale Conservation Management Plan (DAWE 2021)	The document provides guidance on keys terms with the Conservation Management Plan for the Blue Whale.	Relevant guidance is: The recovery plan requirement, Action A.2.3, applies in relation to BIAs. A whale could be displaced from a Foraging Area if impact mitigation is not implemented. This means that underwater anthropogenic noise should not: Stop or prevent any blue whale from foraging. Cause any blue whale to move on when foraging. Stop or prevent any blue whale from entering a Foraging Area. It is considered that a whale is displaced from a Foraging Area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that Foraging Area. Mitigation measures must be implemented to reduce the risk of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur. For the purpose of interpreting and applying Action Area A.2 of the Blue Whale CMP, injury is both permanent and temporary hearing impairment (Permanent Threshold Shift and Temporary Threshold Shift) and any other form of physical harm arising from anthropogenic sources of underwater noise.	
Conservation Advice Balaenoptera physalus Fin Whale (TSSC 2015b)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies anthropogenic noise and acoustic disturbance as a minor threat. Relevant actions are: If required, additional management measures should be developed and implemented to ensure the ongoing recovery of fin whales.	This requirement is met by this impact assessment and the implementation of the following measures: M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales The adopted measures will be implemented and monitored as detailed

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
			in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.
Listing Advice Megaptera novaeangliae Humpback Whale (DAWE 2022a)	Recommends removal as a threaten species but remain a Matter of National Environmental Significance under the EPBC Act as a listed Migratory Species.	Listing advice identifies noise interference as a threat. The listing advice details plans that act to protect the Humpback Whale include EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales.	This requirement is met by this impact assessment and the implementation of the following measures: M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales The adopted measures will be implemented and monitored as detailed in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.
Conservation Advice Balaenoptera borealis sei whale (TSSC 2015c)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice identifies anthropogenic noise and acoustic disturbance as a minor threat. Relevant actions are: If required, additional management measures should be developed and implemented to ensure the ongoing recovery of sei whales.	This requirement is met by this impact assessment and the implementation of the following measures: M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales The adopted measures will be implemented and monitored as detailed in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.
Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)	The long-term recovery objective is to minimise anthropogenic threats to allow the conservation status of the southern right whale to improve so that it can be removed from the threatened species list under the EPBC Act.	Conservation management plan identifies noise interference as a threat. Relevant actions are: If required, additional management measures should be developed and implemented to ensure the ongoing recovery of fin whales. Management practices included in the Seismic Guidelines focus on the prevention of temporary or permanent injuries to the hearing of large baleen whales. In respect to behavioural impacts, rather than specific management practices, the seismic guidelines advise that seismic surveys should be undertaken outside of biologically important areas at biologically important times.	This requirement is met by this impact assessment and the implementation of the following measures: M#01: Activity Limitation – Southern Right Whales M#10: EPBC Act Policy Statement 2.1 - Interaction between offshore seismic activities and whales The adopted measures will be implemented and monitored as detailed in the Implementation Strategy (Appendix B3) to ensure they are effective in managing the impact.

Annex 2: Underwater Acoustic Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Dolphins							
Bottlenose Dolphin	Species or species habitat may occur within area						None identified
Common Dolphin, Short-beaked Common Dolphin	Species or species habitat may occur within area						None identified
Dusky Dolphin	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species			None identified
Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin	Species or species habitat likely to occur within area						None identified
Risso's Dolphin, Grampus	Species or species habitat may occur within area						None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Southern Right Whale Dolphin	Species or species habitat may occur within area						None identified
Whales							
Andrew's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Antarctic Minke Whale, Dark-shoulder Minke Whale	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Arnoux's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blainville's Beaked Whale, Dense-beaked Whale	Species or species habitat may occur within area					None identified	None identified
Blue Whale	Foraging, feeding or related behaviour known to occur within area	Endangered	Migratory	Migratory Marine Species		Foraging (annual high use area)	Conservation Management Plan for the Blue Whale (DoE 2015c)
Cuvier's Beaked Whale, Goose-beaked Whale	Species or species habitat may occur within area					None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Dwarf Sperm Whale	Species or species habitat may occur within area					None identified	None identified
False Killer Whale	Species or species habitat likely to occur within area					None identified	None identified
Fin Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)
Gray's Beaked Whale, Scamperdown Whale	Species or species habitat may occur within area					None identified	None identified
Hector's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Humpback Whale	Species or species habitat known to occur within area		Migratory	Migratory Marine Species		None identified	Listing Advice *Megaptera novaeangliae* Humpback Whale (DAWE 2022a)
Killer Whale, Orca	Species or species habitat likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Long-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Minke Whale	Species or species habitat may occur within area					None identified	None identified
Pygmy Right Whale	Foraging, feeding or related behaviour likely to occur within area		Migratory	Migratory Marine Species		None identified	None identified
Pygmy Sperm Whale	Species or species habitat may occur within area					None identified	None identified
Sei Whale	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Species		None identified	Conservation Advice *Balaenoptera borealis* sei whale (TSSC 2015c)
Short-finned Pilot Whale	Species or species habitat may occur within area					None identified	None identified
Southern Right Whale	Breeding known to occur within area	Endangered	Migratory (as Balaena glacialis australis)	Migratory Marine Species		Reproduction Migration	Conservation Management Plan for the Southern Right Whale (CoA 2012) Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Sperm Whale	Species or species habitat may occur within area		Migratory	Migratory Marine Species		None identified	None identified
Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale	Breeding known to occur within area					None identified	None identified
True's Beaked Whale	Species or species habitat may occur within area					None identified	None identified
Pinnipeds							
Australian Fur-seal, Australo-African Fur-seal	Breeding known to occur within area				Listed	None identified	None identified
Australian Sea-lion, Australian Sea Lion	Species or species habitat known to occur within area	Endangered			Listed	None identified	Conservation Advice *Neophoca cinerea* Australian Sea Lion (TSSC 2020b) Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC. 2013a)
Long-nosed Fur-seal, New Zealand Fur-seal	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle, Luth	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*)* *(*DEWHA 2008)
Loggerhead Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	NA	Recovery Plan for Marine Turtles (DoEE 2017)

Annex 3: Summary of Blue Whale Monitoring Data for Otway Regions

Several whale surveys have been undertaken in the Otway Region in relation to whale. The focus of these surveys has been blue whales, and a summary of the publicly available studies is provided in this section.

Aerial Surveys (2001-02 to 2006-07)

Gill et al. (2011) undertook 69 seasonal aerial surveys for blue whales between Cape Jaffa and Cape Otway over six seasons (2001-02 to 2006-07). This study found that the general pattern of seasonal movement of blue whales is from west to east, with whales foraging in between the Great Australian Bight and Cape Nelson in November and spreading further east in December. Whales are typically widely distributed throughout Otway shelf waters from January through to April (Gill et al. 2011) (Figure E7-2 and Figure E7-3).

Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month is shown in Figure E7-1 with sighting and effort data presented geographically in Figure E7-2: and Figure E7-3. Data is pooled for all seasons, for central and eastern areas, overlaid on gridded aerial survey effort (10 km x 10 km squares), represented as minutes flown per grid square (key, upper right). Thick solid lines represent 50% and 95% probability contours for blue whale distribution from density kernel analysis. Dashed lines are central and eastern boundaries (Gill et al. 2011).

There had been fewer than 50 sightings of blue whales in Bass Strait up to the year 1999, but since that time feeding blue whales have been more regularly observed in the Discovery Bay area and more generally along the Bonney coast from Robe to Cape Otway. Gill et al. (2011) found that across the eastern zone (Cape Nelson to Cape Otway), there were no blue whale sightings in November (2001-2007) despite significant effort (Figure E7-2).

Based on the pooled aerial survey data (2001-2007), encounter rates increased from 1.6 whales per 1,000 km in December, to 9.8 whales per 1,000 km in February, decreased slightly to 8.8 whales per 1,000 km in March, then declined sharply to a single sighting for May (0.4 whales per 1,000 km) (Gill et al. 2011). A mean blue whale group size of 1.3±0.6 was observed per sighting with cow-calf pairs observed in 2.5% of the sightings. Gill et al. (2011) also identified that 80% of blue whale sightings are encountered in water depths between 50 and 150 m; 93% of sightings occurred in water depths <200 m and 10% of sightings occurred within 5 km of the 200 m isobath in the eastern and central zones.

The data from Gill et al. (2011) shows:

- Blue whales are typically widely distributed throughout central and eastern areas shelf waters from January through to April.
- Blue whale numbers are significantly lower in November, December and January in the eastern area compared to the central area.
- No blue whales were sighted in the eastern area during November for any season despite significant effort. Pooled monthly encounter rates increased from 1.6 whales 1,000 km–1 in December, 5 whales 1,000 km–1 in January, peaked at 9.8 whales 1,000 km–1 in February, dropped slightly to 8.8 whales 1,000 km–1 in March, then declined sharply to a single sighting for May (0.4 whales 1,000 km–1).
- Encounter rates in central and eastern zones peaked in February, coinciding with peak upwelling intensity and primary productivity.

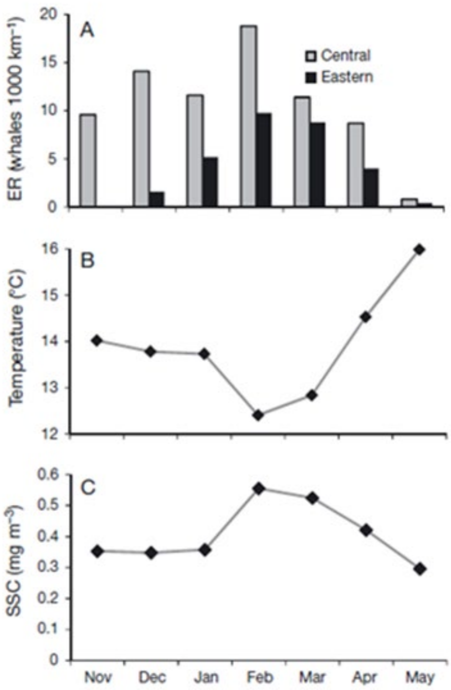


Figure E7-1: Blue Whale Encounter Rates in the Central and Eastern Study (Cape Nelson to Cape Otway) Area by Month (Gill et al. 2011)

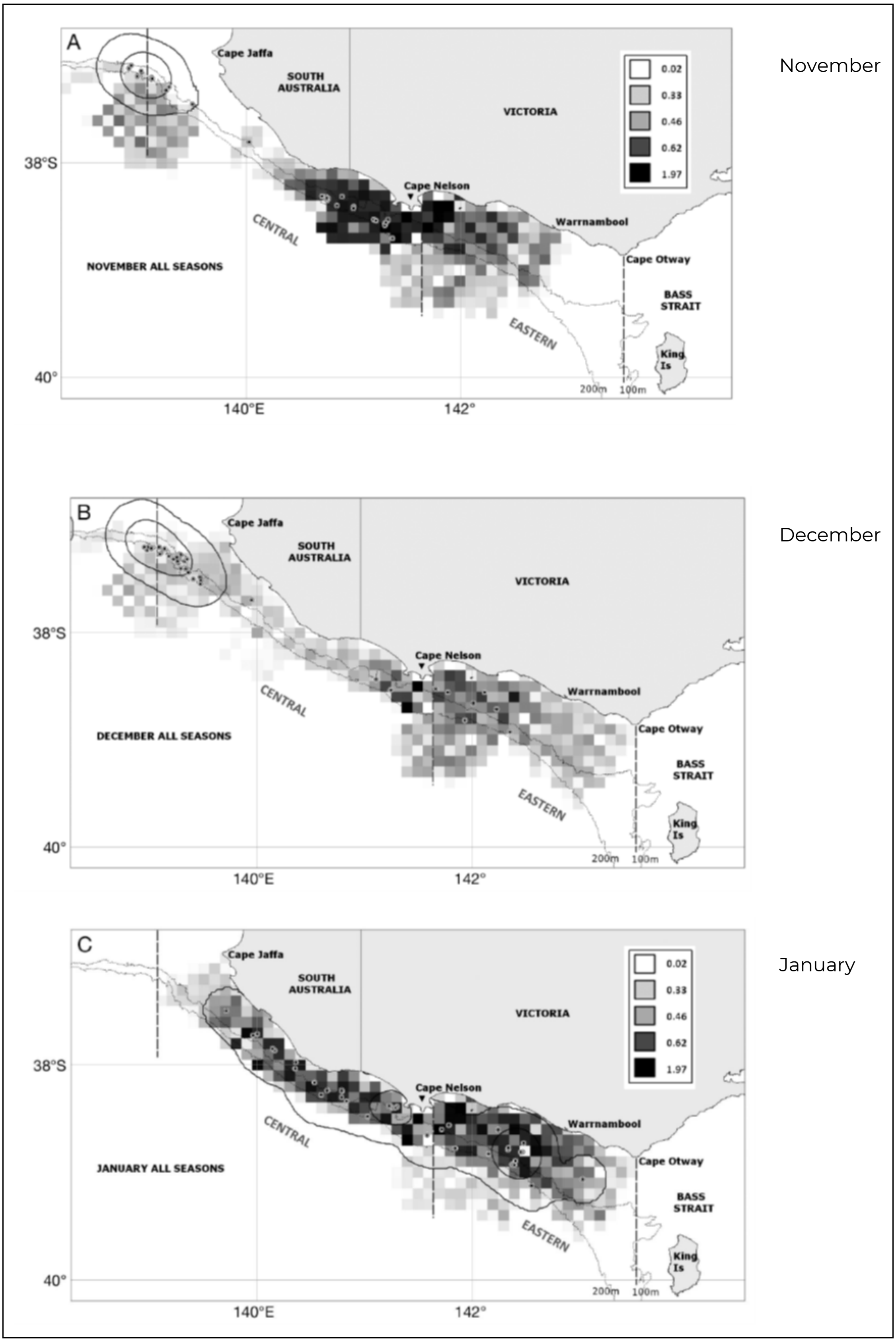


Figure E7-2: Blue Whale Sightings in the Otway Basin (Nov, Dec, Jan) (Gill et al. 2011)

Note: Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square (key, upper right corner of the November and January figures).

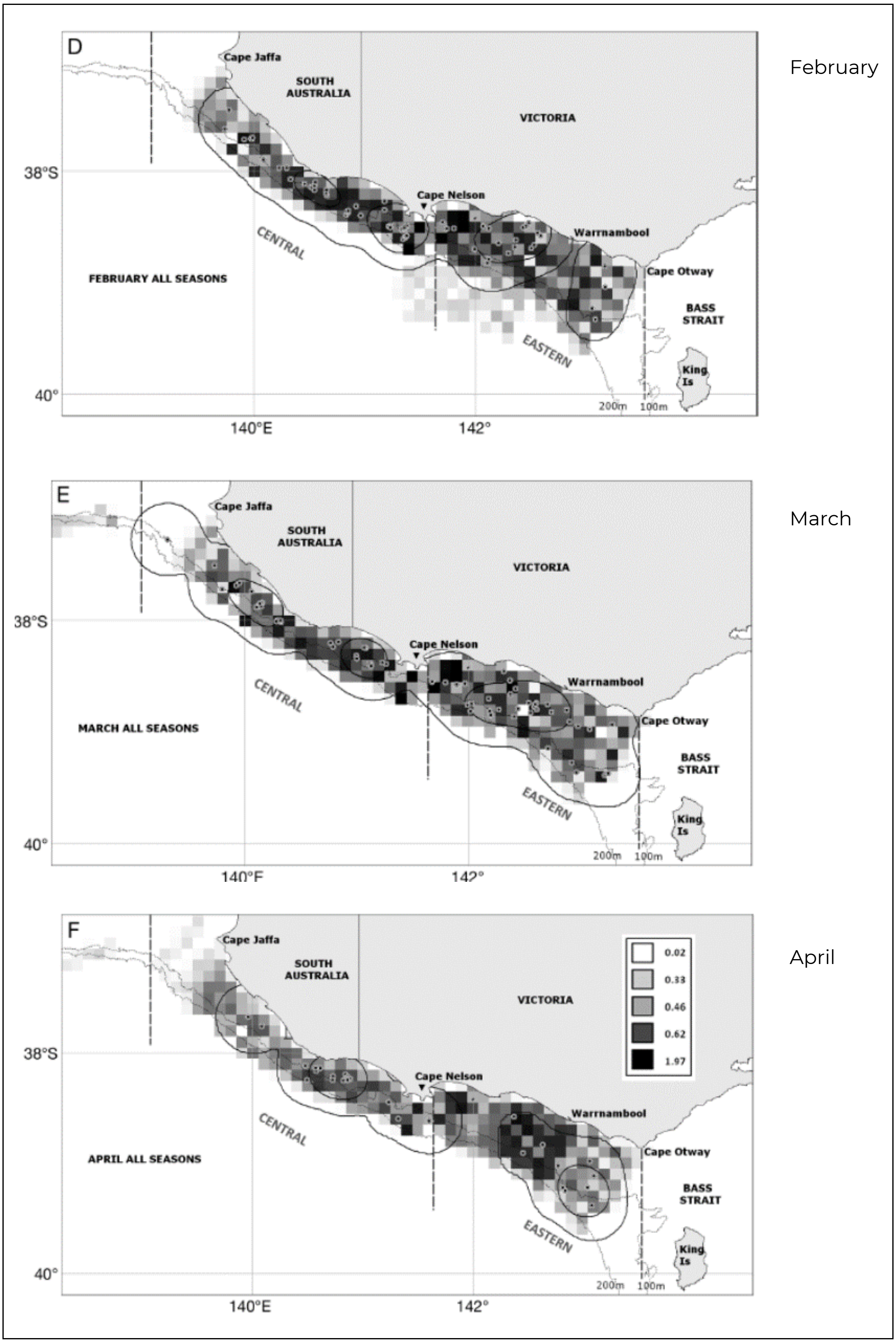


Figure E7-3: Blue Whale Sightings in the Otway Basin (Feb, Mar, Apr) (Gill et al. 2011)

Note: Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square (key, upper right corner of the April figure).

Tagging Study (2015-2016)

Möller et al. 2020 analysis data from the tags of 13 pygmy blue whales that were tagged in the Bonney upwelling region in January 2015 with tags transmitting up to March 2016. In summary:

- Whale movements in the Great Southern Australian Coastal Upwelling System (GSACUS) ranged mostly from eastern South Australia, over the continental shelf south of Kangaroo Island, to between mainland Australia and Tasmania), with a few whales performing some movements to the continental slope and the deep-sea (Figure E7-4).
- In the GSACUS, most tagged whales remained over the continental shelf, utilising this region from at least January to July. This was the area of highest occupancy by the whales, with one whale returning to the Bonney Upwelling in January the year after and remaining there for at least three months. This timing coincides with the upwelling season, which generally occurs from November to March each year.
- A low probability of area restricted search (ARS) behaviour (i.e., high probability of transiting behaviour) was mainly observed between April and June, and then between November and December, suggesting that the pygmy blue whales were mainly migrating during those times.
- Seascape correlates of ARS behaviour for these whales suggested the importance of sea surface temperature, sea surface height anomaly, wind speed and chlorophyll a concentration as proxies of upwelling productivity and presence of krill patches.

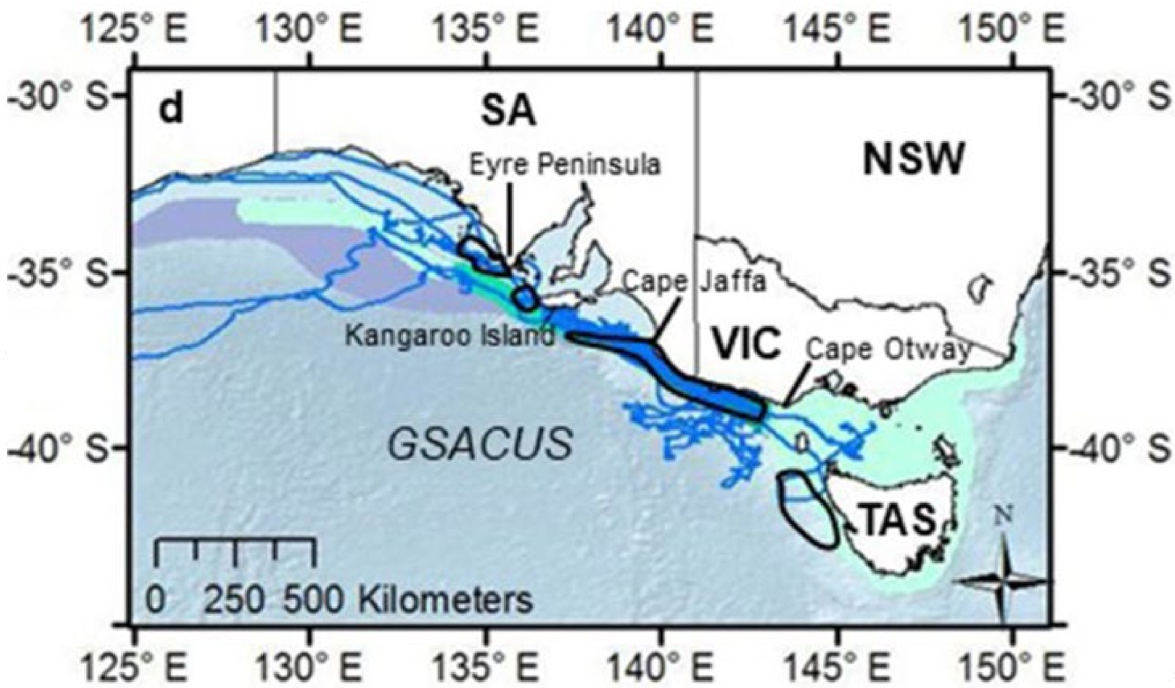


Figure E7-4: Tracks of 13 Pygmy Blue Whales in the GSACUS (Möller et al. 2020)

Passive Acoustic Recorders (2009-2017)

Between 2009 and 2017 the Integrated Marine Observing System (IMOS) recorded underwater sound south of Portland, Victoria. McCauley et al. (2018) analysed the data from to look at blue whale presence, distribution, and population parameters.

McCauley et al. (2018) analysed data from passive acoustic recorders that were located around Australia to look at blue whale presence, distribution, and population parameters. The primary sites comprised central Bass Strait, western Tasmania, the southeast Australian coast, and the Great Australian Bight area. Each study area had multiple receivers and may have had several sites sampled within the area. Temporal sampling focussed on the southern Australian site southwest of Portland, Victoria. Data was used from 2004 to 2016. The study concluded:

- Antarctic blue whale calls were received via deep sound channel propagation south of Portland and the maximum chorus levels occurred from late February to late June with yearly increases in chorus levels. McCauley et al. (2018) suggests that acoustic detection of Antarctic blue whales indicate they predominantly occur along the entire southern coastline.
- Pygmy blue whales have three migratory stages around Australia; the “southbound migration stage” were predominantly between October to December (sometimes into January) whales travel from Indonesian waters down to the WA coast, the “southern Australian stage” where between January and June whales spread across the southern Australian waters, and the “northbound migration stage” where whales travel back up to Indonesia between April and August.
- The “southern stage” involves animals searching for feeding sites, feeding, and then marking their way north towards June.
- Along the southern Australian coastline pygmy blue whales are most frequently detected towards the east along the Bonney coast over late February to early June, utilising secondary productivity produced by a seasonal upwelling event.
- Within a season it is difficult to predict whale numbers and their specific locations, but when correlated across seasons the strength and persistence of this upwelling event as given by time integrated water temperature south of Portland, significantly correlates with time integrated number of individual whales calling from the same site.
- The Bonney coast upwelling is a strong predicator of pygmy blue whale presence at Portland where whale presence in the area is linked to prey availability.
- Sea noise data was available from the Portland site from 2009 to early 2017 detailed:
    - In 2009 and 2011 pygmy blue whales arrived in November or December whereas in the other years, calls were not detected until January or February (Figure E7-5). There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year.
    - There was considerable variability in whale persistence and presence within a season (Figure E7-5) with no consistent trend other than a peak in presence somewhere over February to June.
- It is difficult to predict numbers within a season but when correlated across seasons the strength and persistence of the Bonney coast upwelling, given by time integrated water temperature, significantly correlates with time integrated number of individual whales calling from the same site. The upwelling index explains 83% of the variability in blue whale calling presence across seasons when using seasonal whale counts (not corrected for population growth). When a growth rate of 4.3% is applied a correlation of 90% of the variance in seasonal occurrence is predicted by the upwelling index.
- The number of pygmy blue whale calling in Portland could be expected in increase yearly with whale population growth.

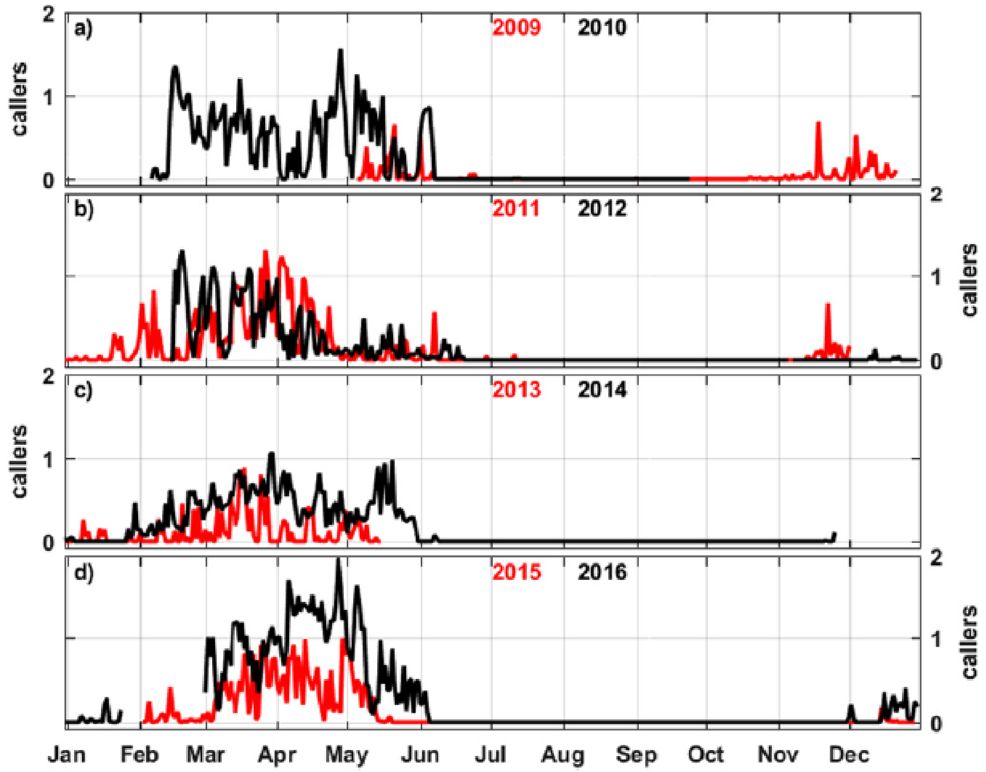


Figure E7-5: Mean Number of Individual Pygmy Blue Whales Calling (McCauley et al. 2018)

Beach Energy Surveys 2021

Beach Energy commenced its Otway drilling program in February 2021 and engaged the Blue Whale Study to undertaken aerial surveys from February to May 2021 to identify blue whale and krill surface swarms within the Otway Development Area and outside of this area (Beach Energy 2022). A preliminary data summary provided to Beach detailed:

- Nine aerial surveys were undertaken from 25 February to 21 May 2021.
- There were 34 blue whale sightings consisting of 43 individuals.
- The highest number of blue whale sightings was on 7 April with 19 blue whales sighted.
- The first blue whale was sighted 25 February and final blue whale sighted 7 April.
- Blue whales and krill surface swarms were distributed throughout the area surveyed.

References

Beach Energy. 2020. Otway Offshore Operations Environment Plan. Rev 12b. July 2022. https://docs.nopsema.gov.au/A865038

Gill PC, Morrice MG, Page B, Pirzl R, Levings AH & Coyne M. 2011. Blue whale habitat selection and within-season distribution in a regional upwelling system off southern Australia. Marine Ecology Progress Series, 421: 243–263. Available from: http://www.intres.com/articles/meps_oa/m421p243.pdf.

McCauley RD, Gavrilov AN, Jolliffe CD, Ward R & Gill PC. 2018. "Pygmy blue and Antarctic blue whale presence, distribution and population parameters in southern Australia based on passive acoustics." Deep-Sea Research Part II: Topical Studies in Oceanography 157-158: 154-168.

Möller LM, Attard CRM, Bilgmann K, Andrews-Goff V, Jonsen I, Paton D & Double MC. 2020. Movements and behaviour of blue whales satellite tagged in an Australia upwelling system. Nature Scientific Reports. 10:21165. https://doi.org/10.1038/s41598-020-78143-2.

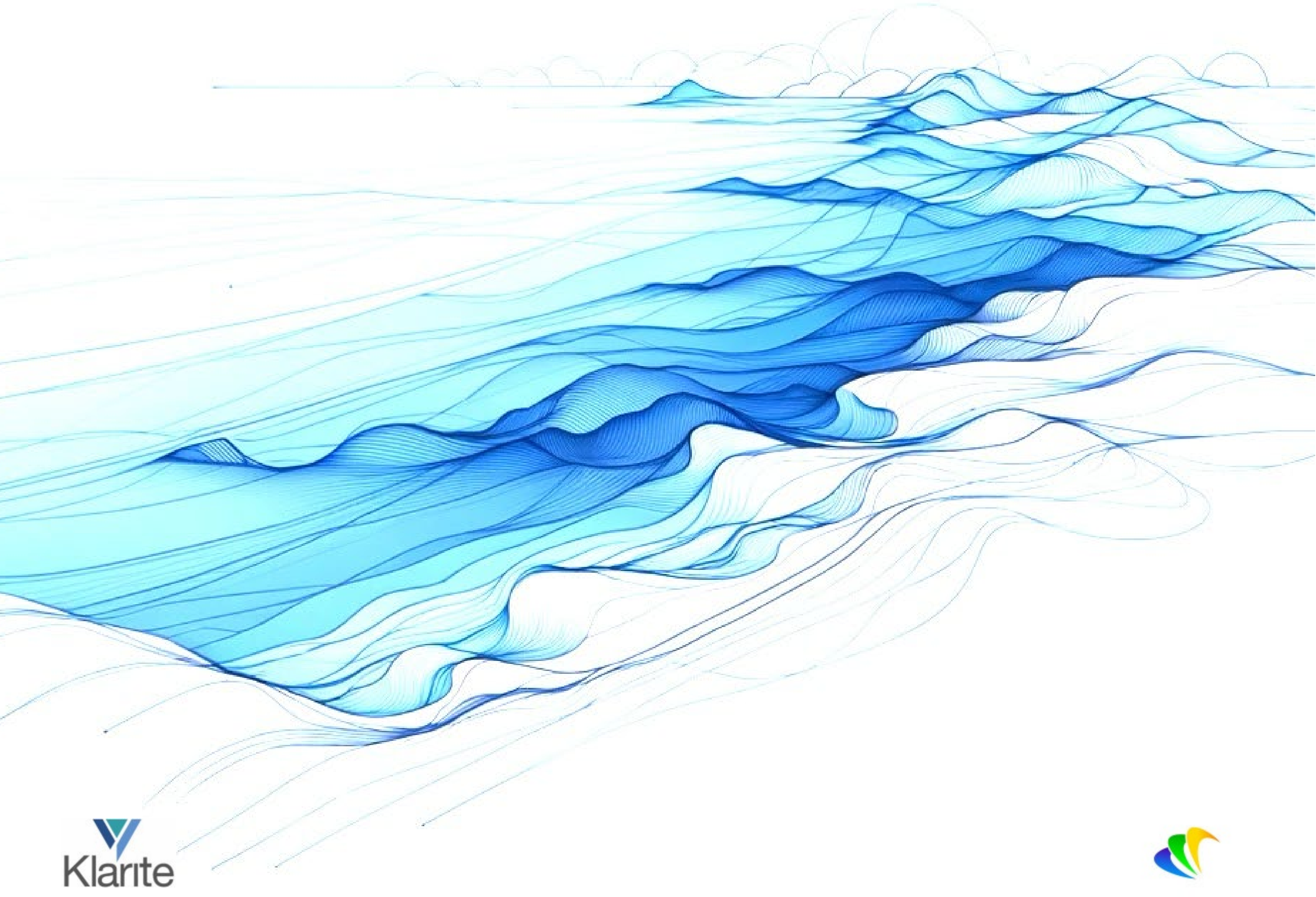
REGIA
Marine Seismic Survey

Impact Assessment Underwater Sound: Diving, Surfing and Swimming

Appendix E8: REG-EP-027-E8

Rev 1

May 2024



Klarite

Table of Contents

1 Introduction

This document presents analysis of an environmental aspect, underwater sound, between the Regia Marine Seismic Survey (Regia MSS) and the existing environment that may be affected by that aspect. This environmental aspect was identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA) (Appendix B4) for further assessment.

This analysis is based on information provided in three preceding studies:

1. Sound Emissions Initial Modelling Report (Appendix B7a)
2. Sound Emissions Secondary Modelling Report (Appendix B7b)
3. Seismic Sound Studies Report (Appendix B8)

This document was first published in draft form to the Document Library of the Regia MSS Consultation Hub on 11 September 2023. This was done to acknowledge that the final full Environment Plan (EP) can be a large document that is difficult for readers to digest in the 30-day public comment period. As such, the public and relevant persons were invited to comment on the document with an explicit request for readers to provide feedback on:

- The accuracy of the described environment that may be affected.
- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
- Any errors or omissions of scientific/peer reviewed literature that should be considered.
- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E8-21, and the feedback received during the public comment period for the completed EP is provided in Table E8-2-2.

2.1 Aspect Specific Relevant Objections and Claims

The feedback received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their insights on environmental values and sensitivities. Feedback was invited and Table E8-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E8-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
An email received detailing that seismic blasting should not occur within 20km of the vicinity of these beaches at any time of the year. These beaches (and others) are utilised all year round by members of our community.	95	CGG will implement a human health threshold exceedance limit of 145 dB re 1 μPa SPL threshold on the coastline adjacent to the acquisition area. CGG will not discharge the sound source at full power in waters shallower than 50 m.
Survey response concerned about the danger to people using the waters because of sound emissions from the testing.	125	
Survey responses concerned about disruption to recreational water activities (swimming/surfing)	410, 413, 419, 421	
Survey response objecting to the activity due to sound disrupting surfing conditions	421, 85	
Persons expressed concern for the divers themselves and how SIMOPS might be managed	253	SIMOPs plan to be developed with divers. Additional modelling for offset distances from specific dive sites.
Stakeholder raised concern for commercial divers and enquiry about SIMOPS management.	263	SIMOPs plan to be developed with divers Additional modelling for offset distances from specific dive sites

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E8-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E8-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, and G1).

3 Aspect – Underwater Sound

3.1 How the Aspect Occurs

Impulsive underwater acoustic emissions will result from the seismic source releasing compressed air (seismic pulse) that creates a sound wave that is directed downwards into the seabed.

3.2 Extent and Duration of the Aspect

Impulsive Sound

Duration: 60 days

Extent: Active Source Area and area of sound propagation within which the human health safety criterion will be exceeded as detailed in the impact assessment sections.

Seismic acquisition where the seismic source will be active will occur for up to 60 days within the Active Source area.

3.3 Legislative and Other Requirements

Annex 1 of this document describes the legal and other requirements that apply to underwater sound and divers, surfers, and swimmers, and how the requirements will be met.

3.4 Cause Effect Pathway

The PEIRA (Appendix B4) identified a cause-effect pathway for underwater sound for the following environmental components:

- Divers, surfers, and swimmers

3.5 Underwater Sound Modelling

CGG contracted JASCO Applied Sciences (JASCO) to undertake a numerical modelling studies of underwater sound levels associated with the Regia MSS acquisition lines to assist in understanding the potential acoustic impacts on key regional receptors including divers, surfers, and swimmers.

The modelling methodology considered source directivity and range-dependent environmental properties likely to be encountered within the proposed survey area.

Two modelling reports were commissioned, one in the preparation phase of the EP (Koessler et al. 2023) available in Appendix B7a, and a secondary report during the public consultation phase (Stephen et al. 2024) available in Appendix B7b. The second iteration of modelling undertaken specifically addressed an amended spatial survey layout to avoid exceedances of the human health threshold on the coastline adjacent to the survey acquisition area. This was achieved by:

1. constraining sound source operation at full power to water depths of no shallower than 50 m, and
2. further constraining the acquisition area away from where the model continued to predict an exceedance on the coastline (Figure E8-5-1).

The reports provide an overview of JASCO's specialised airgun array source model and complementary underwater acoustic propagation models, receptor sound effect criteria adopted and the predicted distances to those criteria.

4 Description of the Existing Environment that may be Affected by the Activity

Via stakeholder consultation it was identified that diving, surfing, and swimming occurs along the coastal area adjacent to the Operational Area daily throughout all seasons.

Popular diving sites are:

- Deen Maar (Lady Julia Percy Reserve)
- Port Campbell Harbour
- Port Fairy – South Beach, Pea Soup Beach, The Passage and Battery Point
- Merri Marine Sanctuary
- Portland Harbour
- Warrnambool Harbour

Popular beaches are:

- Bay of Islands
- Bowkers Beach
- Childers Cove
- Clifton Beach
- Gibsons steps/Gibson Beach
- Massacre Bay
- Newfield Beach
- Rivernook Beach

The secondary modelling report included 13 representative coastal locations as well as Deen Maar where received sound levels were calculated. These locations were spatially spread out along the coastline adjacent to the acquisition area providing considerable coverage for prediction of human health threshold exceedances.

5 Sound Effect Criteria

Scuba divers, surfers and swimmers exposed to high levels of underwater sound can suffer from dizziness, hearing damage or other injuries to other sensitive (mainly air-filled) organs, depending on the frequency and intensity of the sound.

Underwater, the human ear is about 20 dB less sensitive than it is in air at low frequencies (20 Hz), increasing to 40 dB at mid-frequencies (less than 1 kHz), and increasing to 70–80 dB less sensitive at higher frequencies (Parvin 1998).

Information on studies in relation to seismic acoustic emission impacts and diving is provided Seismic Sound Studies Report (Appendix B8).

Seismic activity results in the transmission of acoustic waves through the water which divers or swimmers experience as vibration or a noise analogous to a piling hammer. Multiple reflections of this acoustic wave from the sea surface, seabed and other structures may result in this sounding like a low frequency rumble (DMAC 2020).

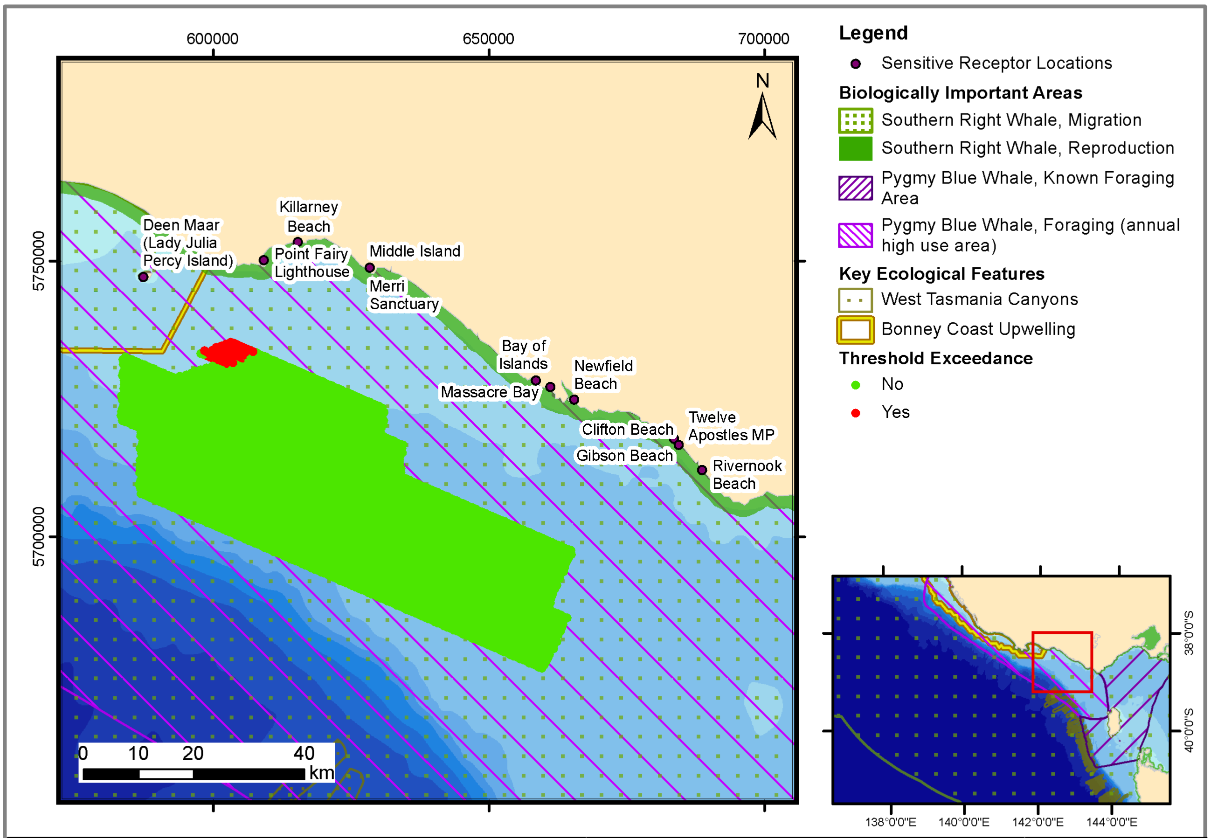
A safety criterion for recreational divers and swimmers of 145 dB re 1 μPa is conservatively used to assess potential adverse effects. This does not imply that this level is associated with the onset of injury, which has not been established due to ethical research protocols. Parvin (2005) reported vibration in forearms and thighs at the much higher level of 180 dB re 1 μPa but no physical injury.

The second iteration of acoustic modelling undertaken deliberately introduced an assessment of sound exposure at 14 relevant sites across the coastline adjacent to the acquisition area. Guidance issued by the Diving Medical Advisory Committee (DMAC 2020) suggests that adverse effects to divers may be experienced at distances of up to 27 km from the seismic source, which is within the range of the modelling distance for the Regia MSS. Five of the coastal locations assessed were within 27 km.

A per-pulse safety criterion of 145 dB re 1 μPa was applied which the modelling indicated could be exceeded at:

- Killarney Beach (150.6 dB re 1 μPa)
- Port Fairy Lighthouse (154.6 dB re 1 μPa)
- Deen Maar / Lady Julia Percy Island (154.8 dB re 1 μPa)
- Merri Sanctuary (151.8 dB re 1 μPa)
- Middle Island (151.8 dB re 1 μPa)

The two closest coastal sites to the survey area (Port Fairy Lighthouse & Deen Maar) at 20.7 and 16.6 km distance, respectively. Figure E8-5-1 illustrates the sound source location where the safety criterion would be exceeded at any of the coastal sites assessed. Received sound levels at the three other coastal sites within 27 km of the sound source (Deen Maar, Middle Island and Merri Sanctuary) were below the safety criterion.



Threshold Exceedance Map: SPL Guidelines for divers	Datum: GDA 1994 Projection: MGA Zone 54	JASCO APPLIED SCIENCES
Regia 3D Marine Seismic Survey	February 2024	

Figure E8-5-1 Assessment of safety criterion exceedance at any coastal sites from within the proposed survey area. Area within the proposed survey area from where exceedance of the safety criterion may occur is indicated in red.

6 Predicted Levels of Impact

Based on the second acoustic modelling report (Appendix B7b) there is the potential for received sound levels at coastal areas where diving, surfing, and swimming occurs to exceed the human health safety criterion. As this would not be acceptable, CGG will adapt the Regia MSS so that received level at coastal areas is below the safety criterion for recreational divers and swimmers. The area in which the sound source would operate at full capacity (acquisition area) has therefore been further constrained to the area from where the human health safety criterion would not be exceeded at any coastal location assessed. This involves avoiding acquisition using the sound source at full power in the area in red in Figure E8-5-1.

The uncertainty level for impact to divers is assessed as low based on:

- The conservative human health safety criterion used to identify where potential adverse effects may be experienced (of 145 dB re 1 µPa).
- There were concerns raised throughout consultation with relevant person regarding sound levels at recreational dive sites close to the Operational Area (Event ID 2028).
- Following these concerns, CGG commissioned a second underwater sound modelling report that deliberately assessed received sound levels at 13 representative locations across the coastline adjacent to the proposed survey area as well as Deen Maar.
- The survey area has been further constrained to areas where the human health safety criterion is not exceeded anywhere on the adjacent coastline or at Deen Maar.

The predicted level of impact based on the effect (negligible) and uncertainty (low) levels is assessed as low. The predicted levels of impact are beneath levels of perception and/or within normal bounds of variation. Good industry practice (including legislation and standards) has been applied and therefore these impacts are of an acceptable level without further reduction measures being required.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Impacts to divers, surfers and swimmers are not predicted as the Regia MSS has been redesigned so that the received sound level at 13 representative coastal locations and at Deen Maar is below the human health safety criterion for divers and swimmers of 145 dB re 1 µPa.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature was used to inform the impact assessment. There is high confidence in the prediction of impacts which is based on peer reviewed and published literature. The sound modelling was revisited with a deliberate effort to assess received sound levels at 13 representative coastal locations and at Deen Maar adjacent to the survey area. The outcomes showed that the survey could not exceed the safety criterion on the coastline except from a small area. This area has now been removed from the acquisition area where the sound source would operate at full power.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	No EPBC Act Management Plans or Recovery Plans were identified that are relevant to divers, surfers or swimmers.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Impacts to biological features are not predicted.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Impacts to ecological features are not predicted.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Impacts to economic receptors are not predicted. The sound source will not be discharged at full power in areas from where it is determined that exceedances of the human health safety criterion may occur.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Impacts to cultural receptors are not predicted.	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is negligible.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	From relevant person consultation the following objections and claims have been made: Impacts to divers and surfers from underwater acoustic impacts. A second modelling report was commissioned which deliberately assessed whether exceedances of the human health safety criterion could be realised on the coastline adjacent to the survey area or at Deen Maar. The discharge of the sound source at full power has been constrained and the acquisition area will not include the area from where exceedances on the coastline were predicted.	Yes
	The views of public have been considered in the impact and risk assessment.		Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#01: Activity Limitation	CGG will adapt the Regia MSS so that received sounds levels on the coastline are below the human health safety criterion for divers and swimmers of 145 dB re 1 μPa.	Yes
M#02: Consultation Management System	A SIMOPS plan will be developed in consultation with divers with an appropriate risk assessment undertaken to reduce risks and impacts to ALARP and Acceptable levels. Such a SIMOPS plan will be consistent with DMAC guidelines and may include additional modelling to be undertaken for specific dive sites not already reasonably considered. Local newspapers and radio will also be used to notify the public.	Yes

9 Conclusions

This impact assessment has demonstrated that the effect of underwater sound to divers, surfers and swimmers has a:

- **Predicted level of effect of negligible.**
- **An uncertainty of low.**
- **Predicted level of impact of low.**

10 Recommendations

The impact assessment has adopted a conservative approach to estimation of the predicted level of impact. Good industry practice (including legislation and standards) has been applied and impacts are therefore considered to be of an acceptable level without further recommendations being required.

11 Document Control

Table E8-3 - Revision History

Date	Revision	Update
6 June 2023	A	Draft prepared for initial comment
20 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA for public comment
14 May 2024	**2**	**EP submission to NOPSEMA for assessment**

12 References

DMAC 2020. Safe Diving Distance from Seismic Surveying Operations. DMAC 12 Rev 2.1. Diving Medical Advisory Committee.

Koessler MW, Muellenmeister AM, Connell SC & McPherson CR. 2023. Regia Marine Seismic Survey: Initial Acquisition Area. Initial Acquisition Area. Document 03076, Version 1.0. Technical report by JASCO Applied Sciences for Klarite.

Parvin SJ. 1998. The effects of low frequency underwater sound on divers. Proceedings of Undersea Defence Technology, pp227- 232, Wembley.

Parvin S. 2005. Limits for underwater noise exposure of human divers and swimmers. Subacoustech. Presented at the National Physics Laboratory Seminar on Underwater Acoustics, Teddington, UK.

Stephen T.J., V.E. Warren, S.C. Connell, M.W. Koessler and C.R. McPherson. 2024. Regia Marine Seismic Survey: Acoustic Modelling for Assessing Sound Exposures. Document 03301, Version 2.0. Technical report by JASCO Applied Sciences for Klarite.

Annex 1: Legislative and Other Requirements Relevant to Underwater Sound and Divers

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Diving Medical Advisory Committee (DMAC 2020)	Provide recommendations for managing seismic survey impacts to divers.	Recommendations are: Where possible, plans should be made to avoid overlapping seismic and diving activities. Where this is not possible, the activities should be prioritised, and a simultaneous operations plan developed. Where diving and seismic activity are scheduled to occur within 45 km (28 miles), it would be good practice for all parties to be made aware of the planned activity where practicable. This should include clients/operators, diving, and seismic contractors. Where diving and seismic activity will occur within 30km (18.6 miles) a joint risk assessment should be conducted, between the clients/operators involved and the seismic and diving contractors in advance of any simultaneous operations. The risk assessment should consider ramp-up trials as well as other risk control measures e.g. reduction in source sizes, changes to firing intervals, timeshare/prioritisation etc. Seismic operators should consider whether a source output modelling study should be undertaken to predict sound pressure levels at diving locations. If so, these sound pressure levels should be considered together with other relevant factors in the risk assessment.	CCG will implement: M#01: Activity Limitation where CGG will adapt the Regia MSS so that received sound levels at coastal areas is below the safety criterion for recreational divers and swimmers of 145 dB re 1 μPa. M#02: Consultation Management System where best endeavours will be made by CGG to develop a SIMOPS plan with divers and titleholders when operating within 40km of known dive sites, consistent with DMAC guidelines. If not possible, local newspapers and radio will be used to notify the public.

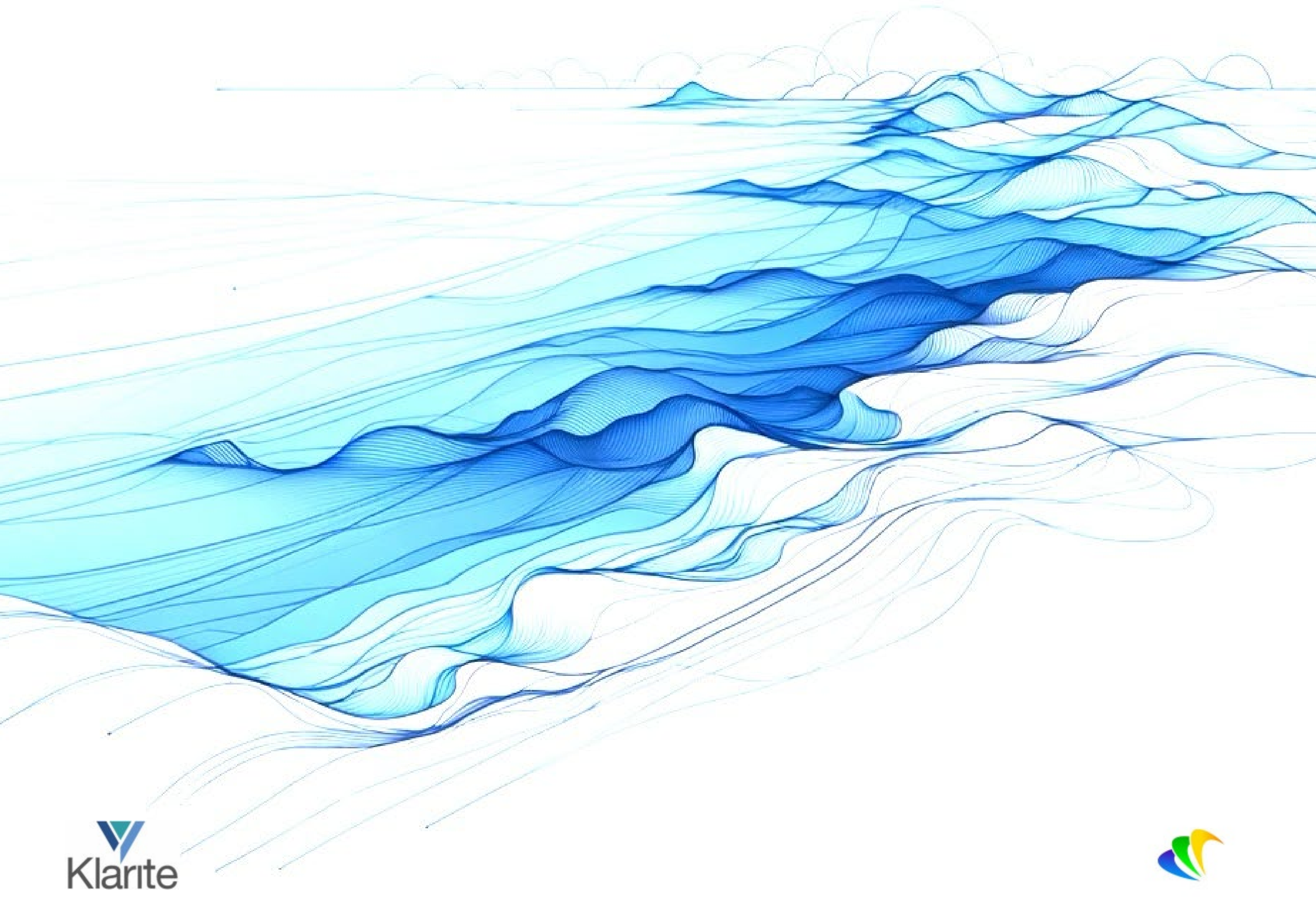
REGIA
Marine Seismic Survey

Impact Assessment Light Emissions

Appendix E9: REG-EP-028-E9

Rev 2

May 2024



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- Any omissions of environmental values and sensitivities relevant to the environmental aspect.
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- Any errors or omissions of relevant legislation or documents of standing that should be considered.
- Any further mitigation or management measures that should be considered.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table E9-2-1, and the feedback received during the public comment period for the completed EP is provided in Table E9-2-2.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table E9-2-1 shows how this feedback has been incorporated into the environmental assessments.

Table E9-2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG agreed to implement the following measures: Activity limitations (various). Sail line plan. OPEP protection priority areas added.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan	201	CGG agreed to implement the following measures: Light management plan including shrouds. OPEP priority for protection.
Received email from Marine Parks requesting activities are timed to avoid species' peak migration and foraging behaviours.	228	CGG agreed to implement the following measures: Fauna Management System

2.2 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. Table E9-2-2 shows how this feedback has been incorporated into the environmental assessments.

Table E9-2-2 - Public comment input

Matter	Matter ID	Changes made arising from public comment
Matter: Acknowledgement of breeding colonies	B02	CGG has included additional detail in EP Appendix E9, Section 5.1.5 (Little Penguin) and 6.1.1 (Birds) and to assess impacts to breeding colonies at Middle Island and Deen Maar and other coastal locations in response to these claims.
Matter: Geographic range and all species need to be defined and considered	I16	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

Matter	Matter ID	Changes made arising from public comment
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has considered these claims and has rerun the PMST reports to ensure that all information on the likely/known presence of relevant species within the area, as well as information on their protection status, Biologically Important Areas (BIAs) and behaviours is up to date. The updated PMST reports are provided in full in EP Appendix B5.

3 Aspect – Light Emissions

3.1 How the Aspect Occurs

Navigational and safety lighting on the seismic and support vessels emit light when operating at night.

3.2 Extent and Duration of the Aspect

Duration: 90 days

Vessel navigational and safety lighting will be required at night for the duration of the activity.

Extent: Operational Area +20 km

The National Light Pollution Guidelines for Wildlife (CoA 2023) detail that where there is important habitat for listed species that are known to be affected by artificial light within 20 km of a project, species specific impacts should be considered through an Environmental Impact Assessment.

The 20 km extent provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km and fledgling seabirds grounded in response to artificial light 15 km away (CoA 2023). Seabird grounding, as described in Rodriguez et al. (2014), relates to impacts of onshore fixed light sources such as streetlights and buildings and the effect this can have on young fledgling birds making their first flight from their nests to the open ocean. Subsequently, 20 km is adopted as the extent of light emissions for the impact assessment.

For zooplankton, fish and invertebrates, the Guidelines detail that for vessel lights zooplankton and their vertebrate predators to descend away from the surface; these effects occurred at depths of up to 200 m, and up to 200 m horizontally from the light source. Experiments using light traps also detailed that some fish and zooplankton species are attracted to light sources (Meekan et al. 2001), with traps drawing catches from up to 90 m (Milicich et al. 1992). Thus, for zooplankton, invertebrates, and fish the extent of impact is may be within 200 m of the light source.

3.3 Legislative and Other Requirements

Annex 1 describes the legal and other requirements that apply to light and species that may be affected by light, and how the requirements will be met.

4 Cause Effect Pathway

The Preliminary Environmental Impact and Risk Assessment (PEIRA) identified a cause-effect pathway for light for the following environmental components:

- Plankton
- Invertebrates
- Fish
- Birds
- Marine reptiles
- Marine mammals
- Coastal communities

The PEIRA (Appendix B4) PEIRA identified that the environmental impact of light to the following environment components was ranked as having a negligible level of effect and are not assessed further in this section:

- Marine mammals
- Coastal communities

The Recovery Plan for Marine Turtles (DoEE 2017) details that artificial light poses a threat to marine turtles because it disrupts critical behaviours as they use light as an orientation cue. Artificial light can inhibit nesting by females (Salmon 2003) and can disrupt hatchling orientation and sea finding behaviour (Philibosian 1976; Witherington and Bjorndal 1991).

The Wildlife Conservation Plan for Seabirds (CoA 2020a) details that all species of seabird are vulnerable to impacts from lighting. The National Light Pollution Guidelines for Wildlife (CoA 2023) details those seabirds active at night while migrating, foraging or returning to colonies are most at risk. Fledglings are more affected by artificial lighting than adults due to the synchronised mass exodus of fledglings from their nesting sites. They can be affected by lights up to 15 km away.

The National Light Pollution Guidelines for Wildlife (CoA 2023) details that there is evidence that night-time lighting of migratory shorebird foraging areas may benefit the birds by allowing greater visual foraging opportunities. However, where nocturnal roosts are artificially illuminated, shorebirds may be displaced, potentially reducing their local abundance if the energetic cost to travel between suitable nocturnal roosts and foraging sites is too great. Artificial lighting could also act as an ecological trap by drawing migratory shorebirds to foraging areas with increased predation risk.

The National Light Pollution Guidelines for Wildlife (CoA 2023) details that artificial light can interfere with daily and seasonal light cues for zooplankton, invertebrates and fish resulting in changes in behaviour.

5 Description of the Existing Environment that may be Affected by the Activity

As detailed in the Section 3.2, the Operational Area plus 20 km has been adopted as the extent of light emissions for the impact assessment to light sensitive species such as marine turtles, seabirds, and migratory shorebirds, thus a Protected Matters Search to identify these species was undertaken for the Operational Area plus 20 km with the report available in Appendix B5.

As detailed in the Section 3.2, the Operational Area plus 200 m has been adopted as the extent of light emissions for the impact assessment to light sensitive species such as zooplankton, invertebrates, fish, thus a Protected Matters Search to identify these species was undertaken for the Operational Area with the report available in Appendix B5.

Annex 2 details those species that may be affected by light from the PMST report and identifies any biologically important areas and conservation advice or management plans.

5.1 Birds

The PMST Report identified multiple bird species or species habitat within the area potentially affected by light emissions. Annex 2 provides a summary of the PMST Report. Several of these bird species were identified to be undertaking biologically important behaviours and/or have BIAs that the area potentially affected by light emissions overlaps. Table E9-51- provides a summary of this information. No habitat critical to the survival of the bird species were identified within the area potentially affected by light emissions overlaps.

PMST searches were run again prior to resubmission to ensure any changes to species or listings were identified to control for passage of time. Conservation Advice has also been updated for several species and subsequent changes have been made to Annex 1 (Legislative and Other Requirements) and Annex 2 (Light Sensitive Species). Changes relevant to the assessment of light emissions include:

- Changes to EPBC Act status of several species
  - Red Knot is listed as Vulnerable (previously Endangered)
  - Sharp-tailed Sandpiper is listed as Vulnerable (previously not listed as threatened)
  - Sooty Shearwater is listed as Vulnerable (previously not listed as threatened)
  - Western Alaskan Bar-tailed Godwit is listed as Endangered (previously Vulnerable)
  - Common Greenshank is listed as Endangered (previously not listed as threatened)
  - Ruddy Turnstone is listed as Vulnerable (previously not listed as threatened)
  - Latham’s Snipe is listed as Vulnerable (previously not listed as threatened)
  - Blue-winged Parrot is listed as Vulnerable (previously not listed as threatened)
- Updates to conservation advice for several species
  - Conservation Advice for *Calidris canutus* (Red Knot) (DCCEEW 2024)
  - Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)
  - Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)
  - Conservation Advice for *Limosa lapponica baueri* (Bar-tailed Godwit western Alaskan) (DCCEEW 2024b)
  - Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e
  - Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c)
  - Conservation Advice for *Gallinago hardwickii* (Latham's Snipe) (DCCEEW 2024d)
  - Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)
  - Conservation Advice for *Calidris ferruginea* (Curlew Sandpiper) (DCCEEW 2023m)
  - Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)
  - Conservation Advice for *Charadrius leschenaultii* (Greater Sand Plover) (DCCEEW 2023o)
- Presence change for Southern Bluefin Tuna from 'species or species habitat may occur within area' to 'species or species habitat known to occur within area'.

These changes have been incorporated throughout the EP and the risk assessment has been revised accordingly [Section added in response to Matters: I16 and I17].

5.1.1 Albatrosses and Petrels

Twelve albatross and two petrel species are identified as having foraging, feeding or related behaviour and/or BIAs within the area potentially affected by light emissions (Table E9-31). These BIAs cover either most or all the South-east Marine Region (CoA 2015a). It is likely these species will forage in the EMBA. In addition, the common diving-petrel breeds on Lady Julia Percy Island which is within the area potentially affected by light emissions.

Albatrosses and petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (CoA 2021). Albatross and petrel species exhibit a broad range of diets and foraging behaviours, and hence at-sea distributions are diverse. Combined with their ability to cover vast oceanic distances, all waters within Australian jurisdiction can be considered foraging habitat, however the most critical foraging habitat is those waters south of 25° where many species spend much of their foraging time (CoA 2021).

Albatrosses have a widespread distribution throughout the southern hemisphere. They feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey (ACAP 2020). Albatrosses are colonial, usually nesting on isolated islands and foraging across oceans in the winter months with most observations along the edge of the continental shelf (CoA 2021).

Petrels are oceanic and have a widespread distribution throughout the southern hemisphere. They are colonial and breed on sub-Antarctic and Antarctic islands in a circumpolar band generally between 40°S and 60°S. Petrel species feed on small fish, cephalopods (octopus, squid and cuttlefish) and crustaceans along the edge of the continental shelf and open waters (CoA 2021).

Table E9-5-1: Bird Species Biologically Important Behaviours and/or BIAs within the Area Potentially Affected by Light Emissions

Receptor	Biologically Important Behaviour
Albatross	
Antipodean Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-059)
Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-060)
Buller's Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-071)
Campbell Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-061)
Indian yellow-nosed Albatross	Species or species habitat likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-063)
Northern Buller's Albatross	Foraging, feeding or related behaviour likely to occur within area
Northern royal Albatross	Foraging, feeding or related behaviour likely to occur within area
Salvin's Albatross	Foraging, feeding or related behaviour likely to occur within area
Shy Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-066)
Southern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area
Wandering Albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-072)
White-capped Albatross	Foraging, feeding or related behaviour likely to occur within area
Petrels	

Receptor	Biologically Important Behaviour
Common Diving Petrel	Breeding known to occur within area
	Foraging, Breeding BIA (Appendix B12 MAP-REG-EPM-062)
Northern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area
Other	
Australasian Gannet	Foraging BIA (Appendix B12 MAP-REG-EPM-073)
Black-faced Cormorant	Breeding known to occur within area
Double-banded Plover	Roosting known to occur within area
Greater Crested Tern	Breeding known to occur within area
Grey-tailed Tattler	Roosting known to occur within area
Lesser Sand Plover	Roosting known to occur within area
Little Curlew	Roosting likely to occur within area
Little Penguin	Breeding known to occur within area
Marsh Sandpiper	Roosting known to occur within area
Orange-bellied Parrot	Migrating likely (Appendix B12 MAP-REG-EPM-058)
Pacific Golden Plover	Roosting known to occur within area
Pied Stilt	Roosting known to occur within area
Pin-tailed Snipe	Roosting likely to occur within area
Red-capped Plover	Roosting known to occur within area
Red-necked Avocet	Roosting known to occur within area
Red-necked Stint	Roosting known to occur within area
Ruddy Turnstone	Roosting known to occur within area
Sanderling	Roosting known to occur within area
Satin Flycatcher	Breeding known to occur within area
Sharp-tailed Sandpiper	Roosting known to occur within area
Silver Gull	Breeding known to occur within area
Short-tailed Shearwater	Breeding known to occur within area
	Foraging BIA (Appendix B12 MAP-REG-EPM-065)
Swinhoe's Snipe	Roosting likely to occur within area
Wedge-tailed Shearwater	Foraging and Breeding BIA (Appendix B12 MAP-REG-EPM-067)
Whimbrel	Roosting known to occur within area
White-bellied Sea-eagle	Breeding known to occur within area
Wood Sandpiper	Roosting known to occur within area

5.1.2 Shearwaters

The Short-tailed Shearwater was identified as breeding known to occur (Lady Julia Percy Island) and a foraging BIA to be present within the area potentially affected by light emissions (Table E9-51). The Short-tailed Shearwater migrates to the Northern hemisphere for the austral winter and generally only present in Australian waters from September to May. They are common in the South-east Marine Region and largely found on numerous islands off Victoria and Tasmania during breeding (Baker and Hamilton 2013, Skira et al. 1996). During breeding they conducts a bimodal feeding strategy, alternating short foraging trips to local waters with long foraging trips (up to 17 days) to the Polar Frontal Zone. Short trips allow greater chick provisioning at the sacrifice of body condition, which is then recovered in richer subantarctic waters. Diet includes fish particularly mycotphids, crustaceans and squid (Weimerskirch and Cherel 1998).

The Wedge-tailed Shearwater was identified as having foraging and breeding BIA within the area potentially affected by light emissions (Table E9-51). The foraging and breeding BIA is associated with Muttonbird Island, however, a review of the DCCEEW Species Profile and Threats Database (SPRAT), Atlas of Living Australia and South-east Marine Region Profile did not provide any information on the Victorian Muttonbird Island Wedge-tailed Shearwater colony. The DCCEEW SPRAT profile does not show any locations for the Wedge-tailed Shearwater in Victoria, and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of Wedge-tail Shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border.

Movement patterns of the Wedge-tailed Shearwater are poorly known but populations at the northern and southern extremities of the known range are migratory, departing nests in early April to early May and spending the nonbreeding season in the tropics (DCCEEW 2023a). In Australia, Wedge-tailed Shearwaters have been observed feeding along the junction between inshore and offshore water masses. There is no detailed analysis of the diet of Australian adult Wedge-tailed Shearwater's, however tropical residing Wedge-tailed Shearwater birds are known to mostly consume fish, some cephalopods, insects, jellyfish and prawns (DCCEEW 2023a). Food is taken by contact-dipping, dipping, surface-seizing and, rarely, deep-plunging up to 2 m deep (DCCEEW 2023a).

5.1.3 Australasian Gannet

The Australasian Gannet was identified as having foraging BIA within the area potentially affected by light emissions (Table E9-51). The BIA is a 40 km buffer around Portland where the Australasian Gannet breeds between July and March.

The Australasian Gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers (CoA 2015a).

5.1.4 Orange-bellied Parrot

The Orange-bellied Parrot was identified as migrating likely within the area potentially affected by light emissions (Table E9-51). The Orange-bellied Parrot breeds in Tasmania during summer, migrates north across Bass Strait in autumn and spends winters on the mainland. The migration route includes the west coast of Tasmania and King Island (Appendix B12 MAP-REG-EPM-058).

Birds depart the mainland for Tasmania from September to November (Green 1969). The southward migration is rapid (Stephenson 1991), so there are few migration records. The northward migration across western Bass Strait is more prolonged (Higgins & Davies 1996). The parrot's breeding habitat is restricted to south-west Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast. The species forage on the ground or in low vegetation (Loyn et al. 1986). During winter, on mainland Australia, Orange-bellied Parrots are found mostly within 3 km of the coast. In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries. The orange bellied parrot may overfly the coastal waters of the area potentially affected by light emissions, however, parrots rarely land or forage out at sea.

5.1.5 Little Penguin

The Little Penguin was identified as breeding known to occur within the area potentially affected by light emissions (Table E9-5-1). However, no breeding biologically important areas (BIAs) were identified with the area potentially affected by light emissions and the nearest breeding BIA is at King Island and is ~ 30 km from the area potentially affected by light emissions.

During consultation breeding colonies were also identified on Lady Julai Percy Island / Deen Maar, and Middle Island [Event ID 2023]. It is understood that even though these colonies do not represent breeding or foraging BIAs, they are of significant value to local communities. Breeding typically occurs from September to February. [Paragraph added in response to Matter: B02]

The Little Penguin is the smallest penguin species and is endemic to Australia and New Zealand. In Australia, the species occurs from Western Australia (Carnac Island) to New South Wales (Broughton Island) and Tasmania. The distribution is not continuous, with sections of the southern coast of Australia without occurrence of breeding colonies (CoA 2020a).

The Little Penguin breeds during the austral autumn to summer months, however, the breeding season can vary between individuals, locations and years. They are the only truly nocturnal penguin species on land and during this period, adults always arrive after dusk and leave before dawn (CoA 2020a). Following nesting the adults go out to sea to feed prior to the moulting season which occurs between December and February. During this period the feathers are not waterproof and the birds need to stay on land. At these times they are particularly vulnerable to land predators and interference. Moulting is followed by another feeding period prior to commencing breeding again. [Paragraph added in response to Matter: B02].

This species is a generalist feeder, with large variability in diet amongst colonies and even between years at the same colony. They feed mainly on clupeids, such as anchovy Engraulis austalis and sardines Sardinops sagax, when feeding chicks, but they may also feed on krill Nyctiphanes australis and several species of cephalopods at all stages of breeding (CoA 2020a).

5.1.6 Shorebirds

Twenty-two shorebirds were identified as breeding or roosting within the area potentially affected by light emissions (Table E9-5-1). These species are commonly found on coastal shores including beaches and rocky shores and either feed at low tide on worms, crustaceans and molluscs or fish species or feed on aquatic biota. Many of the wader species are migratory travelling from the Northern Hemisphere in non-breeding months. Most inhabit intertidal mudflats, rocky islets, sand beaches, mangroves, rocky coastline and coral reefs. Roosting occurs in similar habitats and species are found feeding on fish, crustaceans, aquatic insects, as well as plants and seeds (Higgins & Davies 1996).

5.2 Fish

The PMST Report identified multiple fish species or species habitat within the area potentially affected by light emissions out to 200 m. Annex 2 provides a summary of the PMST Report. None of these fish species were identified to be undertaking biologically important behaviours or have BIAs or habitat critical to the survival of the fish species within the area potentially affected by light emissions. Four threatened fish species were identified from the PMST Report and are discussed below.

The Australian Grayling is a small to medium-sized, slender, silvery fish with soft-rayed fins lacking any spines. It is endemic to south-eastern Australia, including Victoria, Tasmania and New South Wales, and is a migratory species that inhabits estuarine waters and coastal seas as larvae/juveniles, and freshwater rivers and streams as adults (Backhouse et al. 2008).

The Blue Warehou is a medium-sized, deep-bodied fish, reaching a maximum total length of 90 cm and a maximum weight of 7 kg (TSSC 2015). Globally, the Blue Warehou is confined to Australian and New Zealand waters predominantly in coastal shelf, upper continental slope and seamount waters offshore from New South Wales, Tasmania, Victoria and South Australia (TSSC 2015). Blue Warehou is a target species for the Tasmania Scalefish Fishery.

The Orange Roughy is a demersal fish targeted by the Southern and Eastern Scalefish and Shark Fishery. They are widely distributed throughout the world and forms dense spawning and feeding aggregations on or near topographic features such as seamounts, canyons and plateaus (DCCEEW 2023). No spawning or feeding aggregation areas have been identified in the area that may be affected by light emissions.

Southern Bluefin Tuna can grow to 225 cm in length and 200 kg in weight (TSSC 2010). They are a highly migratory species that occurs globally in waters between 30°S and 50°S forming on single global population (TSSC 2010). In Australian waters, they range from northern Western Australia, around the southern region of the continent, to northern New South Wales (TSSC 2010). Southern Bluefin Tuna are a target species for the Southern Bluefin Tuna Fishery.

Most of the listed marine ray-finned fish species identified in the PMST report for the area affected by light emissions are syngnathids, which includes seahorses and their relatives (sea dragon, pipehorse and pipefish). Most of these species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Fishes of Australia, 2015). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as sargassum.

5.3 Invertebrates

Studies by the Museum of Victoria found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions (Wilson and Poore 1987). This is supported by studies in the eastern part of the Operational Area undertaken by Beach Energy (2022) and Cooper Energy (2017) that found:

- In water depths from 20 – 70 m much of the seabed to ~ 60 m water depth was sand or fine gravel. No epifauna were observed and the biological component was likely to be primarily in-faunal or pelagic. Beyond 60 m water depth, this broad flat area has a sparse cover of filter-feeding epifauna dominated by sponges and also probably hydrozoans, bryozoans, and algae.
- In water depths from 70 to 104 m, samples percent cover of epifauna ranged from 0 to 80% but on average the percent cover was typically no more than 37%. Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant.

The Operational Area overlaps the Southern Squid Jig Fishery and Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Squid maximum fished area and where there has been fishing intensity during 2010 – 2020. Details on these fisheries is provided in Appendix B6: Commercial Fisheries Analysis Report. The fisheries target a single species, Gould's squid, using either hand operated or mechanically powered jigs. Squid jigging typically occurs midwater at depths between 50 and 100 m at night using large lights that illuminate the waters around a boat.

5.4 Zooplankton

The PMST Report (Appendix B5) identified that the area potentially affected by light emissions out to 20 km overlaps the Bonney Coast Upwelling Key Ecological Feature (Appendix B12 MAP-REG-EPM-003) which is a seasonal upwelling that brings cold nutrient rich water to the sea surface and supports regionally high productivity. Krill and potentially other zooplankton productivity are a key feature of the upwelling providing a food source for several threatened species, including the blue whale, migrate into the area to forage (CoA 2015a).

Zooplankton is likely to be present throughout the Operational Area as in all marine environments.

5.5 Turtles

The PMST Report identified three turtle species within the area potentially affected by light emissions, green, leatherback and loggerhead turtle. Annex 2 provides a summary of the PMST Report. No BIAs or habitat critical to the survival of the species were identified.

The PMST Report identifies leatherback and loggerhead turtles breeding likely to occur within the area potentially affected by light emissions. However, this is not supported by other information sources:

- South-east Marine Region Profile (DSEWPaC 2012): The region is an important feeding area for the leatherback turtle which is a pelagic feeder that is regularly found in the high latitudes of all oceans. No major nesting has been recorded in Australia, but the species is regularly seen and known to forage in the waters of the South-east Marine Region. Loggerhead turtle species or species habitat known to occur with South-east Marine Region.
- Recovery Plan for Marine Turtles in Australia (DoEE 2017): Does not identify breeding grounds for leatherback or loggerhead turtles in Victoria or waters off Victoria.
- Species Profile and Threats Database: Details that loggerhead turtles show fidelity to both their feeding and breeding areas but does not identify any breeding area in Victoria or waters off Victoria.

- Species Profile and Threats Database: Details that leatherback turtles are regularly found in waters offshore from Victoria with feeding recorded in the coastal waters of all Australian States, however no breeding or nesting sites are detailed in Victoria.

Green turtles' nest, forage and migrate across tropical northern Australia. Green turtles spend their first 5-10 years drifting on ocean currents. Green turtles are predominantly found in Australian waters off the Northern Territory, Queensland, and Western Australian coastlines, with limited numbers in NSW, Victoria and South Australia (DoEE 2017).

Small numbers of leatherback turtles' nest on the Cobourg Peninsula (NT) and there are unconfirmed accounts of leatherback turtles nesting in Western Australia. Leatherback turtles are more commonly found foraging in Australian waters along the east coast and in Bass Strait. The southern waters of Australia are one of five identified foraging sites (where area restricted behaviour occurs) for Leatherback turtles (DoEE 2017).

There are two genetically distinct stocks of loggerhead turtles nesting in Australia, one in Queensland (known as the south-west Pacific stock) and one in Western Australia. Loggerhead turtles forage in all coastal states and the Northern Territory, but are uncommon in South Australia, Victoria and Tasmania (DoEE 2017).

6 Predicted Levels of Impact

Ambient light is defined as the light that is already present within an environment. Any additional emission of light will result in a change in the ambient light. Natural ambient light sources offshore are dominated by solar and lunar luminescence but can also include bioluminescence emission from some marine organisms and incandescence emissions from electromagnetic radiation expressed as lighting.

The primary sources of artificial lighting in the offshore marine environment during the Regia MSS will result from the deck and navigational lights onboard the survey vessels. Deck areas need to be lit at all times for personnel safety, with deck lighting typically consisting of bright white lights focused on working areas. Spot lighting may be required for in-sea inspection, deployment, and retrieval of survey equipment. Navigational lights are typically elevated on the vessel, outwards facing, and of lesser intensity than deck lighting.

The impacts of the changes in ambient light from the vessel are discussed below.

6.1 Change in Fauna Behaviour

For the light impact assessment, the process outlined in the National Light Pollution Guidelines for Wildlife (CoA 2020) is used. The aim of the guidelines is that artificial light will be managed so wildlife is:

1. Not disrupted within, nor displaced from, important habitat.
2. Able to undertake critical behaviours such as foraging, reproduction and dispersal.

6.1.1 Birds

Twelve albatross and two petrel species are identified as having foraging, feeding or related behaviour and/or BIAs within the area potentially affected by light emissions (Table E9-5-1). These BIAs cover either most or all the South-east Marine Region (CoA 2015a). It is likely these species will forage in the EMBA. In addition, the common diving-petrel breeds on Lady Julia Percy Island which is within the area potentially affected by light emissions.

The National Recovery Plan for Albatrosses and Petrels (CoA 2022) identifies that seabirds are at risk of disorientation at night from artificial light sources and that seabird interactions have been reported across the marine infrastructure sectors including vessels. The paper cited (Black 2005) detailed that the species involved in the incidents were consistently small burrow nesting petrels with events occurring in conditions of reduced visibility and in the vicinity of major burrowing petrel breeding sites. The use of ice-lights or other deck lighting was a key factor in all three incidents recorded.

No breeding sites for albatrosses or petrels are present within the area potentially affected by light emissions.

Albatrosses forage most actively during daylight and are less active at night because their ability to see and capture prey from the air is reduced (Phalan et al. 2007). Petrels seem more likely to forage during both that day and night (Brooke (2004) cited on Animal Diversity Web (2020), DCCEEW 2023a).

Though the National Recovery Plan for Albatrosses and Petrels (CoA 2022) identifies marine lighting as a threat to albatrosses and petrels it does not provide a risk category as the number of species affected in or outside Australian jurisdiction as nil.

Two shearwater species were identified within the area potentially affected by light emissions. The Wedge-tailed Shearwater was not identified in the PMST Report for the area potentially affected by light emissions (Appendix B5) though a foraging BIA and a breeding BIA were. The foraging and breeding BIAs are a buffer around Muttonbird Island, Victoria but there is not data to support that this species breeds on the Victorian Mutton Island but there is data to support that they breed on Mutton Island in NSW. This species is listed as marine and migratory and does not have a recovery plan or conservation advice. Light has not been identified as a threat to this species in the SPRAT profile (DCCEEW 2023a) or the Wildlife Conservation Plan for Seabirds (CoA 2020a).

The Short-tailed Shearwater breeds on Lady Julia Percy Island which is within the area potentially affected by light emissions. This species is listed as marine and migratory and does not have a recovery plan or conservation advice. The Wildlife Conservation Plan for Seabirds (CoA 2020a) details that light pollution represents a potential threat to this species in parts of the range. A number much higher than anticipated, of (predominantly juvenile) shearwaters were found dead or injured as a result of being attracted to lights and grounded over a 15-year period of patrols on Phillip Island, Victoria (1999-2013).

During consultation breeding colonies of Little Penguin were also identified on Lady Julia Percy Island / Deen Maar, and Middle Island [Event ID 2023]. Breeding typically occurs from September to February. Studies suggest that penguins were habituated to artificial lights and were unaffected by low level (15 lux) increase in artificial illumination (Rodriguez et al. 2016). [Paragraph added in response to Matter: B02]

The Orange-bellied Parrot migration route overlaps the area potentially affected by light emissions. The Orange-bellied Parrot is classed as critically endangered and there are about 50 remaining in the wild (DELWP 2016a). Survey activities may overlap the period when Orange-bellied Parrot migrates between Tasmania and Victoria between late February to early April (Australian Museum 2020). The Orange-bellied Parrot Recovery Plan identifies illuminated structures and illuminated boats as a potential barrier to migration and movement (DELWP 2016).

Of the other bird species identified from the PMST Report (Appendix B5) that may occur within the area potentially affected by light emissions, the following had conservation advice that identified that disturbance can result from night lighting or that light pollution has indirect impacts on habitat critical to survival; Bar-tailed Godwit (western Alaskan) (DCCEEW 2024b), Common Greenshank (DCCEEW 2024e), Curlew Sandpiper (DCCEEW 2023m), Far Eastern Curlew (DCCEEW 2023n),Greater Sand Plover (DCCEEW 2023o) Latham's Snipe (DCCEEW 2024d), Lesser Sand Plover (TSSC 2016), Ruddy Turnstone (DCCEEW 2024c) and Sharp-tailed Sandpiper (DCCEEW 2024a). These species are migratory wetland species.

The predicted effect level to birds from light emissions is assessed as minor (some affect but not considered significant or long lasting, no overall threat to populations) based on:

- The presence of birds within the area potentially affected by light emissions is expected to be representative of their wide distribution in southern Australian waters during the survey period.
- The increase in light level intersecting the coastline at Warrnambool, Middle Island and Lady Julia Percy Island would be comparable to that associated with light emissions from typical marine traffic and short-duration, minor changes in ambient light in these locations is unlikely to cause behavioural changes or result in injury/mortality to the Little Penguin. [Paragraph added in response to Matter: B02]
- As the area potentially affected by light emissions overlaps a number of foraging and breeding BIAs, the migratory route for the critically endangered, Orange-bellied Parrot and areas where birds are likely or known to be foraging, breeding or roosting all vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines.
- As all survey vessels will have a Vessel Lighting Management Plan (M#05) such that effects to birds from light emissions are predicted to be temporary and not result in significant or lasting effects.

The uncertainty level for impact to birds from light emissions is assessed as low based on:

- Peer review literature and studies have been used to inform the impact assessment.
- A conservative 20 km area has been used for assessment of impacts for birds as recommended by the National Light Pollution Guidelines for Wildlife (CoA 2023) which details that the 20 km is a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km and fledgling seabirds grounded in response to artificial light 15 km away.

- The 20 km area has been used for assessment of impacts for birds does not consider that survey vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions, thus the area of potential impact will be significantly less than 20 km.
- The impact assessment has been undertaken as per the National Light Pollution Guidelines for Wildlife (CoA 2023).
- Mitigation and management measures recommended by the National Light Pollution Guidelines for Wildlife (CoA 2023) relevant to vessels have been assessed and all survey vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low. For birds the predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels.

6.1.2 Fish, Invertebrates and Zooplankton

Normal working lights on marine research vessels—and, by implication, lights from other sources including fishing boats, cargo vessels, recreational watercraft, jetties and oil and gas platforms—have been shown to cause zooplankton and their vertebrate predators to descend away from the surface; these effects occurred at depths of up to 200 m, and up to 200 m horizontally from the light source (Berge et al. 2020 in DCCEEW 2022). Since most zooplankton need to ascend to forage on phytoplankton near the water's surface, light pollution may lead to an overall reduction in zooplankton, with cascading effects on their predators, and so on up the food chain (DCCEEW 2022).

Phototactic behaviour (the attraction to artificial light) has been observed both in fish and squids with some species known to have a positive phototaxis by moving towards and aggregating in the illuminated zone of artificial lights (Ibrahim and Hajisamae 1999). Hence fishing with artificial lights (surface light) is one of the most advanced and successful methods to increase the catch rate of squid and pelagic fish (Nguyen and Winger 2019).

Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al., 2001), with traps drawing catches from up to 90 m (Milicich et al., 1992). Lindquist et al (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

The predicted effect level to fish, invertebrates and zooplankton from light emissions is assessed as minor (some affect but not considered significant or long lasting, no overall threat to populations) based on:

- There are no biologically important areas or habitat critical to the survival of fish or invertebrate species within or adjacent to the area potentially affected by light emissions.
- For threatened or listed fish species identified in the PMST Report, none of the recovery plans, conservation advice or conservation listings identified light emissions as a threat.
- No fish spawning or aggregation areas were identified within the area potentially affected by light emissions.
- The presence of fish and invertebrates within the area potentially affected by light emissions is expected to be representative of their wide distribution in southern Australian waters during the survey period.
- The area potentially affected by light emissions relevant to zooplankton, invertebrates, and fish (200 m) overlaps a small portion of the Bonney Coast Upwelling Key Ecological Feature

which during November to April results in increased productivity, consisting of krill and other zooplankton, within the area. Thus, all vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines. This will ensure that krill and other zooplankton associated with the Bonney Coast Upwelling Key Ecological Feature are not affected by light emissions associated with the survey vessels.

- Several threatened species including the blue whale migrate into the Operational Area and area that may be affect by light, to forage. As the Regia MSS may occur during the November to April when foraging typically occurs, all vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines. This will ensure that krill and other zooplankton are not affected by light emissions associated with the survey vessels.
- As all survey vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions, light emissions will be significantly less and not aimed into the water as per squid fishing vessels, thus attraction of squid to the moving survey vessels is unlikely.
- Effects to fish, invertebrates and zooplankton that may be present in the area potentially affected by light emissions are predicted to be temporary and not result in lasting effects.

The uncertainty level for impact to fish, invertebrates and zooplankton from light emissions is assessed as low based on:

- Peer review literature and studies have been used to inform the impact assessment.
- The impact assessment has been undertaken as per the National Light Pollution Guidelines for Wildlife (CoA 2023).
- Mitigation and management measures recommended by the National Light Pollution Guidelines for Wildlife (CoA 2023) relevant to vessels have been assessed and all survey vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low. For fish the predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels.

6.1.3 Turtles

Light pollution is identified as a high-risk threat in the Recovery Plan for Marine Turtles in Australia (DoEE 2017) with the action of: *Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.*

No habitat critical to the survival of marine turtles or biologically important areas have been identified within or adjacent to the area potentially affected by light emissions, from the Recovery Plan for Marine Turtles in Australia (DoEE 2017) or PMST Report (Appendix B5).

The PMST Report (Appendix B5) identifies leatherback and loggerhead turtles breeding likely to occur within the area potentially affected by light emissions. However, as detailed in the Section 5.5 this is not supported by other information sources. Thus, it is likely that the three marine turtle species identified in the PMST Report (green, leatherback and loggerhead) may be present within the area potentially affected by light emissions and may undertake critical behaviours such as foraging but it is unlikely that they are undertaking breeding.

As there are no habitat critical to the survival of marine turtles within or adjacent to the area potentially affected by light emissions, thus displacement of turtles by artificial light from these areas is not predicted.

Marine turtles use light as an orientation cue, and therefore artificial light has the potential to inhibit nesting by adult females and disrupt the orientation and sea-finding behaviour of hatchlings (CoA 2023; DoEE 2017). The general guidance is that turtles require naturally illuminated beaches for successful nesting and sea-finding behaviour (DoEE 2017a; Limpus et al. 2015; Robertson et al. 2016).

Artificial lighting may adversely affect hatchling sea-finding behaviour in two ways: disorientation – where hatchlings crawl on circuitous paths; or misorientation – where they move in the wrong direction, possibly attracted to artificial lights (CoA 2023). Hatchlings have been observed to respond to artificial light up to 18 km away during sea finding (CoA 2023).

No nesting beaches are present within the area potentially affected by light emissions so disruption to turtle nesting, hatchling orientation, sea-finding and dispersal behaviour is not predicted.

The predicted effect level to marine turtles from light emissions is minor (some affect but not considered significant or long lasting, no overall threat to populations) based on:

- There is no habitat critical to the survival of marine turtles within or adjacent to the area potentially affected by light emissions, thus displacement of turtles by artificial light from these areas is not predicted.
- No nesting beaches are present within the area potentially affected by light emissions so disruption to turtle nesting, hatchling orientation, sea-finding and dispersal behaviour is not predicted.
- The Recovery Plan for Marine Turtles in Australia (DoEE 2017) identifies light pollution as a threat to nesting turtles and hatchlings. Light emissions have not been identified as a threat to turtles away from nesting beaches (i.e. there is no inhibition of orientation cues noted in open waters). There are no nesting beaches within the area potentially affected by light emissions.
- The area potentially affected by light emissions does not represent key foraging, breeding, migration, or aggregation areas for marine turtles; and marine turtle presence is expected to be representative of their wide distribution in southern Australian waters during the survey period.
- Changes to biologically important behaviours (such as nesting, hatchling orientation, sea-finding and dispersal behaviour) for marine turtles is not predicted.
- Effects to turtles that may be present in the area potentially affected by light emissions are predicted to be minor or insignificant and are unlikely to result in lasting effects.

The uncertainty level for impact to turtles from light emissions is assessed as low based on:

- There are long-term tagging studies of sea turtles in Australia, and there are no nesting habitats are BIAs identified within or adjacent to the area that may be affected by may be affected by light emissions.
- The Recovery Plan for Marine Turtles in Australia (DoEE 2017) identifies light pollution as a threat to nesting turtles and hatchlings. Light emissions have not been identified as a threat to turtles away from nesting beaches (i.e. there is no inhibition of orientation cues noted in open waters). There are no nesting beaches within the area potentially affected by light emissions.
- Peer review literature and studies have been used to inform the impact assessment.
- The impact assessment has been undertaken as per the National Light Pollution Guidelines for Wildlife (CoA 2023).
- Mitigation and management measures recommended by the National Light Pollution Guidelines for Wildlife (CoA 2023) relevant to vessels have been assessed and all survey vessels will have a Vessel Lighting Management Plan (M#05) to minimise external light emissions as required by the National Light Pollution Guidelines.

The predicted level of impact based on the effect (minor) and uncertainty (low) is assessed as low. For turtles the predicted levels of impact are clearly below the pre-defined acceptable levels of impact and the mitigation and management measures in place provide sufficient confidence in the predicted effect levels.

7 Comparison of Predicted Level of Impact with Defined Acceptable Levels

Defined Acceptable Level		Predicted Level of Impact	Predicted Level of Impact Below Defined Acceptable level?
Category	**Level**		
Principles of ESD	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.	Predicted impacts are temporary, reversible, small-scale, and light emissions will be reduced to minimum levels for safe operations and navigation.	Yes
	The impact and risk assessment process is based on sufficient information to understand if: Serious/irreversible environmental damage is predicted; or The application of the precautionary principle is applied in the presence of scientific uncertainty.	Available literature and government management plans, recovery plans and conservation advice were used to inform the impact assessment. Serious or irreversible environmental damage is not predicted from light emissions. There is high confidence in the prediction of impacts to light sensitive receptors.	Yes
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.	Management of the activity is consistent with EPBC Act Management Plans and Recovery Plans as detailed in Annex 1.	Yes
Biological	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.	Predicted impacts to biological receptors (fish, invertebrates, birds, turtles) are temporary, reversible, small-scale, and light emissions will be reduced to minimum levels for safe operations and navigation.	Yes
Ecological	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.	Predicted impacts to ecological receptors (zooplankton) are temporary, reversible, small-scale, and light emissions will be reduced to minimum levels for safe operations and navigation.	Yes
Economic	Affected persons will not be worse off as a result of the activity.	Predicted impacts to economic receptors (squid) are temporary, reversible, small-scale, and light emissions will be reduced to minimum levels for safe operations and navigation, thus commercial squid fishers will not be worse off as a result of the activity.	Yes
Cultural	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.	Light emissions are not predicted to impact cultural receptors.	Yes

Defined Acceptable Level		**Predicted Level of Impact**	**Predicted Level of Impact Below Defined Acceptable level?**
Category	**Level**		
Company	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.	All reasonably practicable measures have been adopted to reduce environmental impacts as detailed in the following section.	Yes
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact or risk the effect/consequence rating is medium or below.	The predicted effect level is minor.	Yes
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.	The adopted measures will be implemented and monitored as detailed in the implementation strategy to ensure they are effective in managing the impact.	Yes
Social	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	To date no objections or claims in relation to light emissions have been made by relevant persons. A relevant person raised that they bird watch for pelagic and shorebirds along the southwest coast of Victoria and are concerned about their welfare in relation to the Regia MSS. The impact assessment undertaken identified several pelagic and shorebird species, including BIAs, that occur within the area potentially affected by light. Some of the species identified are threatened or migratory species with a subset of species identified as undertaking biologically important behaviour such as breeding and/or foraging/feeding. As such M#05 CGG Marine Assurance System will ensure that vessels implement a Vessel Lighting Management Plan to ensure light emissions do not impact on pelagic and shorebirds. Thus, impacts to bird watching for pelagic and shorebirds along the southwest coast of Victoria is not predicted to be affected.	Yes
	The views of public have been considered in the impact and risk assessment.	To date there has been no views from the public in relation to the activity's light emissions.	Yes

8 Identification of Mitigation and Management Measures and Demonstration of ALARP

Measures adopted to ensure environmental impacts will be of an acceptable level and ALARP.

Measure	Justification	Adopted
M#05: CGG Marine Assurance System	Vessel will adhere to the requirements of the International Regulations for Preventing Collisions as Sea 1972 (COLREGS) and Chapter 5 of Safety of Life at Sea (SOLAS) as implemented in Commonwealth Waters through the Navigation Act 2012 and associated Marine Orders 21 Safety and Emergency Arrangements, 30 Prevention of Collisions and 31 SOLAS and non-SOLAS certification including: Appropriate lighting, navigation, and communication to inform other users. Use of radar and 24/7 watch. It is a legislative requirement for vessels to comply with the Navigation Act and Marine Orders. The CGG Marine Assurance System ensure compliance of contract vessels with Navigation Act, MARPOL, COLREGS and Marine Orders.	Yes
	Contracted vessels are required to have a Vessel Lighting Management Plan to minimise light emissions while meeting vessel navigational light requirements. Best practice lighting management will reduce light emissions and ensure lighting is managed in line with relevant guidance outlined in the National Light Pollution Guidelines (CoA 2023). For all survey vessels, the following will be implemented where it does not contravene vessel lighting requirement for safe navigation: Non-essential lights switched off when not in use. Window blinds closed at night. Shield lights and contain light spill on the deck unless required for safe operations. Use of suitable light types recommended in the National Light Pollution Guidelines. The Lighting Management Plan will also cover the process for: Handling of birds. Releasing of birds. Reporting to DCCEEW in the case of protected species. Vessel Lighting Management Plans are good industry practice where activities overlap areas where light sensitive receptors are undertaking biologically important behaviours or BIAs are present. The environmental benefit outweighs the additional cost.	Yes

Measures assessed and not adopted.

Measure	Justification	Adopted
Seasonal timing of the survey	Avoiding periods when light sensitive receptors may be present would have a disproportionate cost without a significant environmental benefit. Avoiding periods when light sensitive receptors may be present can result in the survey being undertaken in multiple phases over a longer duration. This increase in time results in increased environmental impacts and risks, and an increase in costs without a significant reduction in the potential effect level as the implementation of a Vessel Lighting Management Plan (M#05) will ensure that impacts from light emission are managed so the fauna can continue to undertake biologically important behaviours without being disturbed.	No

Measure	Justification	Adopted
Surveys only undertaken during daylight hours	Undertaking the survey only in daylight hours would have a disproportionate cost without a significant environmental benefit. Undertaking the survey only in daylight hours would at best double the time taken to compete the survey. This increase in time results in increased environmental and risks and a doubling in costs without a significant reduction in the potential effect level as the vessels would still be required to have lighting to meet navigational and safety requirements.	No

9 Conclusions

The conclusion of the effects of light emissions to birds, fish, invertebrates, zooplankton, and turtles is summarised in the table below.

Invertebrates	Predicted Level of Effect	Uncertainty	Predicted Level of Impact
Birds	Minor	Low	Low
Fish, Invertebrates, Zooplankton	Minor	Low	Low
Turtles	Minor	Low	Low

10 Recommendations

As demonstrated in this impact assessment the predicted level of impact level is low for all light sensitive fauna and are clearly below the pre-defined acceptable levels of impact, good industry practice (including legislation and standards) has been applied. Therefore, these impacts are of an acceptable level without further recommendations being required, therefore there are no further recommendations.

11 Document Control

Date	Revision	Update
6 June 2023	A	Draft prepared for initial comment
20 August 2023	B	Update based on comments and relevant person feedback
11 Sept 2023	0	Approved for release on Regia MSS website
20 Dec 2023	1	EP submission to NOPSEMA

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Annex 1: Legislative and other requirements

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Navigation Act 2012 and associated Marine Order 30: Prevention of collisions	Australian implementation of the International Regulations for Preventing Collisions at Sea. It details the performance requirements for navigation lights and navigation shapes.	Navigation lighting on vessels is required to meet the requirements of the Navigation Act 2012 and associated Marine order 30: Prevention of collisions.	This requirement is met by the implementation of M#05 CGG Marine Assurance System which ensures compliance of contract vessels with Navigation Act and marine orders.
National Light Pollution Guidelines for Wildlife (CoA 2023)	The guidelines outline the process to be followed where there is the potential for artificial lighting to affect wildlife. They apply to new projects, lighting upgrades (retrofitting) and where there is evidence of wildlife being affected by existing artificial light.	The aim of the Guidelines is that artificial light will be managed so wildlife is: Not disrupted within, nor displaced from, important habitat; and Able to undertake critical behaviours such as foraging, reproduction and dispersal. The Guidelines recommend: Always using Best Practice Lighting Design to reduce light pollution and minimise the effect on wildlife. Undertaking an Environmental Impact Assessment for effects of artificial light on listed species for which artificial light has been demonstrated to affect behaviour, survivorship or reproduction. Minimizing effects of intermittent mobile light sources, such as vehicle headlights and vessel deck lights. Avoid lighting above or spilling onto water bodies (including from vessels).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan. Based on the impact assessment undertaken and the requirement for vessels to have a Light Management Plan to ensure lighting is managed in line with the guidance outlined in the guidelines, light emissions will be reduced to a level where wildlife will not be disrupted within, nor displaced from, important habitat; and will be able to undertake critical behaviours such as foraging, reproduction and dispersal.
Birds			

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Wildlife Conservation Plan for Seabirds (CoA 2020a)	The plan aims to provide a national framework for the research and management of listed marine and migratory seabirds and to outline national activities to support the conservation of listed seabirds in Australia and beyond. Threatened species are not covered by the plan and receive separate, approved conservation advice and, in some cases, a recovery plan which sets out what should be done to stop the decline and support the recovery of the species.	Light pollution is identified as a threat in the conservation plan with the following actions relevant to light: Manage the effects of anthropogenic disturbance to seabird breeding and roosting areas. Ensure all areas of important habitat for seabirds are considered appropriately and consistently in the development assessment process.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan. Based on the impact assessment undertaken and the requirement for vessels to have a Light Management Plan, light emissions will be reduced to a level where disturbance to seabird breeding and roosting areas is not predicted.
Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)	The plan provides a framework to guide the conservation of migratory shorebirds and their habitat in Australia and, in recognition of their migratory habits, outlines national activities to support their appreciation and conservation throughout the East Asian-Australasian Flyway (EAAF).	The conservation plan identifies artificial lighting as a threat with the following actions relevant to light: Ensure all areas important to migratory shorebirds in Australia continue to be considered in development assessment processes. The conservation plan refers to the EPBC Act Policy Statement 3.21 Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act Listed Migratory Shorebird Species (CoA 2017).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emission do not impact migratory shorebirds.

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
EPBC Act Policy Statement 3.21—Industry Guidelines for Avoiding, Assessing and Mitigating Impacts on EPBC Act Listed Migratory Shorebird Species (CoA 2017)	The purpose of this policy statement is to assist proponents in avoiding, assessing, and mitigating significant impacts on migratory shorebirds listed under the EPBC Act. This policy statement is a key action under the Wildlife Conservation Plan for Migratory Shorebirds.	Thresholds of significance impacts on migratory shorebirds relevant to light are: Increased disturbance leading to a substantial reduction in migratory shorebird numbers. The guidelines details that defining substantial reduction is made on a case-by-case basis. Factors to consider include: The number of migratory shorebirds historically using an area (based on surveys and historical data). Likely resultant changes in bird numbers and species diversity. Alterations to the value, quality, geographic extent of the area (for example, will the area still be classed as important habitat). The function and role of the area (roosting, foraging) and likely changes in ecology and hydrology. The regional and local context of the area. The nature, extent, duration and timing of impacts.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where disturbance leading to a substantial reduction in migratory shorebird numbers is not predicted.
National Recovery Plan for Albatrosses and Petrels (CoA 2022)	The recovery plan provides a national strategy to guide the activities of government, industry, research organisations, and other stakeholders in the protection, conservation and management of listed threatened albatross and petrel species. The plan replaces the previous plan adopted in 2011.	Artificial light is identified as a threat in the recovery plan. No actions specific to light are identified but the following are relevant.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of albatrosses and petrels are not predicted.
Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice *Botaurus poiciloptilus* Australasian Bittern (TSSC 2019a)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the long-term viability of the species, and the parties that will undertake those actions.	The recovery plan does not identify light as a threat.	NA
Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (DSEWPaC 2013)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (CoA 2022a)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in the wild, and the parties that will undertake those actions.	The recovery plan does not identify light as a threat.	NA
Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Sharp-tailed Sandpiper are not predicted.
Conservation Advice for *Limosa lapponica baueri* Bar-tailed Godwit (western Alaskan) (DCCEEW 2024b)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice details that disturbance can result from night lighting.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Bar-tailed Godwit (western Alaskan) are not predicted.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Commonwealth Listing Advice on Black-browed Albatross (*Thalassarche melanopris*) (TSSC 2005)	Eligible for listing as vulnerable under the EPBC Act.	Listing advice does not identify light as a threat.	NA
Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Common Greenshank are not predicted.
Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice for *Gallinago hardwickii* (Latham's Snipe) (DCCEEW 2024d)	Conservation advice guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Latham's Snipe are not predicted.
Conservation Advice *Halobaena caerulea* Blue Petrel (TSS 2015)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice for *Calidris ferruginea* Curlew Sandpiper (DCCEEW 2023m)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Latham's Snipe are not predicted.

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Ruddy Turnstone are not predicted.
Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPaC 2011)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Ruddy Turnstone are not predicted.
Commonwealth Listing Advice on *Ardenna carneipes* (Flesh-footed Shearwater) (TSSC 2014).	Assessed as ineligible for listing.	Listing advice does not identify light as a threat.	NA
Conservation Advice for *Callocephalon fimbriatum* (Gang-gang Cockatoo) (DAWE 2022)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan (DEC NSW 2006)	Constitutes the formal Commonwealth and New South Wales recovery plan for Gould's Petrel. It identifies the actions to be taken to ensure the long-term viability of the Gould's Petrel in nature and the parties who will carry these out.	The recovery plan does not identify light as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover) (DCCEEW 2023o)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Ruddy Turnstone are not predicted.
Approved Conservation Advice for *Thalassarche chrysostoma* (Grey-headed Albatross) (DEWHA 2009)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice *Falco hypoleucos* Grey Falcon (TSSC 2020a)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice *Thinornis rubricollis rubricollis* Hooded Plover (eastern) (DoE 2014)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice *Charadrius mongolus* Lesser Sand Plover (TSSC 2016)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice details that disturbance can result from night lighting.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Lesser Sand Plover are not predicted.
Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (western Pacific)) (TSSC 2002)	Advice is that it is ineligible for listing as conservation dependent.	Listing advice does not identify light as a threat.	NA
Commonwealth Listing Advice on *Macronectes halli* (Northern Giant-Petrel) (TSSC 2001)	Assessed as ineligible for listing.	Listing advice does not identify light as a threat.	NA

Requirement	**Description of the Requirement**	**Relevance to Environmental Management**	**Demonstration of How the Requirement will be Met**
Commonwealth Listing Advice on *Neophema chrysogaster* Orange-bellied Parrot (TSSC 2006)	TSSC recommends that the list referred to in section 178 of the EPBC Act be amended by transferring from the endangered category to the critically endangered category.	The listing details that birds colliding with structures or becoming disorientated during migration by lights, such as those on squid fishing boats in Bass Strait, may sometimes result in mortality, although further work is required to determine whether or not these processes are threatening Orange-bellied Parrots. While it is reasonable to speculate that there is some threat caused by collision with structures and disorientation caused by artificial lights during migration, the level of threat is not likely to be as great as that of the key ongoing threats.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Orange-bellied Parrot are not predicted.
National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)	The recovery plan outlines the long-term strategy, and short-term objectives and actions, for the recovery of the Orange-bellied Parrot.	The recovery plan identified illuminated boats as a threat to migration and movement. Relevant actions are: Assess the risk from barriers on the migration route. Manage threat if the risk rating warrants action.	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan. Based on the impact assessment undertaken and the requirement for vessels to have a Light Management Plan to ensure light emissions will be reduced to a level where impacts to the migration of the Orange-bellied Parrot are not predicted.
Conservation Advice *Grantiella picta* Painted Honeyeater (DoE 2015b)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
National Recovery Plan for the Painted Honeyeater (*Grantiella picta*). (DAWE 2021)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in nature, and the responsible agencies that will undertake those actions.	The recovery plan does not identify light as a threat.	NA
Conservation Advice *Pedionomus torquatus* Plains-wanderer (DoE 2015a)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*) (DoE and SA DEWNR 2016)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species long-term viability in nature, and the parties that will undertake those actions.	The recovery plan does not identify light as a threat.	NA
Conservation Advice *Calidris canutus* Red Knot (DCCEEW 2024)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat, however does recommend that actions that have indirect impacts on habitat critical to the survival should be minimised (i.e., human disturbance or light pollution impacting habitat).	This requirement is met by this impact assessment and the implementation of M#05 CGG Marine Assurance System which will ensure that all vessels have and implement a Vessel Lighting Management Plan to ensure light emissions will be reduced to a level where impacts to the recovery of Red Knot are not predicted.
Conservation Advice *Anthochaera Phrygia* Regent Honeyeater (DoE 2015)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE 2016)	The plan considers the conservation requirements of the species across its range and identifies the actions that need to be taken to improve the species' long-term viability in nature.	The recovery plan does not identify light as a threat.	NA
Conservation Advice *Thalassarche cauta* Shy Albatross (TSS 2020)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Conservation Advice *Pterodroma mollis* Soft-plumaged Petrel (TSS 2015a)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Commonwealth Listing Advice on *Macronectes giganteus* (Southern Giant-Petrel) (TSSC 2001a)	Recommends that the species be listed as Endangered under the EPBC Act	Listing advice does not identify light as a threat.	NA

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Conservation Advice *Lathamus discolor* Swift Parrot (TSSC 2016a)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros 2011)	The plan considers the conservation requirements of the species across its range, identifies the actions to be taken to ensure its long-term viability in nature and the parties who will undertake these actions.	The recovery plan does not identify light as a threat.	NA
Conservation Advice *Hirundapus caudacutus* White-throated Needletail (TSSC 2019)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Fish			
Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA
Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015)	Recommends that the species be listed in the conservation dependent category under the EPBC Act.	Listing advice does not identify light as a threat.	NA
Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna) (TSSC 2010)	Recommends listing as conservation dependent.	Listing advice does not identify light as a threat.	NA
Turtles			
Recovery Plan for Marine Turtles (DoEE 2017)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles to improve so that they can be removed from the EPBC Act threatened species list.	Light pollution is identified as a threat in the recovery plan with the action of: Artificial light within or adjacent to habitat critical to the survival of marine turtles will be managed such that marine turtles are not displaced from these habitats.	No habitat critical to the survival of marine turtles are within or adjacent to the area that may be affected by light emissions.

Requirement	Description of the Requirement	Relevance to Environmental Management	Demonstration of How the Requirement will be Met
Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*)* *(*DEWHA 2008)	Conservation advices guide recovery planning and identify actions required for conservation and recovery of the threatened species or ecological community.	Conservation advice does not identify light as a threat.	NA

Annex 2: Light Sensitive Species

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Fish							
Australian Grayling	Species or species habitat may occur within area	Vulnerable				None identified	Conservation Advice *Prototroctes maraena* Australian Grayling (TSSC 2021)
Blue Warehou	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice *Seriolella brama* Blue Warehou (TSSC 2015)
Orange Roughy, Deep-sea Perch, Red Roughy	Species or species habitat likely to occur within area	Conservation Dependent				None identified	None identified
Southern Bluefin Tuna	Species or species habitat known to occur within area	Conservation Dependent				None identified	Commonwealth Listing Advice on *Thunnus maccoyii* (Southern Bluefin Tuna) (TSSC 2010)
Australian Smooth Pipefish, Smooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Brushtail Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Common Seadragon, Weedy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Deepbody Pipefish, Deep-bodied Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Hairy Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Halfbanded Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Javelin Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Knifesnout Pipefish, Knife-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Leafy Seadragon	Species or species habitat may occur within area				Listed	None identified	None identified
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Mother-of-pearl Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Port Phillip Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Pugnose Pipefish, Pug-nosed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Red Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Ringback Pipefish, Ring-backed Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Robust Pipehorse, Robust Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Sawtooth Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Short-head Seahorse, Short-snouted Seahorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spiny Pipehorse, Australian Spiny Pipehorse	Species or species habitat may occur within area				Listed	None identified	None identified
Spotted Pipefish, Gulf Pipefish, Peacock Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Tucker's Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	Species or species habitat may occur within area				Listed	None identified	None identified
Seabird							
Antipodean Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Australasian Gannet					Listed	Foraging: year round 40 km buffer around coast off Portland	None identified
Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on Black-browed Albatross (Thalassarche melanopris) (TSSC 2005)
Blue Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice Halobaena caerulea Blue Petrel (TSS 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Campbell Albatross, Campbell Black-browed Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Common Diving-Petrel	Breeding known to occur within area				Listed	Foraging: year round Breeding: July – January Buffer around Tasmania and Victoria	None identified
Fairy Prion	Species or species habitat known to occur within area				Listed	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Flesh-footed Shearwater, Fleshy-footed Shearwater	Species or species habitat known to occur within area		Migratory	Migratory Marine Birds	Listed (as Puffinus carneipes)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Commonwealth Listing Advice on Ardenna carneipes (Flesh-footed Shearwater) (TSSC 2014)
Gould's Petrel, Australian Gould's Petrel	Species or species habitat may occur within area	Endangered				None identified	Gould's Petrel (Pterodroma leucoptera leucoptera) Recovery Plan (DEC NSW 2006)
Greater Crested Tern	Breeding known to occur within area		Migratory	Migratory Wetlands Species	Listed (as Sterna bergii)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Grey-headed Albatross	Species or species habitat may occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Approved Conservation Advice for Thalassarche chrysostoma (Grey-headed Albatross) (DEWHA 2009)
Little Penguin	Breeding known to occur within area				Listed	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a)
Indian Yellow-nosed Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	Foraging Most of the South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Northern Buller's Albatross, Pacific Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable			Listed (as Thalassarche sp. nov.)	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Northern Giant Petrel	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Commonwealth Listing Advice on Macronectes halli (Northern Giant-Petrel) (TSSC 2001)
Northern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Salvin's Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Short-tailed Shearwater	Breeding known to occur within area		Migratory	Migratory Marine Birds	Listed (as Puffinus tenuirostris)	Foraging Buffer around Tasmania including Bass Strait	None identified
Shy Albatross	Foraging, feeding or related behaviour likely to occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	Foraging Whole South-east Marine Region	National Recovery Plan for Albatrosses and Petrels (CoA 2022) Conservation Advice Thalassarche cauta Shy Albatross (TSS 2020)
Soft-plumaged Petrel	Species or species habitat may occur within area	Vulnerable			Listed	None identified	Conservation Advice Pterodroma Mollis Soft-plumaged Petrel (TSS 2015a)
Sooty Albatross	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Sooty Shearwater	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed (as *Puffinus griseus*)	None identified	Wildlife Conservation Plan for Seabirds (CoA 2020a) Conservation Advice for *Ardenna grisea* (Sooty Shearwater) (DCCEEW 2023i)
Southern Giant-Petrel, Southern Giant Petrel	Species or species habitat may occur within area	Endangered	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Southern Royal Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Wandering Albatross	Foraging, feeding or related behaviour likely to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Wedge-tailed Shearwater			Migratory Marine Birds	Migratory Marine Birds	Listed	Foraging: Breeding: August - May 160 km around breeding area on Mutton Bird Island	Wildlife Conservation Plan for Seabirds (CoA 2020a)
White-capped Albatross	Foraging, feeding or related behaviour known to occur within area	Vulnerable	Migratory	Migratory Marine Birds	Listed	None identified	National Recovery Plan for Albatrosses and Petrels (CoA 2022)
Shorebird							
Australasian Bittern	Species or species habitat known to occur within area	Endangered				None identified	Conservation Advice *Botaurus poiciloptilus* Australasian Bittern. Threatened Species Scientific Committee (TSSC 2019a)
Australian Fairy Tern	Species or species habitat known to occur within area	Vulnerable				None identified	Approved Conservation Advice for *Sternula nereis nereis* (Fairy Tern) (DSEWPaC. 2011) National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (DAWE 2020)
Australian Painted Snipe	Species or species habitat known to occur within area	Endangered			Listed - overfly marine area (as *Rostratula benghalensis (sensu lato*))	None identified	Approved Conservation Advice for *Rostratula australis* (Australian Painted Snipe) (DSEWPaC 2013) National Recovery Plan for the Australian Painted Snipe (*Rostratula australis*) (CoA 2022a)
Bar-tailed Godwit	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Black-eared Cuckoo	Species or species habitat known to occur within area				Listed - overfly marine area (as *Chrysococcyx osculans*)	None identified	None identified
Black-faced Cormorant	Breeding known to occur within area				Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Black-faced Monarch	Species or species habitat may occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified
Blue-winged Parrot	Species or species habitat known to occur within area	Vulnerable			Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Neophema chrysostoma* (Blue-winged Parrot) (DCCEEW 2023l)
Cattle Egret	Species or species habitat may occur within area				Listed - overfly marine area (as *Ardea ibis*)	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Common Greenshank, Greenshank	Species or species habitat known to occur within area	Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Tringa nebularia* (Common Greenshank).(DCCEEW 2024e)
Common Sandpiper	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Curlew Sandpiper	Species or species habitat known to occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Calidris ferruginea* Curlew Sandpiper (DCCEEW 2023m)
Double-banded Plover	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Eastern Curlew, Far Eastern Curlew	Species or species habitat known to occur within area	Critically Endangered	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Numenius madagascariensis* (Far Eastern Curlew) (DCCEEW 2023n)
Eastern Hooded Plover, Eastern Hooded Plover	Species or species habitat known to occur within area	Vulnerable			Listed - overfly marine area (as *Thinornis rubricollis rubricollis*)	None identified	Conservation Advice *Thinornis rubricollis rubricollis* Hooded Plover (eastern) (DoE 2014)
Fork-tailed Swift	Species or species habitat likely to occur within area		Migratory	Migratory Marine Birds	Listed - overfly marine area	None identified	None identified
Brown Skua	Species or species habitat may occur within area				Listed (as *Catharacta skua*)	None identified	None identified
Gang-gang Cockatoo	Species or species habitat known to occur within area	Endangered				None identified	Conservation Advice for *Callocephalon fimbriatum* (Gang-gang Cockatoo) (DAWE 2022)
Greater Sand Plover, Large Sand Plover	Species or species habitat likely to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice for *Charadrius leschenaultia* (Greater Sand Plover) (DCCEEW 2023o) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Grey Falcon	Species or species habitat likely to occur within area	Vulnerable				None identified	Conservation Advice *Falco hypoleucos* Grey Falcon (TSSC 2020a)
Grey-tailed Tattler	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed (as *Heteroscelus brevipes*)	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Hooded Plover, Hooded Dotterel	Species or species habitat known to occur within area				Listed - overfly marine area (as *Thinornis rubricollis)*	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Latham's Snipe, Japanese Snipe	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Gallinago hardwickii* (Latham's Snipe) (DCCEEW 2024d)
Lesser Sand Plover, Mongolian Plover	Roosting known to occur within area	Endangered	Migratory	Migratory Wetlands Species	Listed	None identified	Conservation Advice *Charadrius mongolus* Lesser Sand Plover (TSSC 2016) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Little Curlew, Little Whimbrel	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Little Tern	Species or species habitat may occur within area		Migratory	Migratory Marine Birds	Listed (as *Sterna albifrons*)	None identified	Commonwealth Listing Advice on *Sterna albifrons sinensis* (Little Tern (Western Pacific)) (TSSC 2002) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Magpie Goose	Species or species habitat may occur within area				Listed - overfly marine area	None identified	None identified
Marsh Sandpiper, Little Greenshank	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit	Species or species habitat known to occur within area	Endangered				None identified	Conservation Advice for *Limosa lapponica baueri* Bar-tailed Godwit (western Alaskan) (DCCEEW 2024b)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Orange-bellied Parrot	Species or species habitat known to occur within area	Critically Endangered			Listed - overfly marine area	None identified	Commonwealth Listing Advice on *Neophema chrysogaster* (TSSC 2006). National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DEWLP 2016)
Osprey	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Pacific Golden Plover	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Painted Honeyeater	Species or species habitat may occur within area	Vulnerable				None identified	Conservation Advice *Grantiella picta* Painted Honeyeater (DoE 2015b) National Recovery Plan for the Painted Honeyeater (*Grantiella picta*) (DAWE 2021)
Plains-wanderer	Species or species habitat likely to occur within area	Critically Endangered				None identified	Conservation Advice *Pedionomus torquatus* Plains-wanderer (DoE 2015a) National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*) (DoE and SA DEWNR 2016)
Pectoral Sandpiper	Species or species habitat known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Pied Stilt, Black-winged Stilt	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Pin-tailed Snipe	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Rainbow Bee-eater	Species or species habitat may occur within area				Listed - overfly marine area	None identified	None identified
Red Knot, Knot	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Conservation Advice for *Calidris canutus* Red Knot (DCCEEW 2024) Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Red-capped Plover	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Red-necked Avocet	Roosting known to occur within area				Listed - overfly marine area	None identified	None identified
Red-necked Stint	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Regent Honeyeater	Species or species habitat may occur within area	Critically Endangered				None identified	Conservation Advice *Anthochaera Phrygia* Regent Honeyeater (DoE 2015) National Recovery Plan for the Regent Honeyeater (*Anthochaera phrygia*) (DoE 2016)
Ruddy Turnstone	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Arenaria interpres* (Ruddy Turnstone) (DCCEEW 2024c)
Rufous Fantail	Species or species habitat known to occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified

Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Sanderling	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	None identified
Satin Flycatcher	Breeding known to occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Sharp-tailed Sandpiper	Roosting known to occur within area	Vulnerable	Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015) Conservation Advice for *Calidris acuminata* (Sharp-tailed Sandpiper) (DCCEEW 2024a)
Silver Gull	Breeding known to occur within area				Listed (as *Larus novaehollandiae*)	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Swift Parrot	Species or species habitat likely to occur within area	Critically Endangered			Listed - overfly marine area	None identified	National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (Saunders & Tzaros 2011) Conservation Advice *Lathamus discolor* Swift Parrot (TSSC 2016a)
Swinhoe's Snipe	Roosting likely to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
Whimbrel	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
White-bellied Sea-Eagle	Breeding known to occur within area				Listed	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)
White-throated Needletail	Species or species habitat known to occur within area	Vulnerable	Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	Conservation Advice *Hirundapus caudacutus* White-throated Needletail (TSSC 2019)
Wood Sandpiper	Roosting known to occur within area		Migratory	Migratory Wetlands Species	Listed - overfly marine area	None identified	Wildlife Conservation Plan for Migratory Shorebirds (CoA 2015)

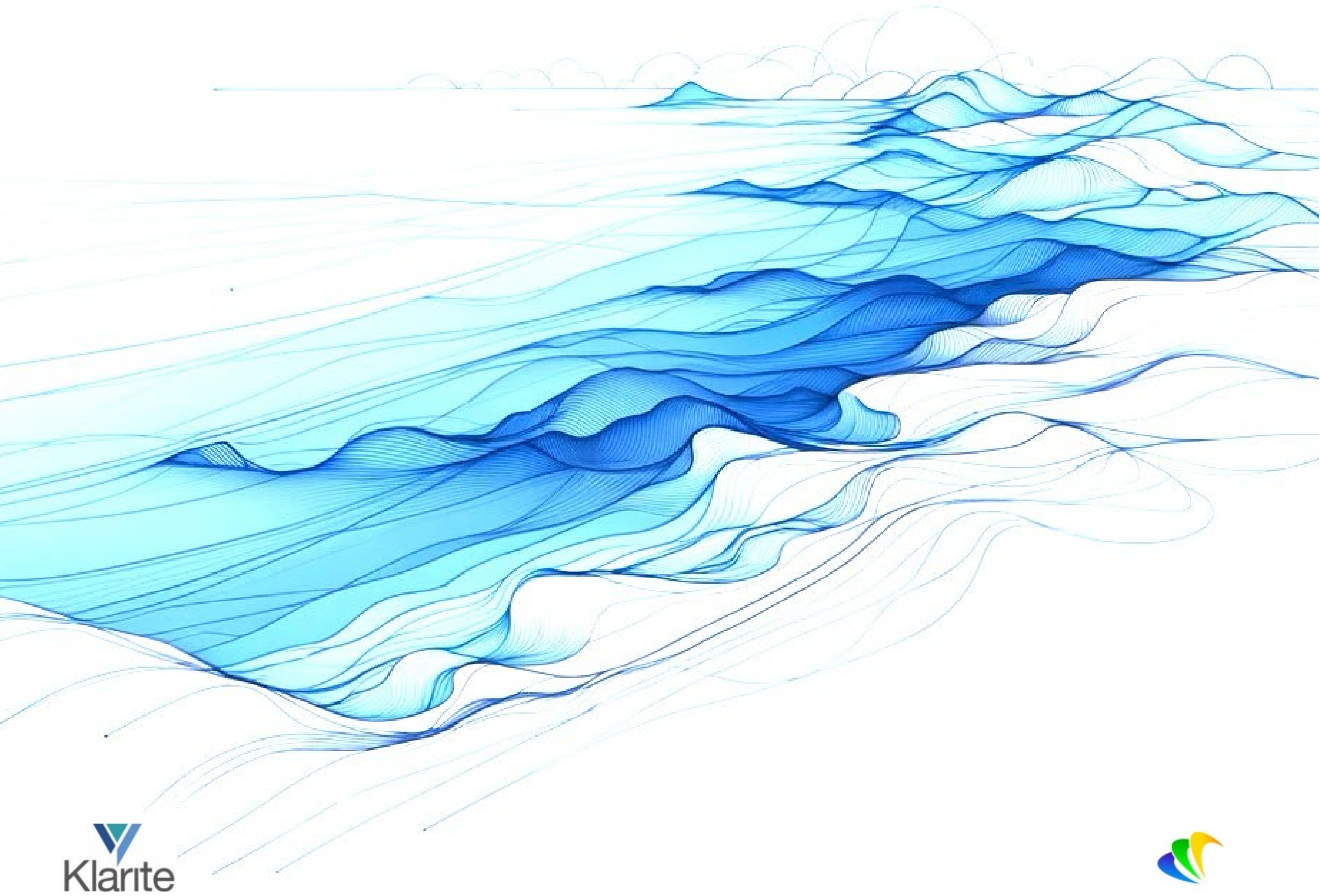
Common Name	Presence	Threatened Category	Migratory Status	Migratory Category	Marine Status	Biologically Important Area	Management Plan Conservation Advice Listing Advice
Yellow Wagtail	Species or species habitat may occur within area		Migratory	Migratory Terrestrial Species	Listed - overfly marine area	None identified	None identified
Turtles							
Green Turtle	Species or species habitat may occur within area	Vulnerable	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)
Leatherback Turtle, Leathery Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017) Approved Conservation Advice for *Dermochelys coriacea* (Leatherback Turtle*) (*DEWHA 2008)
Loggerhead Turtle	Breeding likely to occur within area	Endangered	Migratory	Migratory Marine Species	Listed	None identified	Recovery Plan for Marine Turtles (DoEE 2017)

Otway Cumulative Impact Assessment

Appendix E10: REG-EP-029-E10

Rev 2

May 2024



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1 Introduction

The National Offshore Petroleum Safety and Environmental Management Authority (**NOPSEMA**) defines cumulative environmental impacts in the context of offshore petroleum activities, as successive, additive, or synergistic impacts of collectively significant activities or projects with material impacts on the environment that have the potential to accumulate over temporal and spatial scales (NOPSEMA Environment Plan Decision Making Guideline, N-04750-GL1721).

The effects of past projects and activities, and currently operating projects, are captured when describing the existing condition of, and any pressure or threats affecting the environment. This baseline condition and understanding of the capacity of the receiving environment and receptors to accommodate changes, considering existing pressures and threats, informs the environmental impact assessments conducted in the Preliminary Environmental Impact and Risk Assessment (**PEIRA**) (Appendix B4) and more extensively in Appendices E1 – E9.

The focus of this Cumulative Impact Assessment (**CIA**) is to further build on these assessments by considering the impacts of the proposed activity on key environmental values and sensitivities in conjunction with the impacts from other reasonably foreseeable future projects.

The types of activities and projects typically considered in CIA are large in scale and are of relevance in terms of potentially contributing to or compounding material impacts in the operational area of the Regia MSS.

2 Relevant Person Consultation

Titleholders with ongoing or planned activities in the Otway region are in regular consultation with each other and are working collaboratively to manage potential cumulative impacts.

Consultation carried by these titleholders during the preparation of their Environment Plans (**EP**s) has identified feedback relevant to cumulative impacts as detailed in Table E10-2-1.

Table E10-2-1 - Summary of relevant person input into the CIA

Objections and Claims	Assessment of Merit	Measure adopted because of consultation
Environmental and conservation groups claim that there is a lack of thoroughness of cumulative impact assessments in relation to the number of proposals in the region.	The claim is about the adverse effects of the activities and the titleholders acknowledge that the planned activities in the Otway are predicted in increase in future years.	Titleholders have agreed to work collaboratively on assessing the potential for cumulative impacts and present this CIA as part of addressing this claim.
A community member raised an objection via email regarding the uncertainty about effects of seismic lead to unacceptable impacts (Feedback ID 195)	The objection is about the adverse effects of the activity and the titleholders acknowledge that the planned activities in the Otway are predicted in increase in future years.	CGG will update their impact assessments to better reflect consideration of uncertainty in assessments and undertake a second cumulative impact assessment for future activities.
Objection stating the potential cumulative impacts upon species are not addressed, noting this activity overlaps a recent seismic survey and is near to another that is planned. This should include, but not be limited to acoustic impacts to cetaceans (PTS and TTS) as well as impacts to availability of food (krill) (Feedback ID 229).	The objection is about the adverse effects of the activity and the titleholders acknowledge that the planned activities in the Otway are predicted to increase in future years.	CGG will implement the following measures: • Fauna Management System • An additional cumulative impact assessment.
By email, relevant organisation requested spatial and temporal buffers to any other seismic activities (Feedback 234)	This objection relates to the adverse effects of the activity	CGG will implement the following measures: The industry standard control of 40 km separation distance between operating seismic sources will be applied. TGS and CGG have agreed that their respective surveys will not be acquired at the same time. Cumulative impact assessment to identify if further spatial and temporal buffers are required to manage impacts to an acceptable level.
By email, relevant organisation requested a limit be set to the number of days for acquisition at full power and, or, the total distance of sail lines for acquisition at full power (Feedback 235)	This objection relates to the adverse effects of the activity.	CGG will implement the following measures: Maximum days at 90 days on the water and 60 days acquisition.

3 Methodology

There are many ways of considering cumulative impacts and the following guidelines have been used as the basis of this assessment:

- United Kingdom National Infrastructure Planning Advice Note Seventeen: Cumulative effect assessment relevant to nationally significant infrastructure programs (UK Gov 2019)
- New South Wales Cumulative Impact Assessment Guidelines for State Significant Projects (NSW 2022).

Both guidelines are intended to apply to large-scale national and state significant projects, respectively which have a greater potential for long term cumulative impacts than the Regia MSS. The guidelines are rigorous and have merit for application to the shorter-term, smaller scale, Regia MSS.

3.1 Scoping the Assessment

Scoping considerations identified for CIAs include:

- Successive, additive, or synergistic material impacts.
- Effects on key environmental matters within the relevant spatial extent.
- The pathways for impacts to accumulate over the relevant temporal extent.

Material impacts are impacts of the project and other reasonably foreseeable future projects and activities that may not align with the defined acceptable levels, for example, threats of wide-scale, serious or irreversible damage due to cumulative impacts.

Successive impacts are those that occur one after the other.

Additive impacts are those where the combined impact is the sum of the separate impacts.

Synergistic impacts are those where the combined impact is greater than the sum of the separate impacts.

Key environmental matters are features of the environment (ecological, socio-economic, and cultural values and sensitivities) that are valued because of their rarity or importance, including the critical role they play in supporting systems which are essential for the environment, people and / or the economy (NSW 2022), for example, commercial fisheries and threatened species undertaking biologically important behaviours.

The relevant **spatial extent** depends on the key matter. For example, for ecological impacts the spatial extent may be based on the range and distribution of a listed threatened species when undertaking biologically important behaviour. The NSW (2022) guideline recommends that while the study area chosen for each matter must be broad enough to capture all relevant cumulative impacts, it should not be unnecessarily large or include areas where the cumulative impacts are likely to be negligible relative to the baseline condition of the relevant matter.

Temporal extent is dependent on the key matter and the scale and nature of potential impacts on the matter (NSW 2022). For example, for commercial fishers the temporal extent may be based on a part of a season or several seasons depending on how long the impact may occur. For this CIA the temporal extent selected has been aligned to reasonably foreseeable timeframes associated with the project and other reasonably foreseeable projects and activities within the Otway Basin.

3.2 Identifying Reasonably Foreseeable Future Projects and Activities

This CIA considers projects and activities that are reasonably foreseeable within the spatial and temporal extent of the assessment. This defines the boundaries of the assessment by including projects and activities that have a realistic likelihood of occurring and could contribute to cumulative impacts. It involves considering current industry trends, known development plans, regulatory frameworks, and scientific projections to determine which activities are within the CIA scope.

To identify reasonably foreseeable future projects and activities a search was conducted of the NOPSEMA and DEECA (Vic) Environment Plan website to identify any relevant projects and activities. In addition, titleholders within the Otway Basin have been meeting regularly to discuss environmental management in the region, including processes for improved CIA, focusing on reasonably foreseeable activities. This has provided a more accurate representation of projects and activities and the potential for cumulative impacts, ensuring these are appropriately assessed and managed.

Reasonably foreseeable future projects and activities identified to date, within the term of the EP, are listed in Table E10-31-. Projects and activities that are not reasonably foreseeable or speculative have been excluded from the assessment scope to maintain practicality and relevance in decision-making processes.

Information on projects and activities is typically accessible once consultation commences and relevant technical supporting information is submitted for public comment or assessment. Information relevant to this CIA has been discussed at the ongoing Otway Basin Petroleum Titleholder meetings. Where project/activity-specific data is not yet available, data from similar projects has been used as a proxy prior to technical information being made available. Given the similarity of impacts, there is a high level of certainty in the prediction of cumulative impacts in most cases.

Assumptions around specific timings for projects or activities have been made as there is some level of uncertainty in the schedule and timing of approvals to support activities. Consequently, a conservative approach has been adopted whereby credible worst-case scenarios (e.g. concurrent activities with overlapping environments that may be affected (EMBAs)) are assessed.

Table E10-3-1 - Reasonably foreseeable ongoing and future projects and activities in the offshore Otway region

Titleholder	Activity Type	Status	Window (Activity)
Beach Energy	Production - Thylacine	Ongoing	Ongoing
Beach Energy	Production - Geographe	Ongoing	Ongoing
Cooper Energy	Production – CHN	Ongoing	Ongoing
ConocoPhillips Australia	Otway Drilling	Proposed	2024-2028 (Typically 30-40 days per well, max 6 wells)
Cooper Energy	Production Drilling and tie-in	Proposed	2024-2026
Woodside Energy	Minerva Decommissioning	Proposed	2024-2025 (< 2 months)
Beach Energy	Drilling and tie-in	Proposed	2024-2027
TGS-NOPEC	Seismic Survey (Otway 3D MSS)	Proposed	2023-2027 (200 days per year, 400 days max)
CGG	Seismic Survey (Regia MSS)	Proposed	2023-2028 (60 days)
Beach Energy	Seismic Survey (Calico MSS)	Proposed	2025 (Between February and May)

3.2.1 Temporal Overlap

For proposed activities that are reasonably foreseeable, and following consultation between the titleholders in this region, there is:

- A high likelihood of consecutive drilling (exploration, appraisal, or plug and abandonment (P&A)) activities given the titleholders are all planning on using the same rig.
- A very low likelihood that there will be concurrent drilling activities.
- Some likelihood that there will be concurrent seismic survey and drilling activities.
- A very low likelihood that there will be concurrent seismic operations.
- A slightly higher likelihood that seismic surveys may be consecutive.

3.2.2 Spatial Overlap

Annex 1 shows a matrix of the ongoing and reasonably foreseeable activities in the region. This analysis was completed considering the spatial extent of impacts from the projects and activities rather than just an overlap of activity locations. This analysis revealed that there is:

- An extremely remote likelihood of direct spatial overlap of seismic survey areas.
- An extremely remote likelihood of direct spatial overlap of drilling/P&A areas.
- A possible overlap of 1 seismic survey area and drilling activities over petroleum title VIC/P79.
- A possible likelihood of overlap of light EMBAs associated with concurrent seismic survey and drilling/P&A at a single location.
- An extremely remote likelihood of overlap of sound EMBAs associated with concurrent seismic survey and drilling/P&A at a single location.

3.2.3 Identified Aspects and Extents

During the environmental assessment process, components of the environment and aspects of the ongoing and reasonably foreseeable projects and activities were identified where there was the potential for successive, additive, or synergistic impacts to reasonably accumulate over temporal and spatial scales, when considered in the context of ongoing and reasonably foreseeable future projects or activities. There were some terminological differences between titleholders' environmental components. These have been assessed and are not material to this CIA.

The CIA Scoping Tool (Annex 2 – CIA Scoping Tool) details the assessment undertaken of the components of the environment and aspects of the Otway Exploration Drilling Program to identify where a potential cumulative cause-effect pathway with the other reasonably foreseeable future projects (identified in Table E10-31-) may occur and, if it may occur, was likely to have a material impact. Where a potential cumulative cause-effect pathway and material impact was identified further assessment was undertaken as detailed in Section 0.

The components of the environment and aspects identified during the CIA scoping process requiring further assessment include:

- Light – impacts on light-sensitive bird species.
- Underwater sound – impacts on noise-sensitive species.
- Birds – nocturnal behaviours of species such as the common diving petrel which has a breeding biologically important area (BIA)on Lady Julia Percy Island, and the orange-bellied parrot which may overfly the light EMBAs on migration.
- Marine Mammals – biologically important behaviours of species such as the blue whale and southern right whale within relevant BIAs that overlap underwater sound EMBAs.
- Commercial Fisheries – displacement from within relevant fishery management zones.

It was also identified that the conservation values and sensitivities of the Zeehan Marine Park and the First Nations cultural heritage values associated with the above environmental components could be affected by cumulative impacts.

4 Assessment Process for Cumulative Impacts

For those components of the environment and aspects where a potential cumulative cause-effect pathway and material impact was identified, a CIA process was applied in general alignment with the activity-specific methodologies of titleholders, in accordance with NOPSEMA guidelines and the cumulative impact assessment guidelines.

The CIA process applied to each aspect and component of the environment is provided below which includes a discussion that identifies other reasonably foreseeable ongoing future projects where the environmental aspect has both a temporal and spatial overlap. Then each identified area of potential cumulative impact is assessed by looking at the:

- Conservation (or other) values or sensitivity.
- Management Plans or legislation that applies to the value or sensitivity.
- Threatening processes to the value or sensitivity.
- Relevant spatial and temporal extent of cumulative impact.
- Recovery (or other) actions that apply.
- Baseline environment condition.
- Defined acceptable level of impact.
- Predictive certainty of the assessment.

Once the assessment of cumulative impacts had been completed and the titleholders with ongoing and future activities in the Otway Basin have discussed the outcome and agreed to adopt control measures (individually and collectively) for effects to commercial fishers, light sensitive birds, low frequency hearing whales, and cultural heritage values of First Nations peoples.

5 Cumulative Impact Assessments

Following the scoping phase, the following assessments of cumulative impacts have been made.

5.1 Interference with Commercial Fishers

Cumulative impacts could occur from the occurrence of two successive seismic surveys, one seismic survey occurring concurrently with a drilling activity, and/or consecutive drilling activities with operational exclusion boundaries overlapping fishery management zones.

Commercial fishers with fishing activity in the Regia MSS operational area may be displaced within their Fishery Management Zones in the offshore Otway Basin. This may lead to multiple applications for compensation to be lodged with a range of titleholders and a reduction in the area available to be fished.

Table E10-5-1 - Assessment of cumulative impacts for interference with commercial fishers

Conservation (or other) value	Socio-economic value to local communities and the national economy. Some operational areas overlap moderate or high fishing intensity areas.
Management Plans	Southern and Eastern Scalefish and Shark Fishery (SESSF) Species Summaries (AFMA 2023). Western Victorian rock lobster zone RLAG annual assessment,
Threatening Processes	Nil, other than unintentional fishing pressure on school shark.
Relevant Spatial and Temporal Extent	Fishery management zones focusing on fisheries with evidence of activity in the operational areas.
Recovery (or other) Action	Compensation for evidence-based claims for loss of gear, reduced catch or increased costs due to displacement.
Baseline Environment Condition	Some fisheries overlap with the existing shipping channel and areas with existing oil and gas activity. The fisheries with historical activities in the operational areas have sustainable stock status. However, school sharks are listed as Conservation Dependent (fishing pressure) in the SESSF – Shark Gillnet Sector. The fisheries are "Quota" managed and harvesting is limited to a set amount of "Total Allowable Catch" (TAC) annually.
Acceptable Level	That commercial fishers are not worse off because of petroleum activities in the offshore Otway Basin.
Comparison of Predicted Level of Impact with Defined Acceptable Levels	Predicted impacts are temporary and in most cases avoidable. A compensation process will be implemented in the event that interference with commercial fishers cannot be avoided, and claimants provide supporting evidence.
Predictability/ Certainty of Assessment	Given the intensity of fishing in the area, and the overlap of fishery management zones with the proposed activities of multiple titleholders, the assessment of cumulative impacts is made with a high level of predictability and certainty.

5.1.1 Cumulative Effects on Southern Rock Lobsters

During consultations several commercial rock lobster fishers claimed there were cumulative effects from seismic surveys that were adversely affecting the Southern Rock Lobster stock. Following the first round of consultations, CGG agreed to undertake a case study on the effects of seismic activity on the Southern Rock Lobster population in the Victorian western rock lobster zone over time. Historical catch data would be used to look at the whole of the fishery over the last 20 years and determine if there was any correlation between the previous seismic surveys that have occurred in that timeframe.

CGG made an additional request from the Victorian Fisheries Authority to aggregate data over three previous seismic surveys which fishers identified as particularly damaging to their activities

(Investigator in 1999; Enterprise in 2002/03; and Crowes Foot in 2016). The aggregated data was received by CGG however there were inconsistencies in the totals rendering the data unusable.

Instead, CGG obtained the records of monthly catch between 2006 and 2023 (to June) and completed an analysis of this data with respect to the following surveys:

- Astrolabe MSS
- La Bella MSS
- Enterprise MSS
- Flanagan MSS
- Crowes Foot MSS
- Schlumberger MSS
- Sequoia MSS

Both landed catch in kilograms was analysed as well as monthly catch rates. Table E10-2 and Figure E10-1 show the landed catch with the relevant surveys timing shown in the colour coded months. Table E10-3 and Figure E10-2 show the monthly catch rates for the western zone over the same period.

Table E10-2 - Monthly landed catch for western zone rock lobster 2006 to 2023 (kilograms)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Nov	Dec
2006	80,448	67,773	51,122	18,232	13,564	4,444	10,102	21,613	8,277	24,310	57,969
2007	58,420	60,874	48,526	35,566	15,459			23,622	12,629	30,250	52,531
2008	57,486	46,325	45,760	25,440	15,501			9,710	6,870	16,364	42,874
2009	50,832	38,302	32,925	16,721	12,935	7,380	4,665	8,652	4,403	17,678	40,534
2010	43,258	36,321	30,794	19,515	17,655	6,789	9,427	11,358	6,447	18,803	36,774
2011	51,010	32,071	31,007	23,973	11,098	2,857	14,362	22,781	9,452	20,588	46,788
2012	38,315	36,617	24,814	12,885	6,532	2,587	13,486	17,944	11,377	29,668	50,809
2013	49,542	33,937	24,786	13,506	9,922	3,471	16,131	14,725	11,695	23,051	47,961
2014	53,505	42,108	33,359	11,375	5,151	338	13,514	27,796	9,325	18,866	39,416
2015	35,959	44,462	19,222	13,341	5,214	2,349	7,401	22,587	15,611	14,419	47,935
2016	40,933	39,996	30,252	9,138	3,089	858	6,435	25,889	10,912	15,819	41,918
2017	43,708	18,171	22,373	16,607	6,293	1,770	9,566	25,336	9,302	22,729	49,403
2018	38,983	45,405	18,603	4,229	869	1,159	9,814	26,921	11,704	26,111	54,928
2019	55,358	35,562	13,571	3,391	4,102	3,300	11,489	29,124	16,532	15,052	39,247
2020	43,738	5,028	16,891	18,800	24,036	5,289	14,908	22,558	12,563	12,609	35,590
2021	28,203	35,457	41,889	33,517	14,169	3,148	11,413	22,856	9,413	24,030	54,098
2022	45,875	25,848	24,632	25,927	4,222	1,110	17,923	24,864	6,299	13,594	47,562
2023	51,752	25,591	25,522	27,004	5,511	306					

- Astrolabe MSS
- La Bella MSS
- Enterprise MSS
- Flanagan MSS
- Crowes Foot MSS
- Schlumberger MSS
- Sequoia MSS

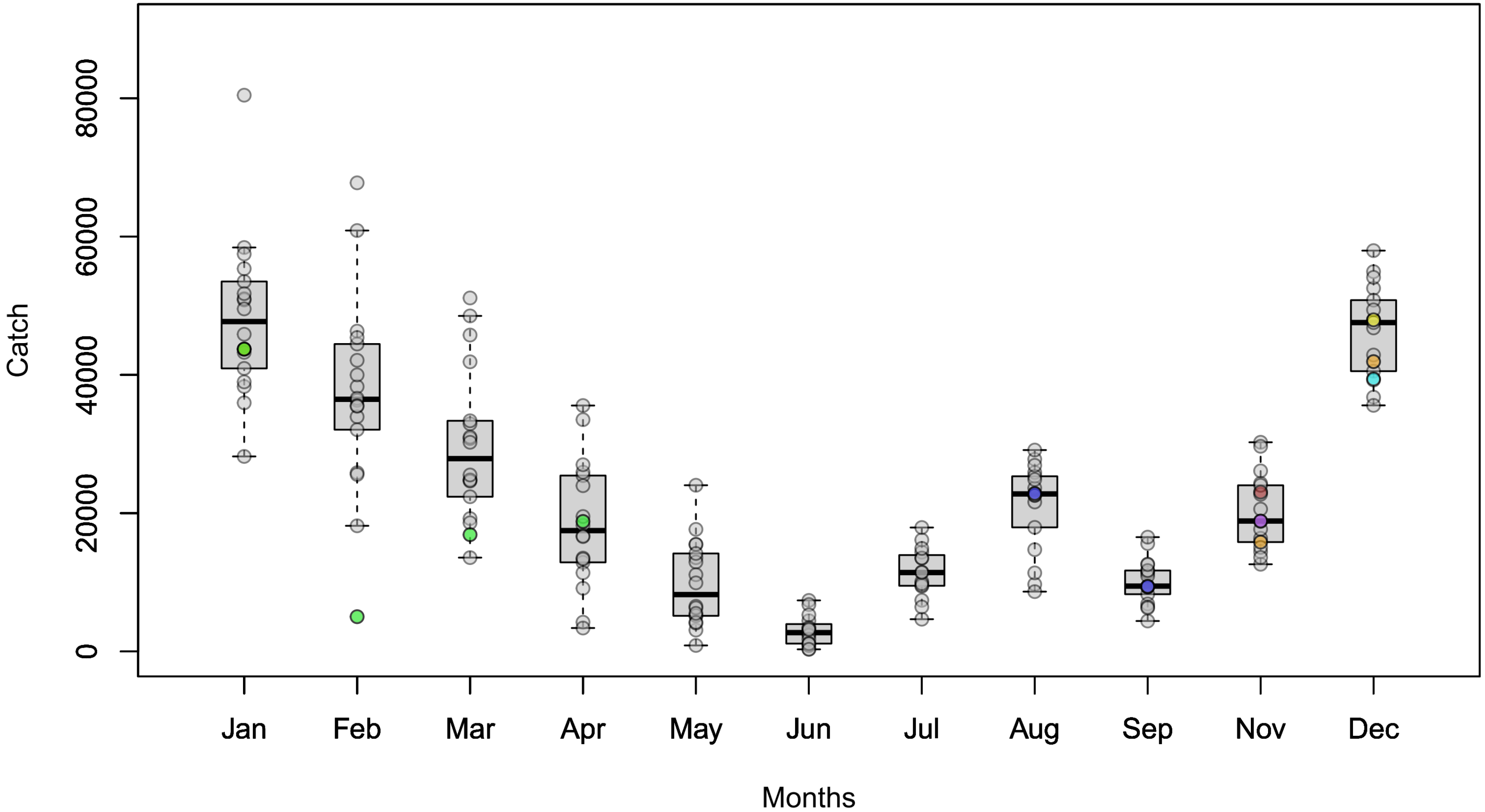

Figure E10-1 - Box plot of catch rates (kilograms) month by month with each year represented by a circle, coloured circles represent months seismic was acquired. Colour corresponds to the survey colour code in Table E10-4.

Table E10-3 - Monthly catch rates for western zone rock lobster 2006 to 2023 (CPUE

2006	0.74	0.67	0.53	0.40	0.27	0.16	0.26	0.25	0.26	0.47	0.57
2007	0.56	0.64	0.54	0.41	0.25			0.28	0.26	0.57	0.49
2008	0.56	0.52	0.47	0.32	0.25			0.18	0.22	0.40	0.50
2009	0.51	0.44	0.40	0.25	0.20	0.12	0.18	0.19	0.15	0.40	0.40
2010	0.45	0.45	0.35	0.30	0.28	0.21	0.22	0.27	0.26	0.49	0.48
2011	0.59	0.56	0.50	0.40	0.29	0.22	0.36	0.32	0.34	0.57	0.61
2012	0.64	0.58	0.48	0.40	0.36	0.29	0.33	0.41	0.41	0.71	0.71
2013	0.69	0.60	0.56	0.42	0.33	0.28	0.41	0.35	0.34	0.58	0.67
2014	0.68	0.59	0.56	0.44	0.37	0.21	0.34	0.44	0.41	0.62	0.70
2015	0.66	0.68	0.45	0.49	0.41	0.32	0.28	0.44	0.51	0.61	0.89
2016	0.77	0.71	0.68	0.50	0.50	0.23	0.33	0.48	0.48	0.60	0.80
2017	0.83	0.65	0.69	0.68	0.47	0.37	0.40	0.52	0.55	0.79	0.96
2018	0.90	0.98	0.95	0.65	0.51	0.34	0.48	0.59	0.56	0.94	1.15
2019	0.99	0.97	0.82	0.52	0.60	0.41	0.53	0.64	0.64	0.74	0.99
2020	1.02	0.93	0.81	0.97	0.79	0.47	0.63	0.72	0.64	0.88	0.97
2021	0.96	1.07	1.07	1.22	0.87	0.44	0.52	0.62	0.59	1.18	1.24
2022	1.20	1.14	1.10	1.25	0.73	0.59	0.83	0.85	0.73	1.25	1.41
2023	1.43	1.24	1.24	1.26	0.89	0.61					

- Astrolabe MSS
- La Bella MSS
- Enterprise MSS
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- Crowes Foot MSS
- Schlumberger MSS
- Sequoia MSS

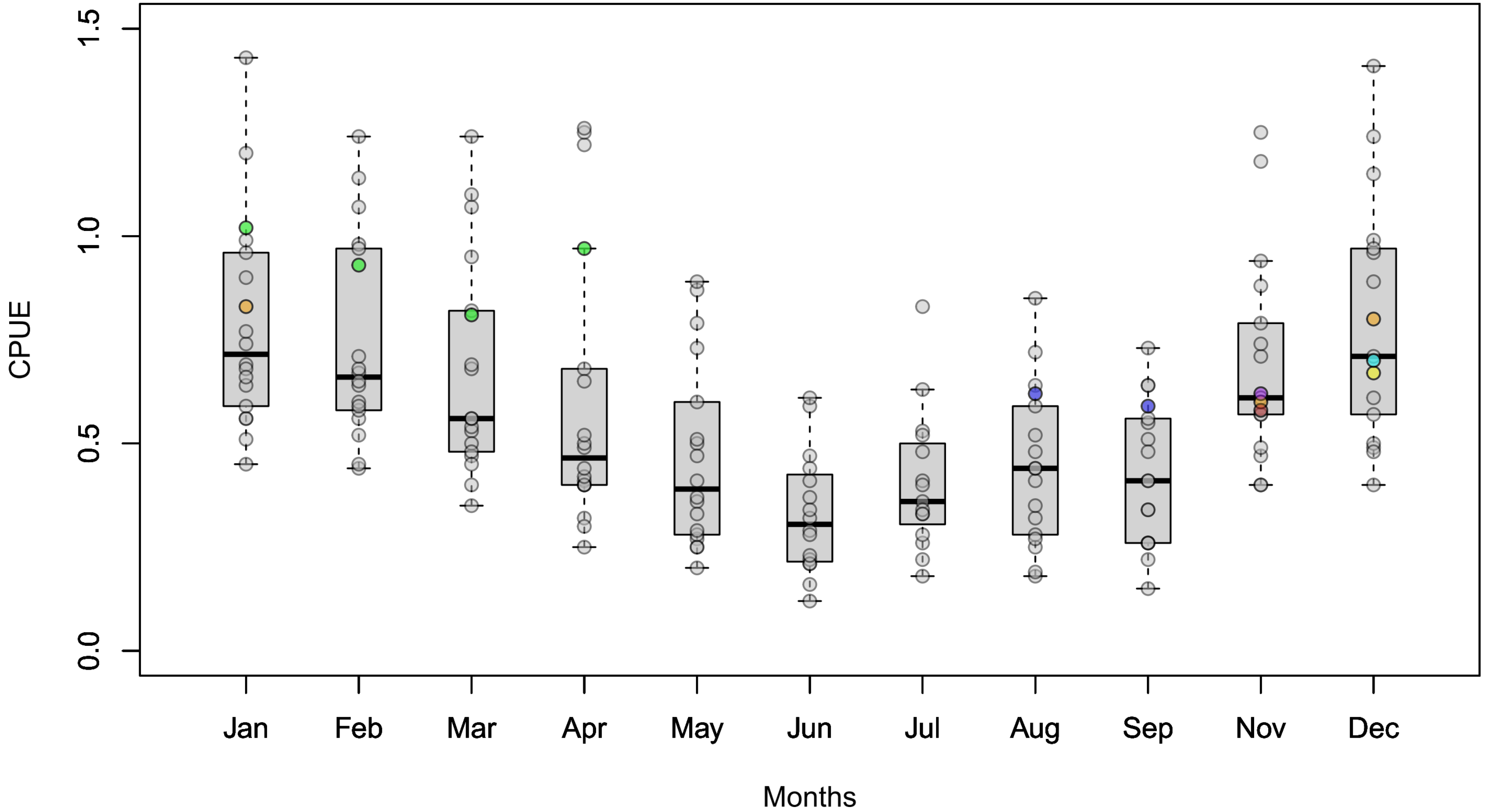


Figure E10-2 - Box plot of catch rates (CPUE) month by month with each year represented by a circle, coloured circles represent months seismic was acquired. Colour corresponds to the survey colour code in Table E10-5.

This analysis shows a general and unsurprising decline in catch in the winter months when males only may be taken, with a slight dip in September (note the fishery is closed on 16th September and opens on the 15th November). The data shows, at the whole of western zone level, the catch rates remain within normal distributions both in the month(s) of the survey and in the subsequent months, and in the subsequent years. This extends to more than 7 years post surveys, the timeframe claimed by fishers that catch rates and populations would take to recover.

The data shows only one statistical anomaly in February 2020 in the landed catch. This is likely to be due to Covid-19 affects in Victoria and a subsequent reduction in fishing effort. The corresponding months CPUE shows that those who were able to fish did not suffer a reduction in CPUE beyond normal distribution. This data is conclusive that there are no detectable long-term effects to catch rates, and presumably the population of Southern Rock Lobster, in the western zone SRL fishery attributable to seismic surveys. Therefore, cumulative impacts to the SRL populations and the knock-on effects to fishers from sub-lethal effects are not measurable.

5.2 Effects of Elevated Levels of Artificial Light to Albatross, Petrels and Shearwaters

There is a potential cumulative impact for birds with foraging BIAs, and it is identified that there is a potential for overlap when considering a single seismic survey and a single drilling operation, as well as with sequential drilling activities. However, when examining the breeding BIAs for the short-tailed shearwater, predictions indicate no significant overlap from multiple projects. The only exception is for drilling within the T/49P area, where the activity impact assessment has forecasted no behavioural impacts or injury/mortality to the species. Consequently, no cumulative impact pathway has been identified.

For the wedge-tailed shearwater breeding BIA, the overlap is anticipated only with flaring from exploration drilling and light from other consecutive drilling activities. Concurrent activities do not contribute to this overlap. With respect to the Common diving-petrel, a species particularly sensitive to coastal light impacts, disturbances to adult nest attendance are a concern when these birds are returning to or leaving their nesting colony. The Regia MSS and ConocoPhillips Australia Otway Drilling Program in the north of VIC/P79 are scheduled in such a way that they do not coincide, thereby minimising potential impacts. These operations are also planned to be more than 18 months apart in this area, and no cumulative impact pathway has been identified for them.

In evaluating the potential for cumulative impacts, it is important to consider the limited spatial extent of effects in comparison to the available area for foraging. Most species conduct foraging activities during daylight hours. The National Recovery Plan for Albatrosses and Petrels has classified interactions with marine infrastructure, including those associated with artificial light, as posing no risk priority, and affecting no species within the Australian jurisdiction.

Specifically for the breeding BIA of the wedge-tailed shearwater, overlap is only by flaring from ConocoPhillips Australia's Otway Exploration Drilling activity, which is restricted to 120 hours per well. Since this species is not listed as threatened and since periodic changes in ambient light within the area affected are unlikely to induce behavioural changes or result in injury/mortality, the effect is low.

Overall, the cumulative impact of light emissions from petroleum activities in the Otway area is assessed to be low, especially when compared to the light emissions from existing shipping and fishing operations. It is also noted that most of these vessels do not follow a Light Management Plan.

Table E10-5-4 - Assessment of cumulative impacts for elevated levels of artificial light to Albatross, Petrels and Shearwaters

Conservation (or other) value	Antipodean, southern royal, wandering, northern royal, Sooty, Buller's, shy, grey-headed, Campbell, black-browed, Salvin's, Indian yellow-nosed, and white-capped albatrosses; southern and northern giant, common diving and white-faced storm-petrels; short-tailed and wedge-tailed shearwaters. Endangered, Vulnerable, not listed, some with foraging BIAs, common diving petrel (nocturnal), short-tailed shearwater and wedge-tailed shearwater with breeding BIAs within EMBAs. Short-tailed shearwater also identified cultural value.
Management Plans	National Recovery Plan for Albatrosses and Petrels (DCCEEW 2022e).

	Wildlife Conservation Plan for Seabirds (DCCEEW 2020). National Light Pollution Guidelines for Wildlife (CoA 2023).
Threatening Processes	Light emissions are identified as a threat in the National Recovery Plan for Albatrosses and Petrels but marine infrastructure interactions, including those associated with artificial light, are classified as having no risk category priority and affecting 'Nil' species in Australian jurisdiction. The National Recovery Plan for Albatrosses and Petrels also states that light associated with coastal developments at or adjacent to breeding sites represents a moderate threat to short-tailed shearwater. Light pollution, including from gas flaring, is listed as a threat to seabirds in the Wildlife Conservation Plan for Seabirds, with potential for consequences affecting individuals but not whole populations.
Relevant Spatial and Temporal Extent	Foraging BIAs for Antipodean, black-browed, Buller's, Campbell, Indian yellow-nosed, shy and wandering albatross, white-faced storm petrel, short-tailed shearwater and common diving-petrel within operational light and flaring EMBAs. Only common diving-petrel identified as foraging at night. Breeding BIAs for short-tailed shearwater and wedge-tailed shearwater within flaring EMBA. Breeding BIA for common diving petrel within operational light and flaring EMBAs.
Recovery (or other) Action	National Recovery Plan for Albatrosses and Petrels: no relevant actions. Wildlife Conservation Plan for Seabirds: Mitigate against impacts of light pollution around breeding colonies. National Light Pollution Guidelines for Wildlife recommend: 1. Always using Best Practice Lighting Design to reduce light pollution and minimise the effect on wildlife. 2. Undertaking an Environmental Impact Assessment for effects of artificial light on listed species for which artificial light has been demonstrated to affect behaviour, survivorship or reproduction.
Baseline Environment Condition	Existing lighting in the area includes fishing vessels, shipping traffic, existing offshore oil and gas platform and coastal developments. The shipping channel for vessels coming from Melbourne to Tasmania is one of the busiest shipping routes in offshore Australia.
Acceptable Level	Cumulative light does not impact breeding colonies of short-tailed shearwaters, wedge-tailed shearwaters or the common diving petrel, or populations of other species that forage in the area.
Comparison of Predicted Level of Impact with Defined Acceptable Levels	Cumulative light impacts to breeding colonies of short-tailed shearwaters, wedge-tailed shearwaters or the common diving petrel, or populations of other species that forage in the area are not predicted based on the rig and vessels will have a Light Management Plan to reduce light emission to as low as reasonably practicable for safe navigation and work and that flaring will be for short durations.
Predictability/ Certainty of Assessment	The overlap of light affected areas with foraging and breeding BIAs is predicted to be limited to only two concurrent activities at a time (e.g. seismic survey and drilling/P&A at one location – Lady Julia Percy Island) and then only consecutively from individual drilling activities. This assessment of cumulative impacts is made with a high level of predictability and certainty.

5.3 Effects of Elevated Levels of Artificial Light to Orange-bellied Parrot

The only interaction between the Otway projects is with light affected areas, rather than any illuminated structures or vessels. Spatially, there's a potential one-season overlap of the Regia MSS and a single drilling operation within light affected areas along the likely migration path. This overlap is temporal as well, with consecutive drilling operations potentially creating light affected areas over this migration route for several years.

The seismic-related cumulative impact of light emissions on the migration path would be brief, occurring only at night when work is carried out on the eastern side, in conjunction with a single drilling operation. The seismic program is confined to a maximum of 90 days, with active acquisition for 60 of those days.

Over the years, a single drilling rig may emit light that intermittently overlaps with various portions of the migration route. However, there has been no evidence of the orange-bellied parrot offshore during Beach Energy's 18-month drilling campaign in the region, nor in the last decade of Beach Otway Operations. Despite continuous petroleum activities in the Otway Basin, the parrot populations are on the rise.

Overall, the cumulative impact of light emissions from petroleum activities in the Otway area is assessed to be very low, especially when compared to the light emissions from existing shipping and fishing operations along the migration route. It is also noted that most of these vessels do not follow a Light Management Plan.

Table E10-5-5 - Assessment of cumulative impacts for elevated levels of artificial light to Orange-bellied Parrot

Conservation (or other) value	Listed as Critically Endangered and Marine under the EPBC Act and noted as a species of cultural significance.
Management Plans	National Recovery Plan for the Orange-bellied Parrot (DoE 2016)
Threatening Processes	Illuminated boats and structures within the migration route as a barrier to migration (weak evidence for impact, moderate risk rating) when overflying the light affected areas.
Relevant Spatial and Temporal Extent	Probable Migration Route September-November (Southward); February-mid-March (northwards). The light affected areas of the reasonably foreseeable activities do not overlap with the Migration Route.
Recovery (or other) Action	Assess the risk of barriers, being illuminated structures or boats, on the probable migration route. Manage threat if the risk rating warrants action. National Light Pollution Guidelines for Wildlife recommends: 1. Always using Best Practice Lighting Design to reduce light pollution and minimise the effect on wildlife. 2. Undertaking an Environmental Impact Assessment for effects of artificial light on listed species for which artificial light has been demonstrated to affect behaviour, survivorship or reproduction.
Baseline Environment Condition	The orange-bellied parrot probable migration route is within the shipping channel for vessels coming from Melbourne to Tasmania - one of the busiest shipping routes in offshore Australia.
Acceptable Level	Light from cumulative sources does not affect migration of the orange-bellied parrot at a population level.
Comparison of Predicted Level of Impact with Defined Acceptable Levels	Cumulative light impacts are not predicted to affect the migration of the orange-bellied parrot at a population level based on the rig and vessels will have a Light Management Plan to reduce light emission to as low as reasonably practicable for safe navigation and work and that flaring will be for short durations.
Predictability/ Certainty of Assessment	There is no published information available on the sensitivity of the orange-bellied parrot to light, and only anecdotal evidence exists regarding the impact of barriers to migration (DELWP 2016). This introduces some uncertainty into the assessment of cumulative impacts.

5.4 Effects of Elevated Levels of Sound to Blue Whales

With the current uncertainty on the timing of some other projects and the distance of underwater sound affected areas, there is the potential for cumulative impact if the following occur within the migration BIA during the biologically relevant periods (nominally November to May):

- Overlap between one seismic survey and one drilling activity for one season.
- Consecutive drilling/P&A activities over several seasons.
- Consecutive seismic surveys in one season or over several seasons.

Without appropriate detection and actions in place there is the potential that blue whales could be exposed to underwater sound from two sources (seismic and drilling) within the foraging BIA that could result in them expending more energy to move away from the sound source to forage or restrict the area of foraging. This could also occur for consecutive years whilst drilling activities are undertaken within the Otway Basin.

Cumulative impacts resulting in an increase in the likelihood of PTS and TTS for foraging blue whales is not predicted due to the small distances to the PTS and TTS noise criteria for activities.

Table E10-5-6 - Assessment of cumulative impacts for elevated levels of sound on Blue Whales

Conservation (or other) value	Listed as Endangered under the EPBC Act.
Management Plans	Conservation Management Plan for the Blue Whale (DoE 2015c) Guidance on key terms within the Blue Whale Conservation Management Plan (DAWE 2021a)
Threatening Processes	Conservation Management Plan for the Blue Whale identifies anthropogenic noise interference as a threat.
Relevant Spatial and Temporal Extent	Underwater sound affected areas overlap Foraging and Annual High Use Foraging BIAs. Blue whales are typically present within the BIAs between November to June, peaking in February and March.
Recovery (or other) Action	Conservation Management Plan for the Blue Whale states that anthropogenic noise in BIAs must be managed so that blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area. DAWE (2021a) details that underwater anthropogenic noise should not: • Stop or prevent any blue whale from foraging • Cause any blue whale to move on when foraging, or • Stop or prevent any blue whale from entering a foraging area
Baseline Environment Condition	The BIAs overlap existing shipping channel, area of high commercial fishing effort, and existing oil and gas activity.
Acceptable Level	Each activity will be carried out in a manner that will not be inconsistent with the Conservation Management Plan for the Blue Whale such that blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area.
Comparison of Predicted Level of Impact with Defined Acceptable Levels	Cumulative impact to Blue Whale's are not predicted as each titleholder will be required to undertake their activity in a manner that will not be inconsistent with the Conservation Management Plan for the Blue Whale such that blue whales can continue to utilise the area without injury and [are] not displaced from a foraging area.
Predictability/ Certainty of Assessment	There is a high level of predictability and certainty in the limited potential for cumulative impacts, given the requirements in place for each activity to prevent impacts.

5.5 Effects of Elevated Levels of Sound to Southern Right Whales

Cumulative impacts from current and reasonably foreseeable activities to the SRW migration and reproductive BIA are not predicted as the sound affected areas do not simultaneously overlap with these areas.

With the current uncertainty on the timing of some other projects and the distance of underwater sound affected areas, there is the potential for cumulative impact if the following occur within the migration BIA during the biologically relevant periods (nominally April and October):

- Overlap between one seismic survey and one drilling activity for one season.
- Consecutive drilling/P&A activities over several seasons.

Without appropriate detection and actions in place there is the potential that SRWs could be exposed to underwater sound from two sources (seismic and drilling) within the migration BIA that could result in them expending more energy to move away from the sound source when migrating to and from coastal breeding areas. This could also occur for consecutive years whilst drilling activities are undertaken within the Otway Basin.

Cumulative impacts resulting in an increase in the likelihood of PTS and TTS for a migrating SRW is not predicted due to the small distances to the PTS and TTS noise criteria for drilling activities.

Table E10-5-7 - Assessment of cumulative impacts for elevated levels of sound on Southern Right Whales

Conservation (or other) value	Listed as Endangered under the EPBC Act and noted as a species of cultural significance in the draft National Recovery Plan for the Southern Right Whale (CoA 2022).
Management Plans	Conservation Management Plan for Southern Right Whale (DSEWPaC 2012b) Draft National Recovery Plan for the Southern Right Whale (CoA 2022)
Threatening Processes	Conservation Management Plan for the Southern Right Whale and draft National Recovery Plan for the Southern Right Whale identify noise interference as a threat.
Relevant Spatial and Temporal Extent	Overlap of underwater sound affected areas with migration and reproductive BIAs. Southern right whales are typically within the migration BIA from April to October.
Recovery (or other) Action	Draft National Recovery Plan for the Southern Right Whale: Actions within and adjacent to SRW BIAs and habitat critical to the survival of SRWs should1 demonstrate that is does not prevent any SRW from utilising the area or cause injury (PTS, TTS) and/or disturbance.
Baseline Environment Condition	The BIAs overlap existing shipping channel, area of high commercial fishing effort, and existing oil and gas activity.
Acceptable Level	The activity will be carried out in a manner that will not be inconsistent with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) such that actions within and adjacent to SRW BIAs should demonstrate that it does not prevent any SRW from utilising the area or cause injury (TTS and PTS) and/or disturbance.
Comparison of Predicted Level of Impact with Defined Acceptable Levels	Cumulative impact to Southern Right Whales are not predicted as each titleholder will be required to undertake their activity in a manner in a manner that will not be inconsistent with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) such that actions within and adjacent to SRW BIAs should demonstrate that it does not prevent any SRW from utilising the area or cause injury (TTS and PTS) and/or disturbance.
Predictability/ Certainty of Assessment	There is a high level of predictability and certainty in the limited potential for cumulative impacts, given the requirements in place for each activity to prevent impacts.

Notes:

1. Legal definition of 'Should' means expected course of action or policy to be followed unless inappropriate for a particular circumstance. No habitat critical to the survival of SRWs have been identified.

5.6 Industry Standard Control Measures

The following sections outline the standard control measure which any titleholder relying on this CIA must adopt, with environmental performance suitable for their activities and management systems specified in their Environment Plan. Titleholders may choose to collaborate with one another on any of the control measures noting the likely need to specify environmental performance on their own terms.

5.6.1 On-Water Communication Protocol

All titleholders in the region will likely apply the industry standard of adopting communication protocol (or similar) to manage interactions with commercial fishing activities.

5.6.2 Compensation/Adjustment Protocol

Each titleholder must adopt a compensation/adjustment protocol to manage cumulative impacts to commercial fishers. Titleholders may collaborate to reduce the burden on affected fishers and standardise the processes for making evidence-based claims.

5.6.3 Light Management Plan

Titleholders predicting elevated levels of artificial light overlapping or adjacent to bird foraging or breeding BIAs, or the orange-bellied parrot migration routes are required to have a light management plan that meets the requirements of the National Light Pollution Guidelines. It is likely that all titleholders will have some form of assurance processes associated with the contracting of rigs and vessels to ensure this control measure in adopted and project rigs and vessels comply with all maritime laws.

5.6.4 Fauna Management System

It is expected that each titleholder will carry out observations, report incidents, and share opportunities for improvement with other petroleum titleholders in the Otway Basin regarding underwater sound management and whale interactions. Titleholders in the region are all individually responsible for ensuring the acceptable level of impact for Blue Whales and Southern Right Whales is not exceeded and titleholders have agreed to collaborate with the aim of minimising the potential for cumulative impacts associated with underwater sound, should activity timings overlap biologically important periods for Blue Whales and or Southern Right Whales.

5.7 Identification of Additional Control Measures

Additional control measures have been considered because of this CIA to support titleholders in the Otway region to demonstrate cumulative impacts have been reduced to as low as reasonably practical (**ALARP**) and meet acceptable levels for cumulative impacts.

Additional control measures may include a review and strengthening of existing measures, investigating the feasibility of additional mitigation measures or adaptive management processes, refining the activity description to reduce impact, and working with the proponents of other relevant reasonably foreseeable future projects to develop holistic mitigation strategies that consistently improve outcomes.

5.7.1 Cultural Heritage Protection Program

First Nations cultural heritage values and sensitivities associated with Sea Country, and those related to the environmental components assessed above, will be protected through the implementation of a collaborative protection program. This program will provide an opportunity for First Nations persons with Sea Country values and sensitivities within or adjacent to the operational areas to co-design and co-implement measures that protect cultural values and sensitivities. This program is open to investment from other parties to further the growth and scope of the program to address cumulative impacts if it continues to be effective.

6 Outcome of CIA

The potential for cumulative impacts is considered low, with lower-order consequences, given:

- The contracting of a single rig to conduct drilling related activities in the region which has eliminated the potential for concurrent cumulative impacts associated with multiple rig and support vessel operations.

- The physical overlap of a drilling activity within a seismic acquisition area has not been predicted and would make one, or the other activity unworkable.
- The commitment from CGG and TGS to not undertake the surveys at the same time eliminates cumulative impacts from these sources. The overall cumulative impact is considered low.

6.1 CIA Outcome on Conservation Values and Sensitivities

Based on the outcome of the CIA, it is considered that cumulative impacts associated with the each of the projects and activities in this CIA both individual and collectively will not affect the representativeness of the South-east Commonwealth Marine Reserves Network, nor the conservation values of the Zeehan Marine Park associated with seabirds, the white shark and marine mammals, or sea-floor features.

6.2 Cumulative Impacts Reduced to ALARP

The residual cumulative impacts are considered to be of lower order because the cause effect pathways to impact have been identified and can be reduced with the adoption of industry standard control measures specified in Section 5.6, plus the additional measures in Section 5.7.

6.3 Cumulative Impacts Reduced to Acceptable Levels

Following completion of the CIA process, the residual cumulative impacts are of lower order because good practice controls are defined and will be implemented and each of the activities will be managed in accordance with relevant company, Commonwealth, international, and Industry standards, guidelines, and requirements.

7 Document Control

Date	Revision	Update
5 January 2024	1	EP submission to NOPSEMA
14 May 2024	**2**	**Reviewed and update following public comment and rerun of the PSMT searches.**

Annex 1 – Spatial overlap analysis

	Thylacine (Beach)	**Geographe (Beach)**	**CHN (Cooper)**	**Otway Drilling (Conoco)**	**Production Drilling (Cooper)**	**Minerva Decom**	**Production Drilling (Beach)**	**Seismic Survey (Otway 3D MSS)**	**Seismic Survey (Regia MSS)**	**Seismi Survey (Calico – Beach)**
Thylacine (Beach)		None	None	Light[1]	None	None	None	None	Sound[3]	None
Geographe (Beach)	None		None	Light[1]	None	None	Light, Sound[2, 3]	None	Sound	None
CHN (Cooper)	None	None		None	Light, Sound[2, 3]	None	None	None	None	None
Otway Drilling (ConocoPhillips)	Light[1]	Light[1]	None		None	None	Light, Sound[2, 3]	None	Light, Sound[2, 3]	None
Production Drilling (Cooper)	None	None	Light, Sound[2, 3]	None		None	None	None	Sound[3]	Sound[3]
Minerva Decommissioning	None	None	None	None	None		None	None	Sound[3]	Sound[3]
Production Drilling (Beach)	None	Light, Sound[2, 3]	None	Light, Sound[6]	None	None		None	Sound[3]	None
Seismic Survey (Otway 3D MSS)	None	None	None	None	None	None	None		Sound[3]	None
Seismic Survey (Regia MSS)	None	Sound[3]	None	Light, Sound[2, 3]	Sound[3]	Sound[3]	Sound[3]	Sound[3]		None
Seismi Survey (Calico – Beach)	None	None	None	None	Sound[3]	Sound[3]	None	None	None	

1. This overlap is based on a 20 km area of effect from these activities noting that ConocoPhillips Australia have not identified final drilling locations.
2. This overlap is from the drilling activities being proximate to the production facilities.
3. The overlap in sound is taking from a conservative estimate of 50 km between sound sources noting that distance is an inadequate but conservative measure to determine spatial overlap between projects and activities.

Annex 2 – CIA Scoping Tool

Environmental Component	Sub-Component	Environmental Aspect (yellow = drilling specific)									CIA Scoping					
		Physical Presence	Seabed Disturbance	Artificial Light - Operational	Artificial Light - Flaring	Atmospheric Emissions	Underwater Sound - Continuous	Underwater Sound - Impulsive	Routine Discharges	Drilling Discharges	**Acceptable Levels (Effect) Ecological integrity and biodiversity conservation (Temporary/reversible/recoverable, small scale and/or low intensity)** **Assessing scale and nature**	Potential for Cumulative Impact - Spatial Extent	Potential for Cumulative Impact - Temporal Extent	Predictability and Certainty	Scoping Assessment Outcome	Cumulative Cause-effect Pathway
Physical Environment	Water Quality		✓						✓	✓	Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity discharge location	N - Limited to duration of individual activity	High for individual and cumulative impacts.	No cumulative impact cause-effect pathway identified. Impacts to water quality from COPA's and other potential activities are predicted to rapidly disperse given the open ocean environment and prevailing currently within 500 m to 2 km of the discharge, thus there is no potential to accumulate over spatial or temporal scales.	None identified
	Sediment Quality		✓							✓	Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity discharge location	N - Limited to months - year after individual activity	High for individual and cumulative impacts.	Cumulative impact cause-effect pathway identified but impacts not material. No impacts to sediment quality are predicted for seismic surveys. Impacts to sediment quality from COPA's and other drilling activities are predicted to be localised within 500 m of each well. Though there is the potential for an increase in potential impact as each area is very small (500 m) material impacts are not predicted.	Identified but impacts not material. No further assessment required.
	Air Quality					✓					Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity discharge location	N - Limited to duration of individual activity	High for individual and cumulative impacts.	No cumulative impact cause-effect pathway identified. Impacts to air quality from COPA's and other potential activities are predicted to be localised and atmospheric emissions will rapidly disperse to background levels close to the emissions source given the open ocean environment and prevailing wind. Emissions are not predicted to affect the achievement of the National Environmental Protection Measure for Ambient Air Quality (NEPM AQQ) (NEPC 2021) protection goals., with no potential to accumulate over spatial or temporal scales.	None identified
	Climate					✓					Small-scale and low intensity impacts.	N - Global climate	N - Indeterminable	High for individual and cumulative impacts.	Although GHG emissions from COPA's and other potential activities will add to the global atmospheric levels of GHG emissions, the quantities estimated to be released are insignificant on a global scale.	None identified
	Ambient Light - Operational			✓							Temporary, small-scale, and recoverable impacts.	Y - Bioregion, BIAs, and biologically important behaviours for sensitive species	Y - Consecutive activities, and seismic and single drilling operation may occur concurrently	High for individual and cumulative impacts.	There is potential for cumulative impacts depending on location of activities and sensitive receptors. Although changes in ambient light are restricted to typically 20 km radius of individual activities, activities may occur consecutively over several years within the Otway Basin and seismic and drilling at a single location have the potential to occur concurrently	Identified and further assessment required to determine if impacts are material.
	Ambient Light - Flaring			✓	✓						Temporary, small-scale, and recoverable impacts.	N - Only single drilling operation at any one time	Y - Consecutive activities if others are flaring in similar location	High for individual and cumulative impacts.	There is potential for cumulative impacts depending on location of activities and sensitive receptors. Although flaring light impacts are restricted to typically 50 km radius of individual short-term operations (max. 120 hours per well), flaring may occur consecutively over several years within the Otway Basin.	Identified and further assessment required to determine if impacts are material.

Environmental Component	Sub-Component	Environmental Aspect (yellow = drilling specific)									CIA Scoping					
		Physical Presence	Seabed Disturbance	Artificial Light - Operational	Artificial Light - Flaring	Atmospheric Emissions	Underwater Sound - Continuous	Underwater Sound - Impulsive	Routine Discharges	Drilling Discharges	Acceptable Levels (Effect) Ecological integrity and biodiversity conservation (Temporary/reversible/recoverable, small scale and/or low intensity) Assessing scale and nature	Potential for Cumulative Impact - Spatial Extent	Potential for Cumulative Impact - Temporal Extent	Predictability and Certainty	Scoping Assessment Outcome	Cumulative Cause-effect Pathway
	Ambient Sound						✓	✓			Temporary, small-scale, and recoverable impacts.	Y - Bioregion, BIAs, and biologically important behaviours for sensitive species	Y - Consecutive activities Seismic and single drilling operation may occur concurrently	Moderate for individual and cumulative impacts.	There is potential for cumulative impacts depending on location and timing of activities and sensitive receptors. Although sound impacts are restricted to within typically 10s of kms around individual activities, activities may be occurring consecutively over a period and seismic and drilling (at a single location) have the potential to occur concurrently.	Identified and further assessment required to determine if impacts are material.
Ecological Environment	Benthic Habitats and Communities		✓							✓	Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity area	N - Limited to weeks-months after individual activity	High in individual and cumulative impacts.	No cumulative impact effect pathway identified. The area of impact is relatively small compared to the extent of the distribution of benthic habitats and associated benthic fauna found within the Otway Basin. Widespread changes to the benthic environment or ecosystem functioning or integrity are not predicted. No overlap with threatened ecological communities. Overlap with Zeehan AMP, which has benthic habitat as a value, only occurs one activity.	None identified
	Coastal Habitats and Communities										N/A for planned activities. (No impact to coastal areas from planned drilling operation impacts).					None identified
	Plankton						✓	✓	✓	✓	Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity area	N - Recovery days post activity	Moderate for individual and cumulative impacts.	No cumulative impact effect pathway identified. Discharges to the water column are not predicted to impact water quality at a cumulative scale and therefore will not impact plankton at an ecological integrity level. Continuous noise from drilling and vessel operation is not predicted to impact plankton. The cumulative impact of impulsive sound from consecutive seismic operations has been assessed and controlled in relevant EPs. Impacts from VSP are short term (<20 hours per well and nor predicted to result in impacts at scale to contribute to cumulative impacts.	None identified
	Invertebrates		✓				✓	✓		✓	Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity with exception of multiple seismic operations	N - Limited to weeks-months after individual activity	High for individual and cumulative impacts.	No cumulative impact effect pathway identified. Continuous noise from drilling and vessel operation and VSP is not predicted to impact invertebrates. The cumulative impact of impulsive sound from consecutive seismic operations has been assessed and controlled in relevant EPs.	None identified

Environmental Component	Sub-Component	Environmental Aspect (yellow = drilling specific)									CIA Scoping					
		Physical Presence	Seabed Disturbance	Artificial Light - Operational	Artificial Light - Flaring	Atmospheric Emissions	Underwater Sound - Continuous	Underwater Sound - Impulsive	Routine Discharges	Drilling Discharges	Acceptable Levels (Effect) Ecological integrity and biodiversity conservation (Temporary/reversible/recoverable, small scale and/or low intensity) Assessing scale and nature	Potential for Cumulative Impact - Spatial Extent	Potential for Cumulative Impact - Temporal Extent	Predictability and Certainty	Scoping Assessment Outcome	Cumulative Cause-effect Pathway
	Fish and Sharks						✓	✓			Not inconsistent with EPBC Act Management Plans, and Recovery Plans. Temporary, small-scale, and recoverable impacts.	N - Limited to individual activity with exception of multiple seismic operations	N - Periods of biologically important behaviours for sensitive species	High for individual and cumulative impact sense.	No cumulative impact cause-effect pathway identified. Underwater sound from drilling is predicted to be localised to within 190 m for recoverable injury and TTS for fish and sharks and within 450 m for VSP. The area of impact from concurrent seismic and drilling activities is small compared to the extent of the distribution of fish and shark species. The area of impact from concurrent seismic and drilling activities is small compared to the white shark distribution BIA but is considered moderate for the foraging BIA. However, seismic survey and drilling operations with the potential to affect the foraging BIA in the northern extent of VIC/P79 are mutually exclusive and cannot occur concurrently. Sound impacts are not identified as a threat within the Recovery Plan for the White Shark (Carcharodon carcharias) (DSEWPaC 2013a).	None identified
	Birds			✓	✓		✓	✓			Not inconsistent with EPBC Act Management Plans, and Recovery Plans. Temporary, small-scale, and recoverable impacts.	Y - BIAs for sensitive species (Bioregion)	Y - Periods of biologically important behaviours for sensitive species	High for individual and cumulative impacts.	There is potential for cumulative impacts associated with light depending on location of activities and sensitive receptors, i.e. foraging, migrating, and breeding birds. There is no cumulative effect pathway for underwater sound with the consequence of underwater sound on birds from drilling activities assessed as negligible. Although changes in ambient light are restricted to typically 20 km radius of individual activities, activities may be occurring consecutively over several years throughout the region and seismic and drilling at one location have the potential to occur concurrently.	Identified and further assessment required to determine if impacts are material.
	Marine Reptiles			✓	✓		✓	✓			Not inconsistent with EPBC Act Management Plans, and Recovery Plans. Temporary, small-scale, and recoverable impacts.	N - No BIAs or critical habitat	N - No periods of biologically important behaviours for sensitive species	High for individual and cumulative impacts.	No cumulative effect pathway identified. Individuals in the area are expected to be transient, with no BIAs, critical habitat, or biologically important behaviours within the Otway Basin. Lighting doesn't impact in water navigation or behaviours and impacts from noise will be temporary and recoverable.	None Identified
	Marine Mammals						✓	✓			Not inconsistent with EPBC Act Management Plans, and Recovery Plans. Temporary, small-scale, and recoverable impacts.	Y - BIAs for sensitive species (Bioregion)	Y - Periods of biologically important behaviours for sensitive species	Moderate for individual and cumulative impacts.	There is potential for cumulative impacts associated with underwater sound depending on location of activities and sensitive receptors, i.e. endangered species, foraging and migrating BIAs. Although sound impacts are restricted to within typically 10s of kms around individual activities, activities may be occurring consecutively over a period and seismic and drilling at one location have the potential to occur concurrently.	Identified and further assessment required to determine if impacts are material.
	Conservation Values and Sensitivities		✓			✓	✓	✓		✓	Not inconsistent with SE Marine Parks Network Management Plan. Temporary, small-scale, and recoverable impacts.	Y - Zeehan AMP	Y - Periods of biologically important behaviours for conservation values	High for individual and cumulative impacts.	The Zeehan Marine Park is overlapped by three proposed activities, including the COPA drilling project. See individual ecological receptors above for assessment of conservation values of the Zeehan Marine Park which include benthic habitats that supports animal communities and invertebrates, seabirds, the white shark and migrating blue whales and humpback whales.	Identified for seabirds and whales and further assessment required to determine if impacts are material.

Environmental Component	Sub-Component	Environmental Aspect (yellow = drilling specific)									CIA Scoping					
		Physical Presence	Seabed Disturbance	Artificial Light - Operational	Artificial Light - Flaring	Atmospheric Emissions	Underwater Sound - Continuous	Underwater Sound - Impulsive	Routine Discharges	Drilling Discharges	Acceptable Levels (Effect) Ecological integrity and biodiversity conservation (Temporary/reversible/recoverable, small scale and/or low intensity) Assessing scale and nature	Potential for Cumulative Impact - Spatial Extent	Potential for Cumulative Impact - Temporal Extent	Predictability and Certainty	Scoping Assessment Outcome	Cumulative Cause-effect Pathway
Socio-economic Environment (Other marine and coastal users)	Coastal Communities and Onshore Tourism Activities	✓		✓	✓						Temporary, small-scale, and low intensity impacts.	N - Not predicted to see multiple activities from single vantage point (King Island, Victorian coast)	Y - May be able to see different activities over time from single vantage point (King Island, Victorian coast)	High for individual and cumulative impacts.	Cumulative effect pathway identified, associated with visibility of different activities over time, but impacts not material. The likelihood of visibility of multiple activities from a single vantage point is considered low given the distances offshore it is not predicted that rig and vessel would be distinguishable from other existing vessel traffic.	Identified but impacts not material. No further assessment required.
	Offshore Petroleum Activities	✓									Temporary, small-scale, and low intensity impacts.	N	N	High for individual and cumulative impacts.	Cumulative effect pathway identified but impacts not material. Other activities are scheduled and/or operate within their own exclusion zones/petroleum titles. Notice to mariners will provide advanced warning and opportunity to plan transit route. At most avoidance of a single seismic survey vessel and towed equipment, and a single drilling location at any given time with minimal impact.	Identified but impacts not material. No further assessment required.
	Offshore Renewable Energy Activities	✓									Temporary, small-scale, and low intensity impacts.	N	N	High for individual and cumulative impacts.	No cumulative impact effect pathway identified. There are no reasonably foreseeable future projects or activities in the offshore Otway Basin.	None Identified
	Defence Activities	✓	✓								Temporary, small-scale, and low intensity impacts.	Y - Displacement from concurrent and consecutive seismic and drilling areas	Y - Displacement from concurrent and consecutive seismic and drilling areas	High for individual and cumulative impacts.	Cumulative effect pathway identified but impacts not material. Industry standard controls in place such as notice to mariners will provide advanced warning and opportunity to plan transit route. At most avoiding a single seismic survey vessel and towed equipment, and a single drilling location at any given time with minimal impact. Impacts to maritime archaeological heritage are not predicted from seismic surveys. Drilling activities required to undertake seabed surveys prior to seabed disturbance. Impacts to UXO are not a planned event and therefore cumulative impacts are not predicted.	Identified but impacts not material. No further assessment required.
	Shipping	✓									Temporary, small-scale, and low intensity impacts.	Y - Displacement from concurrent and consecutive seismic and drilling areas	Y - Displacement from concurrent and consecutive seismic and drilling areas	High for individual and cumulative impacts.	Cumulative effect pathway identified but impacts not material. The area of impact is small compared to the area available for shipping. Industry standard controls in place such as notice to mariners will provide advanced warning and opportunity to plan transit route. At most avoiding a single seismic survey vessel and towed equipment, and a single drilling location at any given time with minimal impact.	Identified but impacts not material. No further assessment required.
	Marine Tourism	✓									Temporary, small-scale, and low intensity impacts.	Y - Displacement from concurrent and consecutive seismic and drilling areas	Y - Displacement from concurrent and consecutive seismic and drilling areas	High for individual and cumulative impacts.	Cumulative effect pathway identified but impacts not material. The area of displacement is small compared to area available for tourism. Industry standard controls in place such as notice to mariners will provide advanced warning and opportunity to plan transit route. At most avoiding a single seismic survey vessel and towed equipment, and a single drilling location at any given time with minimal impact.	Identified but impacts not material. No further assessment required.

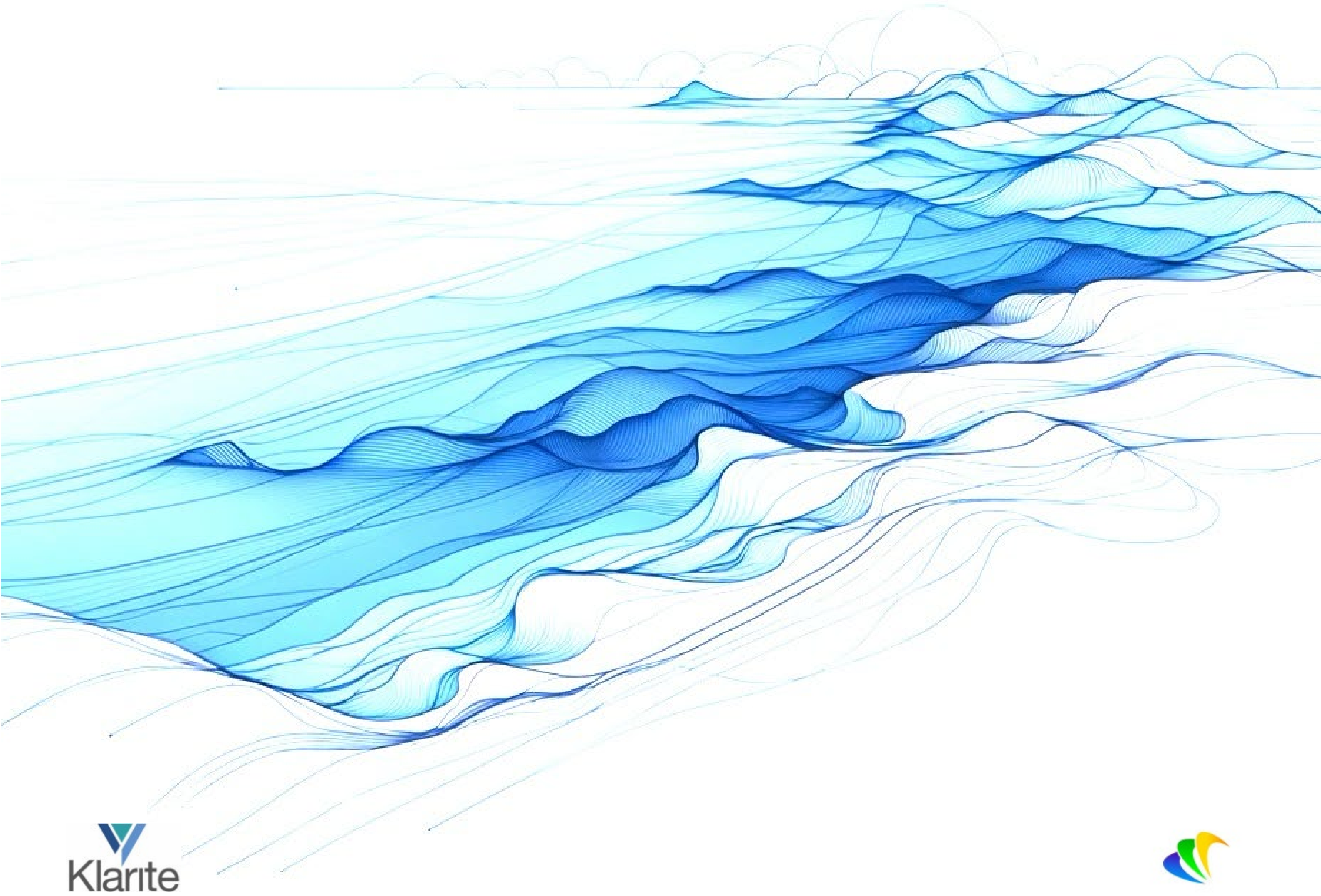
Environmental Component	Sub-Component	Environmental Aspect (yellow = drilling specific)									CIA Scoping					
		Physical Presence	Seabed Disturbance	Artificial Light - Operational	Artificial Light - Flaring	Atmospheric Emissions	Underwater Sound - Continuous	Underwater Sound - Impulsive	Routine Discharges	Drilling Discharges	Acceptable Levels (Effect) Ecological integrity and biodiversity conservation (Temporary/reversible/recoverable, small scale and/or low intensity) Assessing scale and nature	Potential for Cumulative Impact - Spatial Extent	Potential for Cumulative Impact - Temporal Extent	Predictability and Certainty	Scoping Assessment Outcome	Cumulative Cause-effect Pathway
	Recreational Diving and Surfing						✓	✓			N/A for planned activities. No affect to divers and surfers from planned drilling operations are predicted.					None identified
	Recreational Fishing	✓									Temporary, small-scale, and low intensity impacts.	Y - Displacement from concurrent and consecutive seismic and drilling areas on-shelf area	Y - Displacement from concurrent and consecutive seismic and drilling areas	High for individual and cumulative impacts.	Cumulative effect pathway identified but impacts not material. The area of displacement is small compared to area available for recreational fishing. Industry standard controls in place such as notice to mariners will provide advanced warning and opportunity to plan activities. At most avoiding a single seismic survey vessel and towed equipment, and a single drilling location at any given time with minimal impact.	Identified but impacts not material. No further assessment required.
	Commercial Fisheries	✓	✓				✓	✓			Affected persons will not be worse off because of the activity.	Y - Displacement from concurrent and consecutive seismic and drilling areas	Y - Displacement from concurrent and consecutive seismic and drilling areas	High for individual and cumulative impacts.	Cumulative effect pathway identified. Displacement of fishers operating in fisheries with spatial extent that may be overlapped by several offshore activities, i.e. displaced by multiple exclusion zones (rig and seismic survey) or different exclusion zone over time. Although displacement impacts are restricted to within typically 2 kms around individual activities, drilling may be occurring consecutively over a period and seismic and drilling at one location have the potential to occur concurrently. Minor behavioural disturbances are predicted to commercial fish species from underwater sound and cumulative impacts are not predicted.	Identified and further assessment required to determine if impacts are material.
Cultural Environment	First Nations Peoples Heritage including but not limited to Sea Country, Song Lines, and totemic species.	✓	✓	✓	✓		✓	✓		✓	Not inconsistent with Indigenous Protected Area Plans. Temporary, small-scale, and recoverable impacts.	Y - Sea Country	Y - Over term of activities	Moderate in individual and cumulative impacts.	Cumulative effect pathway identified. Drilling and other activities may have the potential to cumulatively affect cultural values and sensitivities in the region.	Identified and further assessment required to determine if impacts are material.
	Maritime Archaeological Heritage		✓								No disturbance of maritime cultural heritage.	N - Only single drilling operation at any one time	N - Control Measures in place to detect and prevent interactions	High for individual and cumulative impacts.	No cumulative effect pathway identified. Impacts to maritime archaeological heritage are not predicted from seismic surveys. Drilling activities required to undertake seabed surveys prior to seabed disturbance. Impacts to maritime archaeological heritage are not a planned event and therefore cumulative impacts are not predicted.	None Identified

ALARP Assessment

Appendix F2: REG-EP-031-F2

Rev 2

May 2024



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1 Introduction

The As Low as Reasonably Practicable (**ALARP**) assessment for the Regia Marine Seismic Survey (**Regia MSS**) serves as a critical component of our commitment to responsible environmental management and risk reduction. CGG recognise the significance of safeguarding the marine environment and minimising environmental impacts and risks.

The primary objective of this ALARP assessment is to systematically evaluate the impacts and risks associated with the Regia MSS, ensuring that CGG operate within a framework that prioritises safety, environmental protection, and compliance with relevant regulations. The assessment focuses on identifying control measures and strategies that can reasonably and effectively reduce risks to the lowest practicable level.

The Regia MSS represents a complex endeavour, and its success relies on a comprehensive understanding of potential hazards and the implementation of robust control measures. This assessment seeks to strike a balance between the project's objectives and the protection of the environment, cultural heritage, and the well-being of local communities.

2 Purpose and Scope

We have adopted a structured approach to this ALARP assessment, which includes defining the scope and objectives, identifying hazardous activities and associated risks, evaluating initial control measures, assessing feasibility, and exploring alternative, additional, or improved control measures. Through a rigorous process, we aim to make informed decisions that promote the safety of personnel, protect the marine environment, and respect the functions, interests, and activities of relevant persons.

This assessment underscores our commitment to continuous improvement. We recognise that risk management is an evolving process, and as such, we will periodically review the effectiveness of control measures, engage in ongoing consultations with relevant persons, and adapt our practices as needed. Our goal is to ensure that the Regia MSS not only meets regulatory requirements but also sets industry benchmarks for responsible and sustainable marine surveys.

3 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table F2-1, and the feedback received during the public comment period for the completed EP is provided in Table F2-2.

3.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Table F2-1 shows how this feedback has been incorporated into the environmental assessments.

Table F2-1 - Relevant person input into the preparation of the EP

Objections and Claims	Feedback ID	Measure adopted because of consultation
In any ALARP analysis, should we not see the numbers eg. how much is CGG going to make and what proportion of this profit spent on mitigation strategies will represent "grossly disproportionate"?	271	This ALARP assessment report has incorporated a more detailed explanation of the ALARP concept and shown in more detail the weighing of impact/risk reduction measures against the sacrifice required to implement them.
We request that you use alternate methods to seismic blasting to map the seabed such as marine vibriosis.	272	No measures were adopted because of this claim. Utilising acoustic sources for marine seismic surveying provides a framework grounded in extensive research and practical experience. Their environmental impacts, both short-term and long-term, have been studied, facilitating the development of effective mitigation strategies. On the other hand, marine vibriosis, while holding promise as a newer technology, is not only more expensive but also shrouded in technical and environmental uncertainties. Its long-term effects, particularly concerning particle motion and its potential impact on marine ecosystems and sensitive aquatic species, remain inadequately explored. Exploring these environmental impacts is unlikely until the technology is commercially competitive. Until we have a comprehensive grasp of these implications, it is prudent to rely on technology with known and manageable impacts rather than embracing potentially riskier avenues with unforeseen or highly uncertain environmental impacts.

3.2 Public Comment

The completed EP was published for public comment on the NOPSEMA website on 25 Jan 2024 for a 30-day period, closing 26 February 2024. Table F2-2 shows how this feedback has been incorporated into the environmental assessments.

Table F2-2 - Public comment input into the preparation of the EP.

Matter	Matter ID	Changes made arising from public comment
Matter: Consideration of alternative survey technology	O01	CGG acknowledges claims regarding the consideration of alternative survey technologies and EP Appendix F2 (ALARP Assessment) has been updated to include additional information on this assessment.

4 ALARP Concept

The ALARP concept embodies a fundamental principle of risk management. It is important to emphasise that in concept, ALARP assessments are not merely a cost/benefit analysis. The ALARP principle involves a more detailed understanding of what is "reasonably practicable." This means assessing the level of impact or risk in relation to the sacrifice involved in adopting measures to avert an impact or risk. Table F2-2 shows the types of consideration on both sides of the ALARP concept.

Table F2-3 - Conceptual parameters in assessing whether ALARP has been reached.

Impact or Risk Reduction Achieveable	Sacrifice Required for Adoption
Reduced Occurrence: This includes decreasing the occurrence (either likelihood or uncertainty) of emissions and discharges.	**Financial Cost:** The most obvious sacrifice is the direct financial cost of implementing a control measure. This includes the cost of purchasing equipment, technology, or services, as well as any ongoing maintenance and operational costs.
Reduced Severity: This includes decreasing the effect or consequence of emissions and discharges.	**Time and Effort:** Implementing new processes or technologies often requires significant time and effort. This can include the time taken for research and development, training staff, and integrating new systems into existing workflows.
Compliance with Regulations: Meeting or exceeding environmental regulations can improve environmental outcomes and avoid legal penalties.	**Operational Disruption:** Introducing new control measures can disrupt regular operations. This might mean downtime, reduced productivity, or the need to alter business practices temporarily or permanently.
Long-term Sustainability: Sustainable practices can ensure long-term viability and resilience of the business and the environment.	**Resource Allocation:** Resources, including human resources, might need to be reallocated. This could mean diverting staff from managing one impact or risk to managing a different or new impact or risk
Ecosystem Preservation: Protecting natural habitats and biodiversity, which has intrinsic value and can support long-term ecological balance.	**Opportunity Cost:** Implementing a control measure might mean foregoing other opportunities. For instance, investing heavily in one area of environmental protection might limit a company's ability to invest in other areas.

In weighing the two sides of an ALARP assessment measures that provide a level of impact or risk reduction that is commensurate to the sacrifice must be adopted. Further, measures that carry a disproportionate sacrifice to the impact or risk reduction achievable must also be adopted. Only measures where the sacrifices are 'grossly disproportionate' to the impact or risk reduction can be rejected by CGG.

This necessitates that the levels of risk or impact are well understand prior to the ALARP assessment. These levels were identified in accordance with the environmental assessment method in Appendix B9 and performed in Appendices D1 – D4 and E1 – E10. These assessments put the existing levels of impact and risk in context of one another. Appendix F3 considers these impacts and risks in their full context. Both contexts are useful in understanding the levels of impact and risks being treated during the ALARP assessment.

4.1 When is a mitigation measure 'grossly disproportionate'?

Conceptually, the sacrifice of adopting a control measure is considered grossly disproportionate to the impact/risk reduction achievable for any of the following reasons:

- **Marginal Reduction:** If the impact/risk is already low and the additional measure offers only a marginal reduction in that impact/risk, the cost is likely to be seen as excessive.

- **Exorbitant Costs:** The measure itself may be extremely expensive, and there would be diminishing returns to adopt the measure, making it impractical compared to the benefit of the slight risk reduction it offers.
- **Limited Effectiveness:** The measure may not be significantly effective in reducing the impact/risk, making the high cost hard to justify.
- **Alternative Are Better:** There might be other, more cost-effective measures or strategies available that can achieve similar impact/risk reduction levels.
- **Unacceptable Trade-offs:** If the implementation of the measure negatively effects other critical operations, environmental aspects, or other parts of the business disproportionately, it might not be justifiable.
- **Impact/Risk Transfer:** The measure might only transfer the impact/risk elsewhere rather than mitigating it, making the cost ineffective in terms of overall reduction.

5 ALARP Assessment Processes

There are many ways to conduct an ALARP assessment and choosing the correct level of analysis is important in the demonstration required under the *Offshore Petroleum and Greenhouse Gas Storage (*Environment*) Regulations 2023* (**the Regulations**). The types and depth of analysis vary according to the nature and scale of the activity. For the Regia MSS, CGG has completed a two-part assessment to demonstrate that the environmental impacts and risks of the Regia MSS have been reduced to ALARP.

Part 1. The activity is evaluated by considering temporal and spatial opportunities for impact and risk reduction. This holistic view ensures that impacts and risks are not merely transferred or overlooked in the broader operational context.

Part 2. Each environmental aspect is individually evaluated to ensure that impacts and risks associated with each aspect are reduced effectively. This includes specific treatments or reduction strategies for each identified environmental impact and risk.

ALARP levels of impact and risk can vary dynamically across time so this assessment process can and will be applied throughout the duration of the Environment Plan (**EP**) ensuring a continuous improvement approach to environmental stewardship and risk management.

5.1 Treatment of Environmental Impacts and Risks

There were five types of mitigation and management measures considered in the preparation of the Regia MSS EP as shown in Figure A2-1. All five management and mitigation measures are valid in the ALARP demonstration. Generally, activity limitations would arise from the consideration of whether the activity itself can be carried out in a manner that reduces impacts and risks of the activity to ALARP. Legislative requirements have already been considered in the previously completed impact and risk analyses. The other management and mitigation measures are the subject of this evaluation.

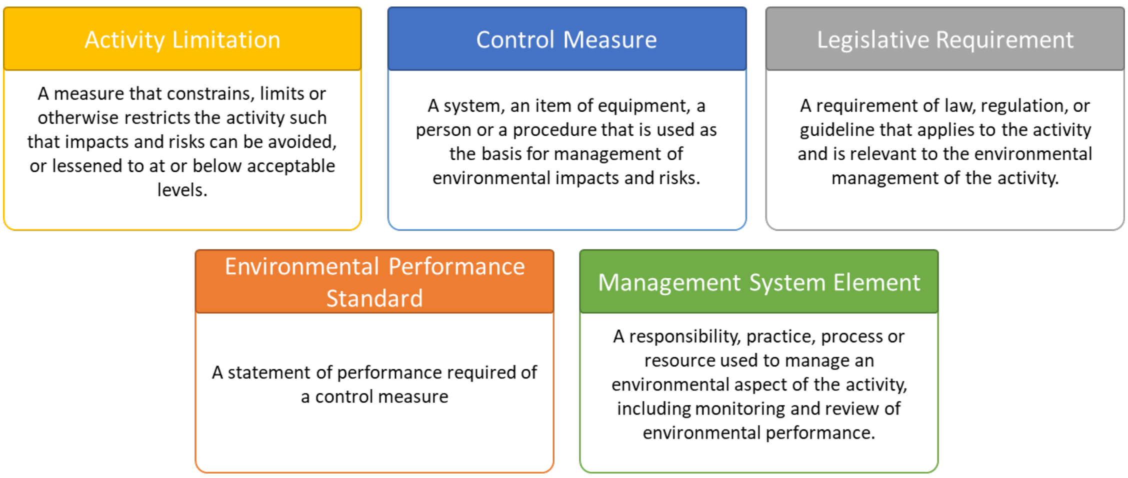


Figure A2-1 - Types of management and mitigation measures

5.2 Evaluation of the Activity

The evaluation process for determining whether an activity has effectively reduced environmental impacts and risks to ALARP is structured in such a way that it can be easily understood and could be repeated by other experts and the same outcomes achieved. It is designed to ensure a comprehensive understanding and management of environmental risks associated with any given activity. Through a series of steps, from risk identification to decision making, this process not only assesses current management and mitigation measures but also seeks to identify and implement improvements wherever feasible. The assessment of whether the Regia MSS has been designed so that it can be carried out in a manner by which the environmental impacts and risks of the activity will be reduced to ALARP must consider the space and time constraints that need to be adopted. Given CGG's interest in the area these are almost exclusively informed by relevant person consultations.

5.3 Evaluation of Environmental Aspects

Table F2-3 outlines the steps used by CGG to complete this task. CGG decided to conduct the ALARP assessment by environmental aspect based on several considerations:

Relevance: Environmental aspects represent specific factors or elements of the Regia MSS activities that have the potential to cause environmental impacts or risks. Assessing each aspect individually allows for a more targeted evaluation of the control measures related to that aspect. It ensures that the assessment directly addresses the factors contributing to potential harm to the environment.

Clarity and Focus: Isolating to a single environmental aspect provides clarity and focus. This approach allows for a deep dive into one aspect, making it easier to understand, evaluate, and document. It also facilitates a clear presentation of the assessment process and findings.

Practicality: Conducting a comprehensive ALARP assessment for each impact or each risk associated with multiple environmental aspects can be time-consuming and complex. By addressing one aspect at a time, it simplifies the assessment process and makes it more manageable for those completing the assessment and for others reading the output.

Tailored Evaluation: Different environmental aspects may require distinct control measures and considerations. Focusing on a single aspect enables tailored evaluation based on its unique characteristics and challenges. It allows for a more nuanced assessment of the feasibility and effectiveness of control measures specific to that aspect.

Progressive Assessment: Conducting the assessment by environmental aspect allows for a progressive evaluation of each aspect's control measures. This stepwise approach ensures that each aspect receives dedicated attention and thorough analysis, helping to identify whether existing controls are ALARP or if improvements are needed.

Communication: Presenting the assessment results by environmental aspect makes it easier to communicate findings and decisions to stakeholders, including regulatory authorities, environmental experts, relevant persons and project managers. It allows for clear reporting on the status of control measures for each specific aspect.

CGG acknowledges that conducting an ALARP assessment by each environmental aspect may lead to a fragmented evaluation, especially when there are multiple environmental aspects involved. This explains why the further evaluation of the activity of the whole was also required.

Table F2-4 - ALARP Assessment Process for Environmental Aspects

Process Step	Description
Step 1: Define the Scope and Objectives	Clearly define the scope of the assessment, including the specific aspects of the Regia MSS that require control measures. Set clear objectives for the assessment, such as identifying feasible control measures and evaluating alternative measures.
Step 2: Identify the Hazardous Activities	Identify and list the hazardous activities associated with the Regia MSS, as well as the potential impacts and risks.

Process Step	Description
Step 3: Identify Standard Measures	List the management and mitigation measures that industry standards or legislative requirements mean are currently in place. These may include any relevant management and mitigation measures such as activity limitations, control measures, environmental performance standards, legislative requirements, management system elements.
Step 4: Feasibility Assessment	For each identified control measure, assess its feasibility: • Evaluate whether the control measure is technically feasible, considering available technology and resources. • Assess the economic feasibility by considering the cost-benefit analysis. • Consider the practicality and logistics of implementing the control measure. • Examine whether the control measure aligns with regulatory requirements and industry standards.
Step 5: Identify Alternative, Additional, or Improved Measures	Research and identify alternative control measures that could be adopted to further mitigate the identified risks. Consider additional measures that could supplement the existing controls. Explore potential improvements to existing control measures to enhance their effectiveness.
Step 6: Evaluate the Alternatives	For each alternative, additional, or improved control measure identified in Step 5, evaluate their reasonableness: • Assess whether they are technically infeasible due to limitations in technology or expertise. • Consider their economic feasibility and whether they are cost-effective compared to the existing controls. • Evaluate their practicality and whether they can be implemented without significant disruption. • Check if they comply with relevant regulations and standards.
Step 7: Decision-making	Perform an assessment for each control measure, considering the likelihood and consequences of potential incidents. Compare the risks associated with adopting or rejecting each control measure. Determine whether the control measures have reduced impact and risk to "As Low As Reasonably Practicable" based on the ALARP principle.

Once the process has been completed, CGG will have a record of the findings of the ALARP assessment, including the control measures evaluated, their feasibility, and the reasons for adopting or rejecting them. This allows for future reviews of the control measures to properly understand the context in which previous decisions were made.

In Appendix B3, the environmental management system requires CGG to continuously monitor changes in technology, regulations, and best practices that may affect the performance of control measures.

5.3.1 Baseline Contexts

When making decisions about the levels of sacrifice required to adopt a measure, or the level of impact/risk reduction achieved through adoption, a baseline is required as a point of comparison. For this assessment CGG has adopted the baselines in Table F2-4 below as part of the ALARP assessment.

Table F2-5 - ALARP Baselines for the Regia MSS

ALARP Assessment	Baseline
Level of Sacrifice	The baseline sacrifice is a calculation of the total costs of preparing the EP, the costs of complying with environmental management law, costs of complying with industry standards, and the costs of consultations. It is inclusive of time value associated with obtaining the approvals necessary to undertake the activity. The baseline sacrifice is expressed as a unit value of 1 (one).
Level of Risk/Impact	The baseline level of impact/risk is taken from the outcome of the draft environmental assessments which applied legislative requirements and industry standards as the base case upon which environmental impacts and risk were assessed. The impact/risk rankings in Appendix B9 were used as the basis of both the baseline and the level of impact/risk reduction achieved by adopting the measure.

Other baselines were considered. In general terms, providing absolute values for costs in any case would require disclosures of commercially-in-confidence information from trusted suppliers to CGG. Similarly, disclosing project costs and assumptions in publicly available documents is not in CGG's overall best interests, nor is it a legislative requirement.

Following feedback from the consultation process CGG did consider requests for different methods of calculating baselines/points of comparison.

A straight monetary value was requested during the consultations whereby the profit of CGG in undertaking the activity should be disclosed and then compared to the monetary cost of adopting the measure. This method of calculating a baseline cost and subsequent comparison was not used because CGG's margin is not calculable due to the terms of sales being on a licence basis, and the method doesn't consider the environmental benefit achieved – only the cost of that environmental benefit which is similarly incalculable.

CGG also considered providing a proportionate assessment of sacrifice. This would have meant using the total project cost as the baseline level of sacrifice and further mitigation measures would have been expressed as a proportionate incremental increase on that baseline. This method was rejected because the relationship between the cost of a measure and its effectiveness on impact/risk reduction is not always linear. For example, using this method weighs the mitigation measures as equally effective for a nominal value, which is often not the case as low sacrifice measures can be highly effective and vis-versa.

5.4 Conclusion of the ALARP Assessment

An ALARP assessment could be an endless exercise, with never-ending permutations and variations on options. The end of an ALARP assessment is either:

- The point at which further reductions in impact and risk are so incrementally low that the sacrifice of further assessing management and mitigation measures is already grossly disproportionate; and/or
- The additional sacrifice of further analysis has reached a point of diminishing returns, and the cost of that further analysis would already be grossly disproportionate.

For the purposes of effective planning and the Regia MSS ALARP assessment, CGG decided to apply a Sacrifice Factor which is a cumulative total of the additional sacrifices made through the adoption of reasonably practical control measures. This was set at 2.5x the baseline sacrifice.

From the calculations shown in Annex 4 – Management and Mitigations Measures Evaluation, the cost of the adopted measures reached 3.456x the baseline sacrifice. In pursuance of the fundamental principles of ALARP, CGG has well exceeded the planned 2.5x baseline sacrifice where instances of low-cost/high mitigation measures were identified and implemented.

The assessment will recommend the control measures that must be adopted and environmental performance standards that must be set. These will be carried through to Appendix G1 where the environmental performance of the Regia MSS is set. The assessment may also recommend management system elements. These will be captured in an update to the Implementation Strategy (Appendix B3).

6 Evaluation of the Activity

When considering weather an activity, and its design parameters, have been reduced to as low as reasonably practicable, the following things need to be considered:

- The timing of the survey.
- The spatial extent and location of the survey; and
- The environmental constraints of these parameters.

In relation to environmental constraints, this includes consideration of the variety, abundance, and distribution of species, as well as their vulnerability, recoverability. The overall environmental health of environmental values and sensitivities within the area also come under consideration.

6.1 Survey Timing Constraints

CGG undertook a presence/absence analysis of environmental receptors in the environment planning area to decide on the preferred timing of the activity. The outcome of the analysis can be found in Annex 1, and this shows that there will always need to be environmental trade-offs in terms of timing. An initial survey timing was required to being consultations. So, initially, the summer months were selected as a time of year where the survey could be completed as quickly as possible. The decision to prefer the summer months was made on the basis that:

- A short survey results in the lowest level of overlap with all sensitivities and is the most efficient from an operations perspective.
- The shallower areas of interest in the activity planning area were coincident with the Southern Right Whale (**SRW**) biologically important area (**BIA**) which can only be accessed from November – April.
- Interactions with Blue Whales (**BW**) could be managed given the larger spatial distribution of the population.

Further, the winter months in the Otway are known for rough seas and high winds. This means seismic surveying is not possible due to safety concerns and weather down time extending the duration of the survey. Therefore, the timing of the survey had to prefer the transitional seasons and the summer months.

6.1.1 Protection of Other Marine Users

This coastline is used for recreational purposes throughout the summer months and surveying close to recreational users of the water during the holiday periods would have required the closure of some beaches for short periods of time. CGG wished to avoid beach closures and as such has made a commitment to protect divers and other marine users from amenity effects by designing the survey in such a way that amenity value thresholds will not be exceeded at popular recreational sites.

6.1.2 Protection of Biodiversity and Ecological Integrity

During the initial consultations CGG communicated its understanding of the values and sensitivities during the summer months. The shallower areas of the activity planning area were identified by commercial fishers, conservations groups, and interested member of the public as being of very high value (e.g. Feedback 99, 128, 135, 164, 190, 203). At the community sessions in Port Fairy and Warrnambool, CGG heard particular concern about the effects of seismic surveys on biodiversity, driven by mortal effects on zooplankton.

Further research during the environmental assessments identified that the summer months, particularly January, February and March, have much higher levels of biodiversity. This meant that effects to biological diversity and ecological integrity could be reduced by avoiding these months. This required a concession that if the Regia MSS was to go ahead, CGG would have to exclude these months from acquisition, and it would not be possible to acquire data within the SRW reproductive

BIA. This concession is likely to add significant cost to the survey from increased weather downtime and less geophysical data than CGG would have liked to acquire. However, CGG decided that, at this time, removing these areas from the proposed Regia MSS was reasonably practicable.

6.1.3 Protection of Southern Right Whales

The SRW reproductive BIA is close to the coast and relatively small meaning that presence and absence can be relatively easily observed. This in turn means that CGG would be better able to manage our interactions with this species. However, with January, February and March now excluded the survey design turned towards undertaking activities in deeper waters during SRW presence within their BIA. This required understanding the distances to temporary threshold shift effect thresholds for SRW. CGG undertook quantitative modelling to understand the appropriate impact management zone to place around the SRW reproductive BIA. This led to an activity limitation that no acquisition could take place within the SRW impact management zone whilst present within their BIA. The measures for detection are discussed later in this chapter in the underwater sound aspect assessment.

6.1.4 Protection of Blue Whales

BW were always a consideration in the summer months when they are present in their foraging BIA. The inability to survey and the winter or January, February and March meant that the Regia MSS now had to consider arrival/departure of BW and not just their presence. BW have been seen in the Otway region at the end of their southward migration in late October and have been known to remain in the region through April and into May.

BW presence and locations are harder to predict, and monitor given the size of the area and lack of annual patterns for both their food sources and foraging behaviour. Therefore, for the survey to commence in April it would be prudent to wait for the peak blue whale numbers to subside before commencing the survey. This is feasible given the ability to observe the departure of BW on their northerly migration. It would mean the survey timing (maximum of 90 days) could extend into July with the weather likely to curtail operations.

The reverse is true in the September to November window whereby the survey should commence as early as possible, likely in early September as the weather improves and could extend into early December. This would coincide with the BW arrival in the area (and other whales associated with the increased food source associated with the summer upwelling events). As such, CGG would have to adopt clear criteria for stopping the survey based on observations of BW with clear stop criteria for the survey due to peak BW abundance within their foraging BIA.

Due to the uncertainty in the numbers of arriving and departing BW, the months of April/May and November/December are included to allow seismic surveys to proceed noting the criteria to start (April) or to end the survey (December) will need to be clear in protecting individual BW from injury or disturbance from foraging.

6.2 Spatial Constraints

The activity planning area was established in February 2023 and identified the preferred geophysical area of interest to CGG, the shallower areas close to the coast.

6.2.1 Protection of marine users

After the first round of consultation, the activity planning area was reviewed, and the first spatial constraints were established. Commercial fishers, including abalone divers, raised concerns about the effects of particle motion on the abalone stocks. After reviewing the literature on these effects CGG decided to eliminate activities within the 30 m depth contour. This decision also considered that the initial review of fishing data from the Victorian Fishing Authority showed a vast majority (>70%) of catch came from fishing blocks abutting the coastline. It was clear that some form of depth exclusion would provide some certainty to some fishers that their activities could continue in parallel with the proposed survey.

The second round of consultation revealed further concerns associated with the increased biodiversity in shallower areas outside of the summer months this concern was raised by both conservation groups associated with the effects from seismic survey on zooplankton and from commercial fishers concerned about access to their stocks. CGG initially implemented a 40 m depth exclusion (Feedback 232) to provide increased levels of protection for these environmental values and sensitivities and after further consideration and consultation with relevant persons this exclusion extended to the 50-metre depth contour (Feedback 262).

6.2.2 Protection of Environmental Management Areas

During the environmental assessment process CGG identified the West Tasmanian Canyons Key Ecological Feature (**KEF**) as an area of increased environmental value in part due to the role the canyons play in the upwelling events which serve as a lead indicator of elevated levels of biodiversity in the region. The mapped KEF is of canyons connecting the ocean abyssal plain to the shallower shelf areas. The shallowest point coincides with the 400 m depth contour and the canyon features of this area extend across the shelf into Victorian waters. As such it can be argued that these canyons have similar value to the upwelling events. Therefore, CGG decided to limit its acquisition area to shallower than 400 metres. Historical observations have shown they can be highly productive areas of food sources for blue whales and excluding acquisition from their likely locations offers protection for foraging blue whales, particularly in the September to December window.

Consultation with Parks Victoria also revealed a request for protection of the values of the Twelve Apostles State Marine Park (Feedback 259 & 237). Having considered the parks management plan, it was deemed reasonably practicable to adopt an impact management zone excluding all activities from the park plus a 5 km buffer area.

6.2.3 Protection of Cultural Heritage Values and Sensitivities

Interactive map comments were received from community members about the cultural significance of Lady Percy Julia Island / Deen Maar and the Australian Fur Seal breeding colonies found on the island (Feedback 180, 209, 217, 222). Consultation with First Nations peoples and a desktop assessment of cultural values in the region revealed the significance of Deen Maar and the waterway between the island and the mainland. The values of the island lead to an impact management zone of 10.3 km, and to eliminate vessels transiting between the island and the mainland. With the activity also being limited to a 50-meter water depth there will be no acquisition within 17 km of the island.

The exclusion zones associated with Lady Percy Julia Island / Deen Maar provided an operational challenge for CGG to maintain its geophysical objectives within the activity planning area and to have sufficient buffer around the acquisition area to undertake line turns in a safe manner. This required an increase on the western edge of the activity planning area to allow for line turns to maintain these measures and safe navigation. The increased activity planning area was only for the operational needs of the survey and not for additional acquisition areas. This change was communicated at subsequent community sessions and to all relevant persons in project updates and a webinar.

In March 2024, the Gunditj Mirring Traditional Owners Aboriginal Corporation published the Gunditjmara Nyamat Mirring Plan 2023-2033, the plan describes Gunditjmara cultural values, concerns and responsibilities. A review of the EP was undertaken to ensure alignment with the Nyamat Mirring plan. [Paragraph added in response to Matter: FN01]

6.2.4 Protection of Other Marine Users

Trawl fishers stated that their operations mostly occur deeper than 200 m. This clear delineation of fishing activities allowed CGG to consider whether acquisition deeper than 200 m was essential for the survey. Given the number of fisheries in the area there would always be an overlap with some commercial fishing activities, however, where there can be less overlap these exclusions should be implemented. Therefore, an acquisition exclusion zone was established along the 200-metre contour. Further, CGG has agreed to minimise operational activities deeper than 200 m, noting that some manoeuvres may be required beyond these depths.

Consultation with one fisher, whose fishing operations are significantly different to most commercial fishers, explicitly requested exclusion of some fishing blocks (Feedback 245). The nature of this fishers' activities being generally restricted to these areas meant that his request for exclusions around those fishing blocks was considered a reasonable request by CGG.

6.3 ALARP Conclusion- Activity

The activity limitations adopted to reduce the activities environmental footprint have resulted in an overall reduction of 39% of the original activity planning area. The remaining area has been reclassified as the active source area and the final design of survey lines is underway. The final acquisition area will be entirely within the active source area, and this will result in a survey acquisition area which will be lower still.

7 Evaluation of Environmental Aspects

The following planned and unplanned environmental aspects were identified by the Preliminary Environmental Impact and Risk Assessment (PEIRA). They are each assessed thoroughly and systematically in this document in accordance with the ALARP assessment process. The full assessments can be found in Annex 2 (Planned) and Annex 3 (Unplanned). Annex 4 presents the evaluation calculations for Steps 6 & 7 to underpin the written conclusions. Summary text for each environmental aspect is presented below.

7.1 ALARP Assessment Outcome for Planned Environmental Aspects

7.1.1 Artificial Light

The assessment of artificial light within the context of the Regia MSS focused on the night-time operations that involve the use of artificial lighting on vessels. The activity has been identified to potentially result in several environmental impacts, such as the discharge of light into the marine environment, which could disrupt natural nocturnal habitats and behaviours of marine species and have adverse effects on light-sensitive ecological receptors.

Current measures to mitigate the impact of artificial light include the use of shielded and directed lighting fixtures to minimise light spillage, as well as advanced lighting technologies that dim lights to reduce their intensity. Additionally, vessels are equipped with blackout curtains or screens to contain artificial light within the vessel during operations. These measures are not only technically feasible, relying on well-established technologies, but also economically justifiable and practically implementable as part of the standard operating procedures of the Regia MSS. They align with legislative and other requirements for minimising light pollution and protecting the marine environment.

Alternative or improved measures considered include the implementation of advanced light filters to further reduce the spectral range of emitted light and increased training and awareness among crew members regarding the importance of minimising artificial light spillage. While the use of advanced light filters was found to be technically feasible, it was also determined that they would not provide substantial additional benefits beyond the existing measures and would entail additional costs. On the other hand, increased training and awareness were deemed highly feasible and cost-effective, supporting ongoing compliance with existing control measures.

7.1.2 Physical Presence

The ALARP assessment for the physical presence of vessels during the Regia MSS comprehensively evaluates the environmental impacts arising from such operations in marine environments. The physical presence of vessels is an integral and unavoidable part of the Regia MSS, and it introduces several environmental challenges, such as interference with other marine users, minor temporary disruptions of marine ecosystems, and navigational hazards that could potentially lead to accidents.

To mitigate these impacts, the Regia MSS has implemented standard measures, including adherence to navigation regulations, the use of advanced navigation systems for precise vessel movements, employment of experienced crew knowledgeable in safe marine operations, and established sail line procedures that minimise impacts on sensitive marine areas. Additionally, a Communication Plan will be adopted to actively engage with local communities and address any concerns.

The technical feasibility of these measures is high due to the reliance on well-established navigation technologies and equipment. Economically, the costs associated with implementing and maintaining these systems, and hiring experienced crew are reasonable given the potential for significant environmental impact and the necessity to meet regulatory requirements. These control measures are practical and have become integral components of standard maritime operating procedures and vessel safety protocols, ensuring compliance with regulatory requirements for vessel safety.

Further measures considered include real-time vessel monitoring systems with collision detection and marine fauna observers, an Adjustment Protocol protects the economic effects on commercial fishers, a Consultation Management System will provide further opportunities for relevant persons to be involved, and there will be a Sea Country Protection Program to respect indigenous values and avoid culturally significant effects. These additional measures have been evaluated for their feasibility and potential to enhance safety and minimise environmental impacts, and where appropriate, have been deemed reasonable and recommended for implementation to ensure compliance with regulatory requirements.

7.1.3 Underwater Sound

The ALARP assessment for underwater sound during the Regia MSS evaluates the impact of elevated underwater sound levels resulting from seismic operations using acoustic sources, and from vessel and helicopter operations during the survey. These activities have the potential to disturb marine fauna due to impulsive underwater sound, presenting an effect that is both unusual in its nature and of higher order in terms of potential impact.

Existing control measures to mitigate underwater sound include comprehensive pre-survey planning and assessment, considering marine fauna presence and environmental factors. Noise mitigation techniques, such as minimum power settings and ramp-up procedures, are implemented to minimise the initial sound impact. Marine Fauna Observers are deployed to monitor fauna before and during survey activities. Mitigation and buffer zones, and sound source limitations are established to ensure compliance with noise levels and to protect marine fauna. Spatial and temporal restrictions on survey activities are enforced during sensitive times and locations. Additionally, communication protocols and adaptive management strategies are in place, based on marine fauna observations and noise monitoring data.

CGG undertook a full assessment of detection technologies to inform itself of the level of technical and commercial development of systems to support marine fauna observations. This report can be found in Appendix F5 and it was used to inform the assessments in Annex 2 and Annex 4.

The technical, economic, and practical feasibility of these measures is high. They rely on established technologies and equipment, are cost-effective, and are practical to implement within the standard operating procedures of the Regia MSS. They also align with regulatory expectations for minimising underwater sound impacts.

To enhance the management of underwater sound, the ALARP assessment recommends the adoption of additional measures such as real-time underwater sound monitoring and advanced marine fauna observation technologies, including passive acoustic monitoring on the vessel and on tethered buoys. These technologies are in various stages of development and integration with existing vessel systems. They are deemed expensive but reasonable and recommended to improve the detection and monitoring of marine fauna in relation to underwater sound sources, despite some uncertainty in their effectiveness.

In response to public comment feedback, CGG also undertook an evaluation of alternative technologies to acquire the survey, as included in Annex 2 and Annex 4. [Sentence added in response to Matter: I01]

7.1.4 Atmospheric Emissions

The ALARP assessment for atmospheric emissions during the Regia MSS addresses the operational activities of vessels that generate emissions, including greenhouse gases. While such emissions are inherent to the use of marine vessels and the levels are not significantly different from other marine operations, the survey has implemented several measures to manage and reduce their impact on ambient physical conditions and ecological receptors.

The existing control measures for managing atmospheric emissions are robust. The survey adheres strictly to environmental regulations and emission standards for vessel operations. These measures are both technically and economically feasible, aligning with regulatory expectations for minimising atmospheric emissions.

Furthermore, the feasibility assessment indicates that the current measures are practical and have become standard operating procedures, considering the atmospheric emissions from the Regia MSS are already at a low baseline like other marine vessels. This is reinforced by a marine assurance system that ensures compliance with international maritime regulations, including MARPOL, COLREGS, and specific Marine Orders.

Alternative additional measures, such as the use of advanced emission reduction technologies on vessels, have been considered. These technologies are technically feasible and available within the maritime industry. However, retrofitting vessels with these technologies for a single survey may not be practical or economically justifiable given the low baseline emissions and the marginal benefit they would provide in addition to the existing measures.

7.1.5 Planned Discharges

The ALARP assessment for planned discharges during the Regia MSS evaluates the management of liquid discharges such as bilge water and wastewater. While these discharges are routine operations for marine vessels, their potential to temporarily affect water quality in a highly localised area requires management.

The existing control measures for planned discharges include a robust marine assurance system that ensures compliance with MARPOL, COLREGS, and various Marine Orders. This system, administered by CGG's Marine team, necessitates a vessel contractor pre-qualification assessment to ensure vessel biofouling controls meet legislative requirements. Furthermore, project vessels are selected based on their equipment's ability to minimise environmental impacts, mostly as specified by maritime law, indicating that emissions levels are already low and align with the baseline performance of other marine vessels.

The technical, economic, and practical feasibility of these measures is high due to their reliance on established maritime practices and equipment. They align with regulatory expectations for managing planned discharges and reducing associated environmental impacts.

In terms of alternative additional measures, the assessment considered enhanced wastewater treatment technologies, recycling and reuse of water onboard vessels, and zero discharge systems that contain and treat all wastewater. However, given the low level of impact already achieved by existing measures and the relatively high costs and logistical challenges associated with advanced technologies, these alternatives were deemed to offer marginal benefits relative to their cost and complexity.

7.2 ALARP Assessment Outcome for Unplanned Environmental Aspects

7.2.1 Accidental release of fuel

The ALARP assessment for the accidental release of fuel during the Regia MSS focuses on evaluating the risks and control measures pertaining to the handling, storage, and transfer of marine diesel fuel on vessels. The primary risk identified is the accidental discharge of fuel into the marine environment, which could result in significant environmental harm.

To manage this risk, the CGG has implemented a range of industry-standard initial measures. These include strict fuel handling and transfer procedures, routine inspections of fuel storage tanks, transfer systems, and fuel lines to detect any signs of wear, corrosion, or leaks promptly. Additionally, an Oil Pollution Emergency Plan has been established to outline procedures and resources for responding to oil spills swiftly to minimise environmental consequences. Vessels are also equipped with the necessary spill response equipment, and crews receive specialised training in spill response procedures, including containment, cleanup, and reporting.

The feasibility assessment of these measures confirms their technical viability, as they rely on well-established maritime practices and involve readily available equipment and training resources.

Economically, the costs associated with these measures are justifiable for risk reduction and are standard for safe maritime operations. Practically, these measures are highly feasible as they conform to industry standards and regulations, ensuring practical implementation within the Regia MSS context. They also align with regulatory requirements for fuel handling, storage, and spill response, which are crucial for maintaining compliance with maritime safety and environmental regulations.

The ALARP assessment concludes that the risk of an accidental fuel release during the Regia MSS is low, based on the effective existing control measures, the nature of the activities, and the low probability of such an event occurring. The existing control measures, supplemented with enhanced crew training, are considered to meet the ALARP criteria for this activity, effectively minimising the risk of accidental fuel release to a level that is as low as reasonably practicable.

7.2.2 Accidental release of materials or waste overboard

The ALARP assessment for the accidental release of materials or waste overboard during the Regia MSS evaluates the risks and control measures related to the handling, storage, and disposal of materials and waste on vessels. The primary concern is the inadvertent release of these substances into the marine environment, which could result in environmental harm.

To address this risk, the Regia MSS has established initial control measures that follow industry best practices. These include proper segregation and storage of materials and waste in designated areas and containers, regular inspections of storage areas and waste disposal systems, and comprehensive crew training in spill response procedures, including containment, cleanup, and reporting. These measures are designed to prevent accidental spills or leaks and ensure prompt and effective response if an incident occurs.

The feasibility assessment of these measures shows high technical, economic, and practical feasibility. They align with well-established practices and equipment for waste management and spill response, are integral to safe maritime operations and environmental protection, and comply with regulatory requirements for waste handling, storage, and spill response.

Alternative additional or improved measures considered include the implementation of advanced waste tracking and monitoring systems and enhanced crew training focused on overboard waste requirements. The advanced waste tracking systems, while technically and economically feasible, were deemed not justifiable for this specific project due to the low risk of accidental releases. On the other hand, enhanced crew training is both feasible and practical and will be implemented, as it is easily incorporated into the crew inductions already required under contract terms.

The ALARP assessment concludes that the risk of accidental release of materials or waste overboard during the Regia MSS is low. This is based on the effectiveness of the existing control measures, the nature of the activities, and the low probability of such releases. Given the low assessed risk and the feasibility of the existing control measures, they are considered ALARP for this activity. The adoption of crew training is warranted to further enhance risk management.

7.2.3 Introduction of marine pest species

The ALARP assessment for the introduction of marine pest species during the Regia MSS addresses the environmental risks and control measures associated with the movement of vessels between different marine regions. The primary risk identified is the unintentional introduction of marine pest species into new ecosystems, which could disrupt local biodiversity and ecosystem balance.

Initial control measures for managing this risk include thorough hull inspections and cleaning procedures before vessels depart from one region to another, to remove any potential marine pests. Additionally, there is a compliance with ballast water management regulations, which includes ballast water exchange or treatment to minimise the risk of transporting marine pests. Crew members are also trained in biosecurity protocols and procedures to prevent the inadvertent transfer of marine pest species.

The feasibility assessment of these measures indicates high technical, economic, and practical feasibility. These measures align with established practices for preventing the spread of marine pest species, are essential for maritime safety and environmental protection, and comply with regulatory requirements related to biosecurity and ballast water management.

An improved control measure considered includes a specific Invasive Marine Species risk assessment procedure for the Regia MSS. This procedure mandates an IMS risk assessment to be conducted on vessels and immersible equipment by a qualified IMS inspector prior to mobilisation to the operational area, ensuring that vessels and equipment are assessed as ‘low risk’ before entering the operational area.

The assessment concludes that the risk of introducing marine pest species during the Regia MSS is moderate, based on the effectiveness of the existing control measures, the nature of the activities, and the low probability of unintentional introductions. Given the moderate assessed risk and the feasibility of the adoption of alternative control measures, they are considered ALARP for this activity, effectively balancing the mitigation of marine pest species risks against the practicalities and costs of control measures.

7.2.4 Collisions with marine fauna

The ALARP assessment for collisions with marine fauna during the Regia MSS addresses the potential risk of vessels colliding with marine animals. This risk is inherent due to the movement of survey and support boats, which could lead to possible injury or mortality of marine fauna.

To mitigate this risk, CGG has implemented several control measures such as visual observation, acoustic monitoring, and radar are employed to detect and monitor marine fauna. Adherence to speed limits and maintaining appropriate manoeuvrability minimises the risk of collisions. Additionally, turtle guards are fitted as standard at the end of hydrophone streamers, and careful activity design has been carried out to avoid known marine fauna habitats and migration routes. Whale mitigation zones are also established around survey vessels, where activities are restricted to reduce the risk of disturbance to marine mammals.

The feasibility of these measures is high. They incorporate well-established practices in maritime operations, utilising available equipment and training resources. The costs associated with these measures are reasonable and integral to safe maritime operations, justifying their implementation for risk reduction. These measures are practical within the Regia MSS context and align with industry standards and regulations. Furthermore, they comply with regulatory requirements for marine fauna protection.

Despite these effective control measures, there remains a residual risk due to the dynamic nature of marine environments and the unpredictability of marine fauna presence. However, the ALARP assessment concludes that the risk of collisions with marine fauna is low. The existing control measures, given their effectiveness and feasibility, are ALARP for this activity, striking a balance between operational practicalities and the need to protect marine life.

8 Conclusion

CGG has concluded that the Regia MSS can be carried out in a manner that this evaluation demonstrates will reduce environmental impacts and risks of the activity to ALARP. CGG has reduced at the spatial and temporal design parameters of the activity, and considered additional, alternative, and improved management and mitigation measures to arrive at a point that further analysis would not materially further reduce environmental impacts and risks.

9 Document Control

Table F2-6 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	29 June 2023	MS	Template created.
0.1	1 October 2023	MS	Updated with control measures from impact and risk assessments.
0.2	6 October 2023	SJ	Reviewed for consistency with the impact and risk assessments.
1	29 December 2023	MS	Updated following consultations and polished for submission to NOPSEMA.
2	**15 May 2024**	**RH/AC/MS**	**Updated after public comment to include adoption of a dedicated spotter vessel and MFOs for marine fauna detection.**

Annex 1 – Presence / Absence Analysis for Species within the Environment Planning Area

Non-peak period - activity known to occur in lower densities/concentrations, or sporadically, or may occur
Peak period - activity known to occur

Presence / Absence Table	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Marine Mammals												
Whales												
Threatened Species												
Blue Whale												
Southern Right Whale					Nearest coastal aggregation areas are in southwest Victoria (Warnambool)							
Humpback Whale				orthern Migrati							Southern Migration	
Fin Whale					General migration window for movement out of sub polar waters to temp							
Sei Whale					General migration window for movement out of sub polar waters to temp							
Non-Threatened Species												
Minke Whale									Based off known migration movements			
Antarctic Minke Whale			*** half of March									
Pygmy Right Whale												
Short-finned Pilot Whale					Prefers open ocean waters, no migratory patterns known							
Long-finned Pilot Whale	Based off records of strandings											
Pygmy Sperm Whale					Prefers offshore waters with 2 sightings in Australian waters, insufficient to assess potential presence							
Dwarf Sperm Whale					Prefers deep water and no sightings in Victoria							
Andrew's Beaked Whale									Based off known records in Victoria			
Blainville's Beaked Whale					One stranding recorded in Victoria, insufficient to assess potential presence							
Strap-toothed Beaked Whale	Based on strandings occurring during Summer-Autumn											
Gray's Beaked Whale	Most strandings occur during December-April											
Hector's Beaked Whale					No records from Victoria							
True's Beaked Whale					Prefers open ocean waters, no migratory patterns known							
Sperm Whale					Window of northward movement. More likely in WA							
Cuvier's Beaked Whale	Most strandings occur from January-July											
Arnoux's Beaked Whale					Prefers slope and escarpment environments							
Dolphins												
Common Dolphin	Assumed present year round											
Risso's Dolphin	Assumed present year round											
Dusky Dolphin				Based off inshore seasonal movements during cooler months								
Southern Right Whale Dolphin					Prefers deep water and the outer edge of continental shelf							
Killer Whale				More likely during winter months, summer months spent further south								
False Killer Whale					Suggested period of migration to coastal/continental shelf waters							
Indian Ocean Bottlenose Dolphin	Assumed present year round											
Bottlenose Dolphin												
Seals												
Australian Fur-seal		Females feeding pups				Northern Migration			Weanin	Weaning/ Breeding		
New Zealand Fur-seal												
Invertebrates of Commercial Importance												
Southern Rock Lobster			Mating						Spawning			
Giant Crab						Breeding Season				Spawning		
Gould's Squid												
Fish - EPBC Listed												
Blue Grenadier	Assumed year round presence					Spawning winter and early spring						
Australian Grayling	Spawning however occurs in freshwater								Assumed presence			
Blue Warehou	Assumed year round presence					Spawning winter and early spring						
Eastern School Whiting	Spawning- (Tasmania: late Summer)			Year round presence with largest catches March- July								
Elephantfish		Spawning	Assumed year round presence									
Ocean Perch	Assumed year round presence							Spawning Winter to early Summer				
Orange Roughy	Assumed year round presence						Spawning (not every year)					
Pink Ling	Assumed year round presence								Spawning - late winter and spring			
Tiger Flathead	Spawning											
White Shark- migration	Moving north along the east coast											South
White Shark- congregation of juvenlies												
Sawshark	Assumed presence year round					Breeding/ Pups are born (12 mth gestation)						
Schoolshark			Assumed presence year round (transitory)						Breeding/ Pups are born (mainly December and January)-			
Gummy Shark	Breeding/ pups born (11-12 mth gestation)		Assumed presence year round									
Turtles - EPBC Listed												
Loggerhead Turtle												
Green Turtle	Low likelihood of presence of turtles in Victoria. No known turtle breeding or nesting sites in Victoria											
Leatherback Turtle												
Commercial Fisheries												
See commercial fisheries section 4.7												
Victorian Fisheries												
Giant Crab - Fishery open (males)												
Giant Crab - Fishery open (females)												
Giant Crab - Highest catch rates (CPUE)												
Southern Rock Lobster - Fishery open (males)												
Southern Rock Lobster - Fishery open (females)												
Southern Rock Lobster - Highest catch rates (CPUE)												
Tasmanian Fisheries												
Giant Crab - Fishery open (males)												
Giant Crab - Fishery open (females)												
Giant Crab - Highest catch rates (CPUE)												
Southern Rock Lobster - Fishery open (males)												
Southern Rock Lobster - Fishery open (females)												
Southern Rock Lobster - Highest catch rates (CPUE)												
Plankton (General)												
The Bonney Upwelling	Sustained		Quiescent	Downwelling							Onset of upwelling	
Western Tasmania Upwelling System		Late austral summer bloom (larger bloom)								Spring bloom		
Birds (migratory seabirds)												
Antipodean Albatross			Fledging	May be foraging							Egg laying austral summer, fl	
Black-browed Albatross				Fledging		Presence			Breeding			
Buller's Albatross Pacific Albatross	Possible presence							Breeding Dec-Oct (New zealand)				
Campbell Albatross	Breeding					Winter presence						
Flesh-footed Shearwater	Breeding & possible presence											
Grey-headed Albatross	Breeds on Macquarie Island, feeds in Southern Ocean											
Northern Giant Petrel	Breeds on subantarctic islands				Most likely presence							
Northern Royal Albatross												
Salvin's Albatross	No breeding colonies in Aus											
Shy Albatross	Presence			Fledging					Eggs laid (breeding Albatross island NW Tas)			
Sooty Albatross			Observed presence									
Sooty Shearwater	No breeding colonies in Aus											
Southern Giant-Petrel, Southern Giant Petrel	Breeds on subantarctic islands											
Southern Royal Albatross	No breeding colonies in Aus											
Wandering Albatross	Fledging		Possible presence. Feeds in Southern Ocean									Eggs laid- Bre
White-capped Albatross	No breeding colonies in Aus											
Birds (Resident seabirds)												
Australian Fairy Tern	Breeding		Possible presence			Less frequent during Winter						
Blue Petrel	Breeds on subantarctic islands											
Common Diving-petrel												
Fairy Prion												
Fairy Prion (southern)												
Gould's Petrel	Breeds on NS\	Breeds on NSW islands										
Great Skua												
Indian Yellow-nosed Albatross			Fledging			Most likely presence in Aus			Eggs laid			
Northern Buller's Albatross	No breeding colonies in Aus											
Short-tailed Shearwater	Foraging (BIA's) + breeding					Migrate Northern hemsiphere						
Soft-plumaged Petrel												
Wedge-tailed Shearwater	Foraging (BIA) + breeding season Sep- May											
White-bellied Storm-Petrel (Tasman Sea)												
White-faced Storm-petrel		Fledging							Return to colonies		Presence	Eggs laid
Migratory Shorebirds												
Common Sandpiper												
Curlew Sandpiper	Presence											
Eastern Curlew, Far Eastern Curlew	Possible presence											
Hooded Plover (eastern), Eastern Hooded Plover												
Pectoral Sandpiper												
Red Knot	Presence			Breeds in North hemisphere								
Sharp-tailed Sandpiper												
Birds - **Other**												
Orange-bellied Parrot	Breeding		Depart Tas							Arrive in Tas for breeding		
Little Penguin			Year round presence						Breeding season (Sep-Feb)			

Annex 2 – ALARP Assessment of Planned Environmental Aspects

Table F2-7 - ALARP Assessment of Planned Environmental Aspects

	Planned Environmental Aspects				
Process Step	**Artificial Light**	**Physical Presence**	**Underwater Sound**	**Atmospheric Emissions**	**Planned Discharges**
Step 1: Define the Scope and Objectives	The scope of this assessment includes evaluating the environmental impact posed by the artificial light generated during night-time operations of the Regia MSS in marine environments.	The scope of this assessment includes evaluating the environmental impact associated with the physical presence of vessels during the Regia MSS in marine environments.	The scope of this assessment is to evaluate the impacts associated with elevated levels of underwater sound during the Regia MSS.	The scope of this assessment is to evaluate the impacts associated with atmospheric emissions during the Regia MSS.	The scope of this assessment is to evaluate the impacts associated with planned discharges during the Regia MSS.
Step 2: Identify the Hazardous Activities	Conducting night-time operations during the Regia MSS, involving the use of vessels with artificial light sources is part of the planned activity and there will be: • Discharge of artificial light into the marine environment. • Disruption of natural nocturnal habitats and behaviours of marine species. • Potential disturbance to marine ecosystems. • Adverse effects on ecological receptors, including light-sensitive organisms as identified by the impact assessment.	The physical presence of vessels operating in marine waters during the Regia MSS is part of the planned activity and there will be: • Interference with other marine users, including shipping, fishing, traditional owners with connection to sea country, and recreational activities. • Minor, temporary, and localised disruption of marine ecosystems and habitats. • Navigational hazards and potential accidents.	Seismic operations using acoustic sources. Vessel and helicopter operations during the survey. Presence of survey vessels interacting with marine fauna. Disturbance of marine fauna due to impulsive and continuous underwater sound.	Hazardous activities leading to this aspect include operation of vessels used in the Regia MSS, which generate atmospheric emissions. Emission of air pollutants, including greenhouse gases, from vessel operations that could affect ambient physical conditions and ecological receptors.	Hazardous activities include the generation of planned liquid discharges, such as bilge water and wastewater, during the Regia MSS. Discharge of pollutants and contaminants into marine waters that could temporarily affect water quality in a highly localised area.

	Planned Environmental Aspects				
Process Step	**Artificial Light**	**Physical Presence**	**Underwater Sound**	**Atmospheric Emissions**	**Planned Discharges**
Step 3: Identify Standard Measures	**Shielded Lighting:** The Regia MSS employs shielded and directed lighting fixtures on vessels to minimise light spillage into the marine environment. **Dimming Technologies:** Advanced lighting technologies are used to dim artificial lights, reducing their intensity. **Blackout Curtains:** Vessels are equipped with blackout curtains or screens to contain artificial light within the vessel during night-time operations.	**Adherence to Navigation Regulations:** Vessels participating in the Regia MSS adhere to established navigation regulations, including maintaining safe distances from other vessels and following established shipping lanes. **Advanced Navigation Systems:** Vessels are equipped with advanced navigation systems and equipment to ensure safe and precise movements. **Experienced Crew:** The Regia MSS employs experienced and trained crew members who are knowledgeable about safe vessel operations in marine environments. **Sail Line Plan:** Sail line plans dictate the routes vessels follow during seismic surveys, minimising overlap and potential impacts on sensitive areas identified by other marine users. **Communication Plan:** A Communication Plan involves active engagement with local communities and relevant persons to address concerns, gather input, and build trust. **Adjustment Protocol:** The Regia MSS commited to adopting a compensation protocol so that no commercial fisher would be worse off as a result of the Regia MSS and that reasonable, evidence-based claims would be paid.	**Pre-Survey Planning and Assessment:** Comprehensive planning and assessment before survey operations, considering marine fauna presence and environmental factors. **Noise Mitigation:** Implement noise mitigation techniques, such as minimum power settings and ramp-up procedures, to minimise initial sound impact. **Marine Mammal Observers:** Conduct marine fauna observations before and during survey activities to detect the presence of marine fauna. **Mitigation Zones:** Establish mitigation zones to ensure compliance with noise levels and to protect marine fauna. **Buffer and Safety Zones:** Maintain buffer and safety zones around noise sources to protect marine fauna. **Sound Source Limitations:** Ensure that acoustic sources comply with sound source limitations to minimise noise emissions. **Spatial and Temporal Restrictions:** Implement restrictions on survey activities during sensitive times and locations. **Communication Protocols:** Establish communication protocols for marine fauna detection and response during seismic operations. **Adaptive Management:** Implement adaptive management strategies based on marine fauna observations and noise monitoring data.	**Compliance with Environmental Regulations:** Ensure strict compliance with all relevant environmental regulations and emission standards for vessel operations. **Vessel Speed and Movement Restrictions:** Implement vessel speed and movement restrictions to reduce emissions during specific phases of the survey.	**Marine Assurance System:** The marine assurance system is administered by CGG's Marine team and, amongst other requirements, ensures compliance of contract vessels with MARPOL, COLREGS, and Marine Orders 21, 30, 59 70,71,72, 91, 95, 96, 97, 98. CGG undertakes a vessel contractor pre-qualification assessment in accordance with its Marine Risk Management Standard (GM-STD- MA-003) to ensure vessel biofouling controls meet these EP requirements. The system also requires the contractor to have a HSE management plan and to provide a bridging document that needs to be approved by CGG prior to execution. **Project Vessels:** The choice of vessels can effect planned discharges. All project vessels have various pieces of equipment that minimise environmental impacts and risks, mostly specified by maritime law.
Step 4: Feasibility Assessment	Technical Feasibility: The technical feasibility of these measures is high, as they rely on well-established lighting technologies and vessel equipment. Economic Feasibility: The costs associated with implementing shielded lighting, dimming technologies, and blackout curtains are reasonable and justifiable considering the potential environmental impact and regulatory requirements. Practical Feasibility: These control measures are practical to implement, as they are integral to the standard operating procedures of the Regia MSS. Regulatory Compliance: The control measures align with legisltive and other requirements for minimising light pollution and protecting the marine environment identified in Appendix B2.	Technical Feasibility: The technical feasibility of these measures is high, as they rely on well-established navigation technologies and equipment. Economic Feasibility: The costs associated with implementing and maintaining navigation regulations, advanced navigation systems, and hiring experienced crew members are reasonable, considering the potential environmental impact and regulatory requirements. Practical Feasibility: These control measures are practical to implement, as they are integral to standard maritime operating procedures and vessel safety protocols. Regulatory Compliance: The control measures align with regulatory requirements for vessel safety and compliance with navigation regulations.	Policy Statement 2.1 measures are technically, economically, and practically feasible. They align with regulatory expectations for minimising underwater sound impacts.	Existing control measures are technically, economically, and practically feasible. They align with regulatory expectations for minimising atmospheric emissions and their associated impacts.	Existing control measures are technically, economically, and practically feasible. They align with best practices for managing planned discharges and reducing associated environmental risks.

	Planned Environmental Aspects				
Process Step	**Artificial Light**	**Physical Presence**	**Underwater Sound**	**Atmospheric Emissions**	**Planned Discharges**
Step 5: Identify Alternative, Additional, or Improved Measures	**Use of Advanced Light Filters:** Implement advanced light filters that further reduce the spectral range of emitted light, minimising the impact on light-sensitive marine organisms. **Increased Training and Awareness:** Enhance crew training to raise awareness of the importance of minimising artificial light during night-time operations and to ensure strict adherence to protocols.	**Real-time Vessel Monitoring:** Implementation of real-time vessel monitoring systems equipped with collision detection and marine fauna observers. Integration with vessel navigation systems to provide immediate alerts and corrective actions. Continuous tracking of vessel movements in relation to other marine users and sensitive areas. **Consultation Management System:** This system would involve engaging relevant persons in ongoing consultation and therefore in decision-making processes. It can enhance the identification and mitigation of environmental impacts and risks more broadly than this one aspect. **Sea Country Protection Program:** A cultural heritage protection program ensures the survey avoids culturally significant sites and respects indigenous values and sensitivities. **Acquire Seismic On Paper (ASOP):** ASOP is a technique that involves initial seismic data acquisition on paper to plan efficient survey lines. ASOP's can optimise survey design, reducing the duration and extent of environmental impacts by minimising the need for adjustments during the actual survey.	**Real-time Underwater Sound Monitoring:** Implementation of real-time underwater sound monitoring systems equipped with hydrophones and advanced sensors. This technology is relatively new to market with the best providing integration with vessel systems to provide continuous monitoring of underwater sound emissions. **Marine Fauna Observation Technologies:** Utilisation of advanced marine fauna observation technologies, such as passive acoustic monitoring, drone technology, infra-red cameras, and others are in various stages of development. It is uncertain how effective these technologies would be for detecting marine fauna. However, where these technologies integrate with existing vessel system to detect and monitor marine fauna in relation to underwater sound sources they should be trialed. **Alternative Techology to Acquire the Survey:** Investigate use of alternative technologies that may emit less underwater sound, whilst still achieving survey objectives. [Added in response to Matter: O01]	**Advanced Emission Reduction Technologies:** Utilisation of advanced emission reduction technologies on vessels, such as exhaust gas cleaning systems (scrubbers) and selective catalytic reduction (SCR) systems. Retrofitting vessels with modern, more environmentally friendly engines to reduce emissions. **Alternative Fuels:** Transitioning to alternative fuels with lower emissions, such as liquefied natural gas (LNG) or hydrogen, for vessel operations. Implementing infrastructure for the supply and use of alternative fuels at ports.	**Enhanced Wastewater Treatment:** Invest in advanced wastewater treatment technologies to further reduce pollutant content in discharged water. **Recycling and Reuse:** Explore opportunities for recycling and reusing water onboard vessels to minimise the volume of discharged water. **Zero Discharge Systems:** Investigate the feasibility of zero-discharge systems that eliminate planned discharges by containing and treating all wastewater onboard.

	Planned Environmental Aspects				
Process Step	**Artificial Light**	**Physical Presence**	**Underwater Sound**	**Atmospheric Emissions**	**Planned Discharges**
Step 6: Evaluate the Alternatives	**Advanced Light Filters:** Technically feasible but may entail additional costs and do not provide substantial additional benefits beyond existing measures. **Increased Training and Awareness:** Highly feasible and cost-effective. Supports ongoing compliance with existing control measures.	**Real-time Vessel Monitoring:** Implementing real-time vessel monitoring systems is technically feasible, utilising existing tracking and communication technologies. The costs associated with real-time monitoring may be moderate but could provide valuable data for enhanced safety. This alternative is practical to implement, as it enhances safety without significant disruption to standard vessel operations. Real-time vessel monitoring aligns with regulatory expectations for vessel safety and environmental protection. **Consultation Management System:** Adopting a consultation management system can provide valuable insights and diverse perspectives, potentially leading to more effective control measures. It promotes transparency and relevant person engagement, aligning with best practices. **Sea Country Protection Program:** Incorporating a cultural heritage protection program not only mitigates cultural and social risks but also demonstrates respect for indigenous communities and their environmental concerns. Given the absence of detailed information about sea country values this program would be precautionary and should be informed by the Traditional Owners of sea country. **Acquire Seismic On Paper (ASOP):** ASOP is a relatively inexpensive step that potentially has large benefits to all aspects, not just physical presence.	**Real-time Underwater Sound Monitoring:** Implementing real-time underwater sound monitoring systems is technically feasible, utilising existing hydrophone and sensor technologies deployed in novel ways. The costs associated with real-time monitoring are reasonable, considering the effectiveness to mitigate underwater sound impacts. This alternative is practical to implement, as it enhances the ability to monitor and control underwater sound emissions. Real-time underwater sound monitoring aligns with regulatory expectations for minimising underwater sound impacts. **Marine Fauna Observation Technologies:** Implementing advanced marine fauna observation technologies is technically feasible, with proven systems available in the market. The costs associated with deploying these technologies are unreasonable, considering the uncertainty in effectiveness to mitigate impacts risks. Integrating marine fauna observation technologies into vessel operations is practical and aligns with safety and environmental protection goals. The use of marine fauna observation technologies supports regulatory compliance by reducing the risk of marine fauna disturbances caused by underwater sound. Based on the thorough technology assessment conducted in Appendix F5, tethered buoys should be deployed with PAM systems tuned to detect low frequency cetaceans. **Alternative Techology to Acquire the Survey, e.g. marine vibroseis and ocean bottom cable or nodes:** The technology that will be utilised for the Regia MSS involves a series of acoustic sources that create acoustic emissions within a specified frequency and amplitude, to detect geological formations. The technology that will be used is the only technology currently available that is feasible for the Regia MSS. Alternative technologies are in development, are unproven and are technically unfeasible. Further, the non-optimal data generated by alternative technologies increases the likelihood that additional surveys and exploration wells would be required, and presents an increased risk when drilling. [Added in response to Matter O01]	**Advanced Emission Reduction Technologies:** Implementing advanced emission reduction technologies is technically feasible, with proven systems available in the maritime industry. The costs associated with implementing these technologies are reasonable, considering the potential to reduce emissions and associated environmental impacts. Retrofitting vessels with emission reduction technologies aligns with environmental protection goals but is impractical to implement for one survey. The use of emission reduction technologies supports regulatory compliance by reducing atmospheric emissions. **Alternative Fuels:** Transitioning to alternative fuels is technically unfeasible, with no established infrastructure for LNG or hydrogen conversion to seismic vessels. The costs associated with adopting alternative fuels are unreasonable, even after considering their potential to reduce emissions.	**Enhanced Wastewater Treatment:** Enhanced wastewater treatment technologies are technically feasible and readily available in the maritime industry, making them a viable option. While there are costs associated with implementing advanced treatment technologies, these costs are unjustifiable given the nature and scale of potential environmental benefits. Further, the existing control measures, such as pollution prevention plans and regular inspections, are already effective in managing planned discharges to an acceptable level. **Recycling and Reuse:** Recycling and reusing water may not be highly applicable to the Regia MSS project due to the relatively small volume of water generated and the logistical challenges of installing and maintaining water treatment systems. The current control measures, including pollution prevention plans and regular inspections, are effective in managing planned discharges, making recycling and reuse unnecessary for this specific project. **Zero Discharge Systems:** Zero discharge systems, which eliminate planned discharges by containing and treating all wastewater onboard, are technically feasible and proven in other industries. The existing control measures, including pollution prevention plans and regular inspections, are effective in managing planned discharges to an acceptable level. The introduction of zero discharge systems may not provide a significant improvement in environmental protection for this project.

	Planned Environmental Aspects				
Process Step	**Artificial Light**	**Physical Presence**	**Underwater Sound**	**Atmospheric Emissions**	**Planned Discharges**
Step 7: Decision-making	The existing control measures (shielded lighting, dimming technologies, blackout curtains) effectively minimise the impacts associated with artificial light. These measures align with best practices and regulatory requirements. The potential adoption of advanced light filters is not deemed reasonable due to limited additional benefits compared to existing controls. Increased training and awareness are considered reasonable and recommended for ongoing adherence to existing measures.	The ALARP assessment concludes that the existing control measures (navigation regulations, advanced navigation systems, experienced crew) effectively mitigate environmental impacts and risks associated with the physical presence of vessels during the Regia MSS. The adoption of additional control measures is deemed reasonable and recommended to enhance safety, minimise environmental risks, and ensure compliance with regulatory requirements. This detailed ALARP assessment for physical presence provides a comprehensive evaluation of control measures and the rationale for adopting additional measures within the context of the Regia MSS.	The ALARP assessment concludes that the existing control measures and the adoption of additional control measures, such as real-time underwater sound monitoring and marine fauna observation technologies, are reasonable and recommended to enhance underwater sound management, minimise environmental impacts, and ensure compliance with regulatory requirements during the Regia MSS.	The ALARP assessment concludes that the existing control measures and the adoption of additional control measures, such as advanced emission reduction technologies are reasonable and recommended to enhance atmospheric emissions management, minimise environmental risks, and ensure compliance with regulatory requirements during the Regia MSS. Alternative fuel technologies are insufficiently mature to utilise for the Regia MSS.	The ALARP assessment concludes that the existing control measures are reasonable and recommended to enhance planned discharges management, minimise environmental risks, and ensure compliance with regulatory requirements during the Regia MSS.

Annex 3 – ALARP Assessment of Unplanned Environmental Aspects

Table F2-8 - ALARP Assessment for Unplanned Environmental Aspects

	Unplanned Environmental Aspects			
Process Step	**Accidental release of fuel**	**Accidental release of materials or waste overboard**	**Introduction of marine pest species**	**Collisions with marine fauna**
Step 1: Define the Scope and Objectives	This assessment focuses on evaluating the risks and control measures associated with accidental releases of fuel during the Regia MSS activities.	This assessment focuses on evaluating the risks and control measures associated with the accidental release of materials or waste overboard during the Regia MSS activities.	This assessment focuses on evaluating the impacts and control measures associated with the introduction of marine pest species during the Regia MSS activities.	This assessment focuses on evaluating the risks and control measures associated with the potential collisions between vessels involved in the Regia MSS activities and marine fauna.
Step 2: Identify the Hazardous Activities	The hazardous activity is the handling, storage and transfer of marine diesel fuel on vessels used in the Regia MSS. The primary risk is the accidental release of marine diesel fuel into the marine environment, which could result in environmental harm.	The hazardous activity is the handling, storage, and disposal of materials and waste on vessels used in the Regia MSS. The primary risk is the accidental release of materials or waste into the marine environment, which could result in environmental harm.	The hazardous activity is the movement of vessels used in the Regia MSS between different marine regions, which may temporarily harbor invasive marine species. The primary risk is the unintentional introduction of marine pest species into new ecosystems, potentially disrupting local biodiversity and ecosystem balance.	The hazardous activity is the movement of vessels, including survey vessels and support boats, during the Regia MSS, which may pose a risk of collision with marine fauna. The primary risk is the potential collision between vessels and marine fauna, which could result in injury or mortality for the animals involved.
Step 3: Identify Initial Measures	**Fuel Handling and Transfer Procedures:** Vessels involved in the survey will adhere to industry-standard fuel handling and transfer procedures. These procedures emphasise safety and spill prevention during fuelling and refuelling operations. **Routine Inspections:** Regular inspections of fuel storage tanks, transfer systems, and fuel lines will be conducted to detect any signs of wear, corrosion, or leaks promptly. **Oil Pollution Emergency Plan:** An oil pollution emergency plan outlines procedures and resources for responding to oil spills promptly, is a regulatory requirement, and is crucial for minimising the consequences of oil spills. **Maintenance of Spill Response Equipment:** Adequate spill response equipment, such as absorbent materials, oil booms, and skimmers, will be maintained and readily accessible on board each vessel in accordance with the vessel SOPEP. **Crew Training:** Crew members will receive training in spill response procedures, including containment, cleanup, and reporting. This training ensures that the crew is prepared to respond effectively to fuel spills.	The initial control measures for managing the risk of accidental releases of materials or waste overboard during the Regia MSS include: **Proper Segregation and Storage:** Materials and waste are stored in designated areas and containers, following industry best practices to prevent accidental spills or leaks. **Regular Inspections:** Routine inspections of storage areas and waste disposal systems are conducted to detect potential issues or leaks. **Crew Training:** Crew members are trained in spill response procedures, including containment, cleanup, and reporting.	**Hull Inspection and Cleaning:** Vessels undergo thorough hull inspections and cleaning procedures before departing from one region to another to remove any potential marine pests. **Ballast Water Management:** Compliance with ballast water management regulations, including ballast water exchange or treatment, to minimise the risk of transporting marine pests. **Biosecurity Training:** Crew members are trained in biosecurity protocols and procedures to prevent the inadvertent transfer of marine pest species.	**Marine Fauna Observation Technologies:** Implementing technologies such as visual observation, acoustic monitoring, and radar to detect and monitor the presence of marine fauna. **Speed and Manoeuvrability:** Adhering to speed limits and maintaining appropriate manoeuvrabilityto minimise the risk of collisions. **Turtle guards:** Guards are fitted as standard at the end of the hydrophone streamers. **Route Planning:** Careful route planning to avoid known marine fauna habitats and migration routes. **Whale Mitigation Zones:** Establishing marine mammal mitigation zones around survey vessels, where certain activities are restricted to reduce the risk of disturbance.
Step 4: Feasibility Assessment	Technical Feasibility: The technical feasibility of the initial control measures is high. These measures are well-established practices in maritime operations and involve readily available equipment and training resources. Economic Feasibility: The economic feasibility is reasonable, as these measures are integral to safe maritime operations. The costs associated with routine inspections, maintenance, and crew training are justifiable for risk reduction. Practical Feasibility: The practical feasibility is high, as these measures align with industry standards and regulations. They are practical to implement within the context of the Regia MSS.	Technical Feasibility: The technical feasibility of the initial control measures is high. These measures align with established practices and equipment for waste management and spill response. Economic Feasibility: The economic feasibility is reasonable, as these measures are integral to safe maritime operations and environmental protection. Practical Feasibility: The practical feasibility is high, as the measures align with industry standards and regulations and are practical to implement within the context of the Regia MSS. Regulatory Compliance: The initial control measures align with regulatory requirements for waste handling, storage, and spill response, ensuring	Technical Feasibility: The technical feasibility of the initial control measures is high. These measures align with established practices for preventing the spread of marine pest species. Economic Feasibility: The economic feasibility is reasonable, as these measures are essential for maritime safety and environmental protection. Practical Feasibility: The practical feasibility is high, as the measures align with industry standards and are practical to implement within the context of the Regia MSS.	Technical Feasibility: The technical feasibility of the initial control measures is high. These measures align with established practices for avoiding collisions with marine fauna. Economic Feasibility: The economic feasibility is reasonable, as these measures are essential for maritime safety and environmental protection. Practical Feasibility: The practical feasibility is high, as the measures align with industry standards and are practical to implement within the context of the Regia MSS. Regulatory Compliance: The initial control measures align with regulatory requirements related to marine fauna protection.

	Regulatory Compliance: The initial control measures align with regulatory requirements for fuel handling, storage, and spill response. They are essential for maintaining compliance with maritime safety and environmental regulations.	compliance with maritime safety and environmental regulations.	Regulatory Compliance: The initial control measures align with regulatory requirements related to biosecurity and ballast water management.	
Step 5: Identify Alternative, Additional, or Improved Control Measures	An alternative control measure could be the implementation of double-walled fuel tanks on vessels involved in the Regia MSS. Double-walled tanks provide an additional layer of containment, reducing the risk of fuel leaks in the event of a collision or impact. A possible improved control measure might involve enhancing crew training and drills focused specifically on fuel spill response procedures. This would aim to further improve spill response readiness.	An alternative control measure could be the implementation of advanced waste tracking and monitoring systems to enhance real-time tracking of waste generation and disposal. An improved measure could involve enhanced crew training and drills focused overboard waste requirements.	An improved control measure could include an IMS risk assessment procedure specific to the Regia MSS. This procedure would mandate an IMS risk assessment be conducted on vessels and immersible equipment by a qualified IMS inspector, prior to mobilisation to the operational area. Vessels/immersible equipment must be assessed as 'low-risk' prior to mobilisation to the operational area.	The assessment of underwater sound led to the adoption of alternative, additional, and improved control measures for the detection, monitoring, and avoidance of marine fauna.
Step 6: Evaluate the Alternatives	**Double-Walled Fuel Tanks:** Double-walled fuel tanks are technically feasible and can reduce the risk of fuel leaks, especially in the event of a collision. However, their adoption might not be reasonable because retrofitting vessels with double-walled tanks would be too costly. Double-bottomed vessels and double-walled fuel tanks will be preferred in vessel selection. **Enhanced Crew Training:** Improved training is technically and economically feasible. It can enhance spill response readiness but may not eliminate the risk entirely. Testing arrangements are required by the regulations and will be implemented.	**Waste Tracking and Monitoring Systems:** Implementing advanced waste tracking and monitoring systems is technically and economically feasible. However, the practicality for this specific project may not justify the investment, considering the relatively low risk of accidental releases. **Enhanced Crew Training:** Improved training is both technically and economically feasible. This measure is easily added to the crew inductions already required under the contract terms.	The identified initial control measures are typical for any vessel transiting in Australian waters. A specific risk assessment procedure for the Regia MSS for managing this aspect reflects the high consequences of ineffective management of invasive marine pest species risks.	See the underwater sound assessments in Appendix E2 to E8.
Step 7: Decision-making	The risk of an accidental fuel release during the Regia MSS is assessed as low. This assessment is based on the effective existing control measures, the nature of the activities, and the low probability of a fuel release. Given the low assessed risk and the feasibility of the existing control measures, they are considered ALARP for this activity.	The risk of an accidental release of materials or waste overboard during the Regia MSS is assessed as low. This assessment is based on the effectiveness of the existing control measures, the nature of the activities, and the low probability of such releases. Given the low assessed risk and the feasibility of the existing control measures, they are considered ALARP for this activity. The adoption of crew training is warranted.	The risk of introducing marine pest species during the Regia MSS is assessed as moderate. This assessment is based on the effectiveness of the existing control measures, the nature of the activities, and the low probability of unintentional introductions. Given the moderate assessed risk and the feasibility of the adoption of alternative control measures, they are considered ALARP for this activity.	The risk of collisions with marine fauna during the Regia MSS is assessed as low. While the existing control measures are effective, there is still a residual risk due to the dynamic nature of marine environments and the potential for unexpected marine fauna presence. Given the moderate assessed risk and the feasibility of the existing control measures, they are considered ALARP for this activity.

Annex 4 – Management and Mitigations Measures Evaluation

Table F2-9 - Management and mitigation measures evaluation

Additional, Alternative, and Improved Management and Mitigation Measures	Baseline Sacrifice	Measure Sacrifice	Aspect Treated	Impact/Risk Reduction Achievable	ALARP Ranking	Reasons Adopted/Rejected
Use of Advanced Light Filters	1	0.125	Artificial Light	Very low considering the levels of impact from light and the effectiveness of existing measures.	Limited Effectiveness	Rejected: Technically feasible but may entail additional costs and do not provide substantial additional benefits beyond existing measures.
Increased Training and Awareness	1	0.008	Artificial Light	Very high given the ease of implementation and the relatively low-cost increase.	Feasible & Proportionate Cost	Adopted: Highly feasible and cost-effective. Supports ongoing compliance with existing control measures.
Consultation Management System	1	0.0084	Physical Presence	Indirect environmental impact and risk reduction at very low relative sacrifice.	Feasible & Proportionate Cost	Adopted: Adopting a consultation management system can provide valuable insights and diverse perspectives, potentially leading to more effective control measures. It promotes transparency and relevant person engagement, aligning with best practices.
Sea Country Protection Program	1	0.08	Physical Presence		Feasible & Proportionate Cost	Adopted: Incorporating a cultural heritage protection program not only mitigates cultural and social risks but also demonstrates respect for indigenous communities and their environmental concerns. Given the absence of detailed information about sea country values this program would be precautionary and should be informed by the Traditional Owners of sea country.
Acquire Seismic On Paper	1	0.02	All	Aligning all CGG staff and contractors is a relatively costly measure but will allow for optimisation of protections.	Feasible & Proportionate Cost	Adopted: ASOP's can optimize survey design, reducing the duration and extent of environmental impacts by minimizing the need for adjustments during the actual survey.
Advanced Emission Reduction Technologies	1	8	Atmospheric Emissions	Excessive costs for little to no impact reduction.	Exorbitant Sacrifice	Rejected: Retrofitting vessels with emission reduction technologies aligns with environmental protection goals but is impractical to implement for one survey.
Alternative Fuels	1	20	Atmospheric Emissions	Excessive costs for little to no impact reduction.	Exorbitant Sacrifice	Rejected: Transitioning to alternative fuels is technically unfeasible, with no established infrastructure for LNG or hydrogen conversion to seismic vessels. The costs associated with adopting alternative fuels are unreasonable, even after considering their potential to reduce emissions.
Enhanced Wastewater Treatment	1	8	Planned Discharges	Little to no real impact reduction given low level of impact already achieved.	Exorbitant Sacrifice	Rejected: While there are costs associated with implementing advanced treatment technologies, these costs are unjustifiable given the nature and scale of potential environmental benefits. Further, the existing control measures, such as pollution prevention plans and regular inspections, are already effective in managing planned discharges to an acceptable level.
Recycling and Reuse	1	0.8	Planned Discharges	Little to no real impact reduction given low level of impact already achieved.	Marginal Reduction	Rejected: The current control measures, including pollution prevention plans and regular inspections, are effective in managing planned discharges, making recycling and reuse unnecessary for this specific project.
Zero Discharge Systems	1	8	Planned Discharges	Little to no real impact reduction given low level of impact already achieved.	Exorbitant Sacrifice	Rejected: The current control measures, including pollution prevention plans and regular inspections, are effective in managing planned discharges, making recycling and reuse unnecessary for this specific project.
Replace acoustic source with althernative technonlogies such as marine vibrioses or ocean bottom cable or nodes.	1	3.8	Underwater Sound	Expensive and untested both for meeting geophysical objectives and for environmental impacts.	Impact/Risk Transfer	Rejected: Utilizing acoustic sources for marine seismic surveying provides a framework grounded in extensive research and practical experience. Their environmental impacts, both short-term and long-term, have been studied, facilitating the development of effective mitigation strategies. On the other hand, marine vibrioseis and coean bottom cables/ nodes, while holding promise as a newer technology, are not only more expensive but also shrouded in technical and environmental uncertainties. Long-term effects, particularly concerning particle motion and its potential impact on marine ecosystems and sensitive aquatic species, remain inadequately explored. Exploring these environmental impacts is unlikely until the technology is commercially competitive. Until we have a comprehensive grasp of these implications, it is prudent to rely on technology with known and manageable impacts rather than embracing potentially riskier avenues with unforeseen or highly uncertain environmental impacts. Further, the non-optimal data generated by alternative

						technologies increases the likelihood that additional surveys and exploration wells would be required, and presents an increased risk when drilling. [Added in response to Matter O01]
Spotter vessel with MFOs	1	0.54	Underwater Sound	Significant cost but extends the range of observation by an extra 3 km radius and provides an additional (and flexible) line of evidence to detections.	Feasible & Proportionate Cost	Apoted: Whilst other measures may be more effective (tethered buoys) the addition of a spotter vessel extends the range of observation utilising methods that are well understood within the industry. The addition of a independent and flexible detection method for whales is a significant benefit to the accuracy and coverage of detections. The impacts and risks of an additional vessel operating in the area are suitably understood based on analysis of how the activity and environment interact.
Real-time Underwater Sound Monitoring (Streamers)	1	0.18	Underwater Sound	Real-time validation of acoustic modelling results would facilitate adaptive management. Whilst the cost is high this measure increases certainty that operational parameters have been met.	Feasible & Proportionate Cost	Adopted: Implementation of real-time underwater sound monitoring systems equipped with hydrophones and advanced sensors. This technology is relatively new to market with the best providing integration with vessel systems to provide continuous monitoring of underwater sound emissions.
Passive Acoustic Monitoring (PAM) - Vessel Detection	1	0.34	Underwater Sound	Has been used lots in the industry (though not a standard measures). Query effectiveness for LF cetaceans, but newer technologies open range for positive detections.	Feasible & Proportionate Cost	Adopted: Implementing advanced marine fauna observation technologies is technically feasible, with proven systems available in the market. Based on the thorough technology assessment conducted in Appendix F5, tethered buoys should be deployed with PAM systems tuned to detect low frequency cetaceans. Aerial surveillance flights is disproportionately costly but does provide some additional protection for SRW/BW. Rejected: The costs associated with trailing all of these technologies are unreasonable, considering the uncertainty in effectiveness to mitigate impacts risks. Integrating marine fauna observation technologies into vessel operations is practical and aligns with safety and environmental protection goals. The use of marine fauna observation technologies supports regulatory compliance by reducing the risk of marine fauna disturbances caused by underwater sound. More than 10 aerial overflights is where the cost of this measure becomes grossly disproportionate as 10 flights would allow for one pre-survey and then one every 10 days during the survey which is the approximate weather window outside of summer months.
Passive Acoustic Monitoring (PAM) - Tethered Bouy Detection	1	0.48	Underwater Sound	Both unmanned craft and tethered buoys are relatively unproven but perform the same function. Excessive cost to implement both so the lower cost measure is preferred.	Feasible & Proportionate Cost	
Passive Acoustic Monitoring (PAM) - Unmanned Craft	1	0.544	Underwater Sound	Both unmanned craft and tethered buoys are relatively unproven but perform the same function. Excessive cost to implement both so the lower cost measure is preferred.	Alternatives Are Better	
Aerial Observations for LF cetaceans (1)	1	0.01	Underwater Sound	Aerial overflights have large coverage and can tie in with a longitudinal BW study. Weather limitations mean they can't be totally reliable. Observations would lead to direct impact reduction measures, including further observations.	Feasible & Proportionate Cost	
Aerial Observations for LF cetaceans (5)	1	0.05	Underwater Sound		Feasible & Proportionate Cost	
Aerial Observations for LF cetaceans (10)	1	0.1	Underwater Sound		Feasible & Proportionate Cost	
Aerial Observations for LF cetaceans (15)	1	0.15	Underwater Sound		Alternatives Are Better	
Drone Technology	1	0.108	Underwater Sound	Measure extends the range a little, but still needs to have the survey vessel as a base so range isn't much more than MMO vision. Could improve positive identification.	Alternatives Are Better	

Intra-red Camaras	1	0.18	Underwater Sound	Measure extends the availability into night-time operations but have a lower range than PAM for LF cetaceans.	Alternatives Are Better	
Double-Walled Fuel Tanks	1	4.4	Accidental release of fuel	Standard measures for seismic surveys are highly effective so low levels of risk reduction achieved.	Limited Effectiveness	Rejected: Retrofitting vessels with double-walled tanks would be too costly.
Enhanced Crew Training	1	0.02	Accidental release of fuel	Low cost of marginal risk reduction should still be adopted.	Feasible & Proportionate Cost	Adopted: Improved training is technically and economically feasible. It can enhance spill response readiness but may not eliminate the risk entirely. Testing arrangements are required by the regulations and will be implemented.
Waste Tracking and Monitoring Systems	1	0.2	Accidental release of materials or waste overboard	Standard measures for seismic surveys are highly effective so low levels of risk reduction achieved.	Limited Effectiveness	Rejected: Implementing advanced waste tracking and monitoring systems is technically and economically feasible. However, the practicality for this specific project may not justify the investment, considering the relatively low risk of accidental releases.
Enhanced Crew Training	1	0.02	Accidental release of materials or waste overboard	Low cost of marginal risk reduction should still be adopted.	Feasible & Proportionate Cost	Adopted: Improved training is both technically and economically feasible. This measure is easily added to the crew inductions already required under the contract teams.
Timing of the survey to avoid January, February, March	1	1.6	Underwater Sound, Physical Presence	High cost of adoption and a high level of environmental protection	Feasible & Proportionate Cost	Adopted: The summer months are the best for completing this survey in the shortest possible duration. The impacts and risk avoided are significant given the biodiversity increase during these months.

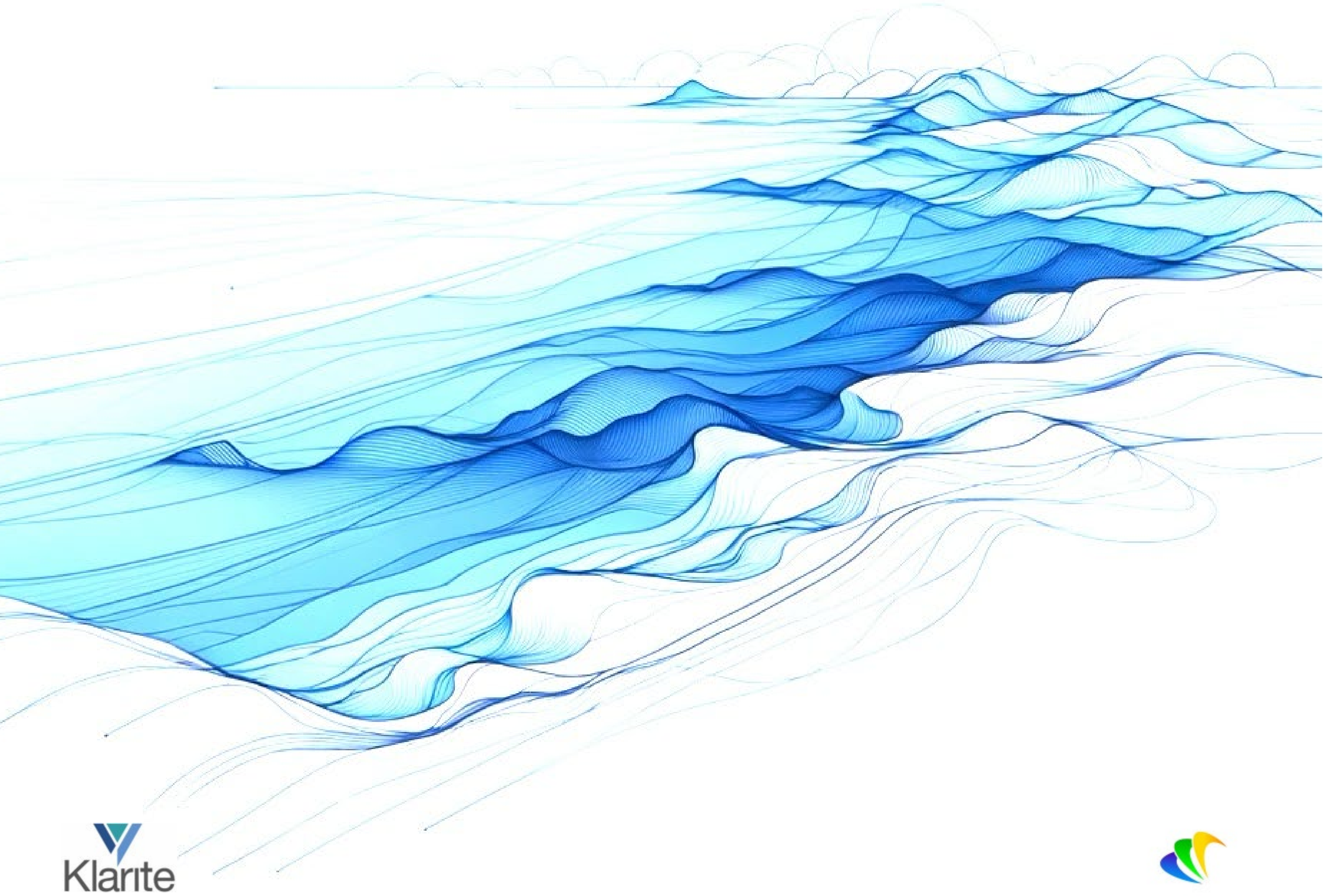
REGIA
Marine Seismic Survey

Acceptable Levels of Impact and Risk

Appendix F3: REG-EP-032-F3

Rev 2

May 2024



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1 Introduction

This document is dedicated to demonstrating that the environmental impacts and risks of the Regia Marine Seismic Survey (Regia MSS) will be of an acceptable level. The Regia MSS, a petroleum activity underpinned by advanced seismic acquisition and processing technologies, aims to survey unexplored regions within the Otway Basin.

This document outlines our commitment to managing environmental impacts and risks to within acceptable levels. It details the rigorous processes undertaken to ensure compliance with environmental regulations and standards. We focus on the key aspects of our operation, including the activity's scope, design, operational details, and our approach to managing potential environmental impacts and risks.

2 Assessment Input

This section should be read as iterative, with some initially adopted measures being updated or refined because of further work arising from Public Comment. Feedback received during the consultation process is provided in Table F3-1, and the feedback received during the public comment period for the completed EP is provided in Table F3-3.

2.1 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this evaluation and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and Table F3-1 shows how this feedback has been incorporated into demonstrating that the impacts and risks of the Regia MSS are of an acceptable level.

Table F3-1 - Relevant person input into the preparation of the EP

<table>
<tr><th>Objections and Claims</th><th>Feedback ID</th><th>Measure adopted because of consultation</th></tr>
<tr><td>Objection raised by a member of the public through website regarding impacts on SRW and Traditional Owner values.</td><td>74</td><td>CGG provided information and sought further feedback.</td></tr>
<tr><td>Objection suggesting the seismic array to operate at low power during line turns to minimise the risk of SRW and BW entering the zone of potential TTS or behavioural disturbance during shut down.</td><td>231</td><td>CGG will ensure low power during line turns are used.</td></tr>
<tr><td>Received comment through the interactive map detailing activities that may prevent or displace Pygmy Blue Whales or Southern Right Whales' use of BIAs are avoided.</td><td>48</td><td rowspan="4">Policy statement 2.1 standards within the Fauna Management System.
No discharge of the sound source in the Southern Right Whale (SRW) reproduction biologically important area (BIA) at any time.
A commitment to undertake periodic overflights of the BIA to help determine presence and behaviour of Koontapool.
An immediate shut-down zone of 3km radius from the seismic acoustic source for Koontapool.
Further assessment of SRW.
Further assessment of BW.</td></tr>
<tr><td>Email received stating there was no mention of ceasing activities during whale sightings during surveying and impacts of sustained noise on cetaceans.</td><td>184</td></tr>
<tr><td>Email received regarding concern about the welfare of whales that visit that area of the coast.</td><td>53</td></tr>
<tr><td>Concern raised through the interactive map about the protection of blue whales over southern right whales.</td><td>160</td></tr>
</table>

Objections and Claims	Feedback ID	Measure adopted because of consultation
A response to the interactive map stating no disruption to SRW calving grounds and First Nations values of them	164	
Email received containing queries demanding for a plan to monitor and reduce the risks and effects of seismic testing on marine species.	199	CGG will produce a OPEP and OSMP
Fishing associations request the need to understand the overlap of the survey with historical fishing activities.	172	CGG commissioned commercial fisheries report that was provided to the public and relevant persons (Appendix B6). CGG will implement an activity limitation of no acquisition beyond 200 m depth contour.
Email received regarding a request for decisions to be consistent with the federal government's Threatened Species Recovery Plan	201	Light management plan including shrouds. OPEP priorities for protection added.
Concern raised stating the unacceptable impact on whale nursey	202, 404	CGG agreed to implement the following measures: Exclude the SRW reproductive BIA from activity area. Exclude activity from SRW BIA (+11.3km) from activity while SRW are present. Fauna management plan. MMO's.
Objection raised by a member of the public through a community session due to impact on marine life and ecosystems from effects on zooplankton.	203	CGG will implement the following measures: Timing of survey outside peak upwelling/biodiversity (summer). Sail line plan to ensure activity limitations are complied with. Fauna Management Plan. Exclusions zones around high productivity fishing areas. MMO's.
Received email from Marine Parks requesting activities are timed to avoid species' peak migration and foraging behaviours.	228	CGG agreed to implement the following measures: Fauna Management Plan MMOs PAM Operators
Received email from Marine Parks suggesting we Identify a comprehensive suite of whale detection measures including regular aerial surveillance flights to identify presence / absence / species and direction of movement and PAMs to support the efficacy and reliability of shut down protocols for marine mammals.	230	CGG will produce a Whale Management Plan - including regular aerial surveillance flights.
During online meeting concerns regarding effects to recruitment of	365	

Objections and Claims	Feedback ID	Measure adopted because of consultation
King George Whiting (KGW) in Corner Inlet were stated.		King George Whiting (KGW) analysis to be undertaken, including historical seismic comparison.
Email stated concern regarding harm to KGW due to the activity.	381	
Email request for historical seismic survey assessment with KGW recruitment.	390	

In preparation of the EP there were several consultations with commercial rock lobster fishers and rock lobster fishing quota owners. Numerous claims were received for which a summary is presented in Table F3-2.

Table F3-2 -Assessment of claims of commercial rock lobster fishers

Claim	Assessment of Merit
The Investigator survey in 1999 killed everything in its path and the area has never recovered. (Feedback 276)	Assessments by the VFA using SRL fisheries data have concluded that CPUE has almost tripled from 2009/10 with standardised catches continuing to increase, reflecting a stable and relatively healthy fishery. Fishing effort has been very low in the greater MSS area including the area encompassing the Investigator seismic survey in 1999. Maps of fishing effort across the area indicate effort is very heavily influenced by the type of bottom habitat available. There is a ridge of more complicated reef (providing more habitat for lobsters) running in a SW direction from the tip of Cape Otway which is clearly seen on navigation charts. Fishing effort data from VFA shows effort is heavily concentrated along this ridgeline and drops off dramatically when the bottom becomes more homogenous - see Figure F3-1 below. Video footage of the bottom as part of the Otway Gas Development confirms a low-profile limestone base dominated by sponges (Beach Energy 2022).
The long-term effects on rock lobsters won't be known for 7 years. (Feedback 277)	There have been multiple seismic surveys conducted across the greater region for over 20 years. There are no patterns of recruitment and stock abundance of SRL that can be linked to a seismic survey. The scale of impact by seismic is overwhelmed by the scale of climate events (currents, wind, water temperatures, ENSO events), spatial distribution of habitat and fishing. There is no stock-recruitment relationship evident at small scales.
Seismic effects the recruitment to the fishery and has resulted in declines in stock. (Feedback 278)	Multiple studies have identified synchrony in larval settlement and recruitment patterns is coherent across southern Australia. This broad scale connectivity completely overwhelms any localised recruitment dynamics and is a key part of imbuing resilience in SRL populations. Rather, it is changing climate that is being identified as a major driver of changes to population dynamics in SRL. Recent work has suggested a regional scale drop in Surplus Production since the late 90's early 2000's is likely behind a reduction in fisheries output across the greater region with changes to water temperature a likely driver of this.
Wherever there has been seismic the fishing grounds are no longer productive.	Fishing effort in the Western Victoria SRL Fishery is now at the lowest it's been since the 1980's. Another way to state this is that it's never been easier to catch a designated quota, with "catches per unit of effort – CPUE" as high as they've ever been. Less and

(Feedback 279)	less pot lifts are being required to catch TACC quotas. Seismic has been occurring adjacent to the Western Victoria coast for over 20 years however SRL populations continue to support an improving fishery.
The fishery is in decline and seismic is a major cause of the decline. (Feedback 280)	As noted above there have been changes to total catch across southern Australia which have been correlated with large scale environmental drivers but not seismic. As reported by the VFA the SRL fishery in Western Victoria is currently in the best health it has been for some time with fleet efficiencies adding to the increasing CPUE since 2010. Surplus production declines which are seen as a major driver of any declines in population of SRL have been occurring over scales much larger than any seismic survey areas.

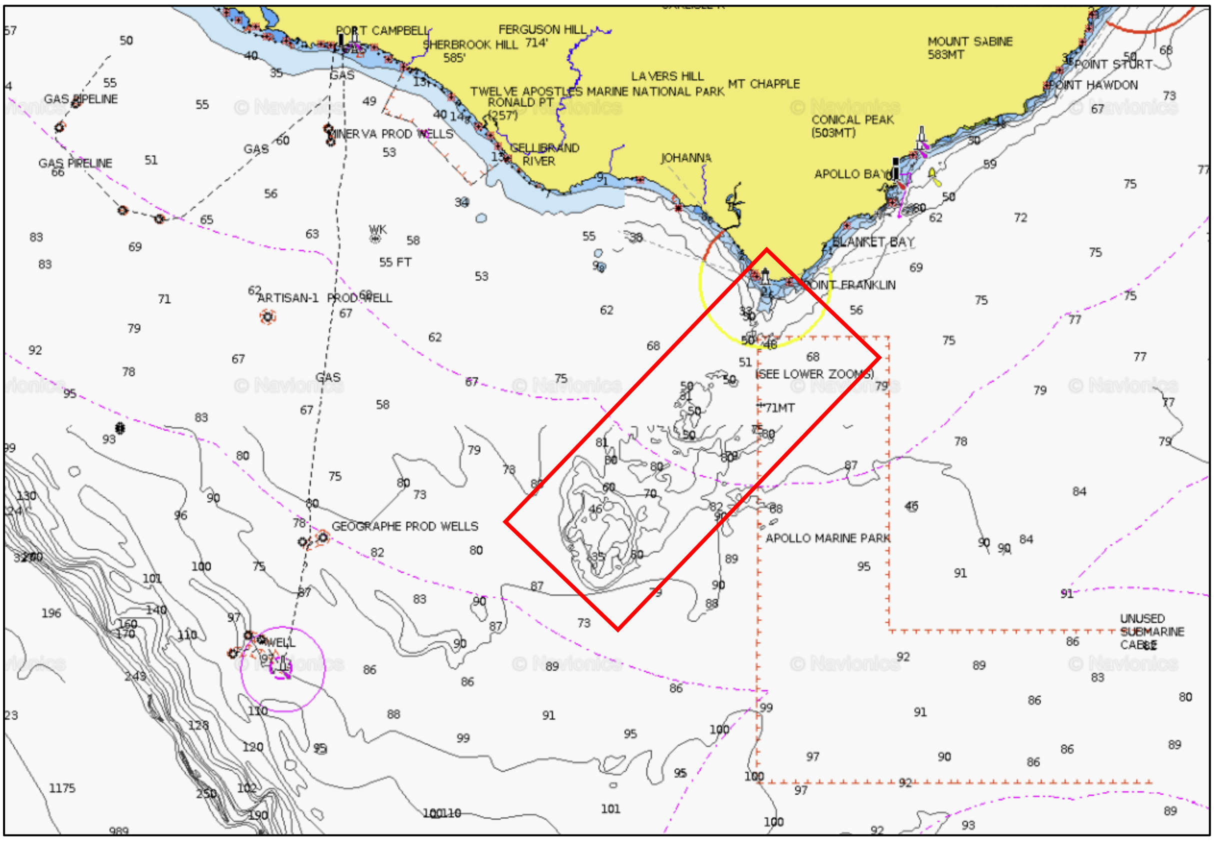


Figure F3-1 - Navionics map of bottom adjacent to intended MSS area. SRL fishing effort is concentrated close to shore and over the ridge line enclosed by the red box. Fishing effort tails off very quickly as habitat suitability for SRL also declines.

2.2 Public Comment

Table F3-3 shows how the Matters raised during public comment have been incorporated into the EP in this document.

Table F3-3 - Public comment input into the preparation of the EP

Matter	Matter ID	Changes made arising from public comment
Matter: Flawed argument regarding animals moving away	I04	CGG has considered these claims and has updated the EP Impact Assessments (Appendices E, and F where relevant) to clarify that, while some displacement is expected from mobile taxa during the Regia MSS, the survey will not preclude animals from the Operational Area in its entirety. Instead, animals are expected to temporarily move away from the active acoustic source, but once the source passes, animals will be free to move back into the habitat that they departed from.
Matter: Impacts to whales' food source	M10	CGG has undertaken further investigation and provided an additional detailed responses related to these this matter in EP Appendix F3, Section 5.2.10.1.
Matter: Limitations of MFOs/MMOs when detecting marine mammals	M43	CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan) and Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Outcomes) to include an additional MFO/ PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage.
Matter: MFOs/MMO's do not have a 360-degree view, the use of one MFO/MMO is inadequate.	M45	CGG has considered these claims and has determined that additional MFO coverage is appropriate to further mitigate the potential for whales to go undetected within the 3 km observation zone. Consequently, CGG has updated EP Appendix G2 (Fauna Management Plan), EP Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Performance) to include an additional MFO/ PAM operator will be present on the vessel to support fatigue management. In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be always onboard a dedicated spotter vessel. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals.
Matter: The use of two PAM operators is inadequate.	M49	CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan) and Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Outcomes) to include an additional MFO/ PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage.
Matter: No modelling of impacts to zooplankton	P04	CGG has considered these claims and is satisfied that all available and relevant modelling studies on seismic effects have been included in the knowledge base used to develop the EP, and the EP has been updated to include reference to recent publications.
Matter: Extent of impacts to zooplankton	P06	CGG has considered these claims and is satisfied that the extent of seismic effects on zooplankton have been appropriately assessed, and the EP has been updated to include reference to recent publications.
Matter: Impacts of underwater sound on octopus	F11	CGG has considered these claims and to ensure that the most up-to-date assessment has been made has provided an extra Acceptability Assessment within Appendix F3 of the EP, which more clearly defines the levels of risk to Octopus from the proposed Regia MSS.
Matter: Impacts on Fisheries (general)	F12	CGG has considered these claims and has added specific analyses of further species including Abalone, Snapper, and Octopus to the Acceptability Assessment within Appendix F3 to ensure all concerns have been investigated and the level of risk has been clarified according to the available evidence.

Matter: Impacts on spawning aggregation areas for King George Whiting	F14	CGG has considered these claims and has added specific analyses for King George Whiting to the Acceptability Assessment within Appendix F3 to ensure all concerns have been investigated and the level of risk has been clarified according to the available evidence.
Matter: Impacts on abalone fisheries	F16	CGG has considered these claims and is satisfied that through scheduling management of the proposed Regia MSS any potential interaction with abalone stocks can be minimised and has conducted a further assessment on abalone in EP Appendix F3 (Acceptability Assessment), Section 5.2.8, which provides a more detailed species-specific examination of impacts.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which have been predicted to result in an exceedance of the safety criterion human health safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2).
Matter: Lack of detail on EPBC-listed species and enforceable measures	I17	CGG has updated EP Appendix F3 (Acceptable Levels Assessment) to include an assessment for the Australian sea lion in response to these claims.

3 Defining Acceptable Levels

This section outlines the framework for defining acceptable levels of environmental impact and risk for the Regia MSS. Our approach aligns with best practices and regulatory requirements. Figure F3-2 is a copy of the conceptual framework for defining acceptable levels and establishing levels of environmental performance from NOPSEMA guidance documents. CGG has adopted this framework in application to the Regia MSS EP.

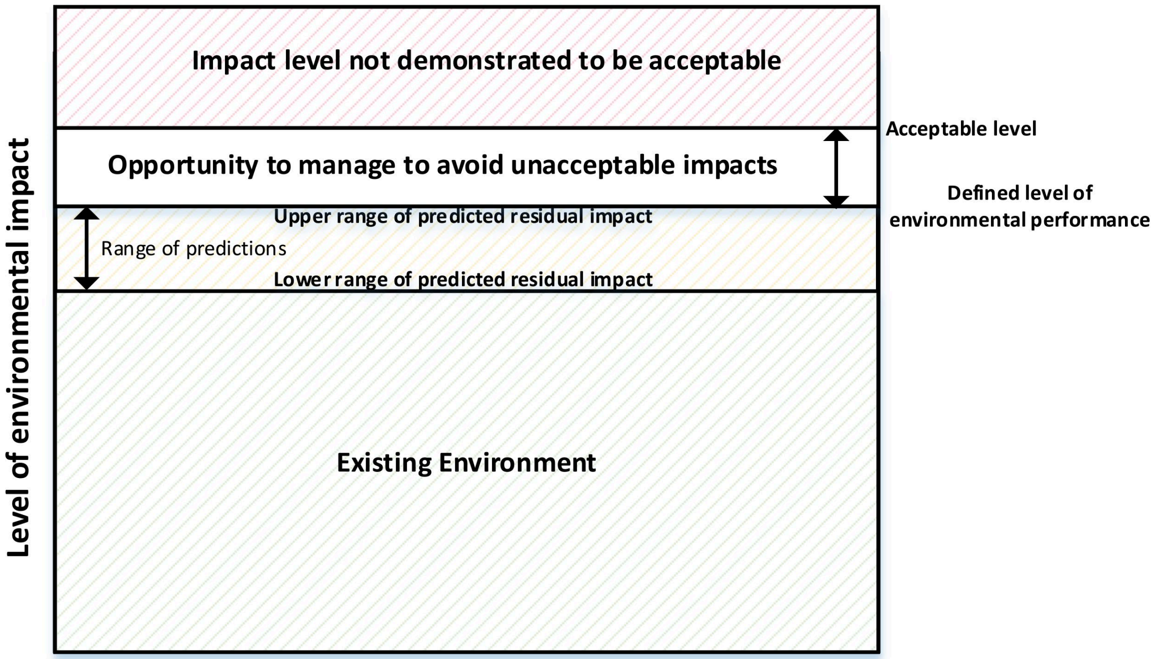


Figure F3-2 - Framework for defining acceptable levels of impact and associated levels of environmental performance (N-04790-GN1663)

In Figure F3-2, the terms used have the following meaning:

- ***Existing environment*** is the condition of the existing environment before the implementation of the project.
- ***Range of predictions*** illustrates that impact prediction processes can result in a range of residual impacts after the implementation of control measures due to a degree of uncertainty attributed to limitations in impact prediction tools, shortfalls in knowledge in the way that the environment responds to pressures.
- ***Opportunity to manage*** is the window that the titleholder must undertake responsive management measures to prevent the impact exceeding the defined acceptable level.
- ***Defined level of environmental performance*** is a level of performance of a proponent in relation to environmental performance outcomes (and environmental performance standards in EPs).
- ***Acceptable level*** is the maximum level of change in environmental parameters before the environmental effects become unacceptable.
- ***Unacceptable impact*** is the change in the environment that has exceeded the acceptable level and usually indicates that a change has occurred that is not acceptable from a socio-economic, ecological, biological, or cultural values perspective.

This conceptual framework considers the defined acceptable level, accounts for limitations in the impact and risk analysis undertaken (Appendices D1 – D4 and E1 – E10) and helps to establish levels of environmental performance in a manner that enables management response to prevent the acceptable level of impact from being exceeded. This framework highlights the opportunity for titleholders to manage their activities to prevent environmental impacts from becoming unacceptable by setting levels of environmental performance such that they represent a level that is better than or at least equivalent to the 'acceptable level' and therefore a precursor to unacceptable impact. By applying this approach, inaccuracies in the impact prediction process and uncertainties in the effectiveness of management controls can be accounted for using responsive management to avoid exceeding the acceptable level.

Table F3-4 establishes five parts of the framework used in this EP as the basis of defining acceptable levels. CGG used specific, defined acceptable levels of impact and risk for the Regia MSS based on these contexts. These levels are tailored to the unique aspects of our project, ensuring a responsible and well-informed approach to environmental management.

Table F3-4 - Framework for defining acceptable levels.

Acceptable Levels Framework	Description
Principles of ESD	We considered the principles of ESD, as set out in the Environment Protection and Biodiversity Conservation Act (EPBC Act), into our impact and risk assessment processes. These principles guide our efforts to manage environmental impacts responsibly, ensuring long-term sustainability. The assessment of the consistency of CGG's decision making with the principles of ESD can be found in Appendix F4.
Environmental Context	We considered the biological, ecological, economic, social, and cultural features relevant to the Regia MSS in each impact and risk assessment (Appendices D1-4 & E1-10). This comprehensive approach allows us to understand and respect the environment's inherent values and sensitivities.
Legislative Context	Our acceptable levels are consistent with legislation and other regulatory requirements, including relevant policy documents, guidelines, and conservation plans. This ensures our activities align with national standards and objectives.
Company (Internal) Context	Management of the activity is aligned with CGG's impact and risk assessment process and implementation strategy. This internal alignment ensures consistency and reliability in our environmental management practices.
External Context	We assess, respond to, and adopt measures in response to objections and claims received from relevant persons, attempting to satisfactorily address concerns in our environmental management strategies.

CGG applied a comprehensive and transparent methodology in defining acceptable levels of impacts and risks for the activity. CGG's impact and risk management method is grounded in the principles, framework, and processes defined by ISO 31000:2009 Risk Management. The method included steps for:

- Identifying and analysing environmental aspects associated with the activity for environmental impacts and risks.
- Predicting the extent, duration, and severity of those environmental impacts and risks.
- Assessing mitigation and management measures.

This process was systematic and evidence-based, incorporating consultation at all stages. Furthermore, the methodology placed a significant emphasis on establishing the context of assessments, incorporating both internal and external environmental factors. This included a detailed examination of the activity description, as well as preliminary information gathered through independent assessments and relevant person feedback. This ensured that acceptable levels of environmental impact and risk are not only in line with legislative requirements but also consider the specific environmental, social, and economic contexts of the Otway Basin.

The defined acceptable levels in Appendix B1 were published in May 2023 on the Consultation Hub alongside our environmental assessment process (Appendix B9) to provide an opportunity to the community and relevant persons to understand the assessment process and influence the criteria used in the assessment process. The opportunity to comment was open for 60 days.

4 Demonstration of Acceptable Levels

There are five parts to this demonstration that the environmental impacts and risks of the Regia MSS will be of an acceptable level. These are:

1. Comparison of predicted levels of impact and risk to pre-defined acceptable levels.
2. Further assessments of key environmental values and sensitivities.
3. Compliance with the EPBC Act.
4. A search for unacceptable environmental impacts.
5. Consideration of predictive uncertainty.

4.1 Comparison of Predicted Levels of Impact and Risk to Defined Acceptable Levels

In evaluating the proposed activity against acceptable levels of environmental impact and risk, CGG has meticulously followed its Decision-Making Criteria as outlined in its environmental assessment documentation (Appendices B1 & B9). Comparing the predicted levels of impacts and risks from the environmental assessments with the pre-defined acceptable levels was completed within each impact and risk analysis' (Appendices D1 – D4 and E1 – E10) and carried significant weight in CGG determining whether the activity complied with its corporate policies and the Regulations.

4.2 Further Assessment of Key Environmental Values and Sensitivities

This part of the demonstration underscores the importance of conducting a thorough evaluation of key environmental values and sensitivities as part of our overall assessment of impacts and risks associated with the Regia MSS. Focusing on key values and sensitivities enables us to:

- Continue the assessment of higher order impacts and risks.
- Change perspective to increase confidence in the assessment process.
- Put the magnitude of impacts and risks into their proper context.
- Address specific concerns raised by relevant persons.

The following detailed evaluations not only enhances the robustness of our overall environmental assessments but also serves to test and validate the appropriateness of our preceding analysis. For each of the key values and sensitivities identified through the environmental assessment process this evaluation will address:

- **Species-Specific Sensitivity:** Assess the vulnerabilities of each species to the seismic activity, including breeding, feeding, migration patterns, and habitat preferences.
- **Magnitude of Effect:** Evaluate the potential scale of impact on each key value and sensitivity, considering both direct and indirect effects.
- **Cumulative Impacts:** Consider the combined effects of the seismic survey with other existing or planned activities in the area.
- **Recovery Potential:** Assess the ability of species or ecosystems to recover from potential impacts.
- **Conservation Status:** Factor in the conservation status of species, especially those that are endangered or protected.
- **Mitigation Effectiveness:** Evaluate the effectiveness of proposed mitigation measures specific to each key value and sensitivity.

4.2.1 Southern Right Whales / Koontapool (*Eubalaena australis*)

4.2.1.1 Species-Specific Sensitivity

Baleen whales, which include SRW, are categorised as low-frequency cetaceans. The acoustic repertoire of right whale species is similar, comprising of a variety of short, low frequency (<1 KHz) vocalisations (DCCEEW 2023, DOSITS 2023). Vocalisations have a fundamental frequency range of 50 to 500 Hz, with modelled hearing range between 10 Hz to 22 kHz (functional range of 15 Hz to 18 kHz), and source levels ranging from 132 to 192 decibels (Parks & Tyack 2005, Parks et al 2007, Nielsen et al 2019).

SRW mother-calf pairs on a Western Australia breeding ground were found to produce low amplitude vocalisations; acoustic tags measured received levels between 123 and 134 decibels at low rates (< 10 calls per hour, 1 call per dive) (Nielsen et al 2019). Calls were more likely to occur during dives, indicating that these signals function to coordinate movements between mothers and calves.

The frequency of the sound produced from each seismic pulse is primarily less than 2 kHz, with the highest levels at frequencies in the range of 10-500 Hz (McCauley 1994). Thus, there is an overlap with low-frequency cetaceans hearing frequencies.

Interestingly, the SRW source level of 132 to 192 decibels means that SRW calls can be louder than the current noise assessment criteria for behavioural disturbance of 160 decibels.

The updated draft National Recovery Plan for SRW (DCCEEW 2023) assessed threats to SRWs through a risk assessment process. For the eastern population of SRWs, which are relevant to the Regia MSS, the consequence of seismic surveys was assessed as moderate, which is defined as population recovery slows or stalls. The risk assessment outcome for threats to the eastern population of SRWs from underwater noise from seismic surveys stated, "the likelihood of occurrence was assessed as likely, expected to occur at least once every five years, resulting in a risk level of high, requiring additional mitigation action and an adaptive management plan required; the precautionary principle should be applied."

The risk assessment is deemed to be conservative as the updated draft National Recovery Plan for SRW (DCCEEW 2023) details there is an increase in long-term population trend for SRW, albeit slowly for the eastern population. This has been achieved whilst co-existing with marine seismic surveys as there has been >80 marine seismic surveys in the last 60 years in the Otway region. This includes at least 10, 3D surveys in the last 20 years.

Other threats assessed as having a moderate consequence and a likelihood of occurrence of almost certain are:

- Anthropogenic underwater noise; industrial noise.
- Habitat degradation; infrastructure of coastal development.
- Habitat degradation; infrastructure of offshore development.

Other threats assessed as having a major consequence and a likelihood of occurrence of almost certain are:

- Entanglement: active fishing or aquaculture equipment.
- Collisions; vessel strike.
- Anthropogenic climate variability and change.

4.2.1.2 Magnitude of Effect

The updated draft National Recovery Plan for SRW (DCCEEW 2023) details that impacts from marine seismic surveys can be classified as physical (e.g., permanent, or temporary hearing loss) when within proximity to a seismic noise source, and behavioural (e.g., avoidance of areas, disruption to calving and nursing behaviour, stress) which may occur many kilometres from the seismic survey. Mortal injuries are not identified as an impact to SRWs from seismic surveys.

The updated draft National Recovery Plan for SRW (DCCEEW 2023) details the potential for impacts from anthropogenic underwater noise is of particular concern within or close to SRW reproduction

BIAs where whales are resident for long periods (e.g., weeks to months) of time and pregnant and nursing females and calves are present. There will be no impact to SRWs within reproduction BIAs based on spatial and temporal exclusion zones.

Permanent or temporary hearing loss to SRWs is not predicted based on the distance of the spatial and temporal exclusion zones to SRW reproduction BIAs. In addition, while SRWs are migrating to and from the coastal reproduction BIAs, they are moving at speeds between 3 – 3.3. km/hr (Charlton 2017) and hence are unlikely to be within the area of cumulative sound exposure for a long enough period to receive cumulative sound levels above the effect criteria.

Thus, effects are limited to behaviour responses to migrating SRW which may range from short term orientation to moving away from the sound source. Disturbance of migrating mothers could increase their energy expenditure which could result in a reduction of energy available for their calf and for their return migration (Christiansen et al 2014). Based on an average swim speed of between 3 – 3.3 km / hr (Charlton 2017) and a distance to the behavioural effect criteria of 9.51 km, the energetic costs would be extremely low if avoidance behaviour occurred.

In addition, SRWs whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (CoA 2012). Along the Australian coast, individual SRWs use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (CoA 2012). Thus, if a SRW avoided the area above the behavioural effect criteria it is unlikely to prevent them from undertaking their seasonal migrations.

As the Regia MSS will only occur during one season when SRWs are present in Australia waters, potential behavioural impacts to individual SRW will not impact on the recovery of the population.

4.2.1.3 Cumulative Impacts

CGG has assessed potential cumulative noise impacts (Appendix E10) of other activities within the Otway Basin and identified additional mitigations to ensure cumulative noise impacts are within acceptable levels.

Cumulative impacts from the Regia MSS with the other highest rated threats identified within the updated draft National Recovery Plan for SRW (DCCEEW 2023), anthropogenic climate change and climate variability; entanglement in fishing and aquaculture equipment; habitat degradation from coastal and offshore development; vessel collision; whaling (if resumed at any time); and prey depletion from overfishing are unlikely based on the Regia MSS will not impact the SRW reproduction BIA and impacts are limit to behavioural response for migrating SRWs for one season. The other highest rated threats are continually present with potential impacts over several seasons.

4.2.1.4 Recovery Potential

The life history traits of Southern Right Whales such a long-life span, low reproductive output, late sexual maturity, and strong fidelity to calving areas, make them vulnerable to anthropogenic threats. These life history traits mean that any long-term response to disturbance and impacts from threats that may affect recovery are unlikely to be detectable, or even reliably identified to a specific threat, over short timescales (i.e., 1 to 3 years).

As SRW recover from commercial whaling and their distribution and abundance increases, anthropogenic underwater noise may have the potential to displace and/or deter SRW from habitat critical to the species or currently unused but historically important areas (DCCEEW 2023).

Based on the magnitude of effect from the Regia MSS to SRWs, which is limited to behavioural avoidance for migrating SRW for one season, no long-term disturbance are impacts that may affect their recovery are predicted.

4.2.1.5 Conservation Status

The SRW is listed as threatened (*Endangered)* under the EPBC Act because population numbers have been severely reduced by historical commercial whaling (DCCEEW 2023). SRW are also listed as Migratory. The updated draft National Recovery Plan for SRW (DCCEEW 2023) identifies the

Commonwealth legislation and management arrangements that relate to the protection of SRWs in Australian waters.

Two populations of SRW occur in Australian waters: the western and eastern. SRW occur seasonally in all State coastal waters, with sightings ranging from Hervey Bay in Queensland on the east coast, along the entire southern coastline and including Tasmania, to Exmouth Gulf in Western Australia. The geographical boundary between the Australian populations is unclear. For management purposes, the western population includes Western Australia and South Australia waters, whereas the eastern population comprises the coastal waters of Victoria, Tasmania, New South Wales, and Queensland. Australian Southern Right (DCCEEW 2023).

SRW predominantly occur in aggregations in coastal water reproductive areas where they calve and nurse their young from May to October, primarily occupying shallow waters (< 10m depth) within 1 km of the coastline (Charlton et al 2019).

CGG has shown in the impact and risk analysis documents that regulatory requirements relevant to the Regia MSS and SRW will be met. Relevantly, the updated draft National Recovery Plan for SRW (DCCEEW 2023) has significant weight in CGG's assessment due to the involvement of Commonwealth and State regulatory agencies, threatened species managers, and scientific experts in the development of the recovery plan. As such, recommended actions from the plan relevant to the Regia MSS have been implemented as detailed in Section 4.2.1.6 Mitigation Effectiveness.

4.2.1.6 Mitigation Effectiveness

Mitigation of the Regia MSS effects can be best implemented with regards to SRW by limiting the spatial boundaries of the survey to avoid SRW reproduction BIAs where whales are resident for long periods (e.g., weeks to months) of time and pregnant and nursing females and calves are present. CCG will implement a spatial and temporal exclusion zone to SRW reproduction BIAs so that received noise levels do not exceed the noise effect criteria within the reproduction BIA when SRWs are present. The if a highly effective mitigation as ensures no impact to SRW within the reproduction BIA.

The updated draft National Recovery Plan for SRW (DCCEEW 2023) details the following in relation to marine seismic surveys:

- The risk of physical impacts to Southern Right Whales is mitigated by implementation of the practical measures outlined in the *EPBC Act Policy Statement 2.1— interaction between offshore seismic exploration and whales* (for which the Regia MSS will implement all Part A and all Part B measures).
- Advises that *EPBC Act Policy Statement 2*.1 does not consider cumulative noise exposure from multiple noise sources and periods and that the precautionary principle should be applied in these cases when a lack of full scientific certainty exists.

CCG will implement the requirements of *EPBC Act Policy Statement 2.1— interaction between offshore seismic exploration and whales* (for which the Regia MSS will implement all Part A and all Part B measures) which has been deemed as an effective mitigation within the updated draft National Recovery Plan for SRW (DCCEEW 2023) to minimise the risk of acoustic injury to whales in vicinity of seismic survey operations. to minimises the risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important areas (e.g., breeding, calving, resting areas or confined migratory routes or feeding areas) or during critical behaviours (e.g., breeding, feeding, and resting).

Though *EPBC Act Policy Statement 2*.1 does not consider cumulative noise exposure from multiple noise sources and periods CGG has assessed potential cumulative noise impacts (Appendix E10) of other activities within the Otway Basin and identified additional mitigations to ensure cumulative noise impacts are within acceptable levels.

In addition, the updated draft National Recovery Plan for SRW (DCCEEW 2023) identifies actions that are relevant to the Regia MSS and underwater noise. CGG has considered each of these actions in the completion of an assessment of the activity (action) according to the principle of ESD (Appendix F4), and the application of a Fauna Management Plan (Appendix G1) which includes minimising the risk of injury and disturbance to SRW.

4.2.2 Blue Whales / Wuulok (*Balaenoptera musculus*)

4.2.2.1 Species-Specific Sensitivity

Blue whales are categorised as low-frequency cetaceans. Blue whales produce high-intensity, low frequency vocalisations which can be detected over large distances (Miller et al 2021). Blue whale calls last up to 18 s and generally consist of three segments: a 9-s-long, 27-Hz tone, followed by a 1-s downsweep to 19 Hz and another, longer-lasting downsweep to 18 Hz (Širović et al 2004, Rankin et al 2005).

Antarctic blue whale source levels have been estimated to be 189 underwater decibels (Širović et al 2007), although a more recent study has estimated source levels to be between 188-191 decibels (Miller et al 2021).

Gavrilov and McCauley (2013) found pygmy blue whales in Australian waters display a diel pattern in vocalisation, noting pygmy whales are more vocally active during hours of darkness compared to daylight hours. Tripovich et al (2015) noted Antarctic blue whales calls were more prevalent in the night to early morning.

The frequency of the sound produced from each seismic pulse is primarily less than 2 kHz, with the highest levels at frequencies in the range of 10-500 Hz (McCauley 1994). Thus, there is an overlap with low-frequency cetaceans hearing frequencies.

The blue whale source level of 188 to 191 decibels means that blue whale calls can be louder than the current sound effect criteria for behavioural response of 160 decibels.

The Blue Whale Conservation Management Plan 2015-2025 (DoE 2015c) assessed threats to blue whales through a risk assessment process. For both the pygmy blue whales and Antarctic blue whales, which are relevant to the Regia MSS, the consequence of seismic surveys was assessed as moderate, which is defined as population recovery slows or stalls. For pygmy blue whales the likelihood of occurrence was assessed as almost certain, expected to occur every year, resulting in a risk level of very high for which immediate additional mitigation action is required. For Antarctic blue whales the likelihood of occurrence was assessed as possible, the event might occur at some time, resulting in a risk level of high requiring additional mitigation action and an adaptive management plan required; the precautionary principle should be applied.

The risk assessment is deemed to be conservative as the Blue Whale Conservation Plan 2015-2025 (DoE 2015c) details that given the behavioural impacts of noise on blue whales are largely unknown, a precautionary approach has been taken regarding assignation of possible consequences.

Other threats assessed as having a moderate consequence and a likelihood of occurrence of possible are vessel collisions. Other threats assessed as having a major consequence and a likelihood of occurrence of possible are climate variability and change.

4.2.2.2 Magnitude of Effect

The Conservation Management Plan for Blue Whales (DoE 2015c) details that impacts from anthropogenic noise can include hearing impairment (e.g. permanent and temporary threshold shifts) masking of communication, displacement, and other significant behavioural changes (including to vocal behaviour). There have been no recorded mortal injuries to blue whales from seismic surveys.

The Conservation Management Plan for Blue Whales 2015-2025 (DoE 2015c) details the potential for impacts from anthropogenic underwater noise is of particular concern within biologically important areas at biologically important times. CCG will implement an activity limitation where the seismic source will only be operated in the pygmy blue whale foraging BIA during April, May and June or September, October, and November when low numbers of pygmy blue whales and other foraging whales are in the BIA off Otway.

During this time permanent or temporary hearing loss and/or displacement of blue whales is not predicted based on the implementation of detection systems and actions as described in the Fauna Management Plan (Appendix G2). Furthermore, it has been suggested that blue whales may continue to forage within 2.5 km of an operating seismic survey if resources are abundant enough to outweigh the physical and energetic costs of acoustic disturbance (Burton et al 2023).

As the Regia MSS will only occur during one season when blue whales are present in Australia waters, potential impacts to individual blue whales will not impact on the recovery of the population.

4.2.2.3 Cumulative Impacts

CGG has assessed potential cumulative noise impacts (Appendix E10) of other activities within the Otway Basin and identified additional mitigations to ensure cumulative noise impacts are within acceptable levels.

Cumulative impacts from the Regia MSS with the other highest rated threats identified within the Conservation Management Plan for Blue Whales, vessel collision and climate variability and change, are unlikely based on the Regia MSS will manage potential impacts to foraging blue whales and the seismic survey will only occur over one blue whale foraging season. The other highest rated threats are continually present with potential impacts over several seasons.

4.2.2.4 Recovery Potential

Blue whales exhibit long life history traits reaching sexual maturity at 10 years old and calve every 2 or 3 years, making their population recovery slow and vulnerable to anthropogenic threats, although it is thought that blue whale populations are recovering.

Estimates of pre- and post-whaling abundance of Antarctic blue whales indicate that they have been increasing in abundance since the cessation of whaling. The estimated original population size was 239,000 (95% interval 202,000 – 311,000) (Branch et al 2004). A more recent estimate of the Antarctic blue whale population was 2,280 (95% interval 1,160 – 4,500) individuals in 1996 (estimated from the circumpolar International Decade of Cetacean Research, Southern Ocean Whale and Ecosystem Research survey conducted from the 1992/1993 to 2003/2004 season) (Branch 2007).

There is little knowledge of the pre-exploitation abundance of Australian pygmy blue whales, making it difficult to assess population recovery. Pygmy blue whales in the sub-Antarctic are estimated to have reduced from 7,598 at the start of the 1960/1961 season to 3,996 at the end of the 1971/1972 season, however this is based on out-of-date methodology and the population identity of these sub-Antarctic blue whales is unknown (Zemsky and Sazhinov 1982). Preliminary estimates of the number of pygmy blues caught are 13,022 though this encompasses all catches from South Africa to New Zealand and the northern Indian Ocean for which the extent of connectivity is unknown (Branch et al 2008).

Based on the magnitude of effect from the Regia MSS to blue whales, no long-term disturbance impacts that may affect their recovery are predicted.

4.2.2.5 Conservation Status

The blue whale is listed as endangered under the EPBC Act as population numbers have been severely reduced by historical commercial whaling (DoE 2015c). The Conservation Management Plan for Blue Whales (DoE 2015c) identifies the Commonwealth legislation and management arrangements that relate to the protection of blue whales in Australian waters.

There are two sub-species of blue whale found in the Southern Hemisphere. The Antarctic blue whale *(B. musculus intermedia*) which occurs in the southern hemisphere and averages 27 m in length and the pygmy blue whale (*B. musculus brevicauda*), occurs in waters of the southern Indian Ocean, eastern South Atlantic Ocean and western South Pacific Ocean, and averages 22 m in length (Victorian State Government, 2009). The Pygmy Blue Whales give birth in the tropical waters of the Banda Sea migrating to and from this area to reach the cool temperate waters of the Southern Ocean.

Antarctic blue whales breed and calve in warm water (latitude 20° S) during the southern hemisphere winter. They then migrate to cold Antarctic waters (60 - 70° S) during the southern hemisphere summer to feed, mainly on krill. Pygmy blue whales occur only in the southern hemisphere (southern Indian Ocean, eastern South Atlantic Ocean and western South Pacific Ocean). They do not migrate as far south as Antarctic blue whales, and in summer are generally found north of latitude 55 °S (DoE 2015c).

Important foraging grounds for blue whales include the Great Australian Bight, South Australia, and off Portland Victoria. Research to date has found that Pygmy Blue Whales occupy the western area of the Bonney Upwelling system in the Eastern Great Australian Bight and adjacent to the Kangaroo Island canyons from November and December (DoE 2015c). Pygmy Blue Whales then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (e.g., between Robe, SA and Cape Otway, Vic). This occurs predominately between January to April (DoE 2015c) though they have been recorded in the Otway area as early as October and as late as June.

CGG has shown in the impact and risk analysis documents that regulatory requirements relevant to the Regia MSS and blue whales will be met. Relevantly, the Conservation Management Plan for Blue Whales (DoE 2015c) and Guidance on Key Terms within the Blue Whale Conservation Management Plan (DAWE 2021) have significant weight in CGG's assessment due to the involvement of Commonwealth and State regulatory agencies, threatened species managers, and scientific experts in the development of the conservation management plan and guidance. As such, recommended actions from the conservation management plan relevant to the Regia MSS have been implemented as detailed in Section 4.2.2.6 Mitigation Effectiveness.

4.2.2.6 Mitigation Effectiveness

Mitigation of the Regia MSS effects can be best implemented with regards to blue whales by temporal exclusions to avoid the periods of time when blue whales are most likely to be present in the foraging BIA. Thus, CGG will implement an activity limitation where the seismic source will only be operated in the pygmy blue whale foraging BIA during April, May and June or September, October and November when no or low numbers of pygmy blue whales and other foraging whales have historically been recorded in the BIA off Otway.

The Conservation Management Plan for Blue Whales (DoE 2015c) details the following in relation to marine seismic surveys:

- The risk of physical impacts to blue whales is minimised by implementation of the practical measures outlined in the *EPBC Act Policy Statement 2.1— interaction between offshore seismic exploration and whales.*

CGG will implement the requirements of *EPBC Act Policy Statement 2.1— interaction between offshore seismic exploration and whales* for the Regia MSS as detailed in the Fauna Management Plan. In addition, detection methods above typical industry standards, such as passive acoustic monitoring and in-water acoustic detection monitoring systems for low-frequency whales will be implemented. This will result in an effective mitigation system for detecting blue whales and taking actions to prevent acoustic injury or displacement to foraging blue whales in vicinity of seismic survey operations.

Additionally, the Conservation Management Plan for Blue Whales (DoE 2015c) identifies actions that are relevant to the Regia MSS and underwater noise. CGG has considered each of these actions in the completion of an assessment of the activity (action) according to the principle of ESD (Appendix F4), and the application of a Fauna Management Plan (Appendix G1) which includes minimising the risk of injury and displacement of blue whales.

4.2.3 Australian Sea Lion (*Neophoca cinerea*)

[Section added in response to Matter I17 and updated in response to Matter F17].

4.2.3.1 Species-Specific Sensitivity

The Australian Sea Lion is an otariid pinniped with Southall et al. (2019) categorising the species within the *other marine carnivores in water* hearing group. Otariid pinnipeds have a generalised hearing range of 60 Hz to 39 kHz (NMFS 2018). Little data exists on sounds produced by the Australian Sea Lion, or on the effects of noise on their behaviour (Pidcock et al. 2003) with available literature mostly referring to the California Sea Lion in the northern hemisphere. This species is considered to show some similar characteristics to the Australian Sea Lion. California Sea Lions make both airborne and underwater sounds, including barks, whinnies and buzzing associated with social interactions (Pidcock et al. 2003). The frequency of these sounds underwater is below 4 kHz. Most energy for these sounds is projected between 0.25 and 2 kHz (Richardson et al., 1995). Underwater source levels for the Australian Sea Lion are unknown as according to Erbe et al 2017 there are no subsea recordings for the species.

The frequency of the sound produced from each seismic pulse from the Regia MSS is primarily less than 2 kHz, with the highest levels at frequencies in the range of 10-500 Hz (McCauley 1994). Thus, there is an overlap with the Australian Sea Lion hearing range.

The impacts to the Australian Sea Lion population which are relevant to the Regia MSS, were assessed as medium. The assessment predicted the Regia MSS to have some effect to seals and sea lions, but the effect is not considered significant or at a level to affect the population.

The Issues Paper for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013a) and Recovery Plan for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013b) list noise as a secondary threat to the Australian Sea Lion. However, research into the vulnerability of the Australian Sea Lion to noise disturbance has not been undertaken with studies only conducted on similar species (e.g. harbour seal and grey seal) in the Northern Hemisphere (DSEWPaCa 2013b).

Historically, the main anthropogenic threat to the Australian Sea Lion was hunting and overharvest through sealing activities during the 1700s, 1800s and early 1900s. Although this activity was stopped in the 1920s, the Australian sea lion population has not recovered to pre-exploitation levels (AFMA, 2010). Estimating the abundance of the Australian Sea Lion is difficult. Techniques used are based on estimates of pup production and the use of population models. Using these techniques, the best estimate for the 2011 population was approximately 14,700 Australian sea lions, with most (86 per cent) occurring in South Australian waters (Shaughnessy, et al., 2011). Population trends at studied colonies varies with some showing decline, with others showing growth. No population data post 2011 could be sourced.

Primary threats to the Australian Sea Lion, (DSEWPaCa 2013a, 2013b) are not activities connected with the Regia MSS. In summary these are:

- interactions with commercial gillnetting operations resulting in drowning.
- interactions with commercial pot fishing for rock lobster resulting in drowning.
- entanglement in marine debris resulting in drowning or causing extensive wounds.

In addition, secondary threats to the Australian Sea Lion (DSEWPaC 2013a, 2013b) which are also not connected to activities during the Regia MSS are:

- loss of habitat due to marine aquaculture.
- entanglement in subsurface equipment from marine aquaculture.
- land based run-off causing habitat degradation.
- human disturbance from either deliberately or accidentally being near Australian sea lions.
- direct killing because of fishers or aquaculture operators shooting animals that are perceived to be a threat to their operations.
- Disease.
- pollution (research is ongoing with to date no supporting evidence).

- oil spills leading to hypothermia if fur is affected and poisoning if toxic hydrocarbons are ingested.
- competition and prey depletion from resulting from human activities and other marine predators.
- climate change associated to events such as sea level rise and 'wave wash' resulting from extreme weather patterns.

4.2.3.2 Magnitude of Effect

The Issues Paper for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013a) and Recovery Plan for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013b) details that anthropogenic noise can cause avoidance behaviour and/or hearing threshold changes in pinnipeds. In addition, seismic pulses may affect marine mammal prey species.

Permanent (PTS) or temporary (TTS) threshold shift (hearing loss) to otariid pinnipeds is not predicted based on underwater noise modelling (Appendix B7 – Sound Modelling Report). The effect criteria for PTS for otariid pinnipeds was not reached. In addition, the effect criteria for TTS for otariid pinnipeds was not reached for the per pulse criteria and was only reached at 50 – 60 m from the sound source for the 24 hr cumulative effect criteria. It is highly unlikely that any pinniped species would stay within 50 – 60 m of the sound source for up to 24 hr, thus TTS impacts are not predicted.

The impacts to otariid pinnipeds, resulting from noise generated by the Regia MSS, are limited to avoidance behaviour within an area between 2.91 km – 11.8 km depending on where in the Operational Area the Regia MSS is being undertaken. As Australian Sea Lions are not dependent on any specific area and typically forage up to 60 km and can forage up to 190 km from their colony, impacts may occur to individuals but not at a level to reduce fitness.

The Australian Sea Lion is a specialised benthic forager, primarily feeding on the sea floor (DSEWPaC 2013b). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC 2013b). Underwater noise modelling (Appendix B7 – Sound Modelling Report) and assessment (Appendix E4 - Underwater Sound: Invertebrates) does not predict mortality or physiological damage to cephalopods. In addition, the predicted effect level to Southern Rock Lobster is assessed as minor as impacts are predicted to have some effect, but the effect is not considered significant or at a level to affect the population given.

Mortality of fish (both immediate and delayed) is not predicted based on lack of documented cases of mortality in free-swimming fish exposed to seismic source emissions under experimental or field conditions (DFO 2004; Boeger et al. 2006; Popper et al. 2014; Popper et al. 2016; Carroll et al. 2017; Popper and Hawkins 2019). Site-attached fish species are species that rely on the benthic habitat and demonstrate a very high degree of site fidelity to the extent that they are unlikely or unable to flee an approaching seismic source and are likely to remain and/or seek refuge within habitat structures. However, impacts to site-attached fish were studied by Woodside at Scott Reef during the Maxima 3D MSS activities (Miller and Cripps 2013) and no lethal or sub-lethal effects on fish were experienced nor any significant decreases in the diversity and abundance of fish after the seismic survey, compared with the long-term temporal trend before the survey.

As the Regia MSS will only occur during a limited period in Australia waters (maximum 60 days acquisition), potential behavioural impacts to individual Australian Sea Lions will not impact on the recovery of the population. Population impacts to prey species for the Australian Sea Lion are also not predicted.

4.2.3.3 Cumulative Impacts

CGG has assessed potential cumulative noise impacts (Appendix E10) of other activities within the Otway Basin and identified additional mitigations to ensure cumulative noise impacts are within acceptable levels.

Cumulative impacts from the Regia MSS with the highest rated threats identified within the Issues Paper for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013a) and Recovery Plan for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013b) (interactions with commercial gillnetting and pot fishing for rock lobster plus entanglement in marine debris) are unlikely based on the Regia MSS will not impact the Australian Sea Lion population. Impacts are limited to behavioural response for the duration of the activity (maximum 60 days acquisition).

Although anthropogenic noise is identified as a secondary threat to the Australian Sea Lion, cumulative impacts are again not predicted with impacts limited to behavioural response for the duration of the activity. Other secondary threats are continually present but with no cumulative effects from the Regia MSS predicted.

4.2.3.4 Recovery Potential

Slow recovery of populations due to the extreme philopatry of females and limited dispersal of males between breeding colonies make Australian Sea Lions vulnerable to anthropogenic threats. The removal of only a few individuals annually may increase the likelihood of decline and potentially lead to the extinction of some of the smaller colonies (DSEWPaCa 2013b).

Based on the magnitude of effect from the Regia MSS to Australian Sea Lions which is limited to behavioural avoidance for the duration of the activity (maximum 60 days acquisition), no long-term disturbance that may affect the recovery of the species are predicted.

4.2.3.5 Conservation Status

The Australian Sea Lion is listed as endangered under the EPBC Act which was based on declining population trends, the life history characteristics of the species and the fact that the species was still under pressure from some sectors of the Australian commercial and recreational fishing industries at the time of listing. The Australian Sea Lion population underwent a massive decline in numbers caused by seal harvesting (DSEWPaC 2013).

The Australian Sea Lion is the only endemic, and least abundant, pinniped that breeds in Australia (DSEWPaC 2013). Breeding colonies for the Australian Sea Lion are found only in South Australian and Western Australian waters; however, the species is known to forage in Commonwealth waters adjacent to these states. The population can be broadly separated into three main metapopulations (Goldsworthy et al. 2009):

- one in SA accounting for ~84% of pup production
- one on the south coast of WA accounting for ~10% of pup production
- one on the west coast of WA accounting for ~6% of pup production.

The Australian Sea Lion uses a variety of shoreline types but prefer the more sheltered side of islands and typically avoid rocky exposed coasts (Shaughnessy 1999).

CGG has shown in the impact and risk analysis documents that regulatory requirements relevant to the Regia MSS and Australian Sea Lions will be met. Relevantly, the Recovery Plan for the Australian Sea Lion (*Neophoca cinerea*) (DSEWPaC 2013) has significant weight in CGG's assessment due to the involvement of Commonwealth and State regulatory agencies, threatened species managers, and scientific experts in the development of the recovery plan. As such, recommended actions from the recovery plan relevant to the Regia MSS have been implemented as detailed in Section 5.2.3.6 Mitigation Effectiveness.

4.2.3.6 Mitigation Effectiveness

Mitigation of the Regia MSS effects can be best implemented with regards to Australian Sea Lions by limiting the spatial boundaries of the survey to avoid the sound source being discharged within 11.8 km of Lady Percy Julia Island / Deen Maar. This distance is the furthest distance to the sound effect criteria for pinnipeds (seals and sea lions). This criterion was used as Deen Maar is the largest Australian Fur Seal breeding colony in Australia with and the Australian Sea Lion may occur within the area.

The Issues Paper for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013a) and Recovery Plan for the Australian Sea Lion (Neophoca cinerea) (DSEWPaCa 2013b) lists noise as a secondary threat to the Australian Sea Lion. However, neither publication provides practical measures on the interaction between offshore seismic exploration and the Australian Sea Lion.

CGG has assessed potential cumulative noise impacts (Appendix E10) of other activities within the Otway Basin and identified additional mitigations to ensure cumulative noise impacts are within acceptable levels.

Assessment of the Regia MSS activities are consistent with the principles of ESD (Appendix F4).

4.2.4 Southern Rock Lobster (*Jasus edwardsii*)

4.2.4.1 Species-Specific Sensitivity

Substantial research on the interaction between seismic surveys and the Southern Rock Lobster *Jasus edwardsii* has confirmed that while lethal effects are not seen, sub-lethal effects are likely to impact all stages of their life cycle that are within ~700m of a seismic system when it is firing (see Appendix B8 and references therein). In adults/juveniles, these effects are principally manifest as an impaired righting reflex and/or delayed progression through the moulting cycle. However, due to seismic signal attenuation over distance, its interaction with variability in individual vulnerability, habitat complexity, and time spent within proximity to the seismic source points, these effects are neither ubiquitous nor consistent. The larval stage of *J. edwardsii* is long (up to 2 years) and subject to persistent and high natural mortality during this time. Any effects on individual animals will not be measurable against the natural mortality rates that exist, and which operate over far greater spatial and temporal scales than the intended MSS schedule.

4.2.4.2 Magnitude of Effect

Individual adult and juvenile animals within proximity to a seismic system when firing is occurring will likely be impacted in a non-lethal way as described above and in Appendix E4. The effects will vary across individuals and reduce with distance from source of the disturbance.

Puerulus settle into their preferred benthic habitat from June – September each year so potential seismic effects on the most vulnerable stage of the life cycle can be drastically reduced by scheduling the MSS for outside this window. Most mortality happens in the larval stages of marine organisms that incorporate a planktonic phase in their life cycle. Estimates can vary widely however > 90% mortality is common (Morgan 1995 - Life and death in the Plankton) hence reducing or minimising impact at time of settlement will provide more powerful mitigation of any potential seismic effects.

All SRL (Southern Rock Lobster) located within the MSS operational area are considered part of a single genetic stock spread across southern Australia (Ovenden et al. 1992; Thomas & Bell 2013). The huge geographical spread of this species means that larval supply to any individual area, such as the MSS operational area, comes from many other areas and hence is not linked to the number of reproductively active animals in any one place. Research has highlighted the complex processes affecting settlement strength in SRL which indicate that environmental conditions that reduce settlement strength in one region of the fishery often increase settlement strength in other regions. A system such as this is extremely resistant to localised disturbances as it receives larvae each year from what is effectively, a ‘bank’ of SRL stretching across southern Australia. Output from modelling of larval supply as seen in Figure F3-3 and Figure F3-4 clearly shows the dispersal extent of larvae released from locations in Victoria and Western Australia.

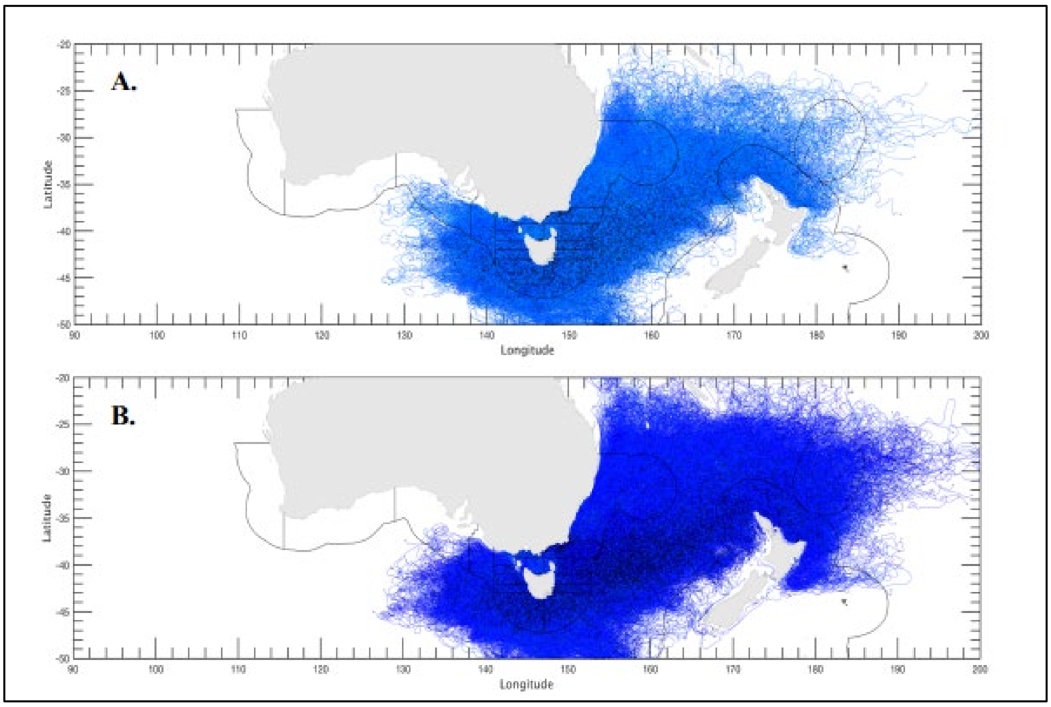


Figure F3-3 - Simulated trajectories of larvae released from Victorian fisheries: A. VIC_W fishery, B. VIC _ E fishery. The location of larvae at the end of the dispersal simulation is marked with black dots (from Vasile 2018 PhD thesis).

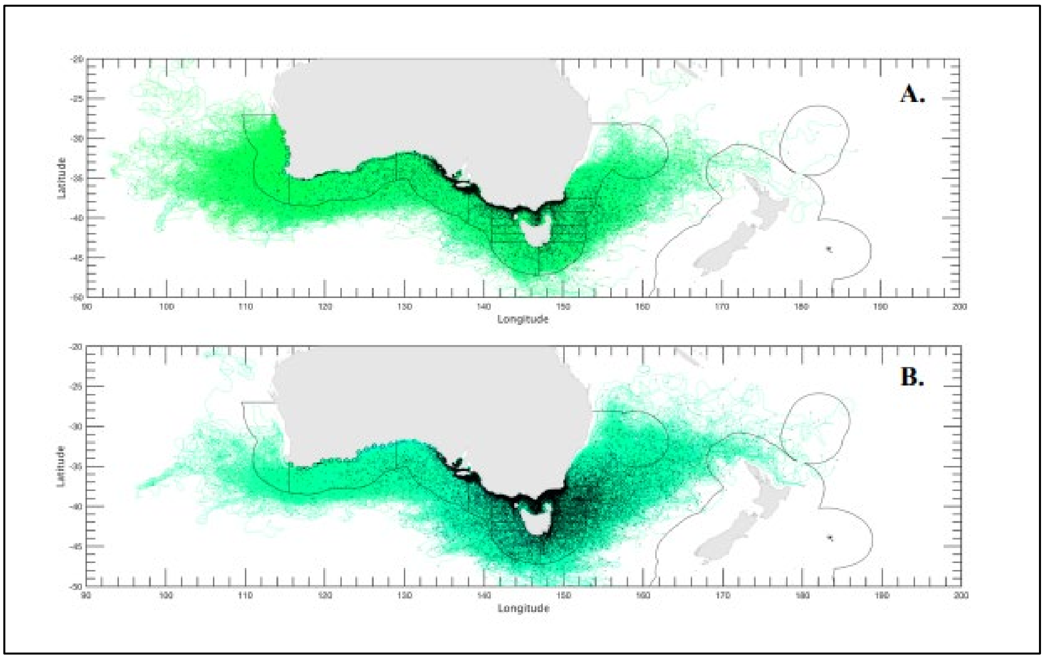


Figure F3-4 - Simulated trajectories of larvae from Western Australia fisheries A. WA _ W fishery, B. WA_ S fishery. The location of the larvae at the end of the dispersal simulation is marked with black dots (from Vasile 2018 PhD thesis).

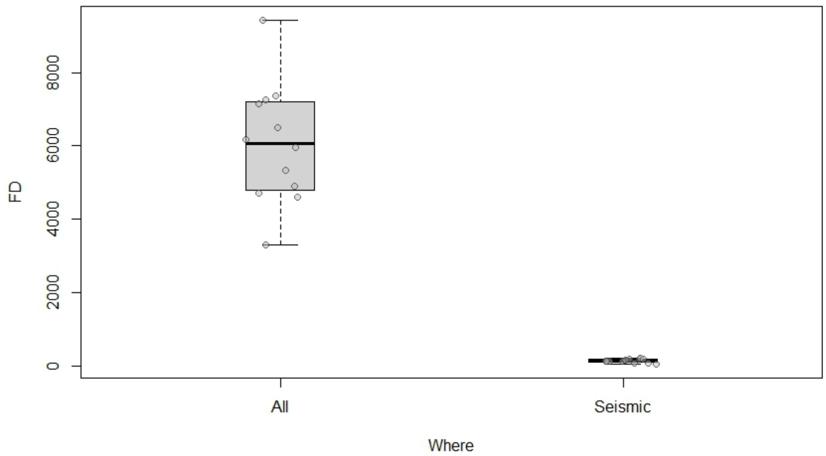
4.2.4.3 Cumulative Impacts

The MSS will be a pulse event with a timeline of 60 days within 90 days. For site attached SRL, individual animals will be exposed to high intensity seismic on a reducing exposure curve which will be defined by the closeness of the individual to the source, the depth of habitat where the individual is residing (defines the minimum distance from the seismic source), the complexity and density of the (limestone) habitat they are inhabiting and the direction and speed of the seismic survey. Hence impacts will be extremely varied and inconsistent. There will likely be a reduction in overall fitness of the population of animals exposed to the MSS which may influence adult mortality for a period, but the scale of any potential impact will be subsumed into the far larger natural and fishing mortality schedules that already exist.

Impacts to larval SRL will be confined to those animals in the plankton present in the area at the time the array is working. Plankton is highly variable in both space and time (Robinson et al 2021) which favours affected larvae being subsumed into a larger planktonic assemblage containing larvae not exposed to the MSS. The nett effect will be any affected larvae will be spread out within a greater pool of non-affected larvae, mitigating the probability of significant localised effects.

The Bureau's (BOM) long-range forecasts indicate warmer than average Sea Surface Temperatures (**SST**s) (up to around 2 °C warmer than average) off the coast of south-east Australia will likely continue through the southern hemisphere summer 2023–24 (http://www.bom.gov.au/climate/enso/). Such large-scale climate changes will exert a much greater influence on population dynamics than the Regia MSS given they can operate at the scale of the entire population. Warming temperatures attributed to climate change have already been shown to increase growth of animals in temperate waters and lead to larger-size-at-maturity (McLeay et al 2019).

Commercial fishing statistics from the VFA 20/21 season Stock Assessment Report highlight that CPUE has almost tripled from 2009/10. While some of these gains have come from fleet modernisation and associated efficiencies, standardised catches have continued to increase, reflecting a stable and relatively healthy fishery. Commercial fishing is a press disturbance and exerts a much greater and clearly quantifiable effect on populations than a pulse disturbance over a defined space. Despite this, the assessment concluded the fishery is stable with increasing recruitment over the past few years from a long-term trend of lower-than-average recruitment. Additionally, within the MSS operational area fishing effort is extremely low with only ~2% of total fishing days occurring within this area over the past 12 years (see Figure F3-5).



** Box encompasses 50% of the data points. Black line indicates median value. Whiskers encompass full range of values.*

Figure F3-5 - Comparison of the number of fishing days (FD) undertaken within all designated fishing blocks across Victoria (All) with number of fishing days undertaken within those blocks encompassed by the proposed MSS (Seismic). Individual data points are yearly.

Further analysis of cumulative impacts on Southern Rock Lobsters based on landed catch and catch effort is presented in Appendix E10. While seismic operations have been shown to cause injury to SRL at the level of individuals there is no evidence that supports population level effects. A large part of this conclusion is based on the research base that exists for SRL and which clearly shows the size of the 'population' of SRL is very large and well connected. The MSS area is a very small component of this system and the SRL population within is resilient because of this.

4.2.4.4 Recovery Potential

Research has indicated that some of the physical and chemical changes seen in SRL exposed to seismic may be permanent. For those individuals their fitness will likely be reduced and their susceptibility to predation may increase. For those animals whose exposure window is smaller there is evidence of recovery although there are no definitive time frames known.

The largest effects on SRL populations are from fishing and climate drivers such as increased water temperatures. Nevertheless, management of the fishery in the state indicates it is stable and actually improving over the past few years. This indicates a population that has the ability to recover even under sustained fishing pressure. Effective management underpinned by continued collection of appropriate data is key to this outcome.

4.2.4.5 Conservation Status

The Fisheries Research and Development Corporation (FRDC) recognises SRL *Jasus edwardsii* as a sustainable species found broadly across Southern Australia. Unlike the Western Rock Lobster in Western Australia whose habitat is a Key Ecological Feature (KEF), SRL have no elevated level of conservation protection.

4.2.4.6 Mitigation Effectiveness

Mitigation of MSS effects to SRL can best be implemented by limiting the spatial boundaries of the survey to minimise interaction with areas of high SLR density and fishing activity, which is predominantly located shoreward of the 40m depth contour. Additionally, timing the MSS to avoid the June-September period when peurulus are settling is also advisable. The period after release of fertilised eggs is the preferred window as this is when natural mortality is extremely high and localised seismic effects are likely to be subsumed into this mortality schedule.

4.2.5 Giant Crab (*Pseudocarcinus gigas*)

4.2.5.1 *Species-Specific Sensitivity*

Giant crabs are a long-lived slow growing species that inhabit soft sedimentary environments and feed on sessile or slow-moving benthic species including gastropods, asteroids, and other decapods. The species is found across all of southern Australia and up into Southern NSW, generally occupying depths between 120-370m but can be found from 20-600+m. Key stages in the life history of *P. gigas* appeared to be synchronised across southern Australia suggesting that factors operating at a large scale are influencing the species' distribution and life cycle off southeast Australia (Levings 2008). These large-scale drivers are responsible for population level changes with small-scale disturbances buffered by connectivity and dispersal across large scales. Genetic studies have indicated that the species is effectively a single stock with little evidence of sub populations. This is likely due to the 3–4-month larval phase and the ability of individual adults to move up to 400km (Currie & Ward 2009).

Climate change is expected to cause a southerly shift of the austral subtropical high-pressure belt, with models predicting more upwelling-favourable winds. This would likely provide *P. gigas* with increased access to benthic food resources and their growth rate may increase in some regions (Levings & Gill 2010). This has the potential to increase productivity at the population level.

Multiple studies have looked at seismic effects on crustacean larvae amongst other taxa, and results have been mixed, with any mortality limited to very close proximity to the source. Adult crab species that have been tested have shown very little response to seismic pulses (Appendix E4 and references therein).

Based on the evidence available the sensitivity of giant crabs to the MSS is likely to be small and immeasurable relative to normal population variance. The species undergoes annual cross-shelf movements to align with favourable temperatures and feeding opportunities (see Figure F3-6 and Figure F3-7) which provides a temporal window for minimising any potential seismic effects.

Fishing for female crabs is banned between June 1st and November 15th to protect the peak timings of their reproductive cycle (see Figure F3-8). To avoid any potential effects from the MSS this period should be avoided to align with fisheries protections already in place.

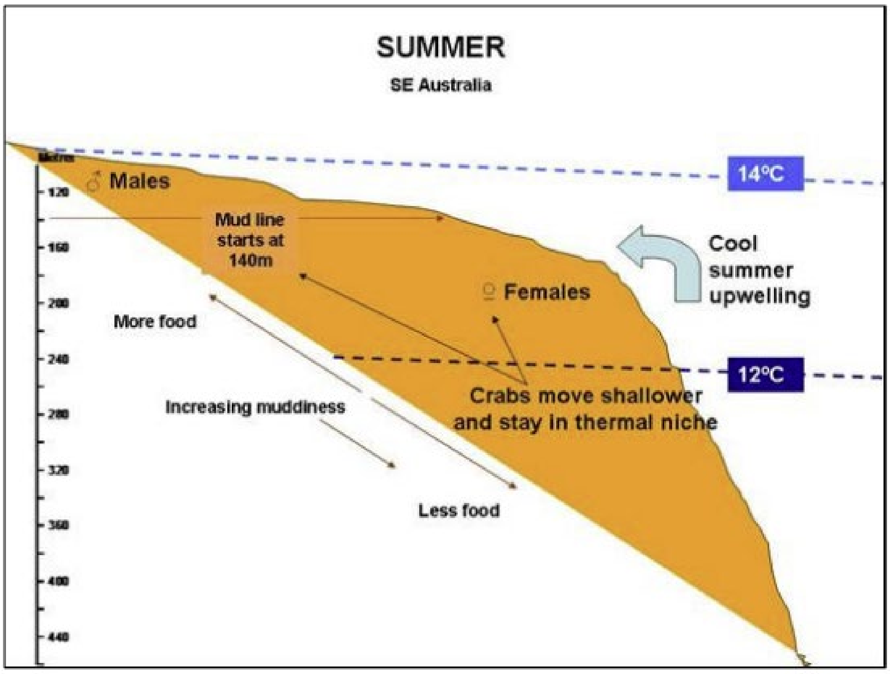


Figure F3-6 - Summer model for P. gigas off south-east Australia (Levings 2008).

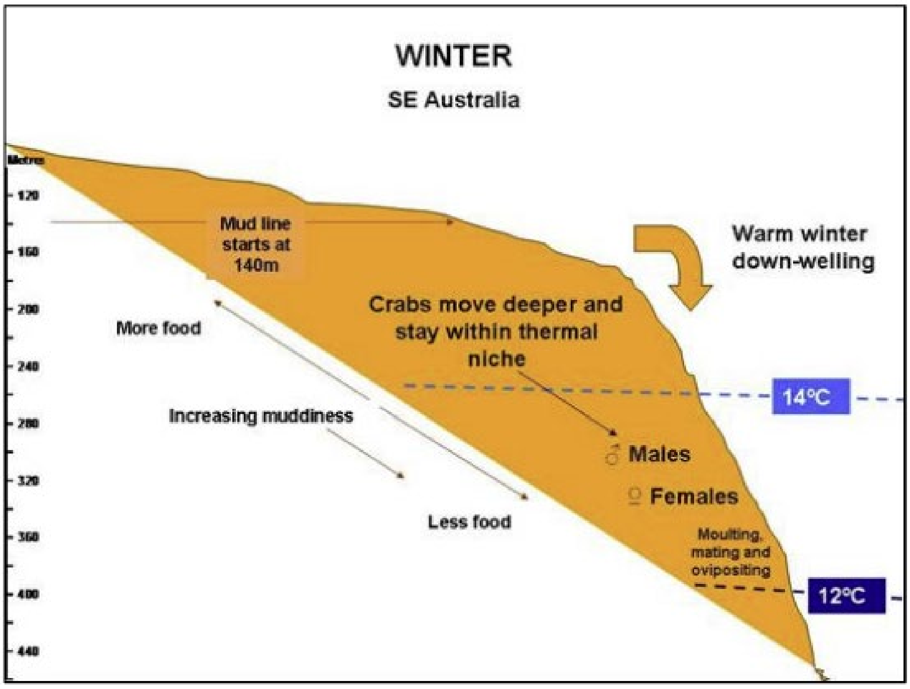


Figure F3-7 - Winter model for P. gigas off south-east Australia (Levings 2008).

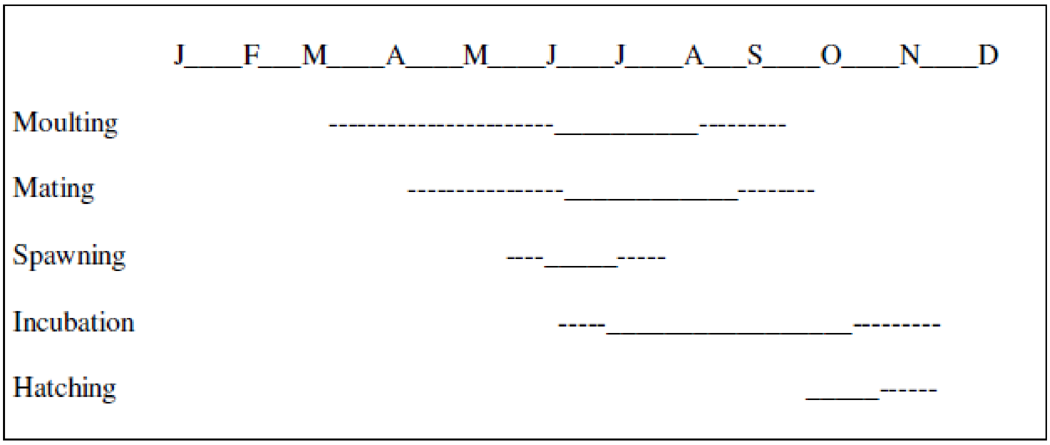


Figure F3-8 - Reproductive cycle of P. gigas based on extensive field observations. Solid lines represent peak periods, while broken lines represent temporal extent of observations (from Levings 2008).

4.2.5.2 *Magnitude of Effect*

Seismic effects on individuals have been shown to be limited to larvae within very close proximity to the discharge source.

Timing the MSS to avoid the peak period in the reproductive cycle period will mitigate any potential impacts.

Fishing days within the Regia MSS Active Source Area averaged out at 17.3 % of total fishing days from 2011-2022. However, fishing effort in the Active Source Area over recent times has shrunk to 7.5% of total fishing days from 2018-2022.

4.2.5.3 *Cumulative Impacts*

As discussed above there is no evidence to support an expectation of significant and measurable cumulative impacts to *P. gigas* as a result of the MSS. Large scale environmental drivers driven by a changing climate, and fishing effort, will continue to be the major influences on the population health of giant crab.

With regard to any impacts on the giant crab fishery, the targeted catch in 2021/22 of 0.95kg per 24 hour was a substantial reduction from 1.27kg/24-hour pot-lift in 2017–18 but still remained well above the limit reference point of 0.52 kg/24-hour pot-lift for the fishery (VFA 2022). Factors including the lack of fishery independent surveys, limited length frequency data, the significant decline in the number of operators targeting giant crab and a decrease in the spatial distribution of the fishery, all add to the uncertainty in the assessment of the Victorian component of the Giant Crab stock. More data is needed from the fishery to better understand the changes to catch rates and to better determine the size of the fishable stock available.

Recovery Potential

The population stocks of *P. gigas* have been declared sustainable across 75% of their range (WA, SA, Victoria) however the Tasmanian population is considered depleted and not sustainable at current fishing levels. Data collection remains insufficient to more accurately assess future trends (FRDC Report 2020 Giant Crab 2020 (fish.gov.au)). Fishing effort is the major anthropogenic driver of changes to populations, and it is this interaction with a changing climate that will drive population changes in the future.

Conservation Status

Based on the evidence presented above, the Giant Crab Fishery (Victoria) management unit is classified as a sustainable stock and there are no conservation concerns. Temperature is a primary driver of their life-history strategy and this, along with fishing effort will be the drivers of population dynamics of this species.

Mitigation Effectiveness

With most of the reproductive cycle occurring in the June-December period ensuring the MSS is undertaken outside this period would provide the most effective mitigation approach to minimising effects from seismic surveys.

4.2.6 Glass Eels / Kooyong (*Aquilla australis*)

4.2.6.1 Species-Specific Sensitivity

There are 2 species of freshwater eels that inhabit the southeast and east coasts of Australia, *Aquilla australis* and *A. reinhardtii* known colloquially as the short-fin and long-fin eel respectively. Only *A. australis* is relevant to the MSS because the westward edge of distribution for the long-finned eel is around Wilsons Promontory which is 300 km from the nearest edge of the MSS survey path (see Figure F3-9).

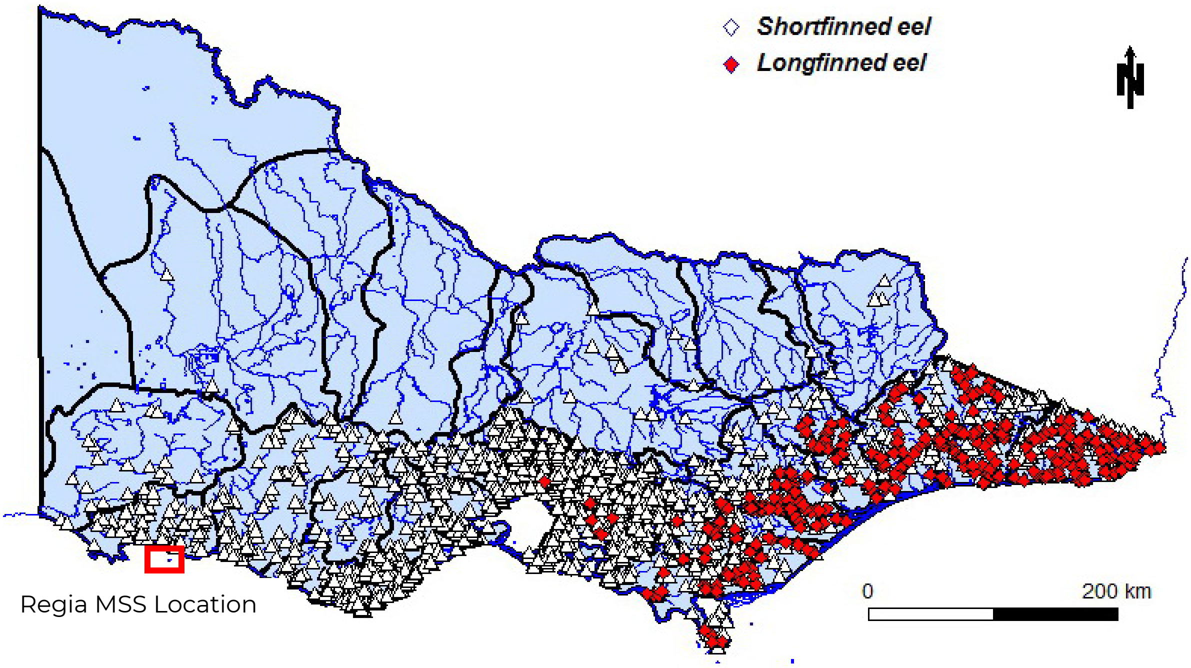


Figure F3-9 - Spatial distribution of both species of freshwater eel across Victoria (VFA Eel Fishery Management Plan) and the location of the proposed Regia MSS survey.

The short-fin eel has a complicated but spectacular life cycle. The juveniles and adults live in freshwater rivers but when reproductively mature the adults migrate many thousands of kilometres to spawning grounds in the Coral Sea. Once spawning has finished the adults perish and never return. The life cycle is then continued by the many trillions of larvae who attempt to make their way back to natal river systems over 200 plus days using prevailing currents and an evolving swimming ability. Adult migration out of the estuaries to the spawning grounds occurs from January to May while the returning glass eels stage occurs during the July-September period.

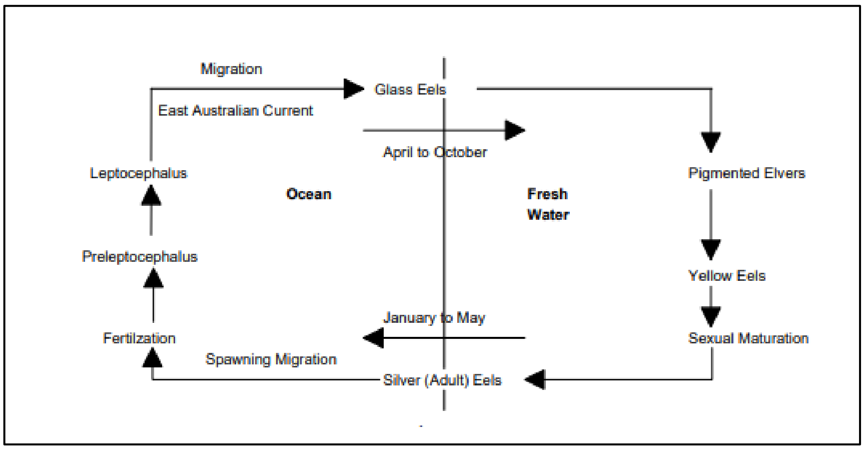


Figure F3-10 - Life cycle of Anguilla australis eels. After Gooley et al. (1999).

This life cycle predisposes this species to very large mortality rates both as larvae and as adults. Adult mortality has been estimated to be at least 30% for migrating adults (Koster et al 2021) and while there have been no direct measurements of larval mortality in eels, as a broadcast spawner it likely exceeds >95 %. Modelling work by Bonhommeau et al. (2009) on *A. anguilla* indicated <0.2 % of larvae survived the trans-Atlantic migration. With a shorter migration length in *A. australis* mortality rates would be less than this but still clearly very high.

Australasian short-finned eels are listed as 'near threatened' on the IUCN Red List of Threatened Species, with barriers to riverine movement and freshwater habitat loss identified as key threats. In addition, changes in ocean currents, primary production, and thermal regimes may affect eel migration, spawning success, and recruitment (Koster et al 2021). These processes operate at landscape scales and are heavily influenced by long term climate trends. Changes to riverine flows and water quality are affected not only by changing climates but also land management regimes adjacent to riverine systems.

Changes in the size of the spawning stock (i.e. adults) have been identified as the most likely cause of declining recruitment of eels (see review by Jellyman 2022) and so it is factors affecting the adult population that are likely to have the largest effect on the population health of *A. australis*. As previously mentioned, climate related changes and modification of the landscape are affecting the carrying capacity of rivers to support populations of eels and other species. Fishing is also a major pressure on eel stocks and there has been a commercial fishery for short-finned eels across Southern Victoria since the 1950's.

Pre-migrating adults have been found to spend a lot of time in the estuaries of rivers before starting their migrations, making them more vulnerable to net fisheries than was previously thought (Crook et al. 2014). Catches reached a peak in the mid 1990's with a low in 2009, but have since stabilised around 30-80 tonnes/year (Southern Shortfin Eel 2020 (fish.gov.au)). The massive decline in catches from 1993 was related to the so-called millennium drought throughout the late 90's and early 2000's (van Dijk et al 2013) illustrating the powerful links between eel health and environmental conditions.

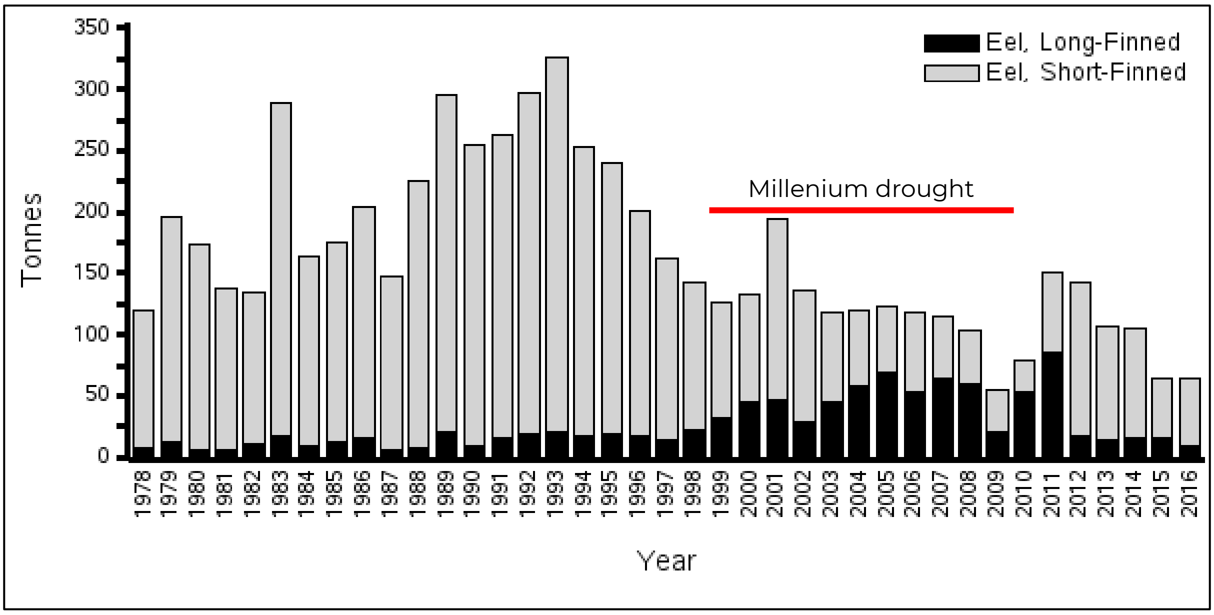


Figure F3-11 - Annual commercial catches of eels in Victoria (VFA 2017). Red line encompasses those years when extended drought conditions prevailed.

Once adults begin migrating to their spawning grounds they travel quickly, with migration speeds between 10-50 km/day (Koster et al 2021). The annual timing of adult migrations is from January to May each year.

There are no scientifically derived studies indicating mortality effects on eels from seismic surveys, which we group with fish containing swim bladders when assessing seismic effect studies. Adult eels are undertaking their migrations over an extended period of 5 months and the work of Crook et al (2014) indicates that migration from estuaries is a highly variable process. Given the extended and volatile timing of migration from estuaries and the high mobility of individual animals we do not anticipate any critical effects to the local populations of eels from the Regia MSS.

4.2.6.2 Magnitude of Effect

If any individual adult eels are within proximity to the seismic arrays when acquisition is occurring, there will likely be non-lethal impacts. However, given the mobility of adult eels, their intrinsic drive to get to their spawning grounds, and the soft startup procedures of the Regia MSS the risks associated with this event are extremely low and impossible to distinguish from the large-scale changes inherent in the population each year and driven by multiple factors as previously described. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04].

For the larval leptocephelae and glass eel stages, they are most prevalent in regional waters during the winter-spring months. If the Regia MSS is scheduled outside this timeframe, then all interactions with this stage of the life cycle will be avoided.

4.2.6.3 Cumulative Impacts

As discussed above there is no evidence to support an expectation of significant and measurable cumulative impacts to short-finned eels because of the Regia MSS. Large scale drivers including fishing continue to be the major influences on the population health of eels.

4.2.6.4 Recovery Potential

There is no identified recovery plan for this species, nor do we anticipate impacts of sufficient scale to be considered for future recovery plans. The species has proven resilient to fishing and other anthropogenic pressures for millennia.

4.2.6.5 Conservation Status

The short-finned eel *Anguilla australis* is not under any conservation status. However, short-finned eels are of cultural significance to First Nations people. The Gunditjmara people of south-western Victoria built and used sophisticated aquaculture systems throughout the Budj Bim Cultural Landscape to exploit eel migrations at least 7,000 years ago. Budj Bim Cultural Landscape is listed as a World Heritage Area and is protected by Victoria's Aboriginal Heritage Act 2006. One of the values of this World Heritage Area is the Budj Bim lava flows, which provides the basis for one of the world's most extensive and oldest aquaculture systems developed by the Gunditjmara, based on deliberate redirection, modification and management of waterways and wetlands (UNESCO 2023). There is no direct effect, and no measurable indirect effect, from the Regia MSS to the Budj Bim Cultural Landscape.

4.2.6.6 Mitigation Effectiveness

Potential impacts could be minimised or avoided by scheduling of the Regia MSS to outside the period when elvers are returning to the river systems along the Southwest coast during the months of April to October. However, this measure would increase the effects on other more sensitive species.

4.2.7 Gould's Squid (*Nototodarus gouldi*)

4.2.7.1 Species-Specific Sensitivity

There remains minimal research completed on the effects of seismic surveys on squid. Two key sources have been the work of McCauley et al (2000) and Fewtrell & McCauley (2012). Startle or alarm responses out to 4-5 km from the seismic source were the only consistent outcomes from the experimental work, and these were shown to reduce with amount of exposure i.e. habituation to the sound. Potential effects from damage to the tissue surrounding the statoliths were not evident as experimental animals showed consistent responses even after multiple seismic pulses.

Gould's Squid which is the primary targeted species in the Southern Squid Jig Fishery (SSJF), is short-lived (<1 year) and has been found to spawn up to 4 times a year. They also display highly variable growth rates and size and age-at-maturity. Populations with life-history characteristics like these have high turnover rates and are consequently much more resilient to fishing pressure. Moreover, with fishing concentrated over the few months of summer there remains multiple other spawning events to provide new recruits for the population.

Research has shown that squid populations are highly responsive to variations in environmental conditions from year to year, however it has been difficult to pinpoint whether any factor is more important than another. This is borne out by the correlation between all the fisheries across SE Australia having peak catches around the same time. A final model for all zones of the SSJF sector combined included Year, zone, depth, and the interaction of depth and moon phase as the variables of most influence with Year explaining the greatest source of variation in CPUE (15.1%; Fig 12) (Koopman et al 2018). Genetic studies support the hypothesis of a single biological stock of Gould's Squid throughout southeastern Australian waters (Jackson and McGrath-Steer 2003) which provides another layer of resilience at the population level.

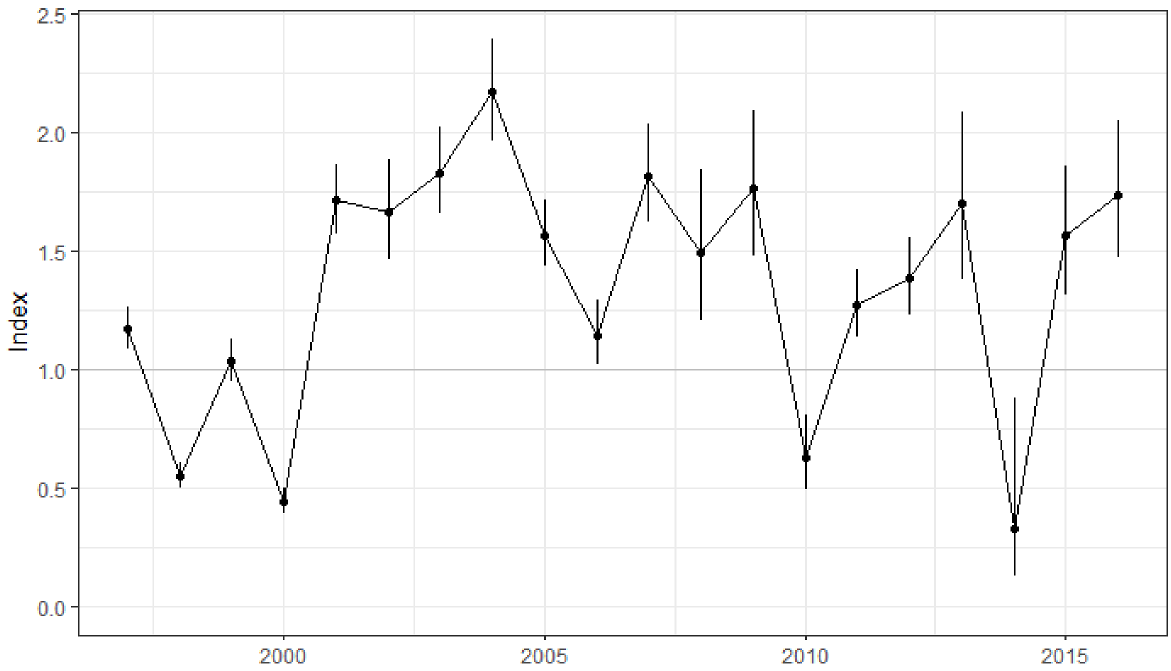


Figure F3-12 - Final model showing annual variation of Standardized CPUE for all catches of Gould's squid.

Very large catches were taken by foreign vessels in the 70's and 80's without appearing to reduce available biomass in subsequent seasons. Modelling of heavy fishing in the GAB fishery has also shown that even when biomass is reduced to 10% of original size, recovery still occurs (Virtue et al 2011). The overall productivity of the region is the likely key driver of dynamics.

4.2.7.2 Magnitude of Effect

Fishing remains the largest anthropogenic impact on populations and this source has been shown to carry less impact on standing biomass of the population than environmental parameters. Hence any potential impacts from seismic activity on the resilience of the squid population in the region is not going to be measurable against the backdrop of annual variation that is naturally occurring.

4.2.7.3 *Cumulative Impacts*

Studies have not identified any large-scale impacts to squid from seismic blasting. Short term behavioural changes as observed are not likely to have any impacts on the squid population in the vicinity of the seismic surveys. Soft starting will provide a catalyst for squid to move and provide scope for a learned response such that subsequent seismic pulses will not illicit as strong a response from individual animals. In this context there is a very low probability of cumulative impacts occurring. However, once the source passes, animals will be free to move back into the habitat that they departed from. [Paragraph updated in response to Matter I04].

4.2.7.4 Recovery Potential

As outlined in the previous sections current knowledge indicates only temporary localised effects to individual squid and no evidence of effects that could cascade into population level impacts. Squid populations are highly dynamic and responsive to larger scale environmental influences.

4.2.7.5 Conservation Status

There are no conservation consequences associated with Gould's squid and The Fisheries Research and Development Corporation (FRDC) recognises Gould's Squid as a sustainable species widespread throughout south-eastern Australia and into the Great Australian Bight.

4.2.7.6 Mitigation Effectiveness

While the probability of adverse consequences for squid populations from seismic is extremely low it is appropriate to reduce any probability to as low as possible. The timing of peak catches has centred around February/ March in the Western Victoria fishery hence avoiding seismic during this period is advisable.

4.2.8 Pale Octopus (*Octopus pallidus*)

[Section added in response to Matters: F11 and F12]

4.2.8.1 *Species-Specific Sensitivity*

While there are a number of species of octopus that can be caught in Victorian waters (e.g. Maori Octopus, *Macroctopus maorum* and Gloomy Octopus, *Octopus tetricus*) the most abundant species and focus of commercial fishing, is the Pale Octopus, *Octopus pallidus*. This species is most commonly found on sandy substrates, often near beds of sponges or sea squirts (VFA website).

The pale octopus is found from the Great Australian Bight across to Tasmania and up into Southern NSW. It has a typical life span of 12 months but can live for up to 18 months. It is a benthic species with no pelagic stage in its development. They spawn throughout the year but with an optimal spawning period during late summer (Leporati et al. 2008). Lack of a pelagic cycle is correlated with strong spatial genetic structuring in populations, with connectivity mostly through movement of adults between locations (Higgins et al 2013)

Cephalopods are increasingly being identified as highly dynamic organisms that grow and mature with great degrees of individual variability, often influenced by external factors such as temperature and diet (Moltschaniwskyj 2004).

Sensitivity of the pale octopus to seismic has been specifically tested through a dedicated research program funded by the Fisheries Research and Development Corporation (FRDC), with the final report recently released (Day et al 2023; Examining the potential impacts of seismic surveys on Octopus and larval stages of Southern Rock Lobster, FRDC). The key findings were that exposure to seismic airgun signals did not kill adult octopus and nor was there any indication of harm to offspring. There were some observed behavioural changes but no indications that this would translate to sustained and deleterious changes in the health of exposed populations.

4.2.8.2 *Magnitude of Effect*

There is no evidence to support significant impacts to pale octopus from the proposed Regia MSS.

4.2.8.3 *Cumulative Impacts*

Fishing and climate changes are the largest impacts to fisheries in general. A stand-alone octopus fishery commenced in Victoria as recently as 2020 and is focussed on Eastern Victoria. Octopus fishing in central and western Victoria is less established and is managed through exploratory, temporary permits. A fishing experiment found that continual local fishing pressure appeared to have altered the age and reproductive structure of the female *O. pallidus* population, reflecting size selective fishing mortality, which could lead to smaller sizes at maturity, fecundity, and ultimately recruitment (Leporati 2008). A recent and substantive meta-analysis of studies looking at climate-change impacts on cephalopods (Borges et al. 2023) has highlighted that ocean warming poses a clear threat to cephalopods with impacts seen across all stages of the life cycle.

4.2.8.4 *Recovery Potential*

There is no evidence to support significant impacts to pale octopus from the proposed Regia MSS such that Recovery Potential has to be assessed.

4.2.8.5 *Conservation Status*

There are no conservation consequences associated with the Pale Octopus in Australian Waters. Stocks in Victoria are classified as undefined with a dedicated octopus' fishery only starting in 2020 in eastern Victoria.

4.2.8.6 *Mitigation Effectiveness*

While the probability of adverse consequences for pale octopus' populations from seismic is extremely low, scheduling the Regia MSS outside of summer months, when spawning peaks, would reduce this probability even further.

4.2.9 Blacklip Abalone (*Haliotus rubra)*

[Section added in response to Matters: F12 and F16]

4.2.9.1 Species-Specific Sensitivity

Blacklip Abalone stocks in Victoria are in relatively poor condition having suffered greatly from disease and overfishing. In addition, the southeast coast of Australia is in a climate change 'hot-spot' where sea surface temperatures are experiencing rapid warming at rates 3–4 times the global average. These increasing SSTs are predicted to have negative impacts on the abundance of *H. rubra* in South coast waters. Modelling work has identified summer SST as the most influential variable on density distribution of *H. rubra*, with smaller sizes and lower catches coinciding with warmer SST's (Young et al 2020 and refs therein).

The pelagic larval duration of abalone is short at ~10 days, nevertheless genetics studies have found that abalone stocks along Victorias south coast are well connected, with high levels of gene flow within and between reef patches. Larval supply and recruitment success may therefore not depend predominantly on local reef sources. The marine physical environment of the south coast is highly variable, driven by converging ocean currents, strong environmental gradients, habitat discontinuities and varying degrees of exposure to wave energy (Miller et al 2016).

Regia MSS will be operating at depths greater than 50m. While almost all diver-harvested abalone will come from depths <30m the majority will come from depths <20m, hence there is approximately 15-20km distance between the 20m and 50m depth contours adjacent to where the proposed Regia MSS will approach the coast.

There has not been any direct testing of seismic effects on Abalone, so a weight-of-evidence approach is taken where we use results from testing on other molluscs, notably scallops and pearl oysters. Testing outcomes on scallops were consistent with studies on seismic effects to other invertebrates, with impacts clearly noted within very close proximity to seismic pulses (i.e. hundreds of metres) but then rapidly dissipating (see response to Matter F09). Estimated mortality rates in all cases remained well below natural mortality rates. A recent, major study into seismic effects on silverlip pearly oysters found no evidence of reduced productivity or mortality (Parsons et al 2024).

We do not therefore, find compelling evidence for a high likelihood of significant lethal or sub-lethal effects to abalone stocks from the proposed Regia MSS. As already stated, Abalone stocks are being influenced by climate, overfishing and disease and these remain the primary areas of concern.

4.2.9.2 Magnitude of Effect

There is no evidence to support significant impacts to black-lip abalone from the proposed Regia MSS. There is a possibility for impacts to abalone divers working in the fishery, however this has been recognised and appropriate measures put in place based on feedback from the Abalone Fishers in the region (see Appendix E8: Underwater Sound – Divers).

4.2.9.3 *Cumulative Impacts*

There is no evidence to support the Regia MSS causing significant impacts to black-lip abalone stocks in the region. Cumulative impacts to Abalone stocks are coming through climate, overfishing and disease and these remain the primary areas of concern. Rebuilding biomass has been proposed through a combination of conservative catch and minimum size limits, spatial management of fishing and catch, and a combination of fishery-independent and fishery-dependent data collection to demonstrate ongoing recovery and guide future TAC setting (Peeters et al 2023). Climate change will however pose further challenges to management objectives as temperature increases have been linked to fitness reductions in abalone along with smaller size and lower catches (Young et al 2020 and refs therein).

4.2.9.4 Recovery Potential

There is no evidence to support significant impacts to black-lip abalone from the proposed Regia MSS such that recovery potential must be assessed.

4.2.9.5 Conservation Status

There is no conservation status classification with black lip abalone in Australian Waters. However, stocks in 2 of 3 fishing zones in Victoria are classified as depleting while the western zone is considered sustainable.

4.2.9.6 Mitigation Effectiveness

While the probability of adverse consequences for black lip abalone from Regia MSS is extremely low, scheduling the Regia MSS for outside of the summer months, when spawning peaks, would reduce this probability even further.

4.2.10 Pink Snapper (*Chrysophrys auratus*)

[Section added in response to Matter: F12]

4.2.10.1 Species-Specific Sensitivity

Pink Snapper are widely distributed in the Indo-Pacific and an important species for both recreational and commercial fisheries in Australia and New Zealand. The reproductive biology of the snapper has been studied in several places across its distribution and is well understood However, there is geographic variation with respect to the timing of spawning, length of season and the environmental conditions associated with spawning, such as water temperature and photoperiod (Saunders et al 2012). Such geographic differences indicate the need to understand the reproductive biology of the species at the local scale to understand regional population dynamics.

Most adult snapper recruiting into the major fisheries in Port Phillip Bay (PPB), Western Port, and Western Victorian coastal waters originate from one major spawning/nursery area in PPB. Spawning happens between November and February with larval durations of ~ 18-32 days. Settlement will start to occur from 1 month after spawning occurs and will continue through to early winter. Therefore, it is the strong fluctuations in juvenile recruitment within PPB that dominate the population dynamics of the entire western Victorian snapper stock (Hamer & Jenkins 2007). Young snapper (1–4 years of age) born in PPB can migrate large distances (100's km) to replenish populations in coastal waters and other bays.

The latest assessment of stock health (Bell et al 2022) classifies snapper as sustainable and highlights the extremely strong recruitment cohorts of 2018 and 2022 which should result in increased adult fish in the system over the following years. Recruitment patterns have been highly variable over the years and are more influenced by local-scale processes e.g. at the estuary level.

Testing of seismic effects on adult snapper has found damage to the sensory epithelia within their ears, for fish exposed to a towed single seismic array <15m away (McCauley et al 2003). However there have been no reports of mortality in adult fish of any species nor evidence to support population-level effects on fish stocks from seismic surveys. A review of the potential impacts of marine seismic surveys on fish & invertebrates (Carroll et al 2017) found that while there was some evidence to support lethal and semi-lethal effects to fish larvae near a seismic source, these effects dissipated with distance and were not consistent between taxa.

Annual counts of snapper recruitment to Port Philip Bay were also compared with counts of annual seismic surveys in the region to see if there was any correlation between the two. We found no evidence of a link, with high recruitment of snapper equally likely to coincide with low or high seismic activity levels (see Figure F3-13).

In summary we find that the species-specific sensitivity to seismic is low for *Chrysophrys auratus* and further reduced because of spatial and temporal distance from the proposed location and timing of the Regia MSS.

4.2.10.2 Magnitude of Effect

Because the key parts of the lifecycle of snapper are centred on PPB and its surrounds and this is ~170km from the proposed Regia MSS zone any possible effects will be substantially diluted. Management of timing for the proposed survey to avoid the peak recruitment period over Dec -Jan - Feb will further mitigate any possible effects.

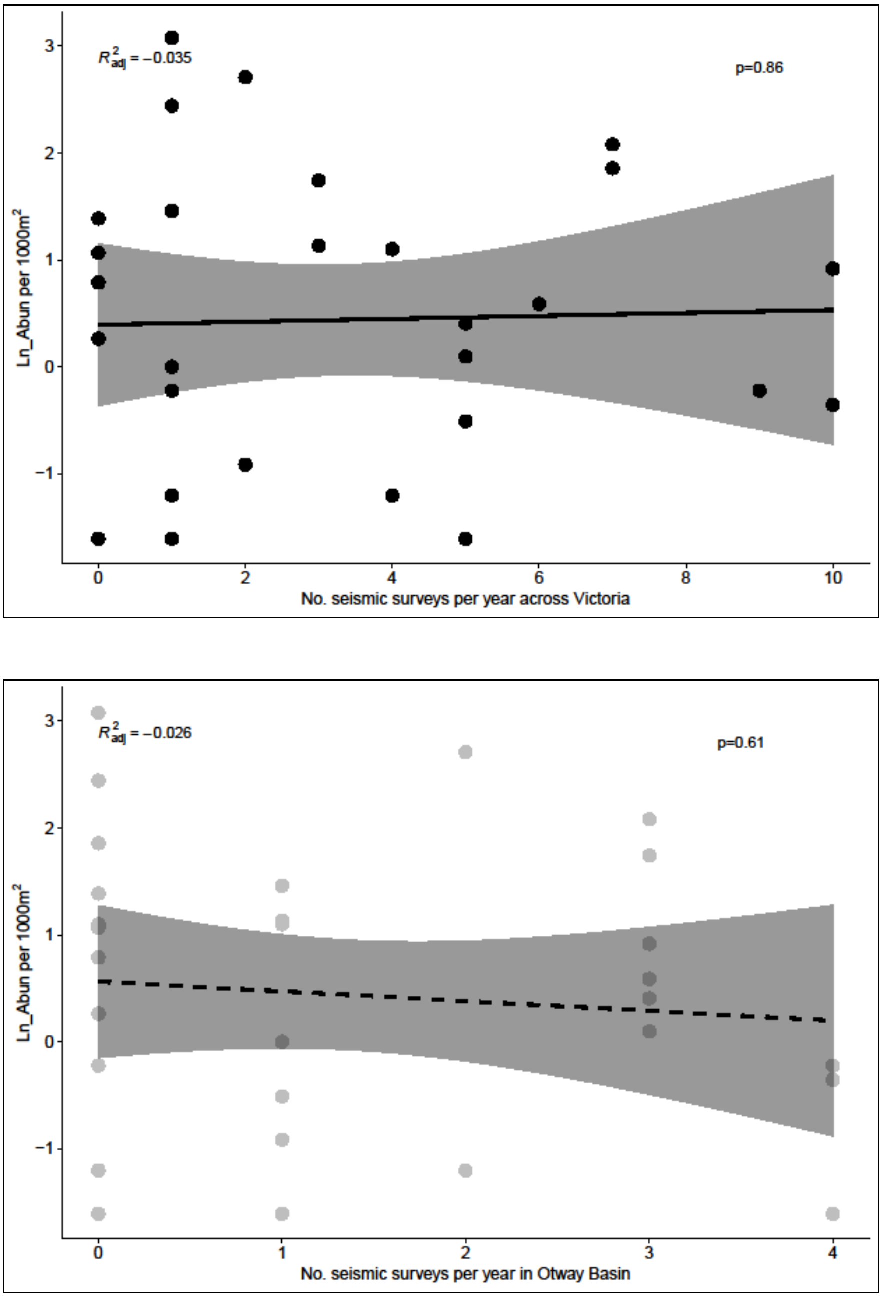


Figure F3-13 - Snapper recruit abundance (transformed) versus level of seismic activity each year for all basins combined (top) and for Otway basin only (bottom).

4.2.10.3 *Cumulative Impacts*

The dynamics of the entire western Victorian snapper fishery, encompassing over 500km of coastline from Portland to Wilsons Promontory, are linked to recruitment variation in PPB. The focus is therefore on maintaining the processes/habitats that support the production and survival of juvenile snapper in PPB. This dynamic demonstrates the importance of the spawning adults that migrate into PPB from coastal waters during spring/summer, and the potential implications of over-fishing of this spawning aggregation. Hence the main impacts to snapper stocks in the region are fishing and the ongoing health of PPB.

4.2.10.4 Recovery Potential

Recent strong recruitment with two high peaks observed during the past 5 years is expected to reverse any declining biomass trends and drive a rebuilding of adult biomass consistent with forecasts from Port Philip Bay creel showing an expected improvement in fishery performance over the next 5–10 years. Length compositions are not showing signs of truncation, and commercial fishing pressure has reduced substantially in recent years due to the Port Phillip Bay buy-outs and reduced landings by South Australian and Commonwealth operators. The available evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.

4.2.10.5 Conservation Status

Pink Snapper are not under any conservation protection status other than state and commonwealth fishing regulations. Snapper populations in Victoria are currently classified as sustainable and improving based on a successful recruitment year in 2018.

4.2.10.6 Mitigation Effectiveness

As noted, the key dynamics of pink snapper stocks in Victoria are centred around PPB and to a lesser extent Westernport Bay. Their distance from the proposed Regia MSS area provides an inherent buffer to any potential effects of seismic. In addition, there are multiple adaptions to the MSS protocols to further reduce risk of seismic effects. This includes soft starting procedures with seismic and depth limitations (>50m). Recruitment dynamics, the health of spawning populations and the interaction with fishing effects remain the main drivers of population health in pink snapper stocks.

4.2.11 King George Whiting (Sillaginodes punctatus)

[Section added in response to Matter: F14]

4.2.11.1 Species-Specific Sensitivity

King George Whiting are found within the bays, estuaries, and coastal waters of Victoria. They are a popular target of recreational fishers with most fish taken within the semi-sheltered waters of Port Phillip Bay (PPB), Corner Inlet-Nooramunga (CI) and Western Port (WP), where commercial fishers are also located. Population dynamics are strongly influenced by climatic factors determining numbers of larvae transported to bay and estuarine nurseries from coastal spawning areas in spring [Jenkins and May 1994, Hamer and Jenkins 1996, Jenkins et al. 2000, Jenkins 2005]. As most King George Whiting leave the bays and inlets permanently by four years of age (prior to adulthood) [Hamer et al. 2004], these fisheries are based on just a few age classes at any one time, making catches highly variable over relatively short time scales. Over the past 60 years catches have shown peaks and troughs at about 10 to 12-year intervals. These cycles that are thought to be related to variation in westerly winds driving larval transport and survival [Jenkins 2005]. Because fishing effort is concentrated in bays and inlets, adults in coastal waters are likely subject to low fishing mortality.

King George Whiting has a complex life history, exhibiting ontogenetic shifts in habitat at different life history stages (Fowler and Jones, 2008). Spawning occurs during late autumn and early winter at offshore reefs, shoals, and mounds in relatively deep water (30–100 m) in exposed locations (Fowler, 2000, Fowler et al., 1999, Steer et al., 2018). The larvae of King George Whiting can be advected across hundreds of kilometers over a prolonged pre-settlement period (3–5 months), dispersing larvae from the offshore spawning grounds to the shallow water nursery areas in protected shallow bays (Fowler et al., 2000b, Rogers, 2019). Juvenile fish develop and grow in the vicinity of these nursery areas until 3-4 years of age (Fowler et al., 2000a) when they move to their offshore spawning grounds to repeat the cycle (Fowler et al., 2000a, Fowler et al., 1999).

Most of the investigative research into seismic effects on fish (and invertebrates) has been from laboratory, or field-based studies where the animals are confined and hence not representative of a normal environment. A recent scientific publication conducted a systematic literature review of the effects of marine seismic surveys on free-ranging fauna only (Affatati & Camerlinghi (2023)). Frontiers in Marine Science Vol 10: 1222523). Unlike many review papers, they looked only at field studies on wild animals to provide the most realistic context for interpreting effects, ending up with 6 relevant publications for fish. Results described either no changes or temporary changes in behaviour/distribution of populations of animals. Studies were constrained to the North Sea and two solitary studies in the NE (Meekan et al. 2021) and SE (Bruce et al. 2018) corners of Australia, reflecting areas with appropriate resources to conduct ‘natural’ experiments.

The scientific evidence is clear that individuals within very close proximity to seismic sources will potentially face lethal or sub-lethal damage. There is, however, no evidence to support levels of disturbance greater than natural rates of mortality, for those species that may encounter the proposed Regia MSS. As such any potential effects will be immeasurable. Long term cumulative drivers of change in KGW fish populations remain closely linked to commercial and recreational fishing pressure and changing climate with little evidence to suggest seismic testing is driving population changes.

4.2.11.2 Magnitude of Effect

To further investigate the potential influence of seismic on KGW populations we sought to understand if there was any relationship between the annual frequency of seismic programs running in Victorian waters and the annual recruitment levels of King George Whiting in Port Philip Bay (PPB). PPB is the main area for KGW stocks in Victoria and hence where any correlations would be most likely to show up.

One of the arguments used by both sides of the “effects of marine seismic testing” issue is that the persistent presence of seismic testing in Victoria over a prolonged period has either been a primary driver of declines in fishing catches or it is evidence that the systems are relatively resilient to the scale of these effects. Providing a direct cause and effect is virtually impossible given the scale of the operating environment and the large number of confounding factors that are also acting at any given point in time and/or space.

In lieu of this, one approach is to look at long term datasets of a resource such as fish and see if the patterns revealed have any coherency with long-term patterns of MSS in the greater region. If seismic testing is having a significant effect on a stock at population level, then it might be argued that the more seismic testing that is done then the greater any likely impact will be. Hence in years of multiple seismic there will be a greater impact than in years where there has been little or no seismic.

To investigate this hypothesis CGG compared a long-term dataset of annual counts of newly settled King George Whiting recruits within Port Philip Bay (as described in VFA 2021 – Review of key Victorian fish stocks) with a similarly long-term dataset on annual seismic surveys in Victorian waters. Patterns of recruitment into this bay are representative of the other 2 catchments of Western Port Bay and Corner inlet as described in multiple papers and reports already submitted as part of the EP.

A simple linear regression approach was used to test for any correlations between the annual recruitment of KGW to Port Philip Bay and the annual count of seismic surveys across Victorian waters. For each of the two seismic datasets CGG compared KGW recruitment counts in the same year and then lagged by 1 year, 2 years and 3 years. For example, with a 1-year lag CGG compare the seismic accounts from 1999 with the recruitment counts in 2000, 2000 with 2001, 2001 with 2002 and so on. For a 2-year lag CGG compared seismic in 1999 with KGW recruitment in 2001 and so on. This analysis is shown in Figure F3-14.

CGG found no evidence of a relationship between annual recruitment levels of KGW to PPB and annual seismic levels, whether in the same year or lagged by multiple years. High recruitment of KGW was just as evident during years with high seismic activity or low seismic activity.

4.2.11.3 *Cumulative Impacts*

As analysed and described in the previous sections we do not foresee any measurable impact on KGW stocks in Victoria from the proposed Regia MSS. Analysis of long-term seismic frequency versus long term KGW recruitment records finds no evidence of linkages between these two outcomes. Therefore, we conclude that the risk of the proposed Regia MSS causing an impact of sufficient scale and intensity as to cause synergistically greater impacts to KGW than already exist, is low.

4.2.11.4 Recovery Potential

Indicators of stock status for King George Whiting are all directly related to juvenile life stages and are highly variable, being primarily driven by recruitment dynamics – which CGG could not link to annual seismic frequency. None of the fishery CPUE or pre-recruit time series show persistently declining trends, providing reassurance that the poorly known and lightly fished adult stock in coastal waters is continuing to be replenished at rates that are sufficient to prevent declines in recruitment potential/egg production. Recent modest post-larval recruitment is expected to result in a decline in fishery performance, but it is expected to remain within historical bounds so the stock should remain sustainable (Bell et al 2022).

4.2.11.5 Conservation Status

King George Whiting is not under any conservation protection status other than state fishing regulations. King George Whiting populations in Victoria are currently classified as sustainable.

4.2.11.6 Mitigation Effectiveness

As noted, the key dynamics of KGW stocks in Victoria are centred around PPB, WPB and CI. Recruitment dynamics, the health of spawning populations and the interaction with fishing effects remain the main drivers of population health in KGW stocks.

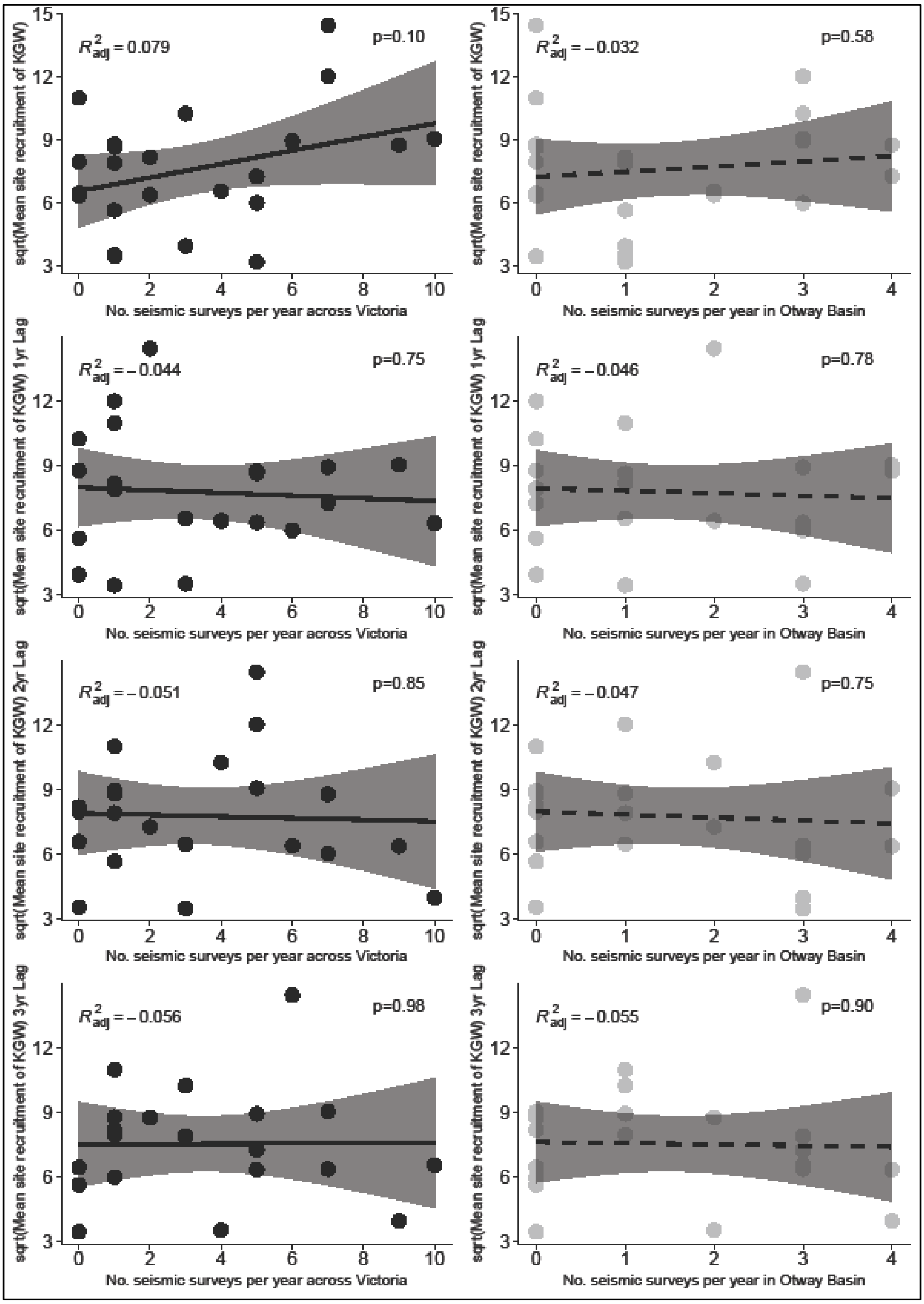


Figure F3-14 - Relationship between frequency of seismic surveys and KGW recruitment levels in PPB.

4.2.12 Plankton Communities and the Bonney Upwelling System

4.2.12.1 Species-Specific Sensitivity

The plankton communities of the general region encompassing the Regia MSS area are dominated by copepods, cladocerans, euphausids (Krill) and chaetognaths amongst others (Kampf & Chapman 2016; Van Ruth & Ward 2009). Much of the work on direct effects of seismic to plankton has focussed on copepods, krill and fish/invertebrate larvae. Results are mixed, with the consensus indicating a range of effects, including mortality, for individuals within close proximity to the seismic pulses at the time of discharging. However, the evidence is much less compelling for large scale mortality and potential population level effects to plankton communities at ever increasing distances from the seismic discharges. A pivotal study cited as definitive proof of large-scale mortality of krill (McCauley et al 2017) presented an outcome more extreme than previous research, concluding that there was large-scale mortality out to 1.2 km from the source. A subsequent study was conducted by three highly cited CSIRO modellers/ researchers (Richardson et al 2017) to model the effects of a seismic survey on zooplankton in a hypothetical survey conducted off the NW Shelf of Australia. This work was also suggested by McCauley et al (2017),

> "*There is an urgent need to conduct further study to mitigate, model and understand potential impacts on plankton and the marine environment…*"

The model outcomes demonstrated substantial impact within 15 km of the seismic in keeping with previous empirical research, but unlike McCauley et al (2017) they found no likely population level effects, with recovery of zooplankton populations within 26 days of the survey completion. Modelling is a proven tool for investigating systems that are difficult to study at large scales and the model outcomes were closely aligned with previous research outcomes across a range of plankton species. As with all models there were numerous caveats due to insufficient information to inform aspects of the model. Richardson et al (2107) however also identified multiple outcomes from the McCauley et al (2017) study that cannot be taken as absolute, especially the apparent lack of any attenuation by distance effects on mortality rates. The obvious conclusions were that there needs to be an independent, rigorous, largescale follow up study to see if the results of McCauley et al (2017) can be verified and validated.

Sensitivity of individual plankton species across multiple studies have all indicated maximum mortality rates from Regia MSS to be below estimated natural mortality rates, with reduced impact at increasing distances/depth from the seismic source (multiple references in the EIA doc on UWS – Plankton).

A significant component of plankton community dynamics in the region is collectively known as the Great Southern Upwelling which mostly refers to three distinct upwelling centres located off the Bonney coast, the southwest coast of Kangaroo Island and the west coast of the Eyre Peninsula. While these centres are not seen as being connected (see Huang and Wang 2019) there is evidence of upwelling at a lower level across the greater shelf region and blue whales are known to aggregate for feeding along the Otway coast SE of Cape Nelson (Gill et al 2011). There is also evidence of sub-surface phytoplankton blooms occurring along the shelf region (Shute et al. 2022, Kampf & Kavi 2017).

Upwelling is a key driver of seasonal biomass enhancements of mesozooplankton (Van Ruth and Ward, 2009), sardine (*Sardinops sagax*) (Ward et al. 2006) and other small pelagic fishes (e.g. *Arripis georgianus*, *Etrumeus teres*, *Trachurus declivis*, *T. novaezelandiae*, *Scomber australicus*, *Emmelichthys nitidus* and *Scomberesox saurus*) (Ward et al., 2008), which are in turn important in the trophic webs of higher order predators in the region (Goldsworthy et al., 2013). Productivity associated with the Bonney Upwelling is also linked to enhancements of euphausiid (*Nyctiphanes australis*) biomass and associated blue whale (*Balaenoptera musculus*) feeding aggregations (Gill, 2002).

In the case of the euphausiid *N. australis*, while its highest abundance is found in summer in response to the upwelling, this species is short-lived and extremely productive, reaching maturity within 4 months and reproducing continuously throughout the year (UTas, IMAS website).

When the upwelling season starts during late spring and early summer (November and December), the influence of the Bonney coast upwelling is often restricted to the coast. During the mid-summer and early autumn (January to March) when the upwelling is the strongest (measured by AoI), the upwelling influence often extended to the shelf break before retreating in April. At the height of the Bonney coast upwelling during February and March, the upwelling's area of influence often exceeds 12,000 km^2, its SST anomaly often exceeds 1 °C, and its chlorophyll-a concentrations are often >1.5 times of its adjacent areas (All part of Huang and Wang 2019).

The upwelling area of influence is affected by ENSO events, especially at inter-annual level (Huang and Wang 2019). El Nino or La Nina events tend to increase or reduce, respectively, the upwelling's area of influence. It has even been suggested that La Nina events could potentially stop the upwelling events from happening altogether. For example, the Bonney coast upwelling season in 2008–09 was restricted to February only. Interannual variation in areal extent (AoI) can be as high as 50 % from year to year. At the Bonney Coast Western Victoria (BCWVIC) area, the highest annual means in 2009–10 (13,029 ± 5894 km^2) and 2015–16 (12,414 ± 7794 km^2) were more than twice the lowest two in 2004–05 (5378 ± 3184 km^2) and 2012–13 (5184 ± 4838 km^2).

The inherent variability in the dynamics of plankton productivity and the oceanographic processes that drive their life cycles, including concentrating food in upwelling systems, is driven by global-scale climate cycles such as the El Nino Southern Oscillation, with rising SST's also impacting at regional scales. While the direct effects of seismic pulses are felt by individual animals within proximity to the Regia MSS the impacts on population dynamics of these communities are insignificant relative to the scales of change that operate normally.

Krill is a key component of the plankton communities of the region. Because of its primary role in the regional food chains, many species long term sustainability is closely linked to the annual upwelling events that drive the krill blooms upon which animals converge to feed. Because upwelling is the key driver of krill population dynamics, it follows that the huge shifts in temporal and areal extent of the GSU both within and between years will cause krill populations to shrink and expand in a similar way. Such changes, as previously noted, can be as much as 50%. The animals that rely on this system (e.g. whales) for their survival must therefore have evolved to survive and thrive within a system that changes markedly in scale and extent. When put into this context the scale of any potential impacts to plankton communities from the proposed Regia MSS will have no measurable effect on the population health of plankton communities. By extension the risk associated with reduced krill biomass available to feeding animals as a result of the proposed Regia MSS is immeasurably low. [Paragraph added in response to Matter: M10].

4.2.12.2 Magnitude of Effect

As noted in Appendix E2 (Underwater Sound – Plankton) there are multiple studies detailing the effects of seismic on fish larvae (see also Sivle et al 2021) and other inhabitants of the plankton. The results consistently indicate that there are deleterious effects on plankton in close proximity to seismic sources however the scale of the impacts is varied and species specific. There is a general relationship of decreasing effects with increasing distance from the seismic sources, although the work of McCauley et al (2017) disputes this relationship.

There has been a constructive assessment of the work of McCauley et al (2017) by Richardson et al (2107) which highlights the need for more research into the findings of this work, especially the apparent lack of attenuation in responses with distance from the seismic source. There is much variation in experimental and study methodologies undertaken to assess seismic effects, and most do not replicate 'real-life' scenarios adequately. Hence more targeted research is needed.

The outcomes discussed by McCauley et al (2017) have indeed catalysed further research into the effects of seismic on planktonic assemblages. Norway has a long history of oil and gas exploration and a concomitant program of research into its effects on the environment (Sivle et al 2021). As a direct result of this work the Norwegian Research Council has funded a 4-year project (ZoopSeis) aimed at uncovering the effects of seismic sound on zooplankton (https://www.hi.no/hi/nettrapporter/toktrapport-en-2022-9). This work is designed to investigate effects under realistic seismic survey conditions and finishes at the end of 2023. Peer-reviewed papers of the research are being completed, with the first publication now available. Mortality rates and reduced growth of copepod larvae of *Acartia* spp were found to be high in the vicinity of the airgun discharges however the actual rates were significantly lower than normal population mortality rates and hence would likely not be detected (Vereide et al 2023). They did not test for the effects of distance-from-seismic in this work, but their results remain consistent with most of the other research already published in this area.

A second publication derived from the ZoopSeis work (Vereide et al. (2024a)) has also found that while there was significant damage at close quarters to seismic discharges, there was not extensive and unattenuated mortality out to 1 km + as reported by McCauley et al (2017). Mortality levels reported were also lower than natural mortality rates and hence are predicted to be difficult to separate from background mortality. As well as experimental work a review was conducted as part of the ZoopSeis program and highlighted the vexed issue of extrapolating experimental results to real-life situations (Vereide et al 2024b). They noted that although a seismic survey may cover up to 3000 km^2 and shoot continuously for many weeks the animals will not be constantly exposed throughout that period. The duration of exposure in the reviewed studies lasted for a maximum of 3–4 days, which could be considered too long to be transferred into a real-life setting, considering advection and migration processes that typically occur in the plankton. [Paragraph added in response to Matters: P04 and P06].

Zooplankton will be exposed to airgun discharges when a seismic survey is conducted but over varying time durations and sound levels. In addition, seasonal, diel, and species-specific changes in copepod distribution, both within and among species (Hygum et al., 2000; Thor et al., 2005), will influence exposure level and, therefore, the overall impact of seismic discharges. Dongen-Vogels et al (2011) found up to 4 magnitudes of difference in the abundance of picophytoplankton communities in GAB which highlighted the role of localised physical events including upwelling, downwelling, water column stratification and eddy formations.

A recent study attempted to quantify the patchiness of planktonic assemblages off Florida and clearly demonstrated the multi-scale nature of this phenomenon – see Figure below (Robinson et al 2021).

While effects of seismic will be felt by plankton assemblages at localised scales the highly dynamic nature of populations in space and time will ensure there are no population level effects hence the magnitude of any effects will be minor.

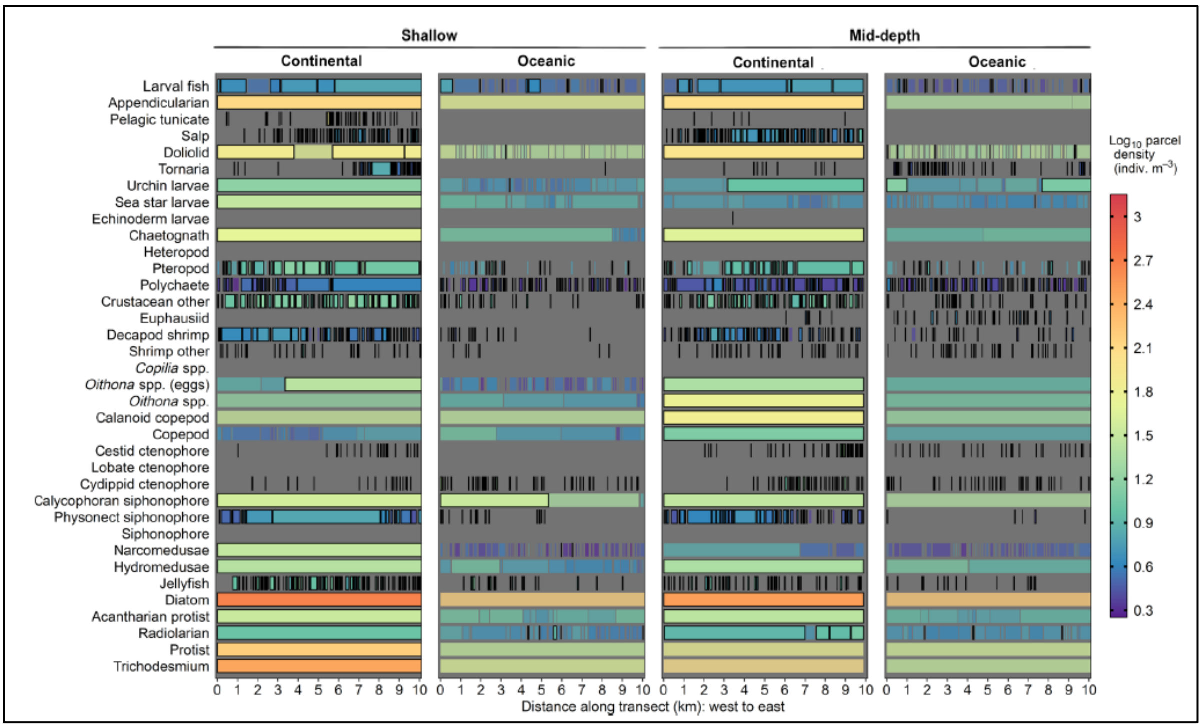


Figure F3-15 - Position and length of plankton catches for 36 taxa. The position and length of patch (coloured bars with black outline) and aggregated parcel (opaque coloured bars) for each taxonomic group along with a single example set of 10-km ISIIS transects in the shallow and mid-depth waters of continental oceanic regions of the SOF. The bar colour gradient indicates the log $_{10}$

– transformed density of individuals (individuals per cubic meter). Multiple groups had patches of aggregate parcels that extended the entirety of the 10-km transects (e.g. diatom).

4.2.12.3 Cumulative Impacts

Potential cumulative impacts would be restricted to locations where aggregation events are occurring, and these would be indirect by potentially affecting animals targeting plankton for feeding. Recognised upwelling locations are located within or at the shelf break which is shoreward of the Regia MSS. There could potentially be localised patches of high zooplankton biomass that could be targeted by baitfish species who would then be targeted by predators such as tuna.

4.2.12.4 Recovery Potential

The scale of seismic effects relative to natural background mortality and patchiness of planktonic communities precludes any impacts on such a scale that 'recovery' would be a process specifically applied to a seismic event.

4.2.12.5 Conservation Status

Planktonic communities of themselves are not given any conservation status. The Bonney Upwelling has been recognised as a Key Ecological Feature however this has no formal legal standing. Whale conservation and management plans may indirectly confer a conservation status on plankton communities in the same area.

4.2.12.6 Mitigation Effectiveness

Plankton exists in the oceanic environment off the Otway coast and greater south coast region all year round. Localised areas of extremely high plankton density such as upwelling areas should be avoided, however they do not exist within the Regia MSS area. Mitigation might otherwise be better targeted towards avoidance of aggregations of animals that either feed on plankton or who target those species that are feeding on plankton.

4.2.13 Spawning Patterns

4.2.13.1 Species-Specific Sensitivity

The commercially important fish species that occur proximate to the survey are largely broadcast spawners (i.e. species that release vast numbers of sperm and eggs into the water column, or in some cases scatter them on the substratum), with several species forming spawning aggregations on the continental shelf, shelf break and slope. The commercially important crustacean species fished in the vicinity of the survey area (i.e. southern rock lobster and giant crab) also spawn eggs but incubate them under their abdomen until hatching. Some species may aggregate at locations to spawn all their eggs and sperm at a specific time within a certain period, batch spawn across a region multiple times during certain seasons (e.g. pink ling and Australian sardine) or spawn continuously throughout the year (e.g. Gould's squid). Significant spawning aggregation areas are not known to occur in the vicinity of the survey area, although information regarding fish spawning in offshore regions of the Otway Basin is generally not well documented.

Spawning periods for key species of Commonwealth and State managed fisheries overlapping the active source area are shown in Table F3-5 and Table F3-6. While there is spawning activity present throughout the year the second half of the year has more species activity and hence is a more sensitive period with respect to key fisheries species that may spawn within the active source area. Austral spring-summer is the predominant spawning period for most species as it coincides with warmer conditions.

Table F3-5 - Commercial fisheries species spawning timings and depths.

	Spawning Timing												
Fish species	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**	**Spawning Depth**
Blue grenadier					■	■	■	■	■	■			200 - 700 m
Tiger flathead	■	■	■							■	■	■	10-400 m
Silver warehou							■	■	■	■			27-650 m
Pink ling					■	■	■	■	■	■			40-700 m
Blue-eye trevalla		■	■	■	■	■	■						40 - 1,500 m
Jack mackerel	■	■										■	10-460 m
Redbait								■	■	■	■		86-500 m
Australian sardine	■	■	■	■					■	■	■	■	0-200 m
Gould's squid	■	■	■	■	■	■	■	■	■	■	■	■	<200 m
Southern rock lobster									■	■	■		<200 m
Giant Crab						■	■	■	■	■	■		100-300 m
Survey Timing			■	■	■				■	■	■		50 - 200 m

Table F3-6 - Fish species potentially spawning in area of effect for plankton.

Fish species	Spawning activity	Impacted by survey
Blue Grenadier	Main spawning areas located off the central west coast of mainland Tas (Gunn et al. 1989b) and eastern VIC / southern NSW (Bruce et al. 2001).	Main spawning areas outside of the active source area and overlap of spawning limited to two months at end of spawning period
Tiger Flathead	Mature fish migrate to shallow continental shelf waters (<200 m depth) prior to the spawning period (AFMA 2017).	Survey overlaps only two-month period.
Silver Warehou	Major spawning areas are located off the west coast of mainland Tasmania.	Main spawning areas outside of active source area and overlap of spawning limited to two months at end of spawning season
Pink Ling	Mature fish migrate to shallow continental shelf waters (<200 m depth) prior to the spawning period (CSIRO 2002).	Main spawning areas deeper than survey and overlap of spawning limited to two months at end of spawning season.
Blue-eye Trevalla	Move into shallower depths (320–400 m) and form spawning aggregations over rough ground and drop-offs on the continental slope, as well as over seamounts (Kailola et al., 1993).	Active source area overlaps in April – June period, with no overlap in September – November period. Spawning is widespread across the South-east Marine Region (CSIRO, 2002) although most spawning activity occurs in waters from central NSW to north-eastern TAS (AFMA, 2017).
Jack Mackerel	Spawning occurs near the edge of the continental shelf with eggs and sperm released among schooling fish deep in the water column (CSIRO, 2002). Larvae are thought to be carried inshore by currents (Marshall et al. 1993).	Multiple spawning events over areas outside of acquisition timing.
Redbait	Spawns on outer continental shelf, mostly at night, once every three to five days over the spawning period.	Multiple spawning events over areas largely overlapping with the active source area.
Australian Sardine	Spawns on continental shelf (200 m) with larvae moving Inshore towards bays and inlets during a planktonic period of around 120 days after hatching.	Multiple spawning events over areas largely overlapping with the active source area.
Gould's Squid	Spawn throughout the year with 2-3 peaks of spawning activity (AFMA website)	Spawning is continuous throughout year with multiple intra-year peaks that can vary from year-to-year depending on inter- and intra-year variability of environmental conditions.
Southern Rock Lobster	See SRL assessment in Section 0.	See SRL assessment.
Giant Crab	See Giant Crab Assessment in Section 7.2.4	See GC assessment. Small overlap with the shelf slope habitat in one area.

Some locations identified as Australian Sardine spawning areas overlap with the Regia MSS area (Table F3-4) with timing of spawning centred around spring-summer months (Table F3-3). Mapping of egg densities along the south coast shows the distribution and abundance of sardine spawning locations is centred around Kangaroo Island and the Cape Otway region (Ward et al. 2018). However, Ward et al. (2018) state that these results are underestimates of the total spawning biomass of the south coast region. Australian Sardine are recognised as one genetically identical stock, subdivided into meta-populations that are still connected but more self-regulating (Izzo et al. 2017). The distribution of spawning areas is extensive across the south and southeast coast and connected at a much larger scale than the Regia MSS area (Figure F3-16 and Figure F3-17). As such, the scale of any effects to the spawning output of sardines across the greater region are expected to be immeasurable.

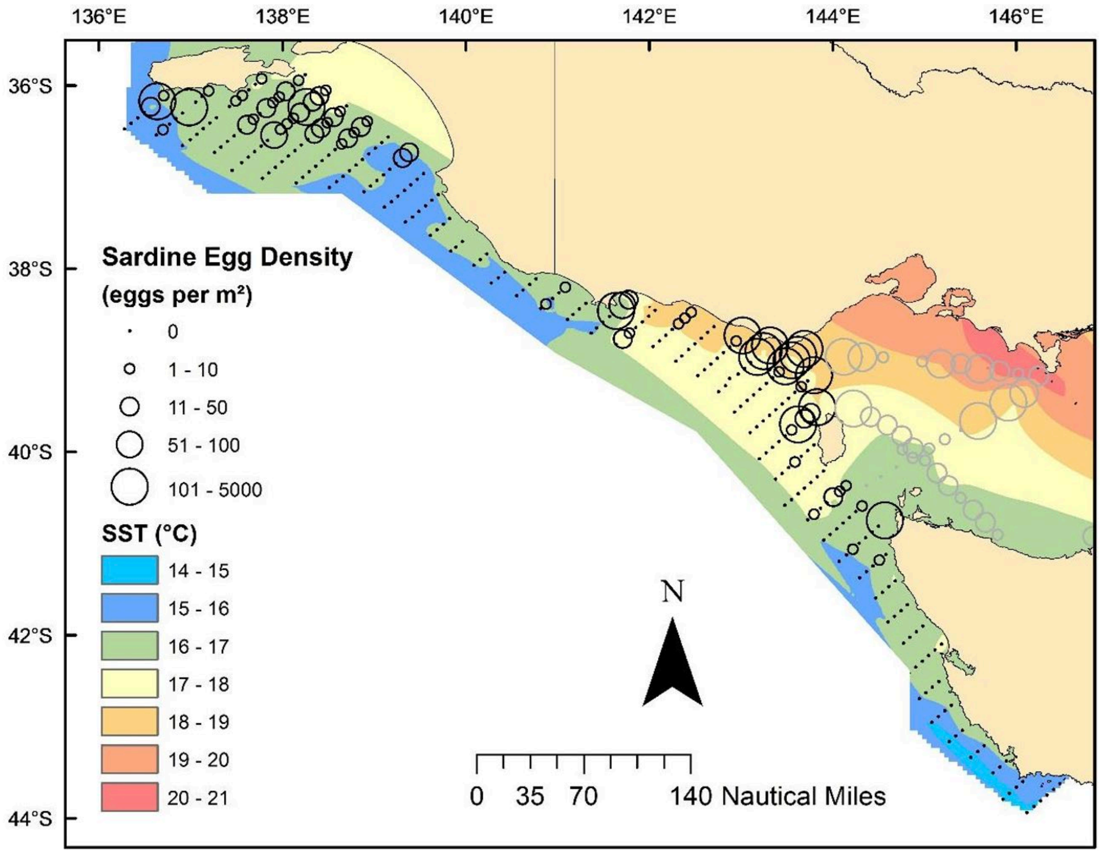


Figure F3-16 - Spatial patterns of Sardine egg distribution and abundance between December 2016 and February 2017. Black circles are egg density (eggs/m²). Grey circles are egg density from sampling in the Bass Strait. Sea surface temperature 9SST) data in Bass Strait are approximations from vessel surface thermometers (AFMA 2018).

There is also overlap of redbait spawning locations with the Regia MSS area (Table F3-5) with timing of spawning during spring/early summer (Table F3-6). However, distribution of redbait eggs was found to be greater to the west and east of the Regia MSS area with highest concentrations off the west coast of Tasmania and the Bonney Upwelling region (Ward et al 2019). (Figure F3-17).

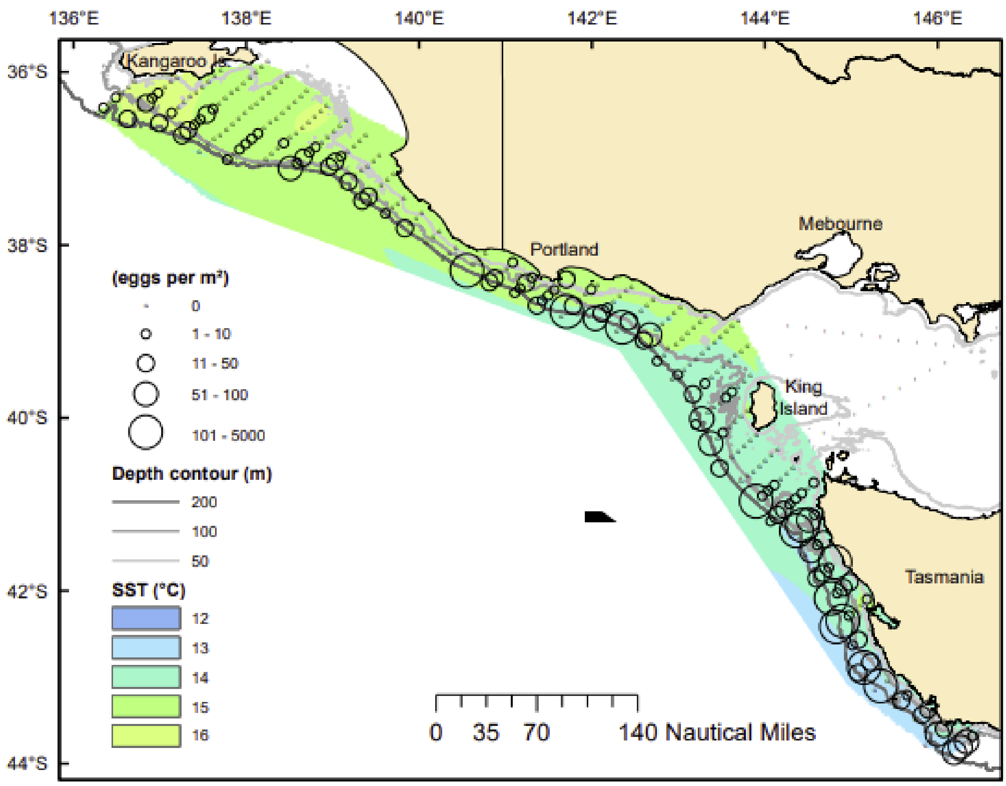


Figure F3-17 - Distribution and abundance of Redbait eggs between western Tasmania and Kangaroo Island in October 2017 (from Ward et al. 2019).

4.2.13.2 Magnitude of Effect

The dominant effect on spawning will be from the operation of the seismic source (airgun array). The levels of energy and scale of effects that marine biota will be exposed to within the ensonified area will vary by species and by individual according to their closeness to the sound energy source, their behaviour and physiology, the complexity and density of their preferred habitat and the speed and direction of the survey. Actual near-field and far-field received sound levels are influenced by several factors including the overall size (capacity) of the acoustic source, the array configuration, water depths in the area, position in the water column, distance from the source and geo-acoustic properties of the seabed.

Appendices B7 and B8 highlight that the distance thresholds selected for understanding the effects of elevated levels of sound on fish eggs and larvae are defined as the active source area plus 230 m. In selecting impact thresholds, the EP considers an extensive list of different studies which have investigated the effects of underwater sound on plankton (which includes the eggs and larvae of finfish and invertebrates). Guideline thresholds for mortality to eggs and larvae have been drawn from the sound exposure guidelines of the ANSI-Accredited Standards Committee S3/SC 1, Animal Bioacoustics Working Group (Popper et al. 2014). The critical level proposed for mortality in eggs and larvae is 207 dB re 1 μPa Lpk and this is based on the maximum sound levels measured from repeated pile driving that indicated no damage to the larvae of the common sole (Bolle et al. 2012). This level has been used for the assessment of underwater sound from seismic on plankton including fish larvae and eggs (see Appendix E2). The spatial extent within which effects are being assessed is conservative in keeping with the precautionary approach because it encompasses all physiological and behavioural disturbance effects to all the marine fauna considered, at the seabed and in the water column.

In general, there have been few studies into the effects of marine seismic surveys on plankton. Up until recently, studies on the effects of noise from airguns on plankton have indicated that any effect is likely to be highly localised (<10 m from the source and typically within 0.5 to 5 m) (Kostyuchenko 1973; Matishov 1992; Booman et al. 1996; Payne 2009). These studies indicated that impacts would be insignificant compared with the naturally high turnover rates of zooplankton.

Key target species for commercial fisheries that overlap the active source area are described in Appendix B6. It is possible that some of these species could spawn in that area at the time of the survey. The potential mortality of larval fish that rely on zooplankton for food is difficult to predict but is not expected to affect a significant proportion of larvae based on the assumptions that not all zooplankton are killed by exposure to airguns (Richardson et al. 2017) and only a very small proportion of the plankton would be exposed at any one time.

4.2.13.3 Cumulative Impacts

No population level effects are predicted from an individual survey, however there is the potential for an overlap with the TGS Otway 3D MSS. TGS and CGG have committed that both surveys will not occur at the same time. The two surveys are targeting acquisition in different water depths such that cumulative effects are not predicted to species whose spawning distributions are depth limited. The only species with depth ranges affected by both surveys have such broad distributions that cumulative effects remain within acceptable levels. The recoverability of populations and levels of natural mortality are such that no effect is predicted to commercially caught species, or to their catch rates as an indirect result of impacts on eggs/larvae.

4.2.13.4 Recovery Potential

Although the work by McCauley et al. (2017) and Richardson et al. (2017) suggests that the zone of impact for zooplankton may be two orders of magnitude higher than previously thought, there is still evidence that for certain components of the plankton effects are likely to be limited to <10 m. Further, for many components of the zooplankton and phytoplankton, recovery is expected to be rapid (in the order of days), so the effects are expected to be limited and within the range of natural variability.

Richardson et al. (2017) showed that zooplankton communities can begin to recover during the survey period during periods of good oceanic circulation (and periods of upwelling). Hence, a continuous decline in zooplankton throughout the survey period is not anticipated, and parts of the survey area would progressively recover as the survey proceeded. It is unlikely therefore that localised patches of reduced food availability for plankton feeders would occur over the period of the survey and during the 3-day recovery period (as modelled by Richardson et al. (2017)).

4.2.13.5 Conservation Status

Fish eggs and larvae are not protected in Australia.

4.2.13.6 Mitigation Effectiveness

There are no known critical spawning areas (i.e. species with restricted distribution and/or a relatively large-scale event) for any commercially important fish species within the Regia MSS area-of-effect and the survey will not have population level impacts on spawning output of commercially important fish and invertebrate species. Given the broad distribution and high natural mortality of spawning and the potential mortal injury effects the only viable mitigation measures are avoidance of spawning timing. In all cases, the avoidance of minor impacts to spawning should not be traded off against higher order effects of moving to other times.

In consideration of the spatial and temporal extent of this predicted impact it is also important to consider the following:

- Any plankton, including fish eggs and larvae, present in the water column within the survey area will not be evenly distributed with substantial spatial patchiness the most likely (e.g. Robinson et al 2021).
- The seismic source will be constantly moving, and plankton populations are constantly being replenished by currents from non-impacted areas. Plankton populations' recover quickly due to their fast growth rates, and the dispersal and mixing of plankton from both inside and outside of the impacted area.

- Any mortality or mortal injury effects to fish eggs and larvae resulting from seismic noise emissions are likely to be inconsequential compared to natural mortality rates of fish eggs and larvae, which are very high (exceeding 50% per day in some species and commonly exceeding 10% per day). For example, in a review of mortality estimates (Houde and Zastrow 1993), the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day.

4.3 Compliance with the EPBC Act

The primary environmental legislation within Australia is the *Environmental Protection and Biodiversity Conservation Act* 2002 (**EPBC Act**). NOPSEMA's authorisation processes have a Part 10 approval that applied to offshore petroleum activities as per the NOPSEMA EPBC Act Program. This program ensures that impacts on matters protected under Part 3 of the EPBC Act are not unacceptable.

Matters protected by the EPBC Act that have been considered in this EP include:

- World Heritage properties
- National heritage values of declared National Heritage Places.
- Wetlands of international importance.
- Listed threatened species and ecological communities.
- Listed migratory species.
- Commonwealth marine environment.

Each impact and risk analyses has considered these matters and provides evidence that the proposed activity is not in conflict with any recovery plans or threat abatement plans for listed threatened species or ecological communities. It respects the management plans in place for Commonwealth reserves, such as Australian Marine Parks, and upholds the Australian IUCN Reserve Management Principles. It shows that the activity will not have unacceptable impacts on the values of these protected areas.

Moreover, the EP content confirms that the proposed activity does not contravene any management plans for World Heritage properties, National Heritage places, or Ramsar wetlands. In the absence of specific management plans, the EP shows that all reasonable steps have been taken to ensure consistency with the Australian World Heritage Management Principles, National Heritage Management Principles, Australia Ramsar Management Principles, and Commonwealth Heritage Management Principles.

The EP also demonstrates due regard for relevant policy documents, guidance, bioregional plans, wildlife conservation plans, management plans, gazettal instruments under the EPBC Act, conservation advices, marine bioregional plans, and other pertinent information, including spatial data, available on the DCCEEW website.

4.4 Search for Unacceptable Environmental Impacts

Whilst all the impacts arising from the Regia MSS have been evaluated looking at the cause effect pathways to environmental components, it is also important to evaluate impacts from the survey more holistically to understand if there are unacceptable impacts. This search looked for unacceptable impacts by considering whether the Regia MSS maintains biological diversity and ecosystem integrity.

4.4.1 Maintenance of biological diversity

Biological diversity underpins resilient and durable ecosystems. High biodiversity is closely linked to ecosystem functions and services, with more diverse systems being seen as more resilient to change (Oliver et al 2015 and references therein). A primary mechanism allowing species to endure and thrive in complex environments is heterogeneity. This occurs in a multi-dimensional framework as reflected in the spatial and temporal differences that exist in all aspects of a species' environment (Wu & Loucks 1995).

Preferred habitat is usually never uniformly available and will be shared and competed for by other species and individuals. For invertebrates and fish with a planktonic larval stage, recruitment back to a location is highly variable in space and time with usually weak stock-recruitment relationships (e.g.

Cury et al 2014). Strength of recruitment pulses are often correlated with better-than-usual environmental conditions during their larval phase resulting in more food and greater survival. These conditions are themselves highly variable in space and time. For marine mammals that aggregate to feed on concentrations of krill, these food sources are equally variable in space and time with strong intra and inter year variations in the upwelling systems that drive the production of krill.

The environmental assessments considered all key organisms likely to interact within the operational area and acquisition area and have indicated that these areas are not primary habitat within the ecosystem. There is no evidence to support the acquisition area as either a major source-or-sink for species inhabiting the greater area. This heterogeneity is key to population stability with minimal reliance on the survey area as a key provider to the greater population of species in the region.

Direct disturbance to those species that are site attached within the acquisition area is the most likely manifestation of impact from use of seismic. However, there has been no experimental evidence of mortality to fishes and invertebrates from this type of activity. Seismic surveys have been conducted across the greater region for many years however existing long-term datasets on key species within the area have not been able to identify impacts that can be unequivocally linked to seismic activity. While some individuals will suffer permanent injury as discovered in experimental work, these effects will be highly variable in space and time due to changes in habitat across areas and the continual movement of the seismic array. The size of impacts will be negligible at a population level and will be virtually impossible to quantify once natural variations and other anthropogenic effects, primarily from fishing, are accounted for.

4.4.2 Maintenance of ecosystem integrity

Maintenance of biological diversity leads naturally to an expectation that ecological integrity will be maintained. At its most fundamental, ecological integrity means the ability of all species within an ecosystem to survive and reproduce such that the overall health of their ecosystem is maintained. Population structures should persist, supported by processes such as connectivity and dispersal that are key to sustaining systems. Associated habitat must also remain capable of supporting critical population levels.

By looking for ecosystem vulnerabilities and comparing these to impacts from the Regia MSS it may be possible to identify unacceptable impacts. Table F3-7 identifies the potential ecosystem vulnerabilities were considered in the context of the Regia MSS.

Table F3-7 - Potential ecosystem weaknesses and unacceptable impacts

Potential Ecosystem Vulnerabilities	Description of potential unacceptable impacts
Low Biodiversity	Ecosystems with few species lack ecological redundancy, meaning there are fewer species that can perform similar roles. This makes the ecosystem more susceptible to disturbances because the loss of any single species can have disproportionate effects on the ecosystem's overall functionality.
Simplified Food Webs	Simple food webs have fewer connections among species, which means energy and nutrients have fewer paths to flow through the ecosystem. This simplicity can lead to instability if a link in the chain is disrupted, as there are fewer alternative pathways to compensate for the loss.
Non-native or Invasive Species	The introduction of species from other ecosystems can create weaknesses by disrupting established relationships among native species. Invasive species often have no natural predators in the new ecosystem, allowing them to outcompete and displace native species, which can lead to reduced diversity and altered ecosystem functions.
Degraded or Fragmented Habitats	Damage to or division of habitats can isolate species populations, limit resource availability, and disrupt the interactions necessary for ecosystem processes. This can weaken the ecosystem's ability to support species diversity and maintain ecological functions.
Overexploited Resources	Overexploitation occurs when the rate of resource use exceeds the ecosystem's capacity to regenerate. This can lead to a decline in species, as well as a decrease in the ecosystem's ability to provide goods and services, such as food and clean water.

Potential Ecosystem Vulnerabilities	Description of potential unacceptable impacts
Climate Change Vulnerabilities	Ecosystems that are particularly sensitive to temperature changes, sea-level rise, or alterations in weather patterns may struggle to adapt to the rapid pace of climate change. This can lead to shifts in species distributions, loss of habitat, and increased susceptibility to diseases.
Limited Genetic Diversity within Species	When species have limited genetic variability, they may not have the necessary traits to adapt to changing environmental conditions or to resist diseases and parasites, making the species and the ecosystem more vulnerable.
Lack of Keystone Species	Keystone species have a disproportionate influence on their ecosystem. Their removal can lead to significant changes in ecosystem structure and function, which may not be easily reversible and could lead to ecosystem collapse.
Over-dependence on Keystone Species	Heavy reliance on a single keystone species makes the ecosystem vulnerable to any changes that affect that species. If the keystone species declines or goes extinct, there may not be another species that can fill its role, leading to ecosystem degradation.
Insufficient Regenerative Capacity	If an ecosystem cannot recover from disturbances such as natural disasters or human activities, it can become stuck in a degraded state, losing its ability to support a diverse community of organisms and provide ecological services.
Overfishing and Unsustainable Fishing Practices	Overfishing reduces populations of key species to below sustainable levels, disrupting the balance of the marine food web. Practices like bottom trawling can also cause irreversible damage to marine habitats, further weakening the ecosystem.
Narrow Timing of Important Life-Cycle Events	Species that rely on specific environmental cues for timing critical life-cycle events, such as breeding or migration, can be thrown off by changes in climate or habitat conditions. This can lead to mismatches in timing that disrupt reproduction and survival rates.
Areas of Concentrated Abundance	Regions with high densities of organisms are critical for the ecosystem but can become points of vulnerability if conditions supporting these concentrations change or if these areas are disproportionately affected by human activities.
Narrow Distribution or Ranges	Species with limited geographical distribution are at a higher risk of extinction due to habitat loss or environmental changes that directly affect their small living area.
Sensitive Life-Cycle Stages of Species	Certain life-cycle stages may be more vulnerable to environmental stresses and impacts on these stages can affect the survival and recruitment of individuals into the population, thereby affecting the overall health of the ecosystem.

Our assessments have identified no measurable changes to ecological integrity or population structures are likely because of the Regia MSS. Any potential changes to standing stock will not be measurable relative to the scale of changes that are manifest through fishing, or relative to the degree of uncertainty that already exists around quantifying abundance and health of large highly mobile marine animals. The one-off, “spatially constrained”, and highly mobile nature of the survey will not by-definition cause population level impacts. The highly connected nature of stocks along the south coast ensures a regular supply of new recruits will be available to settle into habitat that has been surveyed by sonar arrays. Stocks are historically limited by recruitment levels rather than habitat shortages. Seismic surveys will not damage habitat given the is no interaction with the seabed proposed by this activity.

4.5 Consideration of Predictive Uncertainty

In any environmental impact assessment process, predictive uncertainty plays a pivotal role in shaping our understanding and management of potential impacts. This section delves into the complexities and inherent uncertainties associated with predicting environmental effects on sensitive marine species and habitats.

It outlines our methodologies for quantifying and managing these uncertainties, emphasising the limitations of current predictive models. By transparently addressing these uncertainties, we aim to enhance the robustness of our environmental assessments and decision-making processes, ensuring a responsible and adaptive approach to environmental management.

Each impact analysis (Appendix E1 – E10) explicitly considered the levels of uncertainty in our predictions of impact in accordance with the process outlined in Appendix B9. Through this consideration it has been possible to identify areas where uncertainty is highest, or confidence in the predictions is low. In such circumstances there has been a further consideration of whether the uncertainty levels can be reduced prior to the proposed commencement of the activity, during the activity, of afterward.

Application of the precautionary principle is required when there are threats of serious or irreversible environmental damage and a lack of full scientific certainty. There are examples in the analysis where a lack of full scientific uncertainty was identified, however, there were no instances where threats to environmental values and sensitivities were serious or irreversible. Despite this CGG routinely applied precaution in its assessment as such selecting conservative effect thresholds for sound, adjusting the activity design to avoid overlap with sensitive species protected areas (e.g. KEFs), and buffers around marine protected areas. A full assessment of CGG's application of the precautionary principles can be found in Appendix F4.

Ultimately, the Implementation Strategy in Appendix B3 is how all uncertainties are managed adaptively. Appendix B3 discusses various parts of the environmental management system that facilitate adaptive management strategies to ensure there is a dynamic approach to manage and mitigate environmental impacts and risks effectively. Adaptive management is pivotal in this context, allowing for flexible responses to changes and uncertainties identified during the survey. It involves continuous monitoring, evaluation, and modification of management strategies based on real-time data and feedback.

5 Conclusion

The findings of this report show that CGG will be able to carry out the Regia MSS in a manner by which the environmental impacts and risks of the activity will be of an acceptable level.

The environmental assessment method (Appendix B9) is a clear, systematic, defensible, and reproducible process for demonstrating how environmental impacts and risks will be of an acceptable level. It is supplemented with clear decision-making criteria (Appendix B1) that have been applied to the process of analysing and evaluating impacts and risks in the context of how they comply or align with relevant internal and external policy settings, and information received during relevant persons consultation. Relevant legislative requirements including but not limited to applicable plans of management, recovery plans, conservation advice and other guidance for matters protected under the EPBC Act, and the principles of ecologically sustainable development as defined under the EPBC Act, have been properly considered.

The process applied in the environmental assessments and in this document for demonstrating that impacts and risks will be of an acceptable level is commensurate with the nature and scale of the activity and the severity of its impacts and risks because the EP has:

- Applied a process that has driven CGG to apply more effort and rigour to evaluations where there is a higher degree of scientific uncertainty in predictions of impacts and risks and/or severity of potential consequence of impacts and risks.
- Includes appropriate and accurate content to demonstrate that the proposed activity is not inconsistent with a recovery plan or a threat abatement plan for a listed threatened species or ecological community.
- Appropriately identified, acknowledged, and addressed areas of uncertainty in predictions of impact and risk.
- Adopted a precautionary approach (e.g. conservative 'worst-case' approach) for those impacts and risks involving greater uncertainty including but not limited to additional assessment of Key Environmental Matters.
- Provided reasoned conclusions that impacts and risks will be acceptable or managed to acceptable levels with the implementation of suitable control measures to either reduce the consequence/severity or likelihood of environmental impacts and risks.
- Regard for relevant scientific papers, recovery plans for listed threatened species and good practice guidance for the management of impacts and risks when making the case that impacts and risks will be managed to acceptable levels.

The EP has provided further assessment of all environmental impacts and risks of the activity to threatened and migratory whales to show that they will be of an acceptable level because the EP is not inconsistent with the Conservation Management Plans for the Blue Whale and Southern Right Whale. In making this conclusion, CGG has:

- Had regard to the Guidance on Key Terms within the Blue Whale Conservation Management Plan (2021) and Blue Whale Conservation Management Plan – FAQs published by NOPSEMA, Department of Sustainability, Environment, Water, Population and Communities, Marine Bioregional Plan for the North-west Marine Region, Department of the Environment, Water, Heritage and the Arts, EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales: Industry Guidelines (September 2008).
- Adopted all Part A management measures as described in Policy Statement 2.1, as well as adoption of additional Part B measures, which reflected a precautionary approach to managing the risks and impacts of the activity.
- Set an acceptable level of impact for underwater noise impacts on whales which is compared to the predicted level of impact, derived from comparing noise modelling studies with published studies on the distribution and abundance patterns of whales to demonstrate that the environmental impacts of the activity will be managed to an acceptable level.

- Undertaken noise modelling studies, including ANIMAT modelling for southern right whales and blue whales (Appendix B7), which is based on appropriate and representative inputs in relation to the seismic sound source and blue whale movement patterns, and provides realistic effect ranges for mobile marine fauna such as blue whales.
- Examined concerns raised during the consultations about the ANIMAT modelling not being a suitable foundation for the environmental impact assessment of underwater noise impacts on whales and that, as a result, impacts may exceed the acceptable level of impact. After examination of these claims by various experts CGG determined that the inputs and methods of the ANIMAT modelling were suitably conservative and representative to inform the evaluation of impacts. In addition, the commitment to an effective range of control measures (see below) adds an additional level of conservatism that will ensure impacts are managed to an acceptable level.
- Areas of uncertainty in predictions which are addressed by the control measures, including a commitment to cease acoustic emissions immediately if a southern right whale/blue whale (or possible southern right whale/possible blue whale) is detected within detectable distances (these distances are extended beyond the distance at which noise can exceed thresholds known to cause behavioural disturbances.
- Evaluated and accepted the addition of a spotter vessel with trained and experienced MFOs to extend the range of observation and provide an additional independent observation line of evidence.
- Considered responses received from relevant persons in relation to effectiveness of MFO and PAM operators and concluded, CGG will include an additional MFO / PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage. In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be always onboard a dedicated spotter vessel. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals. [Paragraph updated in response to Matters: M43, M45 and M49].
- The method applied to demonstrate that the environmental impacts and risks of the activity from acoustic emissions to threatened and migratory whales is based on:
  - a description of whale distribution, abundance, and behaviour in the ensonified area.
  - contemporary science on effects of noise on whales, source, and location specific acoustic modelling.
  - Policy Statement 2.1 control measures as well as consideration of other commonly used and known control measures for whale detection and mitigation and so is systematic, defensible, and reproducible.
- Considered the potential for permanent and temporary threshold shifts in hearing, behavioural disturbance, and masking due to underwater noise exposure and any subsequent potential impact to individual fitness and population viability. The evaluation for this topic is more detailed than for other environment receptors and so is commensurate to the predicted magnitude of impacts and risks to listed threatened and migratory whale species that may be encountered.
- Evaluated the potential impacts to planktonic food sources and potential foraging activity of pygmy blue whales within their distribution range and excluded likely areas of higher densities of food sources along the canyon structures inclusive of the West Tasmanian Canyons Key Ecological Feature and other canyon structures deeper than 400m in Victorian waters. As such, there is limited potential for impacts to biologically important behaviours of pygmy blue whales.
- Addressed impacts and risks from underwater noise to baleen and odontocete whales, including both mid-high frequency cetaceans and low frequency cetaceans. It details the modelling which predicts that noise levels associated with Permanent Threshold Shift (PTS) and Temporary Threshold Shifts (TTS) in hearing will not be exceeded, or the range to

exceedance will be limited to the immediate proximity of the seismic source therefore indicating that shutdown zones of 2 km will be effective in mitigating auditory injury.

- Adopted world leading detection and mitigation measures including:
  - Pre-start surveys.
  - Extended shutdown zones for the seismic source.
  - The use of qualified and experienced MFOs.
  - The deployment of in-water real-time vocalisation detection technologies to improve efficacy of protection measures at night-time and in periods of low visibility.
  - Passive acoustic monitoring operations and operators to improve the efficacy of whale detection to inform management responses.
  - Use of a spotter aircraft to extend the observation distance for whales to greater than the distance for predicted behavioural disturbance.
- Considered responses received from relevant persons in relation to impacts to threatened and migratory whales have been incorporated into the EP, CGG has considered and addressed these responses, which included objections and claims related to the impact assessment of zooplankton as a source of food for pygmy blue whales, noise impacts on whales including hearing injury, behavioural disturbance and masking, concerns about the accuracy of the underwater acoustic modelling and access to supporting literature used in the evaluation, and that the EP demonstrates that the environmental impacts and risks of the activity to the threatened and migratory whales will be of an acceptable level.
- Comprehensively assessed that anthropogenic noise from the activity will be managed such that any blue whale can continue to utilise biologically important areas without injury and biologically important behaviour can continue and as a result the activity can be managed in a manner that is not inconsistent with the Conservation Management Plan for the Blue Whale.
- Consistent with the Conservation Management Plan for the Southern Right Whale 2011-2021, sought to improve the understanding of what impact anthropogenic noise may have on southern right whale populations by:
  - Assessing anthropogenic noise in key calving areas.
  - Assessing responses of southern right whales to anthropogenic noise.
  - Developed further mitigation measures for noise impacts beyond Policy Statement 2.1.
- Consistent with the Draft National Recovery Plan for the Southern Right Whale:
  - Assessed according to principles of ecological sustainable development to ensure the risk of injury and/or disturbance to Southern Right Whales is minimised.
  - Baseline surveys and monitoring undertaken during activity implementation are conducted in accordance with best practice standards and guidelines to ensure standardised datasets are obtained and suitable to inform environmental management decision making that can reduce the risk of threats to Southern Right Whales.
  - Used current information on species' occurrence, particularly in HCTS, BIAs, and historic high use areas, to inform planning, assessment, and decision-making on marine infrastructure development actions.

Our exhaustive environmental assessments, rigorous impact and risk analyses, and extensive consultations have collectively ensured that all impacts and risks from the activity will remain below an acceptable level. Furthermore, our robust adaptive management approaches provide a structured approach for effectively handling any uncertainties, guaranteeing a dynamic and responsive strategy to environmental stewardship.

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7 Revision History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	2 October 2023	MS	Table of contents established and commenced evaluation.
0.1	6 December 2023	MS/AH/SJ/CT	Concluded demonstration of whether environmental impacts and risks from the Regia MSS were of an acceptable level.
0.2	20 December 2023	MS	Review and update following comments.
1	5 January 2023	MS	Formatting complete and published for public comment.
2	15 May 2024	MS	Review and update following public comment

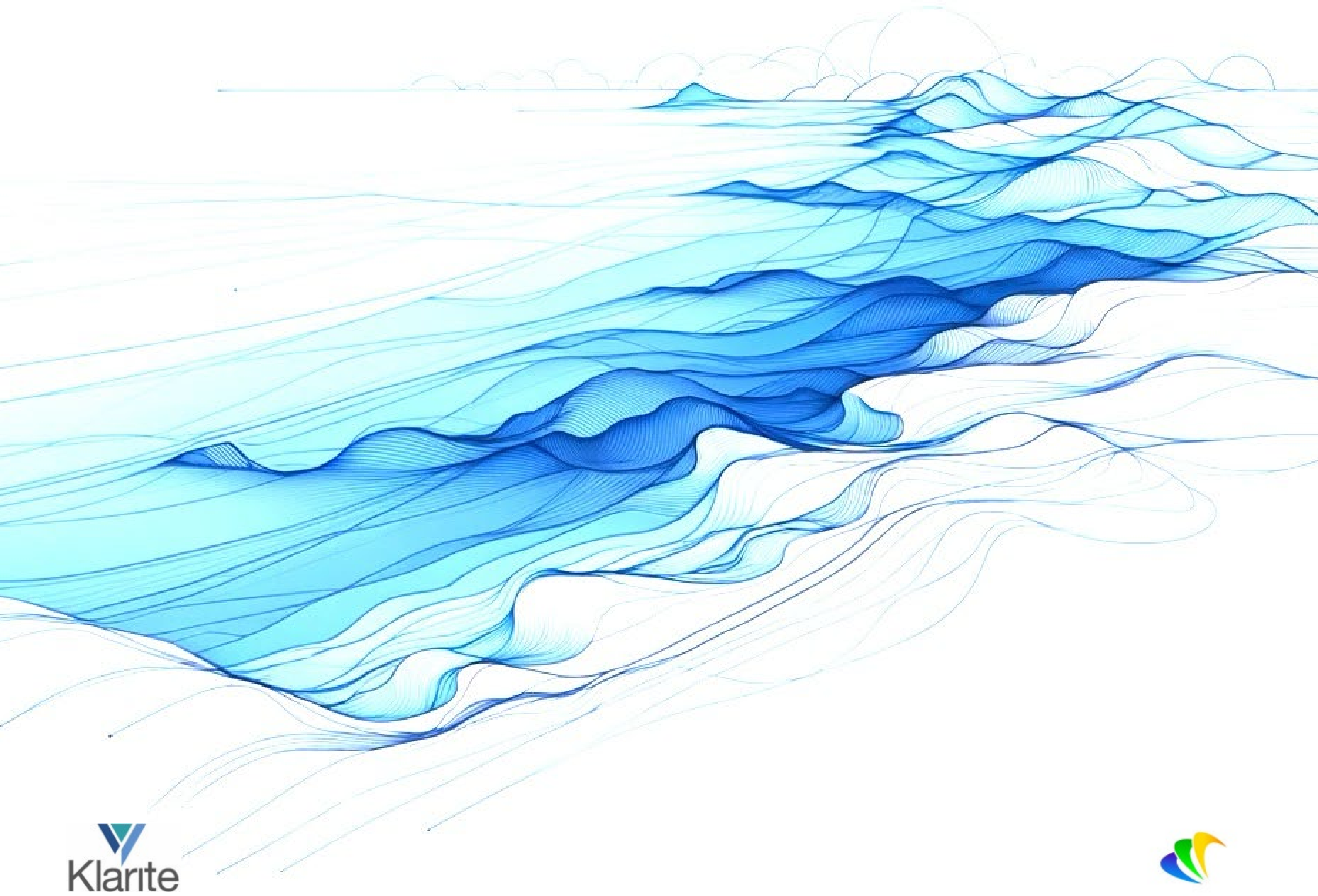
REGIA
Marine Seismic Survey

Assessment of Consistency with the Principles of Ecologically Sustainable Development

Appendix F4: REG-EP-033-F4

Rev 2

May 2024



Executive Summary

This assessment of consistency with the principles of Ecologically Sustainable Development (**ESD**) for the Regia Marine Seismic Survey (**Regia MSS**) petroleum activity provides a comprehensive overview of the project's alignment with key principles of ESD. In summary:

- **Precautionary Principle:** The Regia MSS project demonstrates its adherence to the precautionary principle by taking proactive measures to mitigate environmental harm despite scientific uncertainties. This includes robust monitoring and evaluation strategies, flexible mitigation approaches, and the implementation of safeguards to ensure environmental impacts, especially underwater sound emissions, remain within acceptable levels.
- **Intergenerational Equity Principle:** The project recognizes the marine environment as a shared resource, emphasizing the responsibility to conserve it for future generations. It adopts long-term perspectives in decision-making, implements safeguards to protect environmental health, and engages in comprehensive assessments to avoid irreversible ecological harm.
- **Conservation of Biological Diversity and Ecological Integrity Principle:** The project exhibits a strong commitment to preserving marine biodiversity and ecological integrity. This includes changing operational timings to minimize biodiversity impact, identifying and protecting critical habitats, implementing mitigation measures for sensitive areas, and engaging with experts in marine biology and ecology.
- **Valuation, Pricing, and Incentives Principle:** While less central in the Regia MSS context, the project indirectly contributes to this principle. It acknowledges the importance of identifying gas reserves for future resource valuation and incorporates a compensation protocol for unavoidable interference with commercial activities.
- **Integration Principle:** The Regia MSS project integrates economic, environmental, and social considerations in its decision-making processes. It involves thorough impact assessments, engages with diverse stakeholders, evaluates alternatives for the seismic survey, and maintains transparency and accountability in its reporting.

The conclusion of the assessment for the Regia MSS EP preparation process emphasizes a strong commitment to responsible and sustainable offshore petroleum activities in Australian waters. It underlines the adherence to ESD principles, highlighting the integration of economic, social, and environmental considerations in decision-making processes. The process aligns with key principles like the precautionary approach, intergenerational equity, and conservation of biological diversity. Although the valuation pricing and incentives principle has reduced relevance, there is a focus on protecting natural and human capital, ensuring that costs are adequately considered.

Table of Contents

1 Introduction

The principles of Ecologically Sustainable Development (**ESD**) play in important role in responsible decision-making. ESD encompasses the integration of economic, social, and environmental considerations in pursuit of a shared goal: meeting the needs of the present without compromising the ability of future generations to meet their own needs. Although ESD lacks a precise accepted definition, it is generally recognised as an important concept as it ensures environmental factors and future generations are considered in assessing a current development, in this case the Regia Marine Seismic Survey (**Regia MSS**).

Readers of this document are encouraged to have read and understood the following documents at a minimum which provide important context to this assessment and underpinning evidence.

1. Description of the Activity (Appendix A2)
2. Decision-Making Criteria (Appendix B1)
3. Environmental Assessment Process (Appendix B9)
4. The Environment Plan (Appendix F1)
5. The Environmental Performance Report (Appendix F4)

The remaining documents that make up the Regia MSS Environment Plan (**EP**) also provide context to this assessment.

2 Relevant Person Consultation

The following feedback was received during the preparation of the EP and has been used to inform this assessment and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited and *Table F4-1 Summary of relevant person input into the ESD.*shows how this feedback has been incorporated into the environmental assessments.

Table F4-1 Summary of relevant person input into the ESD.

Objections and Claims	Feedback ID	Measure adopted because of consultation
An objection raised by a member of the public regarding consideration of the protection the environment for future generations.	210	CGG undertook a more detailed assessment of ecologically sustainable development and an assessment of the application of the principle of intergenerational equity.
Requested a more detailed analysis of how the EP preparation process has considered the principles of ESD, particularly the precautionary principle holistically.	281	Request is a reasonable request as the feedback that completing these assessments aspect-by-aspect doesn't give this person the whole picture. Complete further assessment of the consistency with the principles of ESD (this document).

3 Purpose and Scope

This document has been prepared prior to first submission of the EP, and retrospectively assesses the Regia MSS EP preparation process, through the lens of ESD, to demonstrate how this project has been developed consistently with the principles of ESD.

Through this comprehensive analysis, CGG Geophysical Services Pty Ltd (**CGG**) seek to identify the extent to which the Regia MSS project, and CGG, upholds the principles of ESD. This document may be updated during the assessment process if required.

A further purpose of this document is to demonstrate compliance with relevant plans of management and other EPBC Act instruments, most relevantly:

- the mandated action within the Southern Right Whale draft National Recovery Plan which seeks to ensure that coastal and offshore development actions are assessed according to principles of ecological sustainable development to ensure the risk of injury and/or disturbance to Southern Right Whales is minimised.

4 The Activity

This assessment is of the Regia MSS petroleum activity. The Regia MSS is a propose three-dimensional marine seismic survey in the Otway Basin, in Commonwealth waters offshore from Victoria. The activity aims to gather data on the structure and composition of geological formations for the purpose of identifying petroleum resources. The full description of the activity can be found in Appendix A2 which was used as the basis of this assessment.

5 Legislative Background

Within the framework of offshore petroleum activities in Australian waters, a fundamental legal requirement takes precedence, namely, the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations (**the Regulations**).

The Regulations have an objective of ensuring the protection of the marine environment, while simultaneously considering economic interests. A key provision within the Regulations mandates that all petroleum activities must be carried out consistent with the principles of ESD.

This statutory obligation serves as a clear directive to CGG, emphasising the need to not only pursue economic gains but to do so while ensuring the preservation of ecological integrity, societal well-being, and long-term ecological stability. It underscores Australia's commitment to effectively harmonize the facets of development, conservation, and inter-generational equity in the realm of offshore petroleum operations.

6 Principles of Ecologically Sustainable Development

ESD is a foundational concept in environmental decision-making and management, with its principles deeply rooted in international agreements and enshrined in Australian legislation. The core tenet of ESD is to ensure that the needs of the present generation are met without compromising the ability of future generations to meet their own needs. Several key principles guide the application of ESD:

1. **Precautionary Principle:** In cases where there are threats of serious or irreversible environmental damage, a lack of full scientific certainty should not delay measures to prevent environmental degradation. This principle acknowledges the inherent limitations of scientific knowledge and encourages a proactive approach to environmental protection.
2. **Inter-generational Equity:** ESD mandates that the current generation acts as stewards of the environment, maintaining or enhancing its health, diversity, and productivity for the benefit of future generations. It underscores the moral obligation to preserve the planet's natural wealth for those to come.
3. **Conservation of Biological Diversity and Ecological Integrity:** Biodiversity, including ecosystem, species, and genetic diversity, forms the foundation of social and economic

systems. The conservation of biological diversity and ecological integrity should be fundamental considerations in all environmental planning and decision-making processes.

4. **Valuation, Pricing, and Incentives:** Environmental factors should be included in the valuation of assets and services. The "polluter pays" principle holds that those responsible for pollution should bear the costs of containment, avoidance, or abatement. Pricing should reflect the full life cycle of costs, including natural resource use and waste disposal. Moreover, environmental goals should be pursued through cost-effective incentive structures and market mechanisms.
5. **Integration of Considerations:** ESD emphasizes the effective integration of social, economic, environmental, and equitable considerations in decision-making processes. It recognizes that decisions must balance both short-term and long-term perspectives.

These principles are integral to Australia's environmental legislation, including the federal Environment Protection and Biodiversity Conservation Act 1999 (**EPBC Act**). They guide the evaluation of projects, ensuring that they align with the principles of ESD, protect biodiversity, and promote sustainable development. Consistent adherence to these principles is essential for responsible and sustainable environmental management in Australia. There follows and assessment of each principle of ESD having regard to the Regia MSS and the preparation process of the EP.

6.1 Precautionary Principle

The precautionary principle is an approach in environmental management that suggests taking proactive action to prevent harm to the environment when there is scientific uncertainty about potential negative impacts. It is often invoked as a guiding principle in decision-making processes for various activities that have the potential to affect the environment adversely. However, the application of this principle is not always straightforward or appropriate, particularly when considering the impacts of a single activity within a larger environmental context.

Consider, for instance, the case of a minor activity whose potential impact on marine biodiversity is not fully understood. The principle might dictate that in the absence of clear evidence of harmlessness, action should be taken to prevent the activity or mitigate its potential impacts. However, when the levels of natural variation in the marine environment are demonstrably high—such as variations in salinity, temperature, and currents that can have significant effects on marine life—the effects of a single, limited-duration activity may be demonstrably low, even when the uncertainties are factored in.

In such scenarios, the baseline environmental variability can often dwarf the impact of a single activity. For example, the migration patterns and breeding cycles of marine life may be subject to greater influence from natural seasonal changes than from the noise generated by a seismic survey. The introduction of noise into the marine environment from a survey may be a minor addition to the existing soundscape, which includes not only anthropogenic sources like shipping traffic but also natural sources like storms or the vocalizations of marine animals.

In this context, it is essential to consider the proportionality aspect of the precautionary principle. The principle should not be applied in isolation but rather in consideration of the relative scale of impact. If the contribution of an activity to the overall environmental impact or risk is minimal and the natural resilience and variability of the ecosystem are high, the application of the precautionary principle may not be warranted. This is particularly relevant when there is an absence of significant threat or when the threat is negligible compared to the baseline environmental variability.

The principle is most relevant when there is a possibility of serious or irreversible damage, and the activity in question contributes significantly to that impact level. When the activity's impact is minimal and the environmental system exhibits high levels of inherent variability, applying the precautionary principle without the context of the significance of the harm would be disproportionate and could potentially divert resources from addressing more significant environmental threats.

Thus, the application of the precautionary principle should be calibrated to the scale and significance of potential impacts in relation to the broader environmental context. This ensures that environmental management remains focused on significant threats and does not become an impediment to activities with lower order impacts, especially when these activities are conducted responsibly.

The Regia MSS EP preparation process is consistent with the Precautionary Principle because:

1. The EP preparation process recognised the presence of environmental impacts and risks associated with the activity, particularly in terms of underwater sound impacts, atmospheric emissions, and accidental fuel releases. It acknowledged that these impacts and risks, if unmitigated, could lead to serious or irreversible environmental harm.
2. In response to the identified impacts and risks, the process took proactive measures to minimise and mitigate potential harm. It did not rely solely on full scientific certainty before acting but instead acted in anticipation of possible adverse effects.
3. The EP preparation process resulted in the implementation of robust monitoring and evaluation strategies (Appendix B3). It recognised that ongoing assessment and monitoring were essential to detect any unforeseen impacts or changes in environmental conditions promptly.
4. Acknowledging the uncertainty surrounding certain impacts and risks, the process kept flexibility in its mitigation strategies. It is shown through evolution of the activity design and through the consultation process that CGG was prepared to adapt and adjust its survey objectives and proposed mitigation measures based on emerging information and changing circumstances.
5. The process implemented a range of safeguards and best practices to ensure that environmental impacts and risks, particularly underwater sound emissions, were kept within acceptable levels of impact and risk. It recognised that taking precautionary steps was appropriate in preventing potential harm to marine ecosystems and species.
6. The EP preparation process engaged with scientific experts and researchers to assess environmental impacts and risks. It sought advice from specialists who could provide insights into the best available science and mitigation technologies related to the project's environmental aspects (Appendices B4, B5, B6, B7, B8, and F5).
7. To uphold the Precautionary Principle, the process kept transparency in its decision-making and reporting. It ensured that relevant persons, regulatory authorities, and the public were informed about the identified impacts and risks (Appendix B4), the measures taken (Appendix G1), and any updates regarding the project's environmental impact.
8. In line with the Precautionary Principle, the EP preparation process prioritised the prevention of irreversible harm to the marine environment. It recognised that some environmental damage, once done, might be impossible to reverse or remedy, and therefore acted prudently to avoid such scenarios.

In summary, the Regia MSS EP preparation process aligned with the Precautionary Principle by acknowledging the presence of environmental impacts and risks associated with the proposed activity. CGG has proactively taken steps to prevent harm, monitor environmental conditions, and remaining flexible in its approach. It prioritized the protection of the marine environment whilst meeting enough of the original geophysical objectives to ensure a viable project. CGG has acted to appropriately to avoid serious or irreversible environmental damage, even in the face of scientific uncertainty.

6.2 Intergenerational Equity Principle

The Regia MSS Environment Plan (EP) preparation process adhered to the Inter-generational Equity Principle through the key actions and considerations described below:

1. The process acknowledged that the marine environment, including its ecological and biological diversity, is a shared resource. It recognised the responsibility to manage and conserve these resources for the benefit of both present and future generations (Appendix B1).
2. During its decision-making and planning, a long-term perspective was adopted, ensuring that actions taken today would not compromise the ability of future generations to enjoy the same environmental benefits. It considered the consequences of activities on a multi-generational timescale (Appendix B1, Table B1-2 – Defined Acceptable Levels of Impact and Risk).

3. To protect the health, diversity, and productivity of the marine environment, the process implemented a range of safeguards and mitigation measures (Appendix G1). These measures were designed to minimise negative impacts of the Regia MSS on the environment, ensuring that it will remain intact and functional for future generations.
4. The EP preparation process engaged with scientific experts and conducted comprehensive assessments to understand associated environmental impacts (Appendices B4, and E1 to E10) and environmental risks (Appendices B4, and D1 to D4). The EP provided robust scientific evidence, essential for informed decision-making to safeguard the environment for generations to come.
5. Consistent with inter-generational equity, the process prioritised identifying and preventing irreversible environmental damage. CGG understood that once certain ecological harm occurred, it might be impossible to rectify or restore, disproportionately affecting future generations. Consequently, there is no irreversible environmental damage predicted from the Regia MSS.
6. The process actively consulted with indigenous communities, other marine users, policy and regulatory authorities, and the public, regarding environmental values and sensitivities and protection measures. CGG put no restrictions on who could self-identify as a relevant person recognising that the voices and perspectives of current and future generations needed to be heard and considered in shaping the EP.
7. The process kept transparency in its actions, decisions, and reporting, demonstrating accountability to current and future generations. The EP documents CGG's commitment to preserving environmental values and ensuring that actions taken today will benefit those who come after.
8. Recognising that unforeseen circumstances and new information might emerge over time, the process incorporates a mean of adapting to changing circumstances in its environmental management system (Appendix B3). This approach allows for the ongoing adjustment of strategies and actions to align with the evolving understanding of environmental impacts.
9. The process implemented mitigation strategies to minimise the environmental footprint of the Regia MSS. It actively sought ways to reduce ecological harm, particularly in sensitive areas and habitats, with a view to preserving these areas for the enjoyment of future generations.

In conclusion, the Regia MSS EP preparation process prioritised responsible management and ecological conservation, demonstrating commitment to the Inter-generational Equity Principle by safeguarding the marine environment, actively engaging with the community, and ensuring that actions taken today promote the well-being and environmental quality of future generations.

6.3 Conservation of Biological Diversity and Ecological Integrity Principle

Ecological integrity refers to the ability of an ecosystem to maintain its structure, functions, and processes, including its biodiversity, dynamics, and resilience. It is important in environmental assessments because it is crucial to understand how proposed activities might affect the natural balance and health of ecosystems. The Regia MSS EP preparation process consistently upheld the Conservation of Biological Diversity and Ecological Integrity Principle through various actions and considerations as described below:

1. Throughout the EP preparation process, there was a clear commitment to preserving the biodiversity of the marine environment. This included changing the economically preferred timing of the activity to move to a time of the year when biodiversity will be lower (Appendix A2 and Appendix F1, Section 6.1 – Survey Timing Constraints). The process recognised the intrinsic value of diverse ecosystems and species, understanding that they contribute to ecological integrity and overall environmental health.
2. Detailed ecological assessments and studies were conducted to evaluate the impacts of the activity on marine biodiversity. These assessments aimed to identify sensitive habitats, critical species, and potential threats to ecological integrity (Appendices D1 – D4 and E1 – E10).
3. The process incorporated protection measures to safeguard key biological diversity and maintain ecological integrity. These measures included activity limitations (Appendix A2) and

control measures (Appendix G1) designed to minimize any disturbances to marine habitats, breeding grounds, and migratory routes of sensitive species. Further commitments have been made to the protection of cultural heritage and other key receptors.

4. Areas of high ecological significance, including critical habitats and migration corridors, were identified and marked for additional attention. The process recognized the importance of these areas in maintaining ecological integrity and prioritised their protection. Further scientifically justified impact management zones were adopted because of consultation and to eliminate scientific uncertainty.
5. To mitigate potential harm to biodiversity, the process implemented a range of mitigation measures (Appendices A2 and G1). These measures aimed to reduce the footprint of the seismic survey in sensitive zones, minimise disruption to marine life, and prevent significant adverse effects on species and ecosystems.
6. The process engaged with experts in marine biology, ecology, and conservation to inform decision-making. This collaboration ensured that the EP's provisions were aligned with the best available scientific knowledge regarding biodiversity and ecological integrity.
7. The process sought to avoid activities that could harm biological diversity and ecological integrity wherever possible. This included planning the survey timing, sail lines and other operations to avoid critical areas and sensitive habitats.
8. Acknowledging the dynamic nature of ecosystems, the process incorporated an adaptive management approach to both the management of the activity holistically and to key receptors. This approach will allow for real-time adjustments during the survey to respond to unexpected ecological conditions and ensure minimal disruption to biodiversity.
9. Comprehensive monitoring and reporting systems have been put in place to assess the survey's impact on biological diversity and ecological integrity. This data-driven approach will track changes, identify potential issues, and support the implementation of corrective actions as needed.
10. The process engaged with relevant authorities and environmental agencies to align its efforts with broader conservation goals and regulations aimed at preserving biodiversity and ecological integrity.

In conclusion, the Regia MSS EP preparation process demonstrated a strong commitment to the Conservation of Biological Diversity and Ecological Integrity Principle. It proactively addressed potential impacts on marine biodiversity, incorporated protective measures, and relied on scientific expertise to ensure that the seismic survey is conducted with minimal harm to ecosystems, species, and overall ecological health.

6.4 Valuation, Pricing, and Incentives Principle

The Valuation, Pricing, and Incentives Principle has reduced relevance within the context of the Regia MSS EP preparation process. However, it is important to emphasise that the process remains consistent with this principle, albeit to a lesser degree because of the nature of the activity. Several factors contribute to this alignment:

- The primary goal of the Regia MSS project is to identify gas reserves beneath the seabed. While the immediate emphasis is on scientific exploration rather than commercial exploitation, the project's success in locating potential gas reserves is inherently linked to the future valuation and pricing of these resources. Thus, the EP preparation process indirectly contributes to the long-term considerations associated with this principle.
- The Regia MSS project acknowledges the importance of inter-generational equity, recognising that present actions must consider the well-being of future generations. By responsibly exploring and identifying potential gas reserves, the EP preparation process ensures that future generations can make informed decisions regarding the utilisation of these resources. This aligns with the principle's objective of protecting natural and human capital for the benefit of future generations.
- The project's commitment to ecological sustainability and environmental protection indirectly addresses the Valuation, Pricing, and Incentives Principle. By safeguarding the

marine environment and adhering to precautionary measures, the EP preparation process contributes to maintaining the natural capital that underpins any future valuation or pricing of ecosystem services.

- In cases where the Regia MSS project may unavoidably interfere with commercial fishing activities, it incorporates a compensation protocol. This protocol ensures that any potential financial impacts on fishing communities are addressed through calculated and negotiated agreements. While not directly related to traditional pricing mechanisms, it reflects a commitment to fair compensation and social considerations.

In summary, while the Valuation, Pricing, and Incentives Principle may hold reduced relevance in the specific context of the Regia MSS EP preparation process, the approach taken is consistent with the principle to the extent possible. The focus on responsible exploration, inter-generational equity, environmental stewardship, and fair compensation aligns with the broader goals of ensuring that ecological and social values are adequately considered, even though immediate valuation and pricing mechanisms are not central to the project's current phase.

6.5 Integration Principle

The Regia MSS EP preparation process demonstrates consistency with the Integration Principle of ESD as described below:

1. The Regia MSS EP preparation process included a thorough impact assessment considering economic, environmental, and social impacts. It identified and assessed potential positive and negative consequences of the seismic survey on these dimensions, ensuring that decision-makers had a comprehensive understanding of the project's implications.
2. The EP preparation process actively engaged with relevant persons, including indigenous communities, environmental organizations, and local communities. It sought their input and considered diverse perspectives, ensuring that relevant persons were given the opportunity to have their say in the decision-making process, and their concerns were considered.
3. In cases where uncertainties or risks were identified regarding potential environmental harm, the Regia MSS EP preparation process adopted a precautionary approach. It took proactive measures to prevent harm, even in the absence of full scientific certainty, aligning with the precautionary principle.
4. The process assessed how the seismic survey impacted future generations. It ensured that the decisions made did not compromise the ability of future generations to meet their needs and enjoy a healthy marine environment.
5. The EP preparation process integrated the conservation of biological diversity and ecological integrity into decision-making. It involved detailed environmental assessments and implemented measures to protect biodiversity within the operational area.
6. Environmental and social factors were incorporated into economic analyses. The process considered the costs and benefits of the seismic survey, considering its impact on the environment and society, thus fulfilling economic integration (Appendix F2).
7. The EP preparation process maintained clear documentation of the decision-making process. It transparently outlined how economic, environmental, social, and equitable considerations were integrated into the planning and execution of the Regia MSS, ensuring transparency and accountability. This was primarily achieved by using the Environmental Assessment Method (Appendix B9) and the Decision-Making Criteria (Appendix B1).
8. Mechanisms for ongoing review and monitoring of the seismic survey decisions were established in the Implementation Strategy (Appendix B3). This ensures the project will continue to align with ESD principles, with adjustments made as new information becomes available or circumstances change.
9. The process provided transparent and comprehensive reporting on how economic, environmental, social, and equitable considerations were integrated into the decision-making process. This information was shared with relevant persons through the Regia MSS website to uphold transparency and foster trust.

By addressing these aspects, the Regia MSS EP preparation process has demonstrated its commitment to and consistency with the Integration Principle of ESD. This approach ensured that the seismic survey will be conducted in a manner that balances economic, environmental, and social factors, ultimately contributing to ecologically sustainable development.

7 Conclusion

In conclusion, the assessment of the Regia MSS EP preparation process against the principles of ESD reveals a demonstrate a strong commitment to responsible and sustainable offshore petroleum activities in Australian waters. The adherence to ESD principles, as enshrined in the Regulations, underscores the importance of integrating economic, social, and environmental considerations into the decision-making processes surrounding petroleum operations.

Throughout this assessment, it becomes evident that the Regia MSS EP preparation process aligns with these principles. From the precautionary approach to intergenerational equity and the conservation of biological diversity, the EP process consistently reflected a commitment to safeguarding the marine environment, reducing environmental impacts and risks, and preserving the interests of future generations. While the valuation, pricing, and incentives principle may have reduced relevance within this context, the focus remains on ensuring that the cost of protecting natural and human capital is adequately considered.

8 Document Control

Table F4-2 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	2 October 2023	MS	Assessment completed.
0.1	20 December 2023	RH/CT	Reviewed and updated.
0.2	29 December	MS	Reviewed and updated.
1	4 January 2024	MS	Accepted changes and formatted ready for public comment.
2	**15 May 2024**	**MS**	**Updated following public comment.**

Desktop Study: An Assessment of Available Whale Detection Technologies as Additional Management Procedures for the Regia 3D Marine Seismic Survey

Paul Miller

Millodon Consulting

Revision A

Contents

Acknowledgements

The author gratefully acknowledges the assistance of each of the equipment vendors that provided detailed information relating to their individual equipment offerings. This report has been compiled directly from many web-based sources, including government, research organisations, private enterprise, equipment manufacturers and vendors plus AI-based search research results. The views and opinions expressed in this document, based on the research conducted, are those of the author and do not necessarily reflect the views of the Regia 3D MSS survey proponents or its sponsors.

A list of most (but not all) of the sources of data used can be found in the References section at the end of this document.

Introduction

Klarite Pty Ltd (Klarite), on behalf of CGG Australia (CGG), has commissioned Millodon Consulting (Millodon) to conduct a desktop study on the available technologies, both current and in development stages, of systems designed to detect and alert the presence of marine mammals to aid in mitigation measures during seismic surveys.

CGG is planning a 3-Dimensional Marine Seismic Survey (3D MSS) offshore Victoria, to be conducted sometime during 2024. As part of the environmental management planning for the survey CGG is seeking to identify, procure and eventually deploy, suitable systems to mitigate interactions with Species of National Environmental Significance (SNES), with a particular focus on the Blue and Southern Right Whales, known to frequent the survey operational area at certain times of the year, or potentially even all year round.

The systems included within this study are being reviewed for suitability and practicality for consideration as Additional Management Procedures, in addition to those already defined and mandated in the Environment Protection and Biodiversity Conservation (EPBC) Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales. Additional Management Procedures are required in Australian waters where there is a moderate to high likelihood of encountering whales.

This study is not intended to be a full and thorough description of each system's operational or technical intricacies. Where available, URL links will be included to manufacturer's own web-based literature to better cover those subjects. The study is designed to help inform CGG on the most practical system, or combination of systems, to best reduce the risk of marine mammal interactions to as low as reasonably practicable (ALARP), based on information available in the public domain.

Assessment Summary

Millodon Consulting reviewed a range of different technologies for marine mammal detection that are either currently available or in advanced stages of development. Where there are multiple vendors for similar technologies each vendor's equipment was assessed independently.

Detection Technologies Considered

The range of technologies considered for review consisted of the following: -

1. Passive Acoustic Monitoring (PAM)
   a. Towed streamer PAM
   b. Supplementary vessel towed PAM
   c. Fixed/tethered PAM buoys
   d. Unmanned/Uncrewed Surface Vessels (USV)
   e. Unmanned/Autonomous Underwater Vessels (UUV/AUV)
   f. Distributed Acoustic Sensors (fibre optic)
2. Satellite imagery
3. Aerial surveys
   a. Manned Aircraft
   b. Drones
4. Camera-based monitoring systems

Assessment Criteria

Assessment of each system was based on five simple criteria: -

- Availability
- Prior deployment histories and reported effectiveness.
- Practicality of implementation
- Safety & environmental concerns
- Cost versus benefit

Assessment Results

The following list includes assessment summaries of each detection technology or methodology, as reviewed by the author. Systems have been either deemed worthy of implementation or further investigation/consideration, or rejected based on safety and environmental concerns or failing the cost versus benefit criteria.

1. Towed streamer PAM using Sercel's QuietSea in-streamer PAM hydrophones and QuietSea monitoring and automatic detection software is a proven and tested solution that will already be installed and operational on the survey vessel prior to mobilisation. It is recommended the QuietSea system be fully deployed and operational throughout the survey activity. Dedicated PAM Operator personnel, either CGG or contracted, would be considered necessary, with a minimum requirement for full-time PAM monitoring during the hours of darkness.

2. If using supplementary PAM vessel(s) the use of the Seiche towed PAM hydrophone arrays and onboard recording/analysis equipment is considered both practical and cost effective. However, the cost and associated risks of additional vessels and crew need to be considered against the potential benefits gained.

3. Tethered buoy PAM to provide real-time remote monitoring using data telemetry to an onshore or offshore monitoring hub is considered a feasible option. It would appear that the bandwidth requirements for real-time audio frequency spectral signal data via satellite is prohibitive for onshore monitoring at any significant distance offshore, but the use of VHF radio, 2.4GHz Wifi or GSM cellular phone are common options for local telemetry back to a monitoring vessel.

   All buoy-based PAM systems reviewed have the ability to operate autonomously, with real, or near real-time monitoring possible remotely from the buoy. The Sercel manufacture PAM buoy is, at time of writing, still in its late development stage but could be deployed pre-survey for sea trials and performance testing.

   Seiche Ltd has a long history of PAM equipment development and their Modular Buoy Detection System has proven offshore performance for whale detections, though their effective use during seismic surveys has yet to be confirmed by Seiche. The Jasco Ocean Observer Buoy, like the Seiche offering, is a smaller, more light weight option (45Kg) than the large and relatively heavy (220Kg) Sercel Buoys, so would be more easily deployed and recovered. The Jasco Ocean Observer Buoy is also the only unit reviewed that can perform onboard, in-situ processing of detections, with the spectrograms converted to frequency contours for transmission via satellite to the survey vessel or to a shore-based monitoring station for confirmation of detections and relaying of detection information to the survey vessel.

   If a tethered buoy PAM system is to be considered as an option for the Regia 3D survey further investigation into the telemetry ranges involved and the number of buoys needed to provide a ringfence around the active survey area to detect whales entering. The Jasco Ocean Observer Buoy would appear to have the best options available for either onshore or offshore monitoring of detections.

   It is important to note that whilst the majority of the Regia 3D active survey area, as currently mapped, is in water depths of less than 200 metres, the south western survey margin does extend beyond the continental shelf and into water depths exceeding 1300 metres, including the West Tasmania Canyons Key Ecological Feature. Whilst not impossible, the use of tethered buoys in such depths does create additional logistics problems for deployment and recovery. It may, therefore, be worthwhile considering the use of a hybrid PAM array using a combination of tethered buoys in the shallower waters and unmanned surface vessels or underwater gliders in the deeper waters, in order to provide adequate detection coverage from all directions of approach.

4. If considering a hybrid deployed remote PAM array, in order to maintain consistency in monitoring and detection software and associated systems, it would be logical to look at unmanned vessels provided by the same manufacturer/vendor as the selected tethered PAM equipment. Seiche's Autonaut USV can carry the same PAM and telemetry payload as its Modular Buoy Detection System, whilst JASCO's use of the Slocum Autonomous Underwater Glider, integrated with the OceanObserver intelligent acoustic monitoring system is another viable option.

Both vessels can maintain station, within a given radius, by circling (or traversing straight line routes) around a target location. The Autonaut, being a surface vessel, can continually transmit its current location and accept new instructions via an Iridium satellite link. Real-time detection data can be transmitted continually through RF or Wifi link, with a resultant limitation in reception range from the survey vessel monitoring equipment based on the PAM system radio transmitter's effective range.

The Slocum Glider, being an underwater vessel, can only transmit positioning and detection data during preset surfacing periods. However, the Jasco OceanObserver system installed on the glider can, in contrast to the Seiche system, transmit in-situ processed detections to any location via Iridium satellite. However, there would be a variable delay between the vocalisation detection, processing and transmission of detection data to the monitoring station, either onshore or offshore. This may affect the usefulness of any detection if the transmission delay proved to be longer than the transit time of a whale into the active survey area. In any case, the use of a hybrid remote PAM platform array can be considered a feasible option for consideration during the Regia 3D MSS.

5. For manned aerial whale detection survey flights there are several air charter services located in Warrnambool, the closest commercial airport to the Regia 3D MSS survey area. Aircraft available include small, single engine propellor planes, like the Piper Cherokee 150, turboprops like the Pilatus PC-12, up to small private jets. There are currently no designated landing points for helicopters, although the Helicopter Emergency Medical Service (HEMS 4) is based at the airport. Although manned flights for whale detections have been assessed as an option for the Regia 3D MSS, it is felt that the operational limitations, such as bad weather groundings, added safety risks and significant costs of regular sighting flights during survey operations, does not warrant further consideration.

6. Aerial surveying for visual detection of whales using suitably equipped drones is considered a more practical, safe, and cost-effective method than manned aircraft visual detection. A suitably qualified drone pilot may need to be engaged for this option, or additional pre-survey training provided to MMO personnel for the chosen drone equipment. The use of a thermal image capable drones could also provide the option for low-visibility/night flights for visual detection.

   One drone reviewed for this study, the DJI Matrice 30T, is considered a very viable option due to its advanced features, including thermal imaging, extreme optical zoom capacities (200x), laser ranging, dual control capable, weather resistance and more. With the addition of the "DJI Dock" system the drone can operate semi-autonomously, returning to the weatherproof dock to recharge batteries. The author feels this drone warrants further investigation by the Regia survey proponents as an additional whale mitigation management procedure.

7. Survey vessel mounted dual camera-based systems are also considered a viable option to be used to supplement MMO visual detections, especially during poor/night visibility periods. Again, additional MMO personnel may be required for this option to be implemented.

   Of the two systems reviewed, the Seiche Smart Visual Detection System is the more commercially developed system than Thaum's WhalePOD, but both are similar in function and features. The WhalePOD system is an Australian designed and developed unit that, at time of writing, was in the initial stages of its commercialisation phase. Initial field-testing results were positive and industry interest was reported as being high. If the WhalePOD system is a commercially available system in time for deployment on the Regia 3D MSS it would be a valuable platform for early adoption and feasibility testing for use during marine seismic surveys. Based on initial contact with Thaum's WhalePOD team, early adoption could also result in more beneficial commercial terms, making the cost versus benefit assessment a simple task.

8. The use of DAS fibre optic detection systems as a mitigation tool has been investigated and is considered impractical for use during the Regia 3D MSS. Limitations include the need to connect to existing telecommunications infrastructure, or to deploy dedicated cables on the seafloor and physically interface them to the monitoring equipment. Interfacing to existing commercial fibre optic cables is only feasible when the cable is located within proximity to the survey area and has an uninterrupted light path (no electronic repeater nodes) between the DAS control/record unit and the distributed acoustic sensors setup along the cable's length.

Background

Australian Regulatory Framework for Marine Seismic Surveys

Marine seismic surveys involve the use of sound waves to gather information about the seafloor and subsurface geology. These surveys are often conducted in offshore areas for various purposes, including oil and gas exploration, scientific research, and environmental studies. Given the potential environmental impacts of such activities, regulatory frameworks are in place to ensure that they are conducted responsibly and in compliance with relevant laws.

National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA)

In Australia, the regulation of marine seismic surveys falls primarily under the regime of the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA). NOPSEMA is Australia's independent expert regulator for health and safety, structural (well) integrity and environmental management for all offshore energy operations and greenhouse gas storage activities in Commonwealth waters, and in coastal waters where regulatory powers and functions have been conferred. NOPSEMA operates and regulates under the Australian Governments legislation and regulations.

a. **List of legislation**
    i. Public Governance, Performance and Accountability Act 2013
    ii. Offshore Petroleum and Greenhouse Gas Storage Act 2006
    iii. Offshore Petroleum and Greenhouse Gas Storage (Regulatory Levies) Act 2003
    iv. Environment Protection and Biodiversity Conservation Act 1999

b. **List of regulations**
    i. Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011
    ii. Offshore Petroleum and Greenhouse Gas (Safety) Regulations 2009
    iii. Offshore Petroleum and Greenhouse Gas (Environment) Regulations 2023
    iv. Offshore Petroleum and Greenhouse Gas (Regulatory Levies) Regulations 2022

As with any other human activity, marine seismic surveys have the potential for some level of impact on the environment. The type and degree of environmental impact from a seismic survey is influenced by:

- the nature of the biological, social, economic, and cultural features of the marine environment where the survey is proposed to take place,
- the level of spatial and temporal overlap with environmentally sensitive areas and times and
- the individual survey design (e.g. the nature of the sound source and acquisition line spacing).

The Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (OPGGS Environment Regulations) require companies who wish to conduct a marine seismic survey to address these factors through an environmental impact assessment (EIA) for their specific proposed activity circumstances.

The key requirements that apply in Australia are:

- the Environment Protection and Biodiversity Conservation (EPBC) Act Policy Statement 2.1, which sets out procedures for managing interactions with whales
- recovery plans for listed threatened species (particularly where noise is identified as a threat), which define objectives and actions to ensure effective threat mitigation and species recovery
- Australian marine park management plans, which prescribe rules for where seismic surveys can and can't occur, as well as objectives for environmental protection.

There are also a range of international requirements that should be considered, such as:

- the Convention on the Conservation of Migratory Species (CMS) Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities (CMS Guidelines)
- various technical guidelines on applying thresholds for the impact of received sound levels, e.g. marine mammal acoustic technical guidance
- various guidelines and codes of conduct for effectively managing environmental impacts from marine seismic surveys, e.g. IUCN guidance on effective planning of geophysical surveys.

NOPSEMA's environmental assessment processes consider all project and activity-specific environmental impacts and risks, including but not limited to those relevant to matters protected under Part 3 of the EPBC Act. Decision-making ensures that environmental impacts and risks, including to matters protected under Part 3 of the EPBC Act, will be of an acceptable level and reduced to as low as reasonably practicable (ALARP).

The object of the Environment Regulations is also to ensure that any petroleum activity or greenhouse gas storage activity is carried out in a manner consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act.

Of direct relevance to the subject of this report is NOPSEMA's. role as compliance regulator of the EPBC Act, with particular a focus on *Policy Statement 2.1 - Interaction between offshore seismic exploration and whales*, as described in the following section.

EPBC Act Policy Statement 2.1 - Interaction between offshore seismic exploration and whales

About the policy statement

The aim of the policy is to:

1. provide practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations,
2. provide a framework that minimises the risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours, and

3. provide guidance to both proponents of seismic surveys and operators conducting seismic surveys about their legal responsibilities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Scope of the Policy Statement

Under the EPBC Act, a number of whale species are listed as threatened and/or migratory species and are, subsequently, protected under the Act as matters of national environmental significance (NES). Whale species are also part of the Commonwealth marine environment, another matter of NES.

Whales and other cetaceans also have additional protections in the *Australian Whale Sanctuary*. The EPBC Act provides for offences for certain actions that adversely affect whales in the Australian Whale Sanctuary. The Act also provides for permits to be obtained in relation to actions affecting whales in the Australian Whale Sanctuary.

Applicable Species

Not all whales hear the same acoustic frequencies. Seismic survey sound sources are generally focussed at frequencies below 200Hz. Based on the best available scientific information, it is generally understood that baleen whales and some toothed whales are likely to be sensitive to sounds in this lower frequency range.

Due to the difficulties in identifying whales to the species level, particularly at distance, appropriate management procedures (as recommended in Part A Standard Management Procedures and Part B Additional Management Procedures) should be applied whenever **whales** are, or might be, encountered. **'Whales'** includes baleen whales and larger toothed whales, such as, sperm whales, killer whales, false killer whales, pilot whales and beaked whales.

Smaller dolphins and porpoises that have peak sensitivities in the higher frequency ranges are likely to be less disturbed by these lower frequency sounds and less vulnerable to acoustic trauma. Accordingly, this Policy Statement does not apply to encounters with the smaller dolphins and porpoises.

Legislative Responsibilities

If the likelihood of encountering whales is low, the chance of a seismic survey having a significant impact on a whale species should be minimal, provided that the proponent and the operator of the seismic survey adopt the measures outlined in Part A Standard Management Procedures.

While Part A Standard Management Procedures may be sufficient in locations where the likelihood of encounters with whales is low, the proponent may need to consider additional avoidance and mitigation measures for areas and/or seasons where the likelihood of encountering whales is moderate to high. In these circumstances, the proponent should not only apply Part A Standard Management Procedures, but should also consider measures like those outlined in Part B Additional Management Procedures.

Part A Management Procedures

Part A Management Procedures are to be implemented as a minimum requirement for all marine seismic survey activities conducted in Australia where the likelihood of whale interactions is considered low. Part A Management Procedures include: -

1. **Pre-Survey Planning:** to avoid scheduling seismic surveys in areas where and when whales are likely to be breeding, calving, resting or feeding.
2. **Trained Crew:** The survey proponent should ensure that there is sufficient trained crew to fulfil the basic requirements of whale observation, distance estimation and reporting.
3. **During Surveys:** All seismic survey vessels operating in Australian waters must undertake the following basic procedures during surveys irrespective of location and time of year of survey:
   - Pre-start-up visual observation
   - Soft start
   - Start-up delay
   - Operations
   - Power- down and Stop work
4. **Compliance and Sighting Reports:** It is the responsibility of the proponent to maintain a record of procedures employed during operations. Such records should be auditable and account for aspects of the operation that relate to legislative approvals and regulations.

Detailed specifics of the requirements for Part A Standard Management Procedures, such as soft-start durations and mitigation zone distances, can be found in the policy statement document that can be found online at the DCCEEW web site.

Part B Additional Management Procedures

For seismic surveys operating in areas where the likelihood of encountering whales is **moderate to high**, the application of additional measures, to ensure that impacts and interference are avoided and/or minimised, are necessary. The following measures are recommended, however, application of all these measures may not be necessary, applicable or possible for all seismic survey operations.:-

1. **Marine Mammal Observers (MMO):** Whilst listed as an additional management procedure in the policy statement it is now considered standard practice for marine seismic surveys to employ at least one MMO during any seismic survey activity. MMOs should be trained and experienced in whale identification and behaviour, distance estimation, and be capable of making accurate identifications and observations of whales in Australian waters. The MMOs should assist other observers (e.g. trained crew) and be available to provide advice, should whales be encountered.
2. **Night-time/Poor visibility:** For surveys in areas where whales are expected to be encountered, the proponent should include appropriate management measures to detect (or predict) whale presence and apply measures to reduce the likelihood of encounters. Depending on the situation a range of measures may be appropriate, possible measures include:
   - Limiting initiation of soft start procedures to conditions that allow visual inspection of the precaution zone;
   - Daylight spotter vessel or aircraft searches of the night-time survey area to determine if whales are present; and
   - Pre survey research (including surveys) to detect and identify likely whale concentration areas, such as: peak migration paths and times, key feeding sites (e.g. shelf breaks, sea mounts and trenches), or other aggregation areas.
3. **Spotter Vessel(s) and Aircraft:** Where the likelihood of encountering whales is high, spotter vessels/aircraft could be used to assist in detecting the presence of whales. Spotter vessels and aircraft may be usefully employed to determine the presence and likelihood of encountering whales during day and night-time operations; information that can then be used to re-design

the survey or tracks to be run to avoid whales that are in the vicinity. Spotter vessels/aircraft should maintain continuous contact with the seismic survey vessel. An MMO should be employed on board both the survey vessel and the spotter vessel/aircraft.

4. **Increased Precaution zones and Buffer zones:** In some locations and circumstances it may be advisable to apply increased distances for the instigation of power-down procedures from those outlined in Part A Standard Management Procedures.
5. **Passive Acoustic Monitoring:** Deployment of PAM with appropriate technologies and programs to detect whales in real time may provide an additional method of detecting and avoiding whales during surveys and may be particularly useful during night-time and low visibility operations.
6. **Adaptive Management:** Where a survey is proposed in an area that is spatially and temporally on the edge of areas considered to provide biologically important habitat, the proponent may consider implementing adaptive management procedures to manage the potential increased likelihood of encountering whales. Adaptive management could include implementation of daytime only operations if there are three consecutive days on which operators experience three or more whale-instigated shut down/power down situations. Adaptive management may also be used in conjunction with other measures described in Part B. For example, if aerial surveys identify whales in the region, increased buffer zones are implemented.

One of the core objectives of this report is to provide details of whale detection and mitigation systems that could be implemented as part of the Additional Management Procedures that will be implemented during the Regia 3D MSS due to the known presence of both Blue and Southern Right Whales in the vicinity of the Survey Planning Area. The most practical and effective additional management procedures/equipment will, where adopted by the survey proponents, be included as mitigation measure commitments within the Regia Seismic Survey Environment Plan.

Detection Technologies Overview

Introduction

The following section provides a broad overview of the technologies and implementation procedures that have been considered for adoption as Additional Management Procedures during the Regia 3DMSS. Advantages and disadvantages have been provided where an assessed technology is regarded as having both.

Passive Acoustic Monitoring

PAM History

Passive Acoustic Monitoring (PAM) for marine mammal detection has a history that spans several decades. The technique relies on the use of underwater microphones, known as hydrophones, to listen to and record the sounds produced by marine mammals. Here's a brief overview of the key milestones in the history of PAM:

1. **Early Observations (1950s-1960s):** The use of hydrophones to study marine life, including marine mammals, dates back to the 1950s and 1960s. Researchers began recording underwater sounds, but the technology was limited and the focus was primarily on general oceanography rather than specific marine mammal studies.
2. **Navy's Interest (1960s-1970s):** The United States Navy became interested in the use of passive acoustic techniques for detecting submarines. While conducting these naval operations, they unintentionally recorded marine mammal sounds, which led to increased awareness of their vocalisations.
3. **Whalesong Discoveries (1960s-1970s):** Researchers studying humpback whales made significant discoveries in the 1960s and 1970s. They found that humpback whales produced complex and repetitive songs, which piqued scientific interest in using passive acoustics for studying marine mammal behaviour.
4. **The Development of PAM Tools (1980s):** During the 1980s, advancements in hydrophone technology and signal processing capabilities made it easier to detect and analyse marine mammal sounds. This led to the development of dedicated PAM tools and software, making the process more efficient and accurate.
5. **International Whaling Commission's Involvement (1980s):** The International Whaling Commission (IWC) recognised the importance of passive acoustics in studying and conserving marine mammals. They initiated efforts to standardise PAM methodologies and data analysis techniques.
6. **Wide Application (1990s-2000s):** In the 1990s and 2000s, PAM gained broader recognition and became an essential tool for marine mammal researchers worldwide. It was used to study various species, including cetaceans (whales, dolphins, and porpoises) and pinnipeds (seals and sea lions), and assess their distribution, abundance, and behaviour.
7. **Integration with Autonomous Systems (2000s-2010s):** With advancements in underwater autonomous systems, such as autonomous underwater vehicles (AUVs) and gliders, PAM techniques were integrated with these platforms to expand coverage and improve data collection.

8. **Industry Applications (2010s):** PAM found applications beyond scientific research. Industries like offshore oil and gas exploration, renewable energy, and shipping began using PAM as part of their environmental monitoring efforts to reduce the impact of their activities on marine mammals.
9. **Real-time PAM (2010s-2020s):** Real-time PAM systems evolved, allowing researchers and operators to monitor marine mammal activity continuously. These systems could detect vocalisations and other sounds, provide alerts for specific species detections, and help mitigate potential risks for marine life.

Overall, passive acoustic monitoring has become an essential tool in marine mammal research and mitigation, offering a non-invasive and effective means of detecting vocalising marine mammals. Ongoing advancements in technology continue to improve the accuracy, efficiency, and scope of PAM use in a broad range of applications.

PAM During Marine Seismic Surveys

PAM is a valuable tool used during marine seismic surveys to monitor and mitigate the impact of seismic operations on marine life, especially marine mammals. Seismic surveys involve the use of airguns to generate powerful acoustic signals, which may be harmful to marine organisms if not properly managed. PAM helps in minimising the potential negative effects by providing real-time monitoring and detection of marine mammal presence within the detectable range of the acoustic energy source.

Here's how PAM is utilised during marine seismic surveys:

1. **Marine Mamal Detection:** PAM systems are installed on seismic survey or energy source vessels and/or in the vicinity of the seismic survey area to continuously monitor for the presence of marine mammals. These systems consist of hydrophones (underwater microphones) or an array of hydrophones that can detect and record the vocalisations and other acoustic signals produced by marine mammals.
2. **Real-time Monitoring:** The hydrophones are connected to onboard or shore-based monitoring stations, where specialised software analyses the recorded acoustic data in real-time. Some PAM software is capable of automatic identification of individual species of marine mammals based on their vocalisation signatures. If marine mammal sounds are detected during survey, operations can be adjusted or halted temporarily to prevent potential harm to the animals.
3. **Mitigation Measures:** PAM allows for the implementation of mitigation measures when marine mammals are detected. These measures can include shutting down the airguns or altering the survey activity to minimise potential impacts on marine life. The mitigation measures are often guided by the likely species present and environmental regulations and guidelines specific to the area of operation.
4. **Data Collection and Analysis:** The data collected through PAM systems during seismic surveys are also essential for assessing the effectiveness of mitigation measures and studying the behaviour of marine mammals in response to seismic activities. This information helps researchers and regulatory authorities make informed decisions about future seismic operations.
5. **Compliance with Regulations:** Many countries and international organisations have strict regulations and guidelines to protect marine life during seismic surveys. In some countries PAM has been mandated as a required mitigation tool during all seismic survey activities. In Australia PAM use is not yet mandated. However, it is considered best practice as an "Additional

Management Procedure" beyond the "Standard Management Procedure" requirements of the EPBC Act, Policy Statement 2.1.

It's important to note that the use of PAM is just one aspect of a comprehensive environmental monitoring and management plan that operators implement during seismic surveys. Other measures, such as visual monitoring, pre-survey assessments, and adherence to mitigation zones, also play significant roles in safeguarding marine life during seismic operations.

Regardless of the platform on which a PAM system is deployed during a seismic survey activity there is one common disadvantage, or limitation, being the ability to detect marine life acoustic signals in amongst the large impulse noise of seismic airgun arrays being discharged, as well as the engine and propellor noises generated by the survey vessel(s) themselves. During survey data acquisition a typical airgun array discharge repetition rate is between 7 to 10 seconds. This high amplitude noise is received directly by PAM hydrophones through the water column, overpowering lower amplitude sounds.

Dependent on the water depth and subsurface geology, the subsurface acoustic reflections from each seismic source impulse can still be returning to the sea surface whilst the next airgun array impulse is generated. This means that the actual "quiet" period where lower amplitude marine fauna noise source levels can be monitored, without background seismic signal data present, is either minimal or non-existent during active survey periods. Therefore, PAM systems need to be able to filter out, or differentiate between seismic energy returns. The best times for detection of marine mammal vocalisations are the short periods of lower noise levels between seismic airgun pulses and during transits between seismic survey transect lines (line changes).

Towed Streamer PAM

Towed streamer PAM has been utilised for many years and is the most common form of passive acoustic monitoring used during seismic surveys to date. This detection method involves using a dedicated array of underwater microphones, or "hydrophones", which are incorporated in a long cable or "streamer" that is towed behind a seismic survey or associated support vessel.

The hydrophones pick up sounds in the underwater environment, including the vocalisations and other noises made by marine animals, such as whales. The PAM hydrophone arrays are interfaced to bespoke electronic equipment that can filter, digitise, and condition the acoustic signals for analysis by specialist software, such as the Open Source "PamGuard" system.

More recently manufacturers of in-water seismic survey equipment, such as Sercel's "QuietSea", system has incorporated cetacean detection hydrophones within the same streamers used to receive subsurface acoustic reflection data from the seismic energy source. The PAM hydrophone data is fed back to the survey vessel independently of the seismic data and is interfaced to equipment designed to analyse received acoustic signatures and automatically detect and identify cetaceans, alerting survey operators of their presence within the vicinity so that suitable mitigation measures can be instigated.

By incorporating PAM sensors in the seismic streamers, the need for additional dedicated PAM hydrophone arrays is eliminated, removing the risk of entanglement of the PAM streamer with the seismic vessel's towed equipment. It also reduces exposure of personnel to risks associated with the deployment and recovery of third-party PAM streamers from the stern of seismic survey vessels.

The integration of PAM data within the seismic streamers also provides for far greater numbers of hydrophones listening for cetacean vocalisations over a much broader area of the ocean. Dependent on the geophysical objectives, a typical modern seismic streamer deployment configuration during a marine 3D survey is between ten and fourteen individual seismic streamers of up to ten or twelve kilometres in length, spaced between fifty and one hundred and fifty metres apart. This provides a PAM hydrophone array of up to two square kilometres or more. Such large, two-dimensional arrays provide the ability to better compute geographic locations of received vocalisations by comparing the arrival times of individual acoustic signatures across the array to determine bearing and distances to the sound source.

Supplementary Vessel Towed PAM

The use of one or more vessels, in addition to the seismic survey vessel, to deploy towed PAM systems during a seismic survey can add considerably to cetacean mitigation efforts by enabling marine mammal detections at greater distances from the seismic energy source.

Dependent on the species of concern and the regulatory requirements for mitigation buffer zone distances from the active energy source(s) it may be impossible for seismic vessel-based towed PAM to detect cetacean vocalisations out to the required mitigation zone radius. Survey vessel towed PAM receivers are positioned astern of the vessel and therefore offset from the centre of the acoustic energy source. Positioning another vessel with its own towed PAM system ahead of the survey vessel could increase the potential to detect cetaceans ahead of the survey vessel, in the direction of travel along pre-plotted seismic lines.

Advantages of one or more supplementary vessels equipped with towed PAM are:-

- Increased range for detection of cetacean vocalisations from the seismic vessel, potentially providing more advanced warning of whale presence ahead of the energy source.
- Additional platform(s) for visual detections, including using more MMOs and possibly extra automated camera-based detection systems.
- Increased distance from the energy source means a lower level of direct arrival impulse noise as the amplitude decays with distance.
- A secondary vessel can potentially offer verification of received vocalisations and may assist in determining the location of the sound source.

Some disadvantages include: -

- The need for additional people to install, deploy, recover, and operate the PAM equipment, leading to additional safety risks for personnel at sea.
- The costs of an additional vessel and its crew capable of accommodating the extra PAM/MMO personnel and being able to work alongside the survey vessel in all weather conditions is not insignificant.

Tethered Buoy PAM

A tethered buoy PAM system is a tool used in marine research and mitigation efforts to monitor and protect marine animals, particularly cetaceans like whales and dolphins.

Here's how a tethered buoy PAM system works:

1. **Buoy**: The system typically consists of a buoy that floats on the water surface. The buoy is designed to stay afloat and stable in various sea conditions.
2. **Tethered Design**: The buoy is tethered to an anchor or weight on the seafloor. The tether keeps the buoy in place, preventing it from drifting away with ocean currents.
3. **Underwater Hydrophones:** The buoy is equipped with underwater hydrophones. These hydrophones are sensitive to underwater sounds and can pick up a wide range of frequencies.
4. **Data Recorder:** The buoy is connected to a data recorder or logger, which stores the acoustic data captured by the hydrophones. Depending on the system, the data can be stored locally on the buoy or transmitted in real-time, via either radio frequency (including Wifi)or satellite-based data telemetry, to a shore-based monitoring station or onboard the seismic survey vessel.
5. **Acoustic Monitoring:** The tethered buoy PAM system operates continuously, listening for underwater sounds in the surrounding environment. It can detect various marine animal sounds, such as whale calls, dolphin clicks, and other vocalisations.
6. **Research:** Tethered buoy PAM systems are particularly useful for long-term monitoring in specific areas, such as migration routes or important feeding grounds.
7. **Non-Intrusive:** Since the PAM system does not emit any sounds, it is considered non-intrusive and does not disturb marine life during the monitoring process.

Tethered buoy PAM systems have been deployed in the field during marine seismic surveys to supplement the towed array PAM systems typically deployed from the seismic survey vessel and/or the energy source vessel. Buoys can be placed around the perimeter of the active seismic operations area in order to alert survey operations of the arrival of cetaceans within the area.

Dependent on the size of specified mitigation zones, when compared to the distances between the detected animals and the seismic energy source, actions can be taken to either heighten the level of alertness, such as increasing visual or acoustic monitoring efforts, or suspend survey operations until no further detections have been received within a pre-defined period, equivalent to the likely movement of detected whales outside the mitigation zone.

Tethered buoy PAM has the following advantages: -

- Buoys can be deployed around the perimeter of the seismic survey operations area to virtually ringfence the active source area, enabling detections of vocalising cetaceans prior to them entering the mitigation zone.
- Monitoring of real-time buoy PAM can be performed remotely at any location, either onshore or offshore, using satellite-based acoustic data telemetry. No additional personnel need to be assigned to a survey vessel, reducing risk and costs of travel as well as reducing pressure on survey vessel bunk space. Onshore monitoring provides more flexibility in shift timing and manning levels.
- Buoys can be used to compare received energy source sound levels at distances from the centres of sources with the modelled levels used to define the mitigation zones. Mitigation zone distances could be amended based on real-world sound level measurements.

Tethered buoy PAM disadvantages include: -

- Cost of buoy deployment and recovery is not insignificant.

- Corrective maintenance in the event of equipment failure is logistically difficult and costly due to the potential need for third party vessel charter to repair or replace buoys.
- Poor weather can affect buoy operational effectiveness. Buoy surface movement can affect hydrophone data quality through additional noise. Constant cloud cover can reduce solar panel effectiveness to charge system onboard batteries.
- Tethered buoys can become a navigation risk to other vessels. Buoy locations are required to be registered with government and military authorities and released in official Notices to Mariners.

Unmanned Surface Vessel PAM

USVs (Unmanned/Uncrewed Surface Vehicles) can be utilised for various purposes, including Passive Acoustic Monitoring (PAM). USVs can enhance PAM operations by serving as a platform to deploy and maintain the acoustic sensors, collect data, and transmit it to the operators or data centres. Here's how USVs can be beneficial for PAM:

1. **Autonomous operations:** USVs can be programmed to follow specific paths or patrol areas or keep station autonomously, reducing the need for constant human intervention. This autonomy enables extended monitoring periods and increased coverage of marine environments.
2. **Reduced cost and risk:** Using USVs for PAM reduces the need for manned vessels, thereby cutting down operational costs and minimizing risks to human personnel in challenging or dangerous marine conditions.
3. **Extended endurance:** Many USVs can operate for extended periods, even in remote locations, allowing for continuous monitoring of underwater sounds over long durations.
4. **Precise positioning:** USVs equipped with GPS technology can maintain accurate positions, ensuring that acoustic sensors are deployed at specific locations for precise data collection.
5. **Low acoustic interference:** USVs are generally quieter than traditional manned vessels, reducing the potential for acoustic interference with marine life and improving the quality of PAM data.
6. **Remote control and data transmission:** Operators can remotely control USVs and receive real-time data from the acoustic sensors, enabling quick analysis and decision-making.
7. **Flexibility:** USVs can be equipped with different types of sensors, allowing them to perform a variety of tasks beyond PAM, such as meteorological or oceanographic data collection.

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- Configurable payloads and sensors
- Real-time data transfer via satellite telemetry.
- Potential alternatives to tethered buoys, especially in very deep water.

Some USV PAM disadvantages are: -

- Potential navigation risk to other marine users.
- Potential for entanglement of the towed hydrophone array with in-sea debris or fishing gear.
- Unmanned, so potential targets for theft or vandalism in certain deployment scenarios.

Unmanned Underwater Vessel PAM

Unmanned underwater vessels, often referred to as underwater drones or autonomous underwater vehicles (AUVs), can play a crucial role in conducting PAM efficiently. Here's how they could be used for this purpose:

1. **Data Collection:** Unmanned underwater vehicles equipped with hydrophones (underwater microphones) can collect audio data from different depths and locations in the ocean. These vehicles can travel to specific areas of interest and record underwater sounds without disturbing marine life.
2. **Extended Operation:** AUVs can operate for extended periods, covering large areas of the ocean. This allows for continuous or scheduled monitoring, which is especially useful for tracking the migration patterns and behaviours of marine species.
3. **Precise Localisation:** AUVs can be programmed to move to specific coordinates, enabling targeted acoustic data collection near underwater sources of interest, such as breeding or feeding grounds of marine animals.
4. **Real-time Data Transmission:** Some AUVs can transmit data in real-time to a monitoring station on the surface. This feature is advantageous for immediate analysis and decision-making based on the collected acoustic data.
5. **Adaptability:** AUVs can be programmed to follow predefined paths, adapt to changing environmental conditions, and navigate complex underwater terrain, ensuring optimal coverage of the monitored area.
6. **Reduced Human Interaction:** Using AUVs for PAM reduces the need for constant human presence at sea, minimizing the associated risks and costs.
7. **Integration with Other Sensors:** AUVs can carry additional sensors, such as environmental sensors or cameras, to gather more comprehensive data about the underwater environment and the marine life within it.
8. **Data Processing and Analysis:** The collected acoustic data can be processed to identify specific species based on their characteristic sounds. Machine learning algorithms can be employed to automate the analysis process and identify patterns in the recorded sounds.
9. **Reduced Environmental Impact:** Compared to traditional survey methods that involve larger vessels and potentially disruptive activities, AUVs produce minimal noise pollution and disturbance to marine life.

The advantages of autonomous underwater vessel use for PAM are similar to those of autonomous surface vessels, with the addition of the ability to submerge the hydrophone arrays to water depths where sea surface noise in greatly lessened. This provides a quieter environment for detecting distant whale vocalisations. However, this advantage comes at the cost of real-time data telemetry to the PAM monitoring station during periods of submersion, making it impractical as a mitigation option.

Fibre Optic Distributed Acoustic Sensors

Fibre optic distributed acoustic sensors (DAS) are a type of technology that utilises optical fibres to detect acoustic signals along the length of the fibre. These sensors are capable of converting the fibre optic cable into an array of virtual microphones, making them ideal for various applications in monitoring and surveillance.

Here's how fibre optic DAS generally works:

1. **Principle**: The basic principle behind fibre optic DAS is the interaction between light and sound. When an acoustic wave (sound) interacts with the fibre optic cable, it causes minute changes in the properties of the light traveling through the fibre.
2. **Optical Fibre:** The fibre optic cable used in DAS is typically a single-mode optical fibre, which allows only one mode of light to propagate along the fibre core. This is crucial for maintaining the integrity of the signal.
3. **Laser Interrogation:** A laser source is used to generate a continuous wave of light that travels through the optical fibre.
4. **Scattering:** When an acoustic wave interacts with the fibre, it causes minute changes in the refractive index of the fibre due to phenomena like Brillouin scattering or Rayleigh scattering. These changes result in the scattering of light along the fibre.
5. **Interference Measurement:** The backscattered light returns to the DAS unit, where it is analysed to detect changes in the phase and intensity of the light. By analysing these changes, the DAS system can pinpoint the location and characteristics of the acoustic disturbance.
6. **Data Processing:** The collected data from the DAS system is then processed using advanced signal processing algorithms to interpret the acoustic information accurately. This allows the system to distinguish between different types of acoustic events.

Fibre optic DAS has several advantages over traditional point sensors:

- **Continuous Monitoring:** Since the fibre optic cable acts as an array of virtual microphones, DAS provides continuous monitoring along its entire length, enabling the detection of acoustic events over long distances.
- **Sensitivity and Resolution:** DAS systems have excellent sensitivity and high spatial resolution, allowing for precise localization of acoustic events.
- **Versatility:** Fibre optic DAS can be used in various applications, such as pipeline monitoring, perimeter security, seismic monitoring, and structural health monitoring.
- **Immune to Electromagnetic Interference**: Fibre optic cables are not affected by electromagnetic interference, making DAS systems suitable for harsh environments.

Due to these advantages, fibre optic distributed acoustic sensors have gained popularity and are being employed in diverse industries for efficient and reliable acoustic monitoring applications.

An article published in Frontiers in Marine Science in July 2022 titled "Eavesdropping at the Speed of Light: Distributed Acoustic Sensing of Baleen Whales in the Arctic" *(Bouffaut et al)* detailed the successful use of a 120km long sub-sea telecommunications fibre optic cable, with sensing points every 4 metres, to identify and estimate the 3D positions of vocalising baleen whales. It also demonstrated the use of frequency modulated whale vocalisations recorded on the DAS to generate correlated subsurface seismic profiles down to a depth of around 2 seconds.

Disadvantages of DAS include:

- DAS can only operate over uninterrupted lengths of fibre optic cable. It cannot pass through repeater modules or other electronic nodes.
- Use of DAS with existing cables requires the assistance and cooperation of the telecommunications company that owns and/or operates the cables.
- DAS can only be used on dedicated fibres and therefore needs to utilise spare or unused fibres within any existing cable infrastructure.

- Deployment of dedicated DAS fibre optic cables on the seafloor may need some forms of regulatory approval prior to deployment.
- Deployed seafloor cables may be at risk of damage through external sources, such as trawling operations.
- Dedicated DAS cables needs to be physically connected to the recording equipment. In most cases this means the need to run the cable to a shore-based facility or possibly an offshore installation, such as an oil rig/platform. The logistics of this requirement are prohibitive.
- As at 2021, there is only one submarine telecommunications cable, Indigo Central, that passes through the Regia 3D survey area. This cable runs between Sydney and Perth, making the likelihood of potential utilisation due to the distances involved extremely slim.

Satellite Imagery

Satellite imagery has been utilised for various purposes, including environmental monitoring and wildlife conservation. However, using satellite imagery specifically for whale detection presents some challenges.

Whales are massive marine creatures that typically spend most of their time submerged underwater. While some whale species exhibit behaviours such as breaching (jumping out of the water) or spouting (blowing air and water from their blowholes), these activities can be relatively infrequent and challenging to capture from space.

Nevertheless, advancements in satellite technology and image processing algorithms have made it possible to detect large marine mammals, including whales, under certain circumstances. Here are some ways satellite imagery can be used for whale detection:

1. **Large Whale Detection:** Satellites equipped with very high resolution (VHR) optical sensors can detect large whales when they surface for air. These sensors can capture images of large whales like humpback whales, blue whales, and Southern Right whales when they breach or spout. While not continuous monitoring, these images can provide valuable data on whale distribution and migration patterns.
2. **Whale Migration Tracking:** Satellite-tagged whales can transmit signals when they surface, allowing researchers to track their movements and migration routes. This information can be used to understand whale behaviour and identify critical habitats.
3. **Whale Population Estimation:** Researchers can analyse satellite images to estimate whale populations in specific regions, such as areas where seismic survey activities are planned. This approach involves identifying and counting whales in the images, which can provide valuable insights into population trends and mitigation efforts.
4. **Detection of Human Activities Impacting Whales:** Satellite imagery can also be used to monitor human activities that may negatively impact whales, such as ship traffic, coastal development, and oil spills. By identifying potential threats, regulators can take appropriate measures to protect whale habitats.

However, it's important to note that satellite-based whale detection has its limitations. Cloud cover and weather conditions can obstruct the view from satellites, making consistent monitoring challenging. Moreover, smaller marine mammal species, or those that spend more time underwater, might be difficult to detect using current satellite technology.

The field of satellite imagery and marine mammal monitoring is continuously evolving, and there may be more advanced techniques and systems developed in the future. A German company, Space Whale, has developed a cetacean survey method, employing a convolutional neural network (CNN) to automate much of the VHR satellite imagery interpretation. Space Whale offers VHR satellite-based whale detection and monitoring as a service, with end users merely needing to provide corner coordinates for a rectangular area of interest, start and end dates for monitoring and the whale species of interest in order to obtain a quote for services.

At present though, real-time satellite imagery for use in whale detection as a real-time mitigation measure is not considered a practical option. It can certainly be considered as a means to establish whale population presence in a survey operational area over time in order to determine the best time to conduct a seismic survey.

Camera-Based Detection

Infrared Cameras

Infrared, or Night Vision cameras can be used for various purposes, including whale detection. Infrared cameras have been used to monitor and study marine mammal populations, including whales, in both research and mitigation efforts. Here's how infrared cameras are employed for whale detection:

1. **Thermal Imaging:** Infrared cameras are also known as thermal imaging cameras because they detect and capture infrared radiation (heat) emitted by objects, including living beings. Whales, like all warm-blooded animals, generate heat, and this thermal signature can be detected by infrared cameras even when the whales are underwater.
2. **Day and Night Vision:** Infrared cameras can operate in low-light conditions and even in complete darkness, making them valuable tools for marine research, especially in remote locations or during nighttime studies.
3. **Identification and Monitoring:** By using infrared cameras, researchers can identify and track whales without disturbing them or altering their natural behaviour. This helps in studying their movement patterns, behaviour, and population dynamics.
4. **Aerial Surveys:** Infrared cameras mounted on drones or aircraft can conduct aerial surveys of whale populations over large areas, making it easier to assess their numbers and distribution.
5. **Remote Monitoring:** Infrared cameras can be set up at specific locations, such as coastal areas or key migration routes, to continuously monitor whale activity. This allows researchers to collect data over extended periods without the need for direct human presence.
6. **Mitigation Applications:** Infrared cameras can play a role in marine mitigation efforts by providing valuable data on whale populations, migration patterns, and interactions with their environment. This information can be used to develop better mitigation strategies to protect these species.

It's important to note that while infrared cameras are a useful tool for whale detection, they are often used in conjunction with other monitoring techniques, such as acoustic monitoring (PAM) and visual observations (MMOs), for additional mitigation measures during marine seismic surveys.

Advantages of infrared cameras include: -

- Ability to identify whales in low light or dark conditions.

- Up to 360-degree, 24-hour remote scanning of the ocean around the monitoring platform out to the horizon.
- Systems are relatively inexpensive and are lightweight, easily transported, and relatively simple to install.
- Some camera systems incorporate Artificial Intelligence (AI) software to automatically identify whales through thermal imaging and blow detections.

Some disadvantages of infrared camera systems are: -

- Reduced effectiveness during periods of poor weather, including sea state and precipitation and during high sun glare situations. Fog and humidity can also adversely affect camera performance.
- If being used as an additional night time visual mitigation procedure, alongside the use of PAM detection systems, it may be necessary to engage additional MMO personnel to provide full 24 hour visual monitoring coverage onboard the survey or support vessel(s).

Dual Camera Systems

A Dual HD Image and Infrared Whale Detection Camera System is a specialised technology designed to monitor and detect the presence of whales using both high-definition visual imagery and infrared (IR) technology. This type of system is commonly used in marine research, conservation efforts, and environmental monitoring.

Here's how dual camera systems work:

1. **Dual Camera Setup:** The system consists of two types of cameras: high-definition (HD) visual cameras and infrared (IR) cameras. These cameras are typically positioned on a platform, such as a survey vessel or a fixed installation like an oil rig or platform.
2. **HD Image Cameras:** The HD cameras capture visible light imagery of the surrounding ocean. These images provide clear visual information about the appearance, behaviour, and location of whales. HD cameras are particularly useful for identifying specific species, observing behaviour patterns (breaching, swimming, etc.
3. **Distance Measurement:** Some dual camera systems can integrate automatic distance estimation analysis software, such as the Seisch Real Time Automated Distance Estimate at Sea (RADES) software.
4. **Infrared (IR) Cameras:** As detailed previously, IR cameras capture heat signatures emitted by living organisms, including whales, in the form of thermal radiation. Whales generate heat due to their metabolism, and this heat signature can be detected by IR cameras even when visibility is poor, such as in low light or adverse weather conditions. IR cameras are advantageous for night-time observations and in areas with reduced visibility.
5. **Image Processing and Analysis:** The system typically includes image processing software that can analyse the captured images and videos in real-time or post-capture. Machine learning algorithms can be employed to identify and classify whale species based on their visual features and heat signatures.
6. **Whale Detection Algorithms:** The core functionality of these systems lies in their ability to automatically detect the presence of whales within the captured images and videos. Detection algorithms are trained to recognise specific shapes, patterns, and characteristics of whales, both in visible light and in IR images. When a potential whale is detected, or an anomaly in the incoming images flagged, the system can trigger alerts for further observation or examination.

7. **Data Storage and Transmission:** The systems can store the captured images and videos for further analysis and research. Additionally, if a system is connected to a network, it can transmit real-time data to MMOs or a central database for instant analysis and response.
8. **Research and Conservation Applications**: A Dual HD Image and Infrared Whale Detection Camera System has numerous applications. It can aid in understanding whale migration patterns, assessing population sizes, monitoring the health of individual whales, and studying their behaviour. Furthermore, it can be used to support additional mitigation procedures, such as during marine seismic surveys, where they can be used as an additional source of real-time whale monitoring and detection to trigger required mitigation control measures.

This technology combines the advantages of high-definition visual imagery and infrared technology to provide a comprehensive and accurate method for monitoring and detecting whales. The advantages of a dual camera system include all of those previously listed for infrared cameras, plus the ability to better identify whale species and distances during daytime operations. The inclusion of automated distance estimation software further adds to the list of advantages.

The disadvantages of dual camera system use are also similar to those of a straight infrared camera option, being the limited effectiveness during poor sea state and weather conditions. Both systems are also limited by the location of the platform on which they are mounted, with a 360 degree uninterrupted view being almost impossible to achieve on most vessels due to the presence of the ship's mast(s) and any other upper deck superstructures, such as cranes, stacks and the like. Mast-top mounting, where the view is less obstructed, is impractical in most situations due to the height and the increased motion experienced at that height.

Aerial Surveys

Manned Aircraft

Manned aircraft aerial surveys for whale detections are a valuable method used by researchers to study and monitor whale populations in their natural habitats. These surveys involve using aircraft, such as airplanes or helicopters, equipped with specialised equipment and cameras to observe and document the presence of whales in a given area. Here's an overview of how aerial surveys for whale detections typically work:

1. **Survey Planning:** Researchers plan the aerial survey by defining the study area and identifying the target species of whales they want to observe. The study area can be a specific region, a migration route, or a known feeding or calving ground for the whales. For seismic survey planning purposes this would be the survey's Operational Area plus any prescribed mitigation zone buffers.
2. **Aircraft and Equipment:** A suitable aircraft is selected for the survey, considering factors such as range, speed, and altitude capabilities. The aircraft is often equipped with high-quality cameras and, in some cases, specialised sensors like infrared or thermal cameras that can aid in detecting whales more effectively.
3. **Flight Patterns:** Project planners determine the flight patterns based on the study objectives and the characteristics of the whales they are monitoring. The aircraft may fly along predetermined transects, circular patterns, or adaptive flight paths to cover the designated study area systematically.

4. **Detection and Documentation:** During the flight, trained observers/spotters scan the ocean surface for signs of whales, such as blows (exhalations), breaches, or fluke dives. When a whale is sighted, its location, behaviour, and species are recorded. Photographs and videos may also be taken for later analysis and identification.
5. **Data Analysis:** After the aerial survey, observers analyse the collected data to estimate whale abundance, distribution, and behaviour. They use statistical methods to extrapolate the observations to estimate the total whale population in the study area.
6. **Mitigation and Management:** The data gathered from aerial surveys help inform mitigation measures and management decisions related to whale populations. It aids in understanding population trends, identifying critical habitats, and assessing the impact of human activities on whale populations.

Advantages of Aerial Surveys:

- Aerial surveys allow spotters to cover large areas efficiently and rapidly.
- They provide a non-invasive method to study whales without disturbing their natural behaviours.
- Aerial observations can be used to complement data obtained from other survey methods, such as shipboard surveys, shore-based observations, or acoustic monitoring.
- Pre-activity aerial surveys can be used to help plan seismic survey timing to minimise exposure to periods of peak presence of whale species of concern.

Limitations of Manned Aerial Surveys:

- Weather conditions and sea state can affect survey flight operations and the ability to detect whales accurately.
- The altitude of the aircraft may limit the ability to identify smaller whale species or individuals.
- Aerial surveys can be expensive, especially if frequent or ongoing coverage is required.
- Aerial surveys are limited in duration and highly dependent on aircraft fuel endurance and distances from suitable air strips based within practical range of survey locations.

Overall, aerial surveys for whale detections can be a useful addition to marine seismic survey mitigation methods. However, the additional risks associated with personnel spending significant periods of time in low flying aircraft, plus the significant additional costs of this method, combined with the restrictions to flights in poor weather conditions, makes this option less desirable as a real-time mitigation method for a seismic survey, especially when located in areas of frequent bad weather.

Drones

Using drones for whale research and detection has become an increasingly popular and effective method in recent years. Drones offer numerous advantages for studying and monitoring whales in their natural habitats. Here are some ways in which drones are utilised for whale monitoring:

1. **Aerial Surveys:** Drones equipped with high-resolution cameras can conduct aerial surveys over large ocean areas, making it easier to spot whales and other marine mammals from above. This approach is especially valuable for species that spend a lot of time at the surface, like humpback whales and southern right whales.

2. **Behaviour Observation:** Drones allow researchers to observe the behaviour of whales without disturbing them. They can document social interactions, feeding behaviours, breaching, and other activities, providing valuable insights into the lives of these animals.
3. **Population Monitoring:** By flying over known habitats or migration routes, drones can help researchers estimate whale populations more accurately. Traditional survey methods may miss some individuals, but drones can cover larger areas and improve counting accuracy.
4. **Identification:** Drones equipped with specialised cameras, such as thermal or multispectral sensors, can aid in identifying whale species based on unique markings, colour patterns, or heat signatures.
5. **Tagging and Tracking:** Some drones are equipped with specialised dart guns or tagging devices that can safely attach tracking tags to individual whales. These tags allow researchers to monitor the movements and behaviours of specific whales over time.
6. **Acoustic Monitoring:** Drones can also carry hydrophones or other acoustic sensors to record whale vocalisations, helping scientists study their communication patterns and track their presence in areas with low visibility.
7. **Environmental Research:** Drones can be utilised to collect water samples, measure sea surface temperatures, and study other environmental factors that may influence whale behaviour and distribution.

When using drones for whale detections, it is essential to follow ethical guidelines and regulations to minimise disturbance to the animals and their environment. Observers must maintain a safe distance from the whales and ensure that the drone's presence does not cause stress or disruption to the animals. Additionally, adherence to local laws and permits related to drone operations and wildlife observation is crucial.

Advantages of drones:

- Drones are a cost effective and safe means of visual detection of whales. One or more drones can be deployed from either the survey or a support vessel at any time to scan a large area of ocean from heights capable of spotting whales at considerable distances.
- Modern consumer drones have flight times in excess 40 minutes and ranges up to 20km, with real-time, high-definition video streamed back to the drone pilot’s video monitor or First Person View (FPV) goggles. Individual drones can be rotated as batteries are recharged, providing almost continual aerial monitoring, as long as flight conditions are suitable.
- Drones can be fitted with an additional infrared camera for use on low light or night detection flights. Some drones also include a laser range finder for accurate measurement of the geographic coordinates of a visual target.
- Drones can be quickly launched in response to acoustic whale detections to provide visual confirmation of presence and location of detected whales.
- Some drones can use dual controllers, with one controlling the flight while the other controls the cameras, allowing for MMOs to concentrate on species location and identification while the drone pilot focusses on the flight controls.
- Drones can be programmed to autonomously fly preset patterns around moving seismic vessels, such as circular flight paths at fixed offsets, or by using fixed routes around programmed geographic waypoints. They can also be used to scout well ahead of a seismic vessel along survey line transects, providing significant advanced notice of the presence of whales beyond the immediate mitigation zone.

- Drones can be used to electronically tag whales using drop tags to potentially add a valuable whale research data source during a seismic survey activity, in association with a third-party research organisation. This could result in improved PR for the survey operator.

Disadvantages of drones:

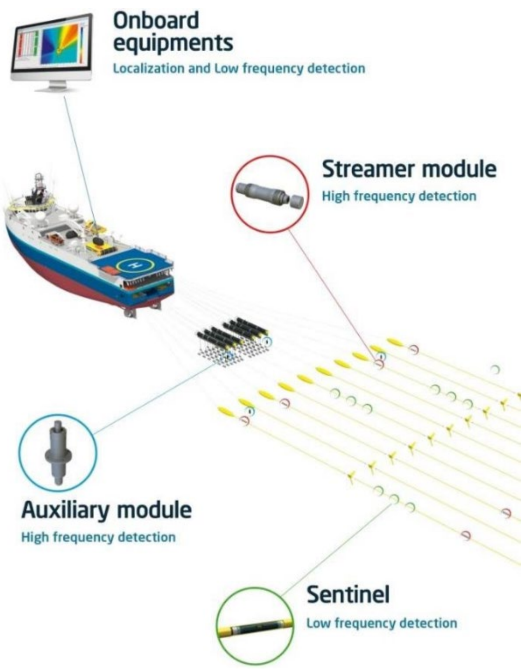
- Most drones cannot operate during periods of very poor weather, such as in strong winds or heavy rain although some high-end commercial drones, such as the DJI Matrice 30 and Autel Robotics EVO II Dual 640T Thermal drones, are weather resistant, including the controllers.
- Drones require trained pilots to get the best operational and safety performance from the aircraft. Pilots may also need to be trained as Marine Mammal Observers (MMOs) to aid in species identification and regulatory regimes. Alternately, MMOs may need to be trained as competent drone pilots.
- Drones can be subjected to attacks from bird species, causing loss of flight control and possible crash landings at sea.
- Drone flight limes are limited by battery life and regular landings are needed to replace batteries.

Vendor Equipment Reviews

Towed PAM

Sercel QuietSea

Conventional PAM (Passive Acoustic Monitoring) systems are composed of a separate PAM antenna at sea with a limited number of sensors. The Sercel system is an innovative PAM system integrated in the seismic acquisition system: for low-frequency detection, it is using up to 384 seismic hydrophones of the streamer sections and for high-frequency detection, up to 120 dedicated broadband hydrophones also integrated in the streamers (QuietSea Streamer Modules) and below impulsive source array (QuietSea Auxiliary Modules, intended to improve detection in the vicinity of the source).



This integrated system offers numerous advantages: good coverage of the exclusion zone (centered on the source) by many sensors, high precision of the marine mammal localization (by the mean of sensors positioning in real-time), reduction of the risk of accidents during deployment, easy retrieval and operation (no separate antenna at sea) and thus, significant reduction of operational downtime and possible equipment replacement costs.

Assessment Criteria	Comment
Availability	Immediate. Will be pre-installed on the survey vessel prior to mobilisation for the survey
Prior deployment histories and reported effectiveness.	Has been used worldwide since 2016 with demonstrated success.
Practicality of implementation	Easily implemented based on historical use
Safety & environmental concerns	No concerns raised
Cost versus benefit	Will be incorporated in survey activity budget. Benefits outweigh costs.

References

- https://www.sercel.com/products/pages/quietsea.aspx
- https://www.sercel.com/products/Lists/ProductSpecification/QuietSea_brochure_Sercel_EN.pdf

Seiche Towed PAM

The base system comprises a towed array cable, deck cable, electronic processing unit including data acquisition devices, computer and headphones. The physical spacing of hydrophones and the frequency response of the system provides optimal performance and the acoustic detection of species of interest. PAMGuard software is integrated as standard. Equipment is provided with 100% back-up.

The system can be readily configured to suit the project requirements. The array section includes either four or six hydrophones arranged in pairs of calibrated hydrophone channels with low noise preamplifiers, identical sensitivity and frequency response. An array depth sensor is integrated at the rear of the array. A 230 m heavy tow cable with a detachable 20-25 m array section may be preferred for harsh environments. A networked PAM station is available to enable the PAM system to be monitored and controlled from the most convenient location onboard.

Assessment Criteria	Comment
Availability	Systems available with advanced shipping notice ex-UK and USA
Prior deployment histories and reported effectiveness.	Many years of prior use on seismic surveys worldwide
Practicality of implementation	Practical for use on support or supplementary PAM vessels. Survey vessel will have Sercel QuietSea fitted.
Safety & environmental concerns	No significant concerns other than the need for additional in-water equipment deployment and recovery, with the potential for entanglement and personnel exposure to deck equipment.
Cost versus benefit	Cost of equipment and additional PAM operator personnel is not prohibitive

References

- https://www.seiche.com/underwater-acoustic-products/acoustic-sensors/towed-pam/
- https://www.seiche.com/wp-content/uploads/2022/10/Seiche-Data-Sheet-Towed-PAM.pdf

Tethered PAM

Sercel Buoy Solution

Automated & Real-time detections via QuietSea algorithms

- Connected via IRIDIUM or 4G
- Harbour porpoise detector available
- Other species under development
- Raw data available for post-processing 〉 High level integration
- Detections are visible on the seismic vessel

Specifications

- Diameter: 1200mm
- Height: 2182 mm
- Weight: 210 kg (without the anchoring)
- Navigational Aid: LED Lantern, AIS Transponder, Real Time GPS tracker
- Telemetry: AIS, Iridium, 4G and Wi-Fi as needed and relevant.

Assessment Criteria	Comment
Availability	Sercel are currently building 4 x buoys for potential deployment as a trail in the Regia 3D survey area.
Prior deployment histories and reported effectiveness.	No history of use during seismic surveys. One prototype buoy in use in the UK for Harbour Porpoise detection trials.
Practicality of implementation	Potentially expensive to ship from Europe and deploy/recover in Victorian waters due to size and weights..
Safety & environmental concerns	None
Cost versus benefit	Unknown cost element but potentially advantageous pricing due to the CGG/Sercel business association and beta test status of the units.

Seiche Modular Buoy Systems

The Modular Buoy Detection System uses Passive Acoustic Monitoring (PAM) to provide a flexible approach to monitoring vocalising marine mammals and underwater noise.

The system consists of a remote moored buoy with a multi-element detachable hydrophone array suitable for mitigation and anthropological noise capture. Signals can be captured up to a sampling rate of 500 ks/s at 16 bit depth. The system can be configured to record the data locally within the buoy or remotely at the receiving station, whichever is required.

Further options include:

- Remote on/off via Radio Frequency (RF) link (868 Mhz)
- Real-time remote monitoring of audio via RF link (2.4 Ghz)
- Truly global remote control via Iridium
- Truly global GPS via Iridium

Telemetry

The buoy has the necessary components to transmit signals received at the hydrophone (PAM data) to the survey vessel, as well as transmitting position information (from an Iridium GPS receiver on board the buoy).

- The telemetry system for the PAM data operates in the 2.4 GHz band
- The position telemetry system operates in the 1–2 GHz band
- The remote power control system operates in the 868 MHz band

Hydrophone

Due to the modularity of the array sections, Seiche can provide custom-made array sections to suit specific needs. However, we also offer an off-the-shelf option with the following specification:

- • Hydrophone element H1
- • Super Broadband 10 Hz to 200 kHz (3 dB points)

Assessment Criteria	Comment
Availability	Unknown availability. No response received from Seiche at time of writing.
Prior deployment histories and reported effectiveness.	Unknown for seismic surveys but many commercial deployments quoted.
Practicality of implementation	Use of RF audio data telemetry, rather than satellite-based, may prove problematic due to distances involved between deployed locations and survey line lengths. However, if the effective operating range is beyond the required detection range it may be possible to deploy an array of buoys to provide continuous coverage around the survey area.
Safety & environmental concerns	None
Cost versus benefit	Unknown cost but likely not prohibitive for the project.

References

- https://www.seiche.com/wp-content/uploads/2022/10/Seiche_Modular-Buoy-Detection-System-Data-Sheet.pdf
- https://www.seiche.com/modular-buoy-systems/
- https://www.seiche.com/underwater-acoustic-products/specialist-systems/satellite-remote-pam/
- https://www.seiche.com/wp-content/uploads/2020/01/Eco-2015-Remote-PAM-new.pdf

JASCO Ocean Observer Buoy

A compact and powerful system for real-time passive acoustic monitoring (PAM), acoustic data collection, and non-acoustic measurements. Based on JASCO's OceanObserver electronics suite, it records data to removable memory with two classes of real-time telemetry options:

- Stream full bandwidth data via Wi-Fi, cellular, or VHF (short range, lifetime of days or weeks)
- Transmit processed information products via Iridium (long range, lifetime of weeks or months)

Collects data from acoustic and non-acoustic sensors and supports a variety of sensor and array options. Transmits full bandwidth data to nearby vessels or shore stations or performs in situ processing to transmit results via satellite, including marine mammal calls and clicks, pitch tracks for validation, vessel noise quantification, and ambient noise statistics. Typically fitted with up to three hydrophones, GPS, AIS, and Wi-Fi. Can be moored or free drifting.

Specifications

Mass:	45 kg , 99.3 lbs
Dimensions:	(D × H*)24 × 77 in [610 × 1956 mm]
Main platform:	JASCO Ocean Observer electronics suite
Local telemetry:	Wi-Fi, cellular, VHF
Global telemetry:	Iridium
Acoustic sensors:	Omnidirectional hydrophones
	Directional sensors
	Small linear or spatial arrays

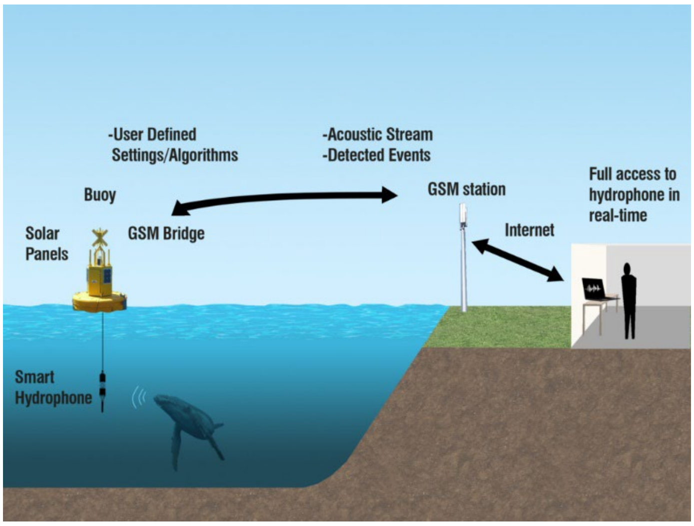
Hydrophone suspension:	Straight cable or inverse catenary
Battery pack:	96 alkaline D-cells (internal)

Assessment Criteria	Comment
Availability	Unknown
Prior deployment histories and reported effectiveness.	Unknown
Practicality of implementation	Similar in size and functionality to the Seiche buoys, the Jasco units would be no less practical to deploy and operate. The use of satellite telemetry to transmit "in-situ processing" needs to be clarified as far as time lag between detection and receipt of notification at the monitoring station. Otherwise the use of VHF telemetry to the survey (or ancillary) vessel limits the real-time detection range to around 30km.
Safety & environmental concerns	None
Cost versus benefit	Costing has yet to be confirmed but it is unlikely to be prohibitive for the project.

References

- https://www.jasco.com/oceanobserver
- https://www.jasco.com/observerbuoy-06m
- https://static1.squarespace.com/static/52aa2773e4b0f29916f46675/t/5df143c8bfd22d29920ce88e/1576092617380/Datasheet_OCEANOBS-0.6M.pdf

PAM Smart Buoy



A Passive Acoustic Monitoring (PAM) Buoy offers real-time acoustic monitoring with a smart hydrophone, environmental data buoy and global system for mobile (GSM) communications bridge. When deployed in the ocean, the PAM Smart Buoy captures sounds from the surrounding environment and facilitates real-time acoustic data transmission.

Ocean Sonics' icListen Kayak new architecture is compact, energy efficient and scalable. This Smart Hydrophone has a wide dynamic range for high quality data & long term stability. This all-in-one instrument processes data while streaming HD acoustic data in real time. It is configured to keep all raw data or keep only data of specific frequency set by the user.

Key Features of Ocean Sonics icListen Kayak Hydrophone

- Passive Acoustic Monitoring (PAM)

- Bandwidth 10 Hz to 200 kHz
- 24-bit Resolution
- Very High Sensitivity
- Ultra Low Noise Sensing Element
- Extra Low Power, 0.2W
- Scalable – can be used in arrays of up to 100 hydrophones

Assessment Criteria	Comment
Availability	Unknown. No response received from vendor enquiry. Vendor based in Cyprus, so potentially an issue.
Prior deployment histories and reported effectiveness.	As above, no response received.
Practicality of implementation	This system utilises GSM data telemetry, so not practical outside GSM coverage areas.
Safety & environmental concerns	None
Cost versus benefit	Unknown cost of equipment of shipping.

Unmanned Vessel PAM

Autonaut USV

The AutoNaut is an uncrewed surface vessel (USV) propelled forward by the motion of the waves. Patented Wave Foil Technology enables long-term mission duration. Powered entirely by renewable energy and with no requirement for offshore personnel the AutoNaut significantly reduces costs and safety risks at sea. Solar energy powers an extensive range of sensors and equipment for 24/7 operation.

- Uncrewed operation: no offshore personnel at risk
- Powered by renewable energy: no fuel costs, no emissions
- Mission duration of several months
- Station keeping within 25 metres
- Storm-proven robustness
- Simple deployment/recovery from vessel or slipway
- Flexible payload and sensor capacity
- Data transfer

SENSORS

Seiche analogue array

The Seiche analogue array incorporates two hydrophone sensors and a depth gauge. It is 30m in length and has been designed for minimal flow noise and simple deployment.

Seiche digital thin line array

This high-sensitivity acoustic array is fully configurable in real-time. Eight digital hydrophone sensors are incorporated within the 25metre array.

Additional sensors

Additional sensors can also be incorporated for supplementary meteorological and oceanographic data as well as visual imaging.

Assessment Criteria	Comment
Availability	Unknown
Prior deployment histories and reported effectiveness.	Unknown
Practicality of implementation	Unknown

Safety & environmental concerns	None
Cost versus benefit	Unknown

OceanObserver on the Slocum Autonomous Underwater Glider

JASCO Applied Sciences has teamed with Teledyne Webb Research to integrate JASCO's OceanObserver™ intelligent acoustic monitoring system into the Slocum underwater glider. The buoyancy driven Slocum glider gathers data as it rises and dives in the water to propel itself forward. The Ocean- Observer system onboard records the underwater sounds while running automated cetacean detectors that flag possible marine mammal calls or other events of interest. The glider surfaces at specified intervals to send the flagged events to shore, where analysts can review and confirm the detections. All data are recorded on 6 TB of removable SD memory cards for full analysis upon retrieval.

Customized Detections and Processing

JASCO's experienced bioacousticians tailor the detection algorithms to the species and call types of your choice. Concurrent detections are associated to provide con-textual information for onshore analysts. During times of high glider self noise, the processing algorithms can be disabled to minimize false alarms, reducing personnel workload and maximizing satellite bandwidth use.

Intelligent Communications

The processed events are prioritized so that important events, like detections of species at risk, are sent first, making best use of the communication window. The event information is then distributed by email. The durations of the event time windows vary, and events are aggregated as ensembles, to maximize the contextual information available to analysts.

Detailed Detection Contours

The acoustic data, and even spectrogram images, are too large to be sent by satellite. So the Observer converts the detection spectrograms into frequency contours that are small enough to be relayed via satellite. Superior to pitch tracks, the contours give a richer representation of the data for easier, more accurate species detection and identification.

Customized Onboard Processing

Marine mammal call detectors for baleen whales, toothed whales, and pinnipeds

Various call types, including moans, whistles, and clicks

Seismic pulse detection and quantification

Ambient sound level calculations

Communication

Telemetry via Iridium (RUDICS) satellite

Detection information distributed via email to end users

Technical Specifications

Acoustics
Sample rate: 8–512 ksps
Resolution: 24 bits
Hydrophone: Customizable options from various manufacturers.
Sensitivities and frequencies tailored to your needs.

Physical
Mass: 55–70 kg 122–155 lbs
Length: 1.5 m 59.1 in
Hull diameter: 220 mm 8.7 in
Maximum depth: 1000 m
Horizontal speed: 0.35 m/s (0.68 knots) average
Up to 0.5 m/s (1 knots) with full drive

Assessment Criteria	Comment
Availability	Slocum Gliders are in use worldwide for various applications and availability is not expected to be an issue.
Prior deployment histories and reported effectiveness.	Has been used for whale detections previously. Unknown for use during a seismic survey.
Practicality of implementation	System can be deployed from the survey or a support vessel by one or two persons.
Safety & environmental concerns	None
Cost versus benefit	Unknown cost of implementation.

Camera-Based Systems

Seiche Smart Visual Detection System (SVDS)

The SVDS camera system consists of: High-Definition Video (HDV) and Long-Wave Infrared (LWIR) & thermal imaging camera pair, with on-board processing and storage. Each unit is housed robustly for maritime use. Various configuration options are available to ensure optimal visual coverage and ranges up to 360 degrees.

The new generation camera system builds on decades of experience of visual and underwater acoustic maritime monitoring combined with technologies originally found in self-driving vehicles. The cameras are more robust, compact, and lighter, making them easier to ship, and install, thereby reducing operational costs. Boasting lower power consumption and 1000x more powerful computing than the previous generation systems, the new cameras are capable of real-time on-board automated detection. For improved data security our cameras have built-in encrypted SSD storage to allow continuous data capture even during network interruption or observer workstation down time. The improved pan and tilt system allows for user configurable automatic scanning of an area up to 360 degrees.

General

- Modular customisable configurations
- Optional mounting systems
- Portable system deployed in hard case
- Fully marinised waterproof housing IP68 (pending certification)
- Hydrophobic glass
- Operating Temperature Range: -30°C to 70°C (pending certification)
- Shock: 1,500 g @ 0.4 msec (pending certification)
- Operating Voltage 19-30 VDC / supply voltage AC 110-240V
- Power consumption: Low power mode 20W Nominal 35W, Max Peak 135W
- On board GPU image processing 32GB on system storage
- On board Dual 4TB storage, main and encryption backup
- Networked removable storage up to 100TB
- Wi-Fi & satellite connectivity available on request
- GigE connectivity

- External triggers available 3.3V, 5V, 12V, serial optional protocol upon request
- Optional Workstations
- Built in 48 Channel GPS
- IMU orientation +/- 0.1°
- 360-visual scan with PTU

Software

- Mysticetus software compatibility
- Fast logging
- Auto detection (customised training dependant)
- Radar map visualisation with built in antenna for target location
- Automatic ranging – accurate target range estimation

RGB Camera: Standard RGB camera

(Optional upgrades):

- Sensor: 1/2.3 CMOS SONY IMX392
- Resolution: 2.4MP
- Array Size: 1920x1080
- Pixel Size: 3.45µm x 3.45µm
- Dynamic Range: 48dB
- Shutter Type: Global Shutter

Thermal camera:

- Thermal sensitivity: <40mK
- Pixel Pitch: 12 µm
- Full Frame Rate: 60 Hz
- Array size: 640 x 512
- f-number: 1.0
- Continuous Electronic Zoom: 1X to 8X zoom
- Spectral Range: Long-wave Infrared; 7.5 µm – 13.5 µm
- Scene Dynamic Range: to 140 °C (high) to 500 °C (low)

References

- https://www.seiche.com/underwater-acoustic-products/specialist-systems/thermal-imaging-hd-camera/
- https://www.seiche.com/wp-content/uploads/2022/10/SVDS-Flyer.pdf
- http://digital.ecomagazine.com/publication/?i=648052&article_id=3590822&view=articleBrowser

Assessment Criteria	Comment
Availability	TBA

Prior deployment histories and reported effectiveness.	TBA
Practicality of implementation	The only limitation could be the ability to mount the camera in a position of unobstructed 360 degree visibility due to ship or USV masts.
Safety & environmental concerns	None
Cost versus benefit	TBA

WhalePOD

Introduction

WhalePOD is a bespoke thermal and colour camera system integrated with artificial intelligence, designed for automatic detections, ranging, and an intuitive software interface tailored for marine mammal detection and compliance reporting. What sets WhalePOD apart from other visual detection systems is our distinct camera platform design and approach. As we developed WhalePOD's camera platform to be deployed on vessels, our emphasis has been on achieving both long-range and high-speed panoramic coverage, day and night.24/7 automated detection of whale surfacing at sea.

Last month, we concluded a shore field trial of WhalePOD during the northern migration at North Stradbroke Island. The preliminary results are outstanding. To illustrate, during a night shift on 11 July, between 1 am and 4 am, I observed 40 whale surfacing events using our thermal camera, at distances ranging from 2 km to 4 km. In daylight, whale blows were visible from well over 10 km away. The system's ability to comprehensively cover an area without compromising detail was crucial in capturing these brief surfacing events. (*pers comms - Aqeel Akbar, Founder & Director, Thaum*)

Description

WhalePOD is an AI-centric product co-designed with regulators, industry, and researchers.

WhalePOD seeks to define a new gold-standard for ESG monitoring. We are aligning business outcomes with responsible stewardship and sustainability.

Feasibility Study: Awarded AUD $100k grant from NOPSEMA and AAD via BRII Priority Sectors, January 2020

ON Accelerate 7: WhalePOD completes Australia's premier deep-tech accelerator run by CSIRO, Feb-May 2023

Thaum, a startup team from the ANU Research School of Physics deep-tech incubator Momentum, is commercialising WhalePOD – a technology to enable a new age of industrialisation where environmental conservation and scientific contribution is an outcome of business, not a burden.

WhalePOD’s disruptive vision capabilities help offshore industries implement harm mitigation strategies to protect marine mammals.

The core platform technology is a high-performance, panoramic, thermal and colour camera that uses artificial intelligence for 24/7, all-weather, and long-range detection of objects of interest in harsh marine environments.

Assessment Criteria	Comment
Availability	Thaum has indicated likely commercial availability in early 2024
Prior deployment histories and reported effectiveness.	Currently under testing for commercial deployment
Practicality of implementation	Unknown due to early stages of commercialisation
Safety & environmental concerns	None
Cost versus benefit	Unknown but unlikely to be cost prohibitive for the potential benefits of system deployment.

Aerial Drones

DJI Matrice 30T (thermal)

The new DJI Matrice 30 Series is DJI Enterprise's flagship drone that fits in a backpack. It integrates multiple high-performance sensors into one single camera payload, controlled with an ingenious redesigned remote control and runs on upgraded Pilot 2 software, which significantly improves the flight experience.

The M30 model offers much more power, endurance and capability for rugged professional uses, while its size makes it ideal for easy transportation and fast setup.

The DJI Matrice 30 series enterprise drone is a weather-proof, relatively portable UAV that offers a 48 MP stabilized camera with up to 200x hybrid zoom, thermal imaging camera, laser rangefinder, and a low-light optimized FPV camera. It comes with a new rugged DJI RC Plus controller. On top of that, an optional DJI Dock is able to automatically operate up to 7km away and charge the drone quickly when needed.

The M30 series comes in two versions, the M30 and the M30T. (Both versions are using a fixed payload system) The only difference is that the M30T also includes a thermal imaging camera. The use cases for this drone range from equipment inspection to seek-and-rescue types of missions.

The M30 model integrates a 48 megapixel 1/2” CMOS sensor zoom camera with 5×~16× optical and 200× digital zoom, a 12-megapixel wide-angle camera, 8k photo 4K/30 fps video resolution, and a laser rangefinder that can give the precise coordinates of objects up to 1,200 meters away.

Despite having integrated payloads, the Matrice 30 Series will continue to support PSDK integration for third-party payload development, including spotlights, loudspeakers, gas detectors, parachutes, and more.

It’s clear DJI wants to revolutionize drone operations by extending flight time and use, regardless of the environment. When equipped with two TB30 intelligent batteries the new Matrice 30 Series drones offers up to 41 minutes of flight time. The self-heating feature of the TB30 batteries helps the M30 stay functional in extremely cold environments.

As part of the M30 Series kit, DJI launched the BS30 intelligent battery station, which can charge 4 pairs of the TB30, at three different levels: standard, storage, and ready to fly. Each level maintains differing charge capacities:

- **Standard:** Charges batteries to 90% in 30 minutes.
- **Storage:** Maintains batteries at 50% for a longer lifespan and overall health.
- **Ready to Fly:** Maintains full charge for immediate hot-swap during operation.

Key Features:

Wide Camera

- Equivalent Focal Length: 24 mm, DFOV: 84°
- 12 MP 1/2" CMOS Sensor
- Video Resolution: 4K/30fps
- Zoom Camera
- 48 MP 1/2" CMOS Sensor
- 5×-16× Optical Zoom
- 200× Max. Hybrid Zoom
- Photo Resolution: 8K
- Video Resolution: 4K/30fps

Thermal Imaging Camera

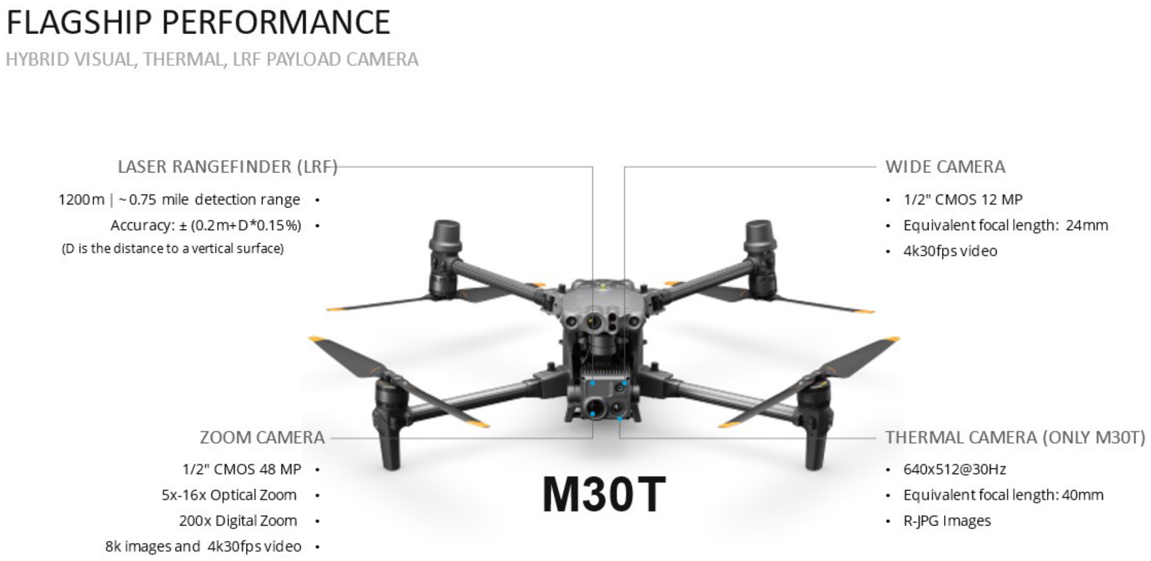
- Equivalent Focal Length: 40 mm
- Resolution: 640×512
- Frame Rate: 30fps
- Measurement Accuracy: ±2°C or ±2%
-
- Laser Rangefinder
- Range: 3 m - 1200 m
- Accuracy: ±(0.2m+D×0.15%)

Powerful Flight Performance

- A balance of power and portability delivers higher operational efficiency. Max Flight Time: 41-min
- Wind Resistance: 15 m/s
- Service Ceiling: 7000 m
- Max Speed: 23 m/s

Environmental Adaptability

- With IP55 protection, the M30 can easily handle adverse weather and temperatures ranging from -20° C～50° C.



FLAGSHIP PERFORMANCE
HYBRID VISUAL, THERMAL, LRF PAYLOAD CAMERA
LASER RANGEFINDER (LRF)
1200m | ~0.75 mile detection range
Accuracy: ± (0.2m+D*0.15%)
(D is the distance to a vertical surface)
WIDE CAMERA
1/2" CMOS 12 MP
Equivalent focal length: 24mm
4k30fps video
ZOOM CAMERA
1/2" CMOS 48 MP
5x-16x Optical Zoom
200x Digital Zoom
8k images and 4k30fps video
THERMAL CAMERA (ONLY M30T)
640x512@30Hz
Equivalent focal length: 40mm
R-JPG Images
M30T

Assessment Criteria	Comment
Availability	Available from several Australian vendors or direct from DJI
Prior deployment histories and reported effectiveness.	No available data on use for whale sighting missions but demonstration video footage of night search and rescue of people in the ocean would suggest whales would also be sighted using the thermal image camera when at the sea surface.
Practicality of implementation	Should be easily implemented with flights based to and from the survey vessel helideck. Need to check the potential for registering moving platform automated Return To Base (RTB) in the event of communications failure.
Safety & environmental concerns	None identified
Cost versus benefit	Relatively inexpensive drone purchase price at ~AUD18K. Cost of an additional contract drone pilot, if required, including bunk space & meals, may prove more costly and logistically restrictive.

Autel EVO II Dual 640T Enterprise

The Autel Robotics EVO 2 Dual 640T V3 is one of the most compact and advanced thermal drones on the market. Featuring a 640x512 radiometric thermal sensor and 50MP RGB lens with 16x digital zoom - it is easy to observe distant targets in amazing detail. The system uses a new image processing algorithm making thermal imaging details clearer and more discernible than competition with the similar resolution and hardware. With a 38-minute flight time and 9.3-mile transmission range - the EVO 2 Dual 640T V3 is a powerful tool professionals can use to get the job done right!

Thermal Camera

The thermal camera is equipped with a 13mm focal length lens and the ability to record at 640 x 512 resolution at 30 Hz. In dangerous situations, you can keep the drone back as you use 16x digital zoom with 4x lossless zoom to find what you're looking for. The V3 thermal image is designed to better display discernible differences and detail. Keep reading to view the array of thermal modes and features the EVO II Dual 640T offers, in addition to its thermal detection, recognition, and identification ranges:

- Central temperature measurement: View real-time temperatures in the center of the remote's display.
- Spot temperature measurement: Tap the remote's display and view an object's temperature in real time.
- Regional temperature measurement: A dynamic view of average, minimum, and maximum temperatures.
- Ten thermal color palettes: White Hot, Cold and Hot, Rainbow, Enhanced Rainbow, Ironbow, Lava, Arctic, Searing, Gradation, and Heat Detection.

- Picture-in-picture display mode: View visual and thermal imaging at the same time.
- Temperature alarm: This will monitor a set temperature in real time and set off an alarm if reached.
- Isotherm: Set a temperature range and the system will detect any object in view that's within that range.
- Image enhancement: Real-time adjustment of the thermal image brightness, contrast, and details; the system will highlight any object within the target temperature.
- Infrared thermal analysis tool: The IRPC tool quickly imports images, edits and analyzes temperature measurements, and generates detailed reports for sharing and collaboration.
- Detection range: Detects a person up to 0.34 miles away, an SUV from up to 1.03 miles away, and a truck from up to 1.8 miles away.
- Recognition range: Recognize if an object is a person from up to 443' away, an SUV from 0.26 miles away, and a truck from up to 0.45 miles away.
- Identification: Identify a person from up to 223' away, an SUV from up to 682' away, and a truck from up to 0.22 miles away.

Visual Camera

Inspections and rescues are not the only things you can do with your EVO II Dual 640T. The 50MP visual camera is capable of capturing stunning professional footage at 4K HDR resolution. With its 0.8" RYYB CMOS sensor instead of a traditional RGB sensor, the larger surface area delivers a high level of detail in high-contrast lighting conditions. Dynamic tracking shots are possible with the quick focusing of the PDAF+CDAF system, and low-light scenes will be clearer thanks to the moonlight algorithm 2.0's increased noise suppression.

Smart Controller V3 with SkyLink 2.0

Utilizing SkyLink 2.0, the Smart Controller V3's built-in 7.9" display can receive HD video transmission in flight from up to 9.32 miles away (or QHD quality from up to 0.62 miles away). Reception is engineered to be stable and interference-free, thanks to triple-band (900 MHz, 2.4 GHz, and 5.8 GHz) frequency hopping. Thanks to the display's 2000 cd/m² brightness, you can easily view the drone's footage, even in direct sunlight. You're not restricted to flying on sunny days, though. The Smart Controller V3 can withstand -4 to 104°F temperatures and is IP43-rated for all-weather performance.

360-Degree Obstacle Avoidance

While in flight, an array of 19 sensors, including 12 visual sensors, the main camera, ultrasound IMUs, and more, can build a 3D map of the drone's surroundings and plan a clear path to its destination in real time.

Additional Features

- Foldable design
- Can deploy and take off in under a minute
- Up to 38 minutes of flight time
- Up to 39 mph of maximum wind resistance
- Maximum flight speed up to 45 mph

- Maximum payload up to 2 lb
- Can be flown even if the firmware and app are not fully updated
- Without built-in fly zones, nothing prevents you from taking off when needed
- The EVO II Dual 640T is not under the United States ITAR (International Traffic in Arms Regulations)
- Compatible with optional Live Deck 2 for broadcasting live mission intel

Assessment Criteria	**Comment**
Availability	Available from at least one Australian vendor or from Autel based in Honk Kong or Shenzen.
Prior deployment histories and reported effectiveness.	No available data on use for whale sighting missions but demonstration video footage of night search and rescue of people in the ocean would suggest whales would also be sighted using the thermal image camera when at the sea surface.
Practicality of implementation	Should be easily implemented with flights based to and from the survey vessel helideck. Need to check the potential for registering moving platform automated Return To Base (RTB) in the event of communications failure.
Safety & environmental concerns	None identified
Cost versus benefit	At ~ AUD$10K the Autel 640T is less costly than the DJI M30T but lacks some of the DJI technology, like laser ranging and 200X image zoom. Cost of an additional contract drone pilot, if required, including bunk space & meals, may prove more costly and logistically restrictive.

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Control Measures and Environmental Performance

Appendix G1: REG-EP-035-G1

Rev 2

May 2024

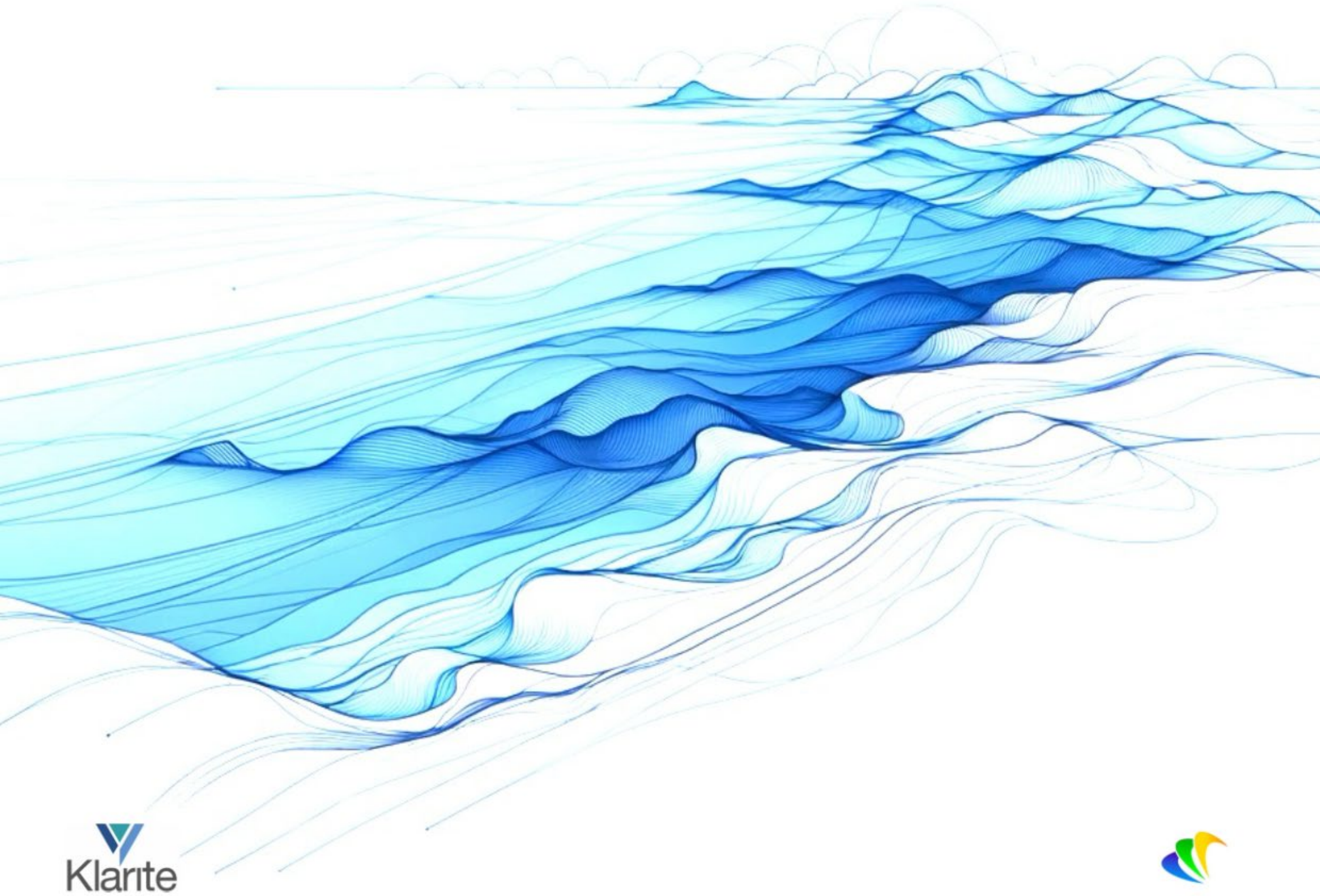

Table of Contents

1 Introduction

This document provides the details of the control measures and environmental performance required of the Regia Marine Seismic Survey (**Regia MSS**) to ensure that environmental impacts and risks will be reduced to As Low As Reasonably Practicable (**ALARP**) and to below an acceptable level. As such, this document will be periodically updated throughout the impact and risk assessment, and because of the consultations. The document will remain a live and public document to provide transparency to the community about CGG's environmental performance.

This document details the control measures and environmental performance adopted after the ALARP assessment. For information on the additional or alternative control measures considered throughout the environmental management process please refer to Appendix F2 – ALARP Assessment.

This document is intended to demonstrate compliance with the following Regulations:

- Section 21 (5)(c)
- Section 21 (7)

In this document, each control measure is evaluated against criteria of functionality, availability, reliability, survivability, independence, and compatibility with other measures, ensuring a multi-faceted approach to risk management.

2 Aspect Specific Relevant Person Objections and Claims

The following feedback was received during the preparation of the EP and has been used to inform this analysis and the overall assessment of environmental impacts and risks arising from the Regia MSS. The consultation sought to improve the predictive quality of the assessments by encouraging relevant persons and the public to share their environmental values and sensitivities. Feedback was invited on the draft impact and risk analysis and no feedback was provided on the mitigation measures, or the ALARP assessments conducted in these documents.

Whilst these was no feedback on the proposed measures in the draft analyses, there are many measures adopted because of the consultation that occurred in the preparation of the Regia MSS. Some of these appear in the Environment Plan (**EP**) as control measures or environmental performance standards (**EPS**) and can be shown to generally mitigate or otherwise manage the possible consequences on a relevant person's functions, interests, and activities. Table G1-1 has a column which indicated the EPSs that were adopted because of the consultations.

Further, Annex 4 shows the how the control measures adopted for the Regia MSS generally address the subject-centred groups consulted. This analysis shows that there is good coverage across the control measures with a high reliance placed on the Adjustment Protocol to function properly.

Further analysis of the appropriateness of measures adopted because of the consultations can be found in Appendix C1.

2.1 Public Comment

The following consultation feedback was received since the beginning of the public comment period starting 25 January 2024. As this feedback relates to a control measure, the Fauna Management Plan (FMP), details of how this feedback has been incorporated into the FMP are stated in this parent document, in Table G1-2 below.

Table G1-2-1 - Public comment input

<table>
<tr><th>Matter</th><th>Matter ID</th><th>Changes made arising from public comment</th></tr>
<tr><td>Matter: Impacts on fin and sei whales</td><td>M36</td><td>EP Appendix G2 (Fauna Management Plan) has been updated to include species exhibiting biologically important behaviours, being Fin and Sei Whales.</td></tr>
<tr><td>Matter: MFOs/MMO's do not have a 360-degree view, the use of one MFO/MMO is inadequate.</td><td>M45</td><td>CGG has considered these claims and has determined that additional MFO coverage is appropriate to further mitigate the potential for whales to go undetected within the 3 km observation zone. Consequently, CGG has has updated EP Appendix G2 (Fauna Management Plan), EP Appendix F3 (Acceptability Assessment) and EP Appendix G1 (Environmental Outcomes) to include an additional MFO/ PAM operator will be present on the vessel to support fatigue management. In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be onboard a dedicated spotter vessel at all times. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals.</td></tr>
<tr><td>Matter: Limitations of MFOs/MMOs when detecting marine mammals</td><td>M43</td><td rowspan="2">CGG has considered these claims and has updated EP Appendix G2 (Fauna Management Plan), G1 (Environmental Performance) and F3 (Acceptability Assessment) to include an additional MFO/ PAM operator to ensure fatigue management is appropriately addressed with allowance for 24/7 coverage.</td></tr>
<tr><td>Matter: The use of two PAM operators is inadequate.</td><td>M49</td></tr>
</table>

Matter	Matter ID	Changes made arising from public comment
Matter: Impacts on whales and whale songlines	FN05	CGG has considered these claims and the identified potential impacts and their measures concerning First Nations cultural values regarding whales has been added to Appendix G2, Fauna Management Plan, Annex 2.
Matter: Impacts to dive-based fisheries	F17	CGG has considered this claim and, based on the updated secondary sound modelling, has updated EP Appendix E8 (Impact Assessment – Underwater Sound: Surfers, Divers and Swimmers), Appendix A2 (Description of the Activity) and M#01: Activity limitation, to reflect that the sound source will not be discharged at full power from areas which result in an exceedance of the safety criterion for recreational divers, surfers and swimmers along the coastline. CGG has also made updates to modelling in Appendices (E1, E2, E3, E4, E5, E6, E7, F1 F3, G1 and G2.).
Matter: Mitigating sound exposure impacts to seabirds	B15	Clarification has been provided in EP Appendix E5 (Impact Assessment – Underwater Sound: Birds) and EP Appendix G2 that the acoustic source will be reduced to the low power setting if flocks of foraging birds are observed by the Marine Fauna Observer within 500 m of the source. Full power can commence when the seismic source is > 500 m from any flocks of foraging birds.

3 Definitions

The following definitions apply throughout this document:

Environmental performance means the performance of a titleholder in relation to the environmental performance outcomes and standards mentioned in the Environment Plan.

Environmental performance outcome (EPO) means a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.

Environmental performance standard (EPS) means a statement of the performance required of a control measure.

Control measure means a system, an item of equipment, a person or a procedure that is used as the basis for management of environmental impacts and risks.

4 Management and Mitigation Measures

There are five types of management and mitigations measures specified in the Regia MSS Environment Plan (EP). These are defined as follows:

Activity Limitations: A measure that constrains, limits, or otherwise restricts the activity such that impacts and risks can be avoided, or lessened to at or below acceptable levels.

Control Measures: Previously defined.

Environmental Performance Standard: Previously defined.

Legislative Requirement: A requirement of law, regulation, or guideline that applies to the activity and is relevant to the environmental management of the activity.

Management System Element: A responsibility, practice, process, or resource used to manage an environmental aspect of the activity, including monitoring and review of environmental performance.

The control measures and environmental performance standards adopted for the Regia MSS can be found in this document. Activity limitations can be found in Appendix A2. Legislative requirements can be found in Appendix B2. The management system elements can be found in Appendix B3. The adoption of these control measures follows the impact and risk evaluation process in Appendices F1, F2, F3, & F4.

Consultation with relevant persons often leads to management and mitigation measures being implemented, either to eliminate an impact altogether or ensure that impacts are managed to below acceptable levels. Throughout this document there is an indication of whether a control measure or environmental performance standard has been adopted because of the consultations and the subject-centred groups defined in Appendix A3 – Community Consultation and Engagement Plan.

5 Process for setting appropriate environmental performance.

Appropriate EPOs were set by taking the environmental aspects of the activity and linking them to a measurable level of performance of CGG in protecting the environment. Then, these levels of performance were checked for alignment with the defined acceptable levels to ensure that, if the EPO's are met, that the activity could be carried out in a manner by which the environmental impacts and risks of the Regia MSS would be of an acceptable level.

Then we decided on the control measures that would be required to ensure the EPOs could be met. A control measures is a system, procedure, item of equipment, or person that lessens levels of environmental impacts and risks.

Then, CGG is required to state the effectiveness of the control measures in the form of EPSs. These statements of performance need to consider the function, availability, reliability, survivability, independence, and compatibility of the control measures so that enough can be know about the levels of performance for NOPSEMA to monitor compliance of the activity against these standards.

Then, CGG is required to include the measurement criteria that will be used in our own efforts to monitor compliance of the activity against the EPOs and EPSs.

6 Environmental Performance Outcomes

EPOs set for the Regia MSS are as follows:

EPO 1. To ensure effective communication and engagement with relevant persons and local communities throughout the activity's lifecycle, fostering transparency, understanding, and responsiveness to their needs and concerns.

EPO 2. No death or injury to fauna, including listed threatened or migratory species, from the activity.

EPO 3. Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area.

EPO 4. Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.

EPO 5. No introduction of a known or potential invasive marine species.

EPO 6. To guarantee that all contracted vessels strictly adhere to international and national maritime regulations, including MARPOL, COLREGS, and specific Marine Orders.

EPO 7. To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment.

EPO 8. To establish and maintain a framework for Sea Country protection that manages the interaction of the activity with First Nations cultural values and sensitivities.

EPO 9. Interference with other marine users is of no greater extent than is necessary for the exercise of right conferred by the titles granted.

EPO 10. To establish and maintain an effective Oil Pollution Emergency Plan (OPEP) that ensures swift and efficient response to oil spill incidents, minimizing environmental harm, protecting sensitive ecosystems, and safeguarding human health and safety.

EPO 11. To align all staff and contractors involved in the activity to ensure environmental protections implemented in this EP can and will be met.

These EPOs have been set having had regard to the defined acceptable levels of impact and risk, previously accepted EP's, relevant CGG policies, the legislative requirements that apply to the Regia MSS, and the outcomes of the impact and risk assessments.

6.1 EPOs Link to Defined Acceptable Levels

It is good practice, and required by NOPSEMA's decision making guideline, to check and ensure that the EPO's set for the activity are clearly linked to the maintenance of environmental impacts and risks to below the defined acceptable levels of impact and risk for the activity.

Annex 2 provides a matrix of which EPOs are linked to defined acceptable levels of impact and risk. There are no defined acceptable levels without related EPOs. The defined acceptable level related to ensure affected persons will not be worse off because of the activity is highly reliant on the Adjustment Protocol and the associated communication of this control measure to commercial fishers.

6.2 Clearly linked to environmental aspects

It is good practice, and required by NOPSEMA's decision making guideline, to check to ensure that the EPO's set for the activity are clearly linked to the environmental aspects of the activity. Annex 3 examines the links between the environmental aspects of the Regia MSS and the EPOs. There are no environmental aspects without at least one EPO though the Adjustment Protocol for ensuring affected persons will not be worse off because of the activity is highly relied upon. Similarly, the Oil Pollution Emergency Plans are heavily relied on in the event of an accidental release of fuel.

6.3 Measurability

The EPSOs for the Regia MSS are measurable because they describe specific, observable results or changes that can be tracked and quantified. Each one is measurable because:

EPO 1: It focuses on the quality of communication and engagement, which can be measured through surveys, feedback forms, and the number of meetings or interactions with the community.

EPO 2: The absence of death or injury to fauna is a clear and quantifiable outcome. It can be measured by monitoring and recording incidents involving fauna.

EPO 3: The impact of sound emissions on whales can be assessed using acoustic monitoring data and behavioural observations of whales to ensure they continue to utilise their biologically important areas.

EPO 4: Biologically important behaviours can be monitored and recorded to ensure they continue during the seismic activity, which can be measured by direct observation or acoustic monitoring.

EPO 5: The introduction of invasive species is a quantifiable outcome, with prevention measured by regular inspections.

EPO 6: Adherence to maritime regulations is measurable through compliance audits and inspections of contracted vessels.

EPO 7: Ensuring activity within specified boundaries and technical requirements can be monitored using GPS tracking and compliance checks against the sail line plan.

EPO 8: The establishment of a framework for Sea Country protection is measurable through the creation of documented protocols and the frequency of consultations with First Nations representatives.

EPO 9: The extent of interference with other marine users can be measured by the number and nature of reported incidents or conflicts.

EPO 10: The effectiveness of an Oil Pollution Emergency Plan is measurable through drills, response times in emergencies, and the extent of environmental harm in incident reports.

EPO 11: The alignment of staff and contractors with environmental protections can be measured through training records, performance evaluations, and compliance rates.

Measurement criteria are discussed in Section 9 and Table G1-2 and each EPO can be linked to a specific target that can be evaluated using stated methods and metrics, ensuring that the environmental impacts and risks of the seismic survey are monitored and minimised.

7 Adopted Control Measures

The following sections of this document provide the details of the control measures adopted for the Regia MSS, as required by Section 21 (5)(c). Control measures are adopted to ensure that the EPO's can be met.

7.1 Consultation Management System (CMS)

The Consultation Management System (CMS) is designed to establish an organized and efficient process for consulting with and gathering feedback from relevant persons throughout the lifecycle of the activity. It includes procedures and tools to identify, engage, and respond to relevant persons, ensuring that their concerns and perspectives are considered and addressed.

7.1.1 Activity Consultation Plan

The CMS includes a consultation plan which ensure that relevant persons and local communities are informed about the progress of the activity at the frequency requested during preparation of the EP. There are various people involved in ensuring that the communications procedure is followed with the overall responsibility for ensuring the performance residing with the Environment Advisor.

7.1.2 Fisheries Liaison Officer (FLO)

The CMS includes the appointment of a Fisheries Liaison Office who will be in the region to be able to meet fishers in person to discuss the Regia MSS operational outlook and support fishers with claims under the Adjustment Protocol (Section 7.6)

7.2 Fauna Management System

The Fauna Management System is designed to safeguard marine fauna, with a primary focus on protection of Southern Right Whales (**SRW**s) and Blue Whales (**BW**), during the Regia MSS. This control measure employs various surveillance methods to detect marine mammal presence, assess their classification, monitor behaviour, and ensure the adaptation of the acquisition plan to minimize the impact of sound on these mammals.

7.2.1 Fauna Management Plan

CGG has developed a Fauna Management Plan (**FMP**) (Appendix G2) that governs the protection of marine fauna interactions with the survey. The FMP has clear guidance for pre-survey and on-water actions to protect marine fauna, along with shoreside support, decision, and review mechanisms to improve the fauna management system over time. The FMP has roles and responsibilities for staff involved in the protection of marine fauna and functions as the primary document that ensures the EPO's related to protection of marine fauna will be met.

7.2.2 Fauna Detectors

The Regia MSS will employ three types of fauna detectors; Marine Fauna Observers (**MFO**) and Passive Acoustic Monitoring (**PAM**) Operators who are on the vessel, and Acoustic Detection Monitoring (**ADM**) Operators who will be based ashore. All three of these roles collaborate through the Survey Environment Advisor (**SEA**) to correlate vocalizing marine mammals' identification and localization. The role of these people is crucial to ensuring compliance with environmental regulations and minimizing the impact of seismic survey operations on marine mammals, including SRW, BW, and other protected species. MFOs and PAM operators provide environmental expertise to the vessel crew, implementing various measures outlined in the EPBC Act Policy Statement 2.1, the Australian National Guidelines for Whale and Dolphin Watching 2017, and the FMP. They play a key role in mitigating risks associated with marine fauna interactions.

7.2.3 CGG Environment Officer

The CGG Environment Officer has multiple responsibilities related to the Regia MSS. These are fully described in Appendix B3. As it relates to the Fauna Management System, this position is responsible for coordination and updates of the SRW and BW Expert Panel as required, especially during detections and shutdowns. The Environment Officer will also coordinate and document reviews of the FMP's effectiveness and compliance and develop its implementation plan with inputs from various stakeholders. Before the Regia MSS begins, it is crucial to ensure all FMP implementation requirements are established. Reviews of the FMP's effectiveness and compliance are scheduled within the first week and every four weeks thereafter during the MSS. Additionally, the Environment Officer will create training materials to communicate FMP requirements and provide an overview during the Regia MSS induction. The daily FMP reports must be reviewed to ensure compliance, and the officer will support the Survey Environment Adviser as needed.

7.2.4 Fixed Buoy Acoustic Detection

A series of fixed buoys (no less than 3) will be installed prior to the survey. The buoys are fitted with equipment for real time reporting of whale species and location. The buoys will be tuned to be able to detect low low-frequency whales such as BW and SRW. Prior to deploying acoustic detection systems, they are subjected to testing to validate their reliability. These tests are specifically designed to confirm their capability to detect whales, including those emitting low-frequency calls. However, it is acknowledged that the detection of marine mammals through acoustic means is contingent upon their vocalisation. The location of the fixed buoy detection system will be determined based on recommendations from the SRW and BW Expert Panel.

7.2.5 Aerial Surveillance

Complementing vessel-based observations and acoustic monitoring, aerial surveys are another component of CGG's multifaceted approach for detecting whales and will be used to detect the movement of SRW into and out for the coastal reproduction and the movement of BWs into and out of the Otway area. Deployment of aerial surveillance is largely determined through recommendations of the SRW and BW Expert Panel associated with the Regia MSS.

7.2.6 Expert Panel

CGG will establish an expert panel of independent and qualified experts in SRW and BW. This expert panel is required to review and advise on the FMP Implementation Plan prior to survey commencement. The panel will also assist CGG in responding to the dynamic situations that are likely to arise during the survey and take appropriate action to ensure that the EPO's are achieved. Further details on the expert panel are available in the FMP.

7.2.7 Spotter Vessel

CGG will adopt a dedicated spotter vessel with two MFO's to monitor the detection zone during survey operations. This provides an independent, additional, and flexible detection platform for marine fauna. This is highly effective as a measure because it provides an additional line of evidence into the SEA with which to make decisions with the Vessel Master related to protection of marine fauna.

7.3 Sail Line Plan

The sail line plan is a procedural control measure and is primarily in place to ensure that activity is carried out by the contractor to the specifications of CGG. It includes spatial and technical data consistent with the description of activity including the limits and boundaries of the operational area and acquisition area for operation of the seismic source and excised zones. The MSS acquisition lines will be acquired working from:

- Shallow lines to deep lines if the survey period is during the April to June period.[1]
- Deep lines to shallow lines if the survey period is between September to November

The sail line plan includes all the specifications of the acoustic source and streamer configuration and all activity limitations as specified in Appendix A2.

The sail line plan will be provided to the seismic contractor for agreement before the survey begins, and all variations to the plan will be agreed upon and documented in writing between CGG and the seismic contractor. The sail line plan is first agreed during the Acquire Seismic On Paper workshop.

7.4 Marine Assurance System

The marine assurance system is administered by CGG's Marine team and, amongst other requirements, ensures compliance of contract vessels with MARPOL, COLREGS, and Marine Orders 21, 30, 59 70,71,72, 91, 95, 96, 97, 98. CGG undertakes a vessel contractor pre-qualification assessment in accordance with its Marine Risk Management Standard (GM-STD-MA-003) to ensure vessel biofouling controls meet these EP requirements. The system also requires the contractor to have a HSE management plan and to provide a bridging document that needs to be approved by CGG prior to execution.

7.4.1 Project Vessels and Gear

Like most systems the Marine Assurance System includes the project vessel and gear. The activity includes one support vessel (for equipment and crew transfers), one chase vessel (for safe navigation) and the acquisition vessel. As per the requirements of the implementation strategy the vessels will be always staffed with qualified and experience crew and will be required to complete an environment induction. All project vessels have various pieces of equipment that minimise environmental impacts and risks, mostly specified by maritime law.

All project vessels will have means of communication with each other and other marine users. Project vessels are equipped with suitable and fully functioning navigation aids, including automatic identification systems (AIS). Competent crew members ensure 24-hour visual, radio, and electronic surveillance to enhance navigational safety.

Throughout the seismic survey, at least one support vessel will be in constant attendance. The support vessel will be responsible for equipment and crew transfers and, when safe, assist in the recovery of lost equipment or unintentional garbage discharges. Support and/or chase vessels will accompany the seismic vessel during surveying operations to patrol and maintain a clear zone ahead of the vessel. This includes scouting for and communicating with commercial, recreational, shipping, and other marine users to ensure their safety.

The streamers will have recovery units fitted to prevent benthic disturbance in the event of loss. Streamer tail buoys will be used to mark ends of the streamers so that they can be detected by other vessels. Streamer tail buoys will be of a design that does not represent an entrapment risk to turtles or turtle guards will be used.

7.4.2 IMS Risk Assessment Procedure

The Marine Assurance System also includes a procedure which mandates an IMS risk assessment be conducted on vessels and immersible equipment by a qualified IMS inspector, prior to mobilisation to the operational area. All contracted vessels must have anti-foulant systems that are properly maintained and in compliance with the International Convention on the Control of Harmful Anti-Fouling Systems on Ships. Vessels/immersible equipment must be assessed as ‘low risk’ prior to mobilisation to the operational area. If any project vessels, including the seismic vessel and spill response vessels, have an overseas 'last port of call,' a Pre-Arrival Report must confirm that the vessel meets ballast and quarantine requirements.

[1] Measure adopted on request from relevant person to minimise interference with Southern Bluefin Tuna (Event ID 4370).

IMS risk assessments are conducted for all vessels and immersible equipment before deployment. The CGG IMS Risk Assessment Procedure aligns with national standards for IMS management. This procedure assures CGG's adherence to the International Convention for the Control and Management of Ship's Ballast Water and Sediments 2004 and the Australian Ballast Water Management Requirements.

7.4.3 Vessel Bunkering Procedure

The Marine Assurance System also includes a procedure which ensures that good practice and industry standards are applied to bunkering operations at sea. All contracted vessels will have a vessel bunkering procedure in place for bunkering operations and this will be checked as part of OVID-style inspections prior to the start of survey operation.

7.5 Sea Country Protection Program (SCPP)

The CHPP is a comprehensive program designed to identify, preserve, and protect cultural heritage sites and values within the environment planning area. It will start with a process of consultation to inform the design of mutually beneficial outcomes between First Nations peoples and the programs funders.

7.6 Adjustment Protocol for Commercial Marine Users

An adjustment protocol for unavoidable interference between commercial marine users and petroleum titleholders is an industry standard control measure. ConocoPhillips, TGS, and CGG are founding members of a collaborative initiative called the Otway Marine Industries Coexistence Cooperative (OMICC). This initiative was in response to requests from commercial fishers, fishing industry associations, other stakeholders, and regulators for greater simplicity in making claims for compensation and to reduce consultation fatigue across the sector. OMICC has developed the Otway Adjustment Protocol (OAP), which originated from the National Energy Resources Australia (NERA) Commercial Fishing Industry Adjustment Protocol (NERA, 2021). The Otway Adjustment Protocol has been amended following feedback from fishers and fishing associations who TGS, CGG and ConocoPhillips have consulted with.

The OAP will be available for review by all commercial fishers and commercial fishing associations in Tasmania, Victoria, and South Australia between 1 May 2024 and 2 July 2024. Commercial fishers have been given the draft protocol including an invitation to comment on the content, and an opportunity to nominate suitably qualified persons for consideration as claims assessors. Once feedback has been collated the founding titleholders will update the OAP and communicate the changes through direct liaison with commercial fishers in the region.

The OAP will have the following features:

- As a minimum, claims processes for direct losses from:
  - Accidental damage or loss of deployed fishing equipment causes by the presence of the seismic vessel (either repair or replace).
  - Displacement for increased transit times which result in increased fuel and crewing costs from moving fishing locations,
  - Reduced catch per unit effort if survey acquisition timing directly overlaps a previously fished area, within the fishing season, demonstrated by the reported data.
- The claims process will require a fisher to provide evidence (or authorisation to access evidence) for claimed losses that enables a calculation of how much compensation may be due.
- Details about the role, responsibilities, and instructions for nominated claims assessors who will be third parties to the titleholder.

- An assessment report on each claim will be provided by the claim assessor to the titleholder and the claimant.
- The assessment report will include the details and methodology used to conclude the claim and an Outcome Notification.
- There will be a dispute mechanism requiring additional assessment by a different claims' assessor.

The claim assessor(s) will be suitably experienced and qualified is defined as a person or organisation with proven demonstrated experience in data analysis and data auditing processes and procedures within the industry. Nominees for claims assessors can be made by titleholders and claimants and then agreed upon before the commencement of a claim.

There is a claims process specified in the OAP which will be followed by the titleholder and the claims assessor. If a claimant disagrees with a claim assessment outcome, and an agreement cannot be reached between the titleholder and the claimant, the claimant may, within 30 days of receipt of the Outcome Notification, request that a suitably experienced/ qualified independent third-party is engaged to review and determine the outcome of the claim. The independent expert reviewer must provide a view as to whether the claim assessment process has been conducted in line with the requirements of the OAP. The independent expert reviewer may also consider any additional information deemed appropriate by them, including information provided by either the claimant or the titleholder. An independent expert review decision may differ from the initial assessment outcome.

7.7 Oil Pollution Emergency Plans

The Oil Pollution Emergency Plan (OPEP) and Operational and Scientific Monitoring Program (OSMP) for the Regia MSS is a comprehensive document designed to address potential oil spill incidents during operations. This OPEP and OSMP are crafted to align with the national system for oil spill preparedness and response, ensuring consistency with established protocols and coordination mechanisms. It outlines specific procedures, responsibilities, and resources necessary to respond to any oil spill event promptly and effectively.

The OPEP and OSMP are documents that must be submitted as part of the Implementation Strategy (Appendix B3) and must therefore be accepted by NOPSEMA prior to the activity commencing.

7.8 Acquire Seismic on Paper (ASOP)

This exercise is designed to bring all stakeholders, technical staff, and decision makers together, from all companies working on the project to share knowledge, identify any project risks, and map out possible improvements before the operations phase.

7.9 Company Site Representatives

CGG will have the following people always onboard the vessel:

- Quality Control and Reporting (QCR) Representative
- Health, Safety and Environment (HSE) Representative
- Survey Environmental Advisor (SEA)

Their responsibilities include ensuring the activity is conducted in accordance with the EP and contract.

8 Environmental Performance Standards

The Environmental Performance Standards (**EPS**s) set in Table G1-1 function as conditions of approval and form the basis of compliance monitoring for the Regia MSS. Any inconsistencies in other parts of the EP are superseded by this document and they have remained in the EP either as an artefact to demonstrate the iterative nature of the process, or through error.

Table G1-1 starts by identifying each control measure. Then at least one EPS is set for each control measures due to an identified need. Each EPS is a statement of performance of the associated control measures and provides information about the effectiveness of the control measure in practice.

Table G1-1 then identified, for each EPS, if the measure was adopted because of the:

- initial ALARP assessments in Appendix D1 – D4 or E1 – E10.
- final ALARP assessment (Appendix F2).
- consultations with relevant persons.
- legislative or other requirements that apply to the activity.

9 Measurement Criteria

The measurement criteria in Table G1-2 are what CGG will use to determine whether each EPO and each EPS is being met. For ease of presentation Table G1-2 lists the applicable control measures for each EPO, rather than restate each EPS. Each measurement criteria have a clear target, measurement method, reporting frequency, role responsible, and evidence required.

Table G1-2 - Environmental Performance Standards

Control Measure	Title	Environmental Performance Standards	Measure Required By Assessment?	Adopted Because of the Consultations?	Legislative Requirement?
M#02 Consultation Management System (See Section 7.1)	Communications Plan	All relevant persons will receive notification of the activity's commencement upon acceptance of the Environmental Plan (EP) or a minimum of 2 weeks before the survey, unless they have requested otherwise.	-	-	-
		Information about the survey, including .kmz files, 5-minute updates, and a 48-hour look-ahead, will be provided to relevant persons who have identified a need for this information.	-	Yes	-
		Relevant persons requesting 24, 48, or 72-hour look-aheads for acquisition will receive daily notifications throughout the survey duration.	-	Yes	-
		Timely notifications will be made to the Australian Maritime Safety Authority's Joint Rescue Coordination Centre (AMSA JRCC) 48 hours prior to the activity's commencement. A 'Notice to Mariners' will be issued via RAN Australian Hydrographic Service (AHS) before the survey begins.	Yes	Yes	-
		Maintain the Regia MSS website and interactive map and respond to comments within 48 hours of a comment being made.	-	-	-
		Maintain an up-to-date list of relevant persons, including their contact information, roles, and interests.	-	-	-
		Pre-survey visits will be conducted along with Otway coast to communicate NOPSEMA assessment outcomes, gather additional feedback, and liaise with local government bodies.	-	-	-
	SIMOPS Plan	Best endeavors will be made to develop a SIMOPS plan with divers and titleholders when operating within 40km of known dive sites, consistent with DMAC guidelines. If not possible, local newspapers and radio will be used to notify the public.	-	Yes	-
		A simultaneous operations plan will be developed if the seismic vessels or any equipment will enter the 500 m Petroleum Safety Zone of the Thylacine-A platform.			
	Fisheries Liaison Officer (FLO)	A Fisheries Liaison Officer (FLO) will be appointed to conduct specific consultation with commercial and recreational fishers and process compensation claims.	-	Yes	-
M#03 Fauna Management System (See Section 7.2)	Fauna Management Plan	The Fauna Management System (Appendix G2) details how the requirements of EPBC Regulations 2000 – Part 8 Division 8.1 Interacting with Cetaceans and EPBC Act Policy Statement 2.1 will be met (and exceeded).	Yes	-	Yes
		Ensures that two trained and qualified MFOs with previous survey experience are resident on the seismic vessel at all times during daylight operations. CGG will include further resources for detection of whales, namely an additional qualified person who can provide relief, as required, across both visual observation and acoustic detection monitoring tasks. [Sentence added in response to Matters M43, M45 and M49].	Yes	-	-
		Utilize Passive Acoustic Monitoring (PAM) for whale detection 24 hours a day, including night and low-visibility conditions.	Yes	-	-
		In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be onboard a dedicated spotter vessel at all times. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals. [Row added in response to M45].	Yes	-	
		Ensures that two PAM operators with previous survey experience are present on the seismic vessel, covering 24-hour operations to detect marine mammals. CGG will include further resources for detection of whales, namely an additional qualified person who can provide relief, as required, across both visual observation and acoustic detection monitoring tasks. [Sentence added in response to Matters M43, M45 and M49].	Yes	-	-
		During the 'run in' to the acquisition area, soft start procedures occur for a minimum of 30 minutes.	Yes	-	Yes
	Sound source	Operate the sound source at low power during line turns and if transiting between survey lines anywhere in the Operational Area to reduce the number of start-up procedures and minimize the risk of SRWs or BW entering the zone of potential Temporary Threshold Shift (TTS) or behavioral disturbance during shutdown.	-	Yes	-
	CGG Environment Officer	Ensure the requirements for the implementation of the FMP are in place prior to the commencement of the Regia MSS.	-	Yes	-
		A review of the effectiveness and compliance with the FMP will be undertaken within one week of commencement of the Regia MSS and thereafter every four weeks while the Regia MSS is being undertaken.	Yes	-	-
	Survey Environment Advisor (SEA)	An SEA will be located on the vessel at all times and will ensure the Fauna Management System remains functional. The SEA will call meetings of the Expert Panel as required.	Yes	-	-
		Collaborate with the vessel master to effectively implement the observation, low-power, and shut-down zones.	Yes	-	-
	Fixed Buoy Acoustic Detection	There will be a minimum of three acoustic detection buoys with real-time reporting of LF cetacean vocalisations to the ADM Operators. Triangulation of location detections will be attempted as data allows.	Yes	-	-
	Aerial Surveillance	There will be a pre-commencement aerial survey and subsequent aerial surveillance activities will be based on the advice of the SRW and BW Expert Panel and suitable weather.	Yes	-	-
	Spotter Vessel	There will be a dedicated spotter vessel with an additional two MFOs as an additional line of evidence for marine fauna detections at all times during the survey.	Yes		
	Expert Panel	The Expert Panel will have a minimum of three members with expertise and qualifications in BW, SRW, and marine fauna observations at sea respectively.	Yes	-	-
	Seabird aggregation monitoring	The sound source will be reduced to the low power setting if flocks of foraging birds are within 500 m of the source. Full power can commence when the sound source is > 500 m from any foraging birds.	Yes	Yes	-

Control Measure	Title	Environmental Performance Standards	Measure Required By Assessment?	Adopted Because of the Consultations?	Legislative Requirement?
M#04 Sail Line Plan (See Section 7.3)	Activity Limitations	The sail plan will comprehensively define the activity limitations (Appendix A2) and operational area, acquisition area, depth contours, and distances related to environmental management control measures.	-	-	-
	Sail Line Pre-Plots and Optimization	The sail plan will contain sail line pre-plots for acquisition, with instructions on how and when these sail lines will be optimized and updated throughout the survey due to operational and environmental constraints.	-	-	-
M#05 Marine Assurance System (See Section 7.4)	IMS Risk Assessment Procedure	Vessels conduct pre-port entry checks using the National Introduced Marine Pest Information System database and assess changes in known invasive species.	Yes	-	Yes
		Ballast water exchange activities will be conducted exclusively in open waters, avoiding areas designated as Marine Protected Areas (AMPs), to prevent environmental contamination.	-	-	Yes
		Ensure the sound source and towed streamers will be inspected and cleaned (where required) prior to deployment for the Regia MSS.	Yes	-	Yes
	OVID-style Inspections	Project vessels, as part of the CGG contracting process, will undergo OVID-style inspections to verify the validity and compliance of certificates required by COLREGS, the Navigation Act, SOLAS and various Marine Orders, and the presence of a vessel bunkering procedure, a Ballast Water and Sediment Management Plan, a Ballast Water Record Book, a Biofouling Management Plan and Record Book, an Oily Water Record Book, a Shipboard Oil Pollution Emergency Plan (SOPEP), an Ozone-Depleting Substances Record Book, and a Garbage Management Plan and Garbage Record Book, all tailored to the vessel's class and operational requirements.	-	-	-
	Project Vessels and Gear	Contracted vessels are required to have a Vessel Lighting Management Plan to minimise light emissions while meeting vessel navigational light requirements.	Yes	-	-
		Contracted vessels will feature water separation systems to ensure that bilge discharges overboard do not exceed 15 parts per million (ppm).	-	-	Yes
		To preserve Marine Parks proximate to the Regia MSS, no discharges of any kind will be allowed from contracted vessels within these protected areas.	-	Yes	-
		Ensure vessels have a documented Preventative Maintenance System (PMS) that provides a status on the maintenance of equipment as per the manufacturer's specification for maintenance procedures.	Yes	-	-
		Ensure material or equipment that have the potential for spill overboard are within contained/bunded areas and spill kits must be readily available on project vessels to respond promptly to any potential spills or incidents.	Yes	-	Yes
		All contracted vessels will be equipped with dry-break couplings and bunkering hoses that are inspected, certified, and regularly maintained.	-	-	Yes
		The seismic vessel is required to have procedures for streamer inspection, maintenance, deployment, and retrieval. Streamers are required to have recovery units, tail buoys to mark the end of the streamers so that they can be detected by other vessels, and tail buoys designed so they do not represent an entrapment risk to turtles or turtle guards will be used.	Yes	Yes	-
	Vessel Bunkering Procedure	Bunkering operations will commence during daylight hours and will involve continual monitoring of hoses and tank levels from both the supplying and receiving vessels.	-	-	-
		Bunkering equipment such as dry-break couplings and bunkering hoses, are inspected, certified, and regularly maintained.	-	-	-
		Transfer process (e.g. safety, communication, monitoring, inventory, emergency shut down, spill response and incident reporting).	-	-	-
		Bunkering operations will not occur within 50 km of a Commonwealth or State marine parks.	-	Yes	-
M#06 Sea Country Protection Program (See Section 7.5)	Preserve and protect Sea Country	The SCPP shall offer the opportunity to participants to systematically identify, record, and document cultural heritage sites, stories and songlines within the project area, complying with applicable regulations and best practices.	-	Yes	-
		The SCPP shall be established through a robust consultation process with indigenous communities, seeking their input and consent regarding cultural heritage protection measures.	-	Yes	-
		The SCPP shall implement effective measures to preserve cultural heritage sites, artifacts, and values within the project area, minimizing impacts from petroleum activities.	-	Yes	-
		The SCPP shall develop and implement mitigation strategies in response to identified cultural heritage risks, addressing potential impacts promptly and comprehensively.	-	Yes	-
		The SCPP shall be open to investment from other parties to further the growth and reach of the program.	-	Yes	-
M#07 Adjustment Protocol (See Section 7.6)	Communication	Each activity using the Otway Adjustment Protocol must give 28 days' notice to OMICC registered commercial fishers of the commencement of an activity. The notification will include information to support avoidance of the activity and information about how to make a claim.	-	Yes	-
	Coverage	Adjustment can be claimed during a petroleum activity and for 6 months after the completion of each activity.	-	Yes	-
	Claims Process	Subject to a claim being lodged, a suitably experienced/qualified independent person/organisation will be engaged by the titleholder as the assessor of the claim, in consultation with the claimant.	-	Yes	-
	Commitment to Assess	Appropriately documented claims will be assessed, in accordance with the processes outlined in the OAP, and completed within 30 days of receipt of the required data.	-	Yes	-

Control Measure	Title	Environmental Performance Standards	Measure Required By Assessment?	Adopted Because of the Consultations?	Legislative Requirement?
	Commitment to Pay	Successful claims will receive compensation within 30 days of the Outcome Notification being executed.	Yes	Yes	-
M#08	Notifications	CGG will notify any incidents in accordance with the procedures in the OPEP and OSMP.	-	Yes	Yes
Oil Pollution Emergency Plans (See Section 7.7)	Response strategies	CGG will execute a comprehensive monitoring and evaluation strategy aimed at assessing the environmental fate and ecological consequences of any potential spill incident in strict accordance with the OPEP and OSMP.	-	-	-
		CGG will establish an oiled wildlife response strategy in collaboration with the relevant State government to safeguard listed and migratory species in the event of an oil spill, ensuring prompt and effective protection measures are in place.	-	-	
M#09	Alignment of activities during the survey	The ASOP will occur prior to the commencement of the survey.	-	-	-
Acquire Seismic On Paper (See Section 7.8)		There will be a terms of reference, attendee list, and ASOP report written up and adjustments to the EP or operational procedures will be recorded in a report.	-	-	-
		The ASOP will involve all operational stakeholders including relevant environmental experts.	-	-	-
		The ASOP will involve a marine mammal expert when discussing control measures and monitoring programmes.	-	-	-
M#10	Compliance Monitoring	Oversight of the project and implementation of EPO's and EPS's within the EP.	-	-	-
Company Site Representatives (See Section 7.9)		Verify that the project vessels are performing as per the agreed contract and executing the seismic in accordance with the agreed (and varied) sail line plan.	-	-	-
		Conduct daily informal HSE checks of vessel operations to ensure that the EP commitments are implemented.	-	-	-
		Attend the daily operational meeting and toolbox talks recording any environment matters discussed.	-	-	-
	Documentation	Record details of any environmental incidents that have occurred in the previous 24 hours.	-	-	-

Table G1-3 - Measurement Criteria for the Regia MSS

		Measurement Criteria					
EPO	**Relevant Control Measures**	**Title**	**Target**	**Measurement Method**	**Reporting Frequency**	**Responsibility**	**Evidence Required**
EPO 1: To ensure effective communication and engagement with relevant persons and local communities throughout the activity's lifecycle, fostering transparency, understanding, and responsiveness to their needs and concerns.	Consultation Management System	The community and relevant persons are informed.	Ensure that all relevant persons receive notifications, updates, and information at the prescribed intervals as outlined in the performance standards.	Maintain a record of all community engagement activities conducted under the CLP throughout the year. Track the number of events, meetings, workshops, and interactions with community members, as well as the outcomes achieved during these activities.	Quarterly	Communications Advisor	Communication logs, email records, and copies of notifications sent.
		Relevant persons objections and claims are promptly assessed.	Complete the assessment of merit of an objection or claim is completed within 48 hours and any environmental protection requirements are implemented as soon as practical.	Timings of communication show the responsiveness of CGG to relevant persons raising	Monthly	Communications Advisor	Communication logs, email records, and copies of notifications sent.
		Comprehensive Documentation and Record Keeping	The CMS must maintain comprehensive and well-organized documentation and records for all relevant person information, engagement plans, consultation activities, and complaints/ feedback.	Regularly review and audit the RPCMS to ensure that all relevant person-related information, engagement plans, consultation activities, and complaints/feedback are accurately and completely documented and recorded.	Quarterly	Communications Advisor	Audit reports demonstrating the completeness and accuracy of documentation and records. Sample records from the RPCMS, showcasing well-documented relevant person information, engagement plans, consultation activities, and complaints/feedback.
EPO 2: No death or injury to fauna, including listed threatened or migratory species, from the activity. EPO 3: Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area. EPO 4: Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.	Fauna Management System	Effective Marine Mammal Surveillance	Ensure all marine mammal surveillance activities, including aerial surveys, drone monitoring, vessel-based monitoring, and night-time observations, are conducted according to specified schedules and protocols outlined in the FMP.	Regularly review surveillance reports, including the frequency, coverage, and data collected from various surveillance methods.	Weekly reports on the status and outcomes of marine mammal surveillance activities.	Environment Officer	Records of all marine mammal surveillance activities, including schedules, participants, and observations.
		Compliance with MMO and PAM Operator Protocols	Ensure that all MMO and PAM operator protocols, as outlined in the EPSs, are strictly followed throughout the seismic survey operations.	Regularly review MMO and PAM operator reports, logbooks, and records to verify compliance with the specified protocols.	Ongoing monitoring and reporting throughout the seismic survey operations.	The designated MMOs, PAM operators, and the vessel master.	MMO and PAM Operator Reports. Daily reports.
		Speed and separation compliance	Vessels maintain speeds below 5 knots within 300 meters of marine mammals and birds, with a minimum separation distance of 100 meters (except for dolphins).	Continuous monitoring of vessel speed and distance to marine mammals and birds.	Daily reporting.	Officer of the Watch & MMO	Daily reports and records of vessel operations.
EPO 5: No introduction of a known or potential invasive marine species. EPO 6: To guarantee that all contracted vessels strictly adhere to international and	Marine Assurance System	Functionality of navigation equipment	Continuous availability and operation of navigation aids and AIS.	Regular inspection and testing of equipment.	Monthly inspection reports.	Vessel operators and designated personnel.	Inspection records and reports.
		Presence of support vessels	Continuous presence as required by the activity limitation.	Vessel tracking and logs.	Daily tracking reports.	Vessel operators and seismic survey management.	Vessel tracking data and presence logs.

		Measurement Criteria					
EPO	**Relevant Control Measures**	**Title**	**Target**	**Measurement Method**	**Reporting Frequency**	**Responsibility**	**Evidence Required**
national maritime regulations, including MARPOL, COLREGS, and specific Marine Orders.		IMS risk assessments completion and compliance	100% of vessels and immersible equipment assessed as 'low-risk' by IMS inspector, IMS inspections conducted by qualified inspectors, port entry checks using NIMBI'S database performed, biofouling cleaning for immersible equipment, and alignment with national IMS management standards	Review of IMS risk assessment records, inspector qualifications, port entry records, NIMBI'S database queries, equipment cleaning records, and alignment documentation	Monthly	IMS Inspector, Vessel Crew, IMS Coordinator	IMS risk assessment reports, inspector qualification records, equipment cleaning records, and documentation of alignment with national standards
		Compliance Percentage	Maintain a compliance rate of 100% with all applicable maritime, environmental, and safety regulations and standards.	Regular audits and inspections of contracted vessels and immersible equipment, review of compliance documentation, and assessment of maintenance records.	Monthly compliance reports.	CGG Operations Manager	Audit and inspection reports, compliance documentation, maintenance records, and electronic compliance reports.
		Number of bunkering operations conducted offshore.	Zero offshore bunkering operations, indicating that all vessels have sufficient tank capacity or adhere to the vessel bunkering procedure when needed.	Regularly review and record the details of bunkering operations, including the date, location, vessels involved, and reason for bunkering.	Quarterly	Environmental Advisor	Records of bunkering operations, including dates, locations, vessels involved, and documented adherence to the vessel bunkering procedure when needed.
		Activity Compliance Index	Achieve an ACI score of 90% or higher during the seismic survey.	Calculate the ACI based on sail line adherence to the EPSs, excision of sensitive areas, and environmental compliance. ACI = (Number of Sail Lines Compliant / Total Number of Sail Lines) * 100.	The ACI will be calculated and reported after each seismic survey.	CGG Operations Manager	Documentation of sail line pre-plots, optimization records, excision areas, and all sail line-related communications between CGG and the seismic contractor, as well as records of survey operations, will be required as evidence for the ACI calculation and reporting.
EPO 7: To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment.	Sail Line Procedure	Daily reporting on environmental performance.	To prepare a daily report on the conduct of the activity, including any environmental performance issues.	Review of the daily reports.	Daily	Quality Control Representative	Daily report.
EPO 8: To establish and maintain a framework for Sea Country protection that manages the interaction of the activity with First Nations cultural values and sensitivities.	Sea Country Protection Program	Sea Country Protection Progress	Achieve successful implementation and outcomes for each component of the SCPP as outlined in the Environmental Performance Standards (EPSs).	Conduct regular assessments of indigenous communities and program stakeholders to gather feedback on the effectiveness and satisfaction with the SCPP. This may include structured interviews, surveys, and consultation sessions to qualitatively evaluate program performance.	Quarterly	Environment Advisor	Evidence will include documentation of cultural heritage identification efforts, records of indigenous community consultations, preservation measures, mitigation strategies, and collaboration agreements as proof of progress and adherence to the SCPP.
EPO 9: Interference with other marine users is of no greater extent than is necessary for the exercise of right conferred by the titles granted.	Adjustment Protocol for Commercial Marine Users	Reasonable, evidence-based claims are promptly assessed and paid.	Assessments of claims are made within 30 days and paid within a further 30 days.	Evidence of the claim report and the transaction.	Monthly	Environmental Advisor	Claims, claims reports, correspondence emails, bank records.

		Measurement Criteria					
EPO	**Relevant Control Measures**	**Title**	**Target**	**Measurement Method**	**Reporting Frequency**	**Responsibility**	**Evidence Required**
EPO 10: To establish and maintain an effective Oil Pollution Emergency Plan (OPEP) that ensures swift and efficient response to oil spill incidents, minimizing environmental harm, protecting sensitive ecosystems, and safeguarding human health and safety.	Oil Pollution Emergency Plans	Respond to incidents in a timely manner.	No delay to notifications and communication of situational awareness.	Communication records show the immediacy of notifications and regular updated to the designated Control Agency.	Daily (in the event of an incident)	Operations Manager	Daily reports, correspondence, vessel logs, emails.
EPO 11: To align all staff and contractors involved in the activity to ensure environmental protections implemented in this EP can and will be met.	Acquire Seismic On Paper, Company Site Representatives	Team alignment survey	Survey respondents show 100% understanding of roles and responsibilities.	End of workshop survey of attendees.	End of workshop.	Survey Environment Advisor	Survey completion records.

11 Analysis of appropriateness of control measures

As per NOPSEMA's Decision Making Guideline, each control measure is evaluated against criteria of functionality, availability, reliability, survivability, independence, and compatibility with other measures, ensuring a multi-faceted approach to risk management.

It is useful to outline how each of these criteria are defined:

- **Functionality**: Evaluates the effectiveness of control measures in achieving their intended EPO, ensuring practical efficacy in the specific operational context of the Regia MSS.
- **Availability**: This criterion assesses whether the necessary control measures are readily available for use during the survey. This is sometimes referred to a 'up-time'.
- **Reliability**: Focuses on the consistency and dependability of control measures, ensuring they perform effectively under various conditions without failure.
- **Survivability**: Examines the control measures' ability to withstand extreme conditions without losing their effectiveness in environmental protection.
- **Independence**: Assesses how control measures operate without interference or reliance on other control measures, ensuring the resilience of the environmental protection strategy.
- **Compatibility**: Evaluates the integration of control measures with each other and the overall operations, ensuring harmonious functionality without compromising the effectiveness of other measures.

Annex 1 presents analysis of each of the control measures adopted for this activity against these criteria and shows that there has been consideration of the limitations of the control measures and how other measures reinforce or improve the performance of each other.

12 Conclusion

This report has been prepared to ensure that the Regia MSS EP provides for appropriate environmental performance outcomes, environmental performance standards, and measurement criteria. Prior to submitting this EP, the test for CGG was whether the proposed environmental performance has fulfilled its function under the legislation and there is confidence that the Regia MSS can be carried out in accordance with the objects of the Regulations.

An appropriate level of environmental performance effectively balances the operational objectives of the survey with the need to protect marine ecosystems and species through the reduction of environmental impacts and risks. The environmental performance of the Regia MSS is appropriate because the activity:

- Complies with environmental management law by adhering to all relevant local, national, and international environmental laws and guidelines to ensure that the survey operations are legally compliant.
- Minimises impacts and risks to social, economic, and cultural features of the environment by implementing strategies to manage interactions arising from the activity.
- Will be continuously monitored in real-time and has measures in place to escalate protections and to adapt strategies in response to unexpected changes or discoveries from observations in the field.
- Has mechanisms for involving local communities, environmental groups, and other relevant persons in the ongoing planning and execution phases of the survey.
- Implements effective mitigation measures to offset negative economic effects on commercial fishers if impacts are unavoidable.
- Ensures that the survey can be carried out in a manner whereby environmental impacts and risks of the activity can be reduced to ALARP and be of an acceptable level.

CGG has tried to not only meets the minimum requirements for environmental protection but also demonstrates a proactive and responsible approach to preserving marine life.

13 Recommendations

There has been significant interest during the consultations for further information about control measures for protecting whales, compensating fishers, and preserving cultural heritage. CGG notes that this report is focused on providing appropriate environmental performance for the control measures adopted for the Regia MSS and does not provide the full documentation of the control measures themselves. It is recommended that the following control measures are provided in full for public comment, and for subsequent assessment.

- Whale Management Plan (Appendix G2)
- Oil Pollution Emergency Plan (Appendix G3)
- Sea Country Protection Program (Appendix G4)
- Commercial Marine Users Adjustment Protocol (Appendix G5)

14 Document Control

Table G1-4 - Revision history

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	29 March 2023	MS	Template created.
0.1	9 April 2023	MS	Community Liaison Program added.
0.2	5 May 2023	MS	Project vessels, IMS risk assessment procedure, marine assurance system, and bunkering procedure added.
0.3	7 May 2023	MS	Sail line procedure added. Reframed all measurement criteria to be more detailed.
0.4	28 August 2023	MS	Marine mammal adaptive management plan, and marine mammal observers added.
0.5	14 September 2023	MS	Acquire seismic on paper, and OPEP/OSMP added. Added column to EPSs to show whether the standard was adopted because of the consultations.
0.6	24 September 2023	MS	Moved into Regia MSS document template. Cultural heritage protection program, and Adjustment protocol added. Modified throughout to include all requirements from impact and risk assessments.
0.7	2 October 2023	PR/LT	CGG Review.
1	20 December	MS	Updated following CGG review and consultations with relevant persons.
2	**15 May 2024**	**MS**	**Updates following public comment and the adoption of additonal environmental performance standards for spotter vessel, an additional MFO/PAM Operator.**

Annex 1 – FARSIC Analysis of Control Measures

		Effectiveness Assessment					
Environmental Performance Outcomes	**Control Measures**	**Functionality**	**Availability**	**Reliability**	**Survivability**	**Independence**	**Compatibility**
EPO 1	M#02: Consultation Management System (CMS)	Highly functional in intended purpose.	Available and adaptable throughout the life of the activity.	Consistently reliable under various conditions. Some performance standards rely on other to push messages out e.g. fishing associations and AHS.	Unaffected by conditions.	Operates independently without interference.	Well integrated with the RPCMS, the ASOP, and the Sail Line Plan.
EPO 2, 3, & 4	M#03: Fauna Management System	Highly functional in intended purpose to extend the range of observations of marine mammals to required distances.	Resources and technologies readily available although relatively new to the market.	Relatively new technology applied within the WMP is offset by having lots of methods to escalate observations as needed. Technology can be tuned to detect certain species (e.g. LF cetaceans).	Capable of withstanding extreme operational conditions.	Operates independently without interference.	Well integrated with the MMO's and PAM Operators to expand the range of detections and the escalation of observations/mitigations.
		Highly functional in intended purpose though MMO's have limited range (<3 km).	Resources and technologies readily available. MMO's only available during daylight hours. PAM Operators provide nighttime coverage.	Consistently reliable in good visibility conditions with less reliability in detecting species.	Limited effectiveness in low visibility conditions such as fog or heavy seas.	Operates independently without interference, though with reduced range without the WMP. And less effective at night without the WMP.	Well integrated with the Whale Management Plan to expand detection ranges, particularly at night.
EPO 5	M#04: Marine Assurance System: IMS Risk Assessment Procedure	Highly functional given the escalation processes in place for circumstances.	Assessment available all the time.	Escalation mechanisms increase reliability.	Unaffected by conditions.	Operates independently without interference.	Well integrated with the marine assurance system.
EPO 6	M#04: Marine Assurance System	Highly functional and meets many requirements of environmental management law.	Constantly in operation with higher effort required once survey is commissioned, prior to commencement.	CGG and their contractors have a good track record of no major and few minor incidents after following this system.	Unaffected by conditions.	Operates independently without interference.	Well integrated with other measures and operations
	M#04: Marine Assurance System: Project Vessels	Highly functional in intended purpose.	Resources and technologies readily available	Consistently reliable under various conditions	Capable of withstanding sea states up to 5.5 m swells. Otherwise, operations will cease until calmer weather arrives.	Operates independently without interference.	Well integrated with MMO's and the Marine Assurance System
	M#04: Marine Assurance System: Vessel Bunkering Procedure	Highly functional in intended purpose.	Resources and technologies readily available	Consistently reliable under various conditions	Capable of withstanding extreme operational conditions with maximum sea state criteria for as sea refuelling.	Operates independently without interference.	Well integrated with other measures and operations

		Effectiveness Assessment					
Environmental Performance Outcomes	**Control Measures**	**Functionality**	**Availability**	**Reliability**	**Survivability**	**Independence**	**Compatibility**
EPO 7	M#05: Sail Line Plan	Highly functional in intended purpose.	Available 99.9% of the time. Survey likely to stop if unavailable.	Onboard real-time monitoring of survey performance because geophysical objectives require high accuracy.	Unaffected by conditions.	Operates independently without interference.	Well integrated with the CLP and Adjustment Protocol.
EPO 8	M#06: Sea Country Protection Program (SCPP)	New measure for seismic survey but likely to be functional in intended purpose.	Available all the time.	Reliability depends on engagement with First Nations persons and organisations. Increases in performance possible with more collaboration.	Unaffected by conditions.	Operates independently without interference.	Indirectly integrated with the Sail Line Plan and other measures.
EPO 9	M#07: Adjustment Protocol for Commercial Marine Users	Highly functional in intended purpose.	Available during the survey and up to 3 months afterward.	High reliability because there are calculation methods and dispute mechanism in the event of disagreement.	Unaffected by conditions.	Operates independently without interference	Well integrated with other measures and operations
EPO 10	M#08: Oil Pollution Emergency Plans (OPEP, OSMP, SOPEP)	Highly functional in intended purpose.	Available all the time.	Consistently reliable under various conditions.	Some response strategies in the plan are more effective in extreme conditions.	Operates independently without interference	Well integrated with the CSR and the ASOP.
EPO 7, & 11	M#09: Acquire Seismic on Paper Procedure	Highly functional in intended purpose.	To be effective must be completed within 1 month of the survey starting.	Consistently reliable under various conditions	Unaffected by conditions.	Operates independently without interference.	Well integrated with all other measures as it is a coordinating measure prior to the survey commencing.
	M#10: Company Site Representative (CSR)	Highly functional in intended purpose.	Available 24/7 whilst the survey is on site.	Experienced staff likely to increase reliability.	Unaffected by conditions.	Operates independently without interference.	Well integrated with other measures and operations.

Annex 2 – Analysis of EPOs links to defined acceptable levels.

		Environmental Performance Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
Defined Acceptable Levels of Impact and Risk	The petroleum activity results in temporary / reversible, small scale, and/or low intensity environmental damage.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	The impact and risk assessment process is based on sufficient information to understand if serious/irreversible environmental damage is predicted; or the application of the precautionary principle is applied in the presence of scientific uncertainty.		✓	✓	✓	✓					✓	
	Environmental management of the activity must not be inconsistent with EPBC Act Management Plans and Recovery Plans.		✓	✓	✓			✓			✓	
	Impacts and risks to biological features will be temporary / reversible, small scale, and/or low intensity environmental damage at population levels.		✓	✓	✓	✓	✓	✓			✓	✓
	Impacts and risks to ecological features will be temporary / reversible, small scale, and/or low intensity damage to the overall health, diversity, or functioning of the ecosystem.		✓	✓	✓	✓	✓	✓			✓	✓
	Affected persons will not be worse off because of the activity.	✓						✓		✓		
	Impacts and risks to cultural features including cultural values, traditions, or practices, will be temporary / reversible, small scale, and/or low intensity.			✓	✓	✓			✓			
	All reasonably practicable measures have been adopted to reduce environmental impacts and risks.		✓				✓	✓		✓	✓	✓
	Environmental impacts and risks are consistent with the CGG impact and risk assessment process such that for an impact the consequence category is below a rating of Moderate or below. For a risk the risk level is medium or below.		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	The implementation strategy includes specific measures to ensure that measures adopted continue to be effective in managing the impact or risk.							✓			✓	✓
	Measures have been adopted based on the consultation process to address relevant objections and claims of relevant persons.	✓		✓	✓	✓		✓		✓		
	The views of public have been considered in the impact and risk assessment.	✓						✓	✓			

EPO 1. To ensure effective communication and engagement with relevant persons and local communities throughout the activity's lifecycle, fostering transparency, understanding, and responsiveness to their needs and concerns.

EPO 2. No death or injury to fauna, including listed threatened or migratory species, from the activity.

EPO 3. Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area.

EPO 4. Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.

EPO 5. No introduction of a known or potential invasive marine species.

EPO 6. To guarantee that all contracted vessels strictly adhere to international and national maritime regulations, including MARPOL, COLREGS, and specific Marine Orders.

EPO 7. To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment.

EPO 8. To establish and maintain a framework for Sea Country protection that manages the interaction of the activity with First Nations cultural values and sensitivities.

EPO 9. Interference with other marine users is of no greater extent than is necessary for the exercise of right conferred by the titles granted.

EPO 10. To establish and maintain an effective Oil Pollution Emergency Plan (OPEP) that ensures swift and efficient response to oil spill incidents, minimizing environmental harm, protecting sensitive ecosystems, and safeguarding human health and safety.

EPO 11. To align all staff and contractors involved in the activity to ensure environmental protections implemented in this EP can and will be met.

Annex 3 – Links between environmental aspects and EPOs

		Environmental Performance Outcomes										
		1	2	3	4	5	6	7	8	9	10	11
Environmental Aspects	Artificial light				✓			✓				✓
	Physical presence	✓	✓		✓		✓	✓	✓	✓		✓
	Underwater sound	✓	✓	✓	✓			✓	✓			✓
	Atmospheric emissions						✓	✓				✓
	Planned discharges						✓	✓				✓
	Accidental release of fuel	✓					✓				✓	✓
	Accidental release of materials or waste overboard						✓					✓
	Introduction of marine pest species				✓	✓	✓					✓
	Collisions with marine fauna		✓		✓				✓			✓

EPO 1. To ensure effective communication and engagement with relevant persons and local communities throughout the activity's lifecycle, fostering transparency, understanding, and responsiveness to their needs and concerns.

EPO 2. No death or injury to fauna, including listed threatened or migratory species, from the activity.

EPO 3. Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area.

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EPO 11. To align all staff and contractors involved in the activity to ensure environmental protections implemented in this EP can and will be met.

Annex 4 – Control measure protection of subject-centred groups functions, interests, or activities

		Control Measures									
		Consultation Management System	**Whale Management Plan**	**MMOs & PAM Operators**	**Marine Assurance System**	**Sail Line Plan**	**SCPP**	**Adjustment Protocol**	**OPEPs**	**Acquire Seismic On Paper**	**CSRs**
Subject-centred Groups	Commerce	✓			✓				✓		✓
	Petroleum titleholders	✓			✓	✓			✓	✓	✓
	Conservation groups	✓	✓	✓	✓		✓		✓		✓
	Educational bodies	✓			✓				✓		✓
	Tourism operators	✓			✓				✓		✓
	Commercial fishers	✓			✓	✓		✓	✓	✓	✓
	Fishing associations	✓			✓				✓		✓
	Other marine users	✓			✓	✓			✓	✓	✓
	Traditional Owners	✓	✓	✓	✓	✓	✓		✓	✓	✓
	Recreational fishers	✓			✓	✓			✓	✓	✓
	Commercial shipping	✓			✓	✓			✓	✓	✓
	Ports and harbours	✓			✓				✓	✓	✓
	Port users	✓			✓				✓		✓
	Native title land councils	✓			✓		✓		✓		✓
	Local councils	✓			✓				✓		✓
	Heritage groups	✓	✓	✓	✓		✓		✓		✓

REGIA
Marine Seismic Survey

Fauna Management Plan

Appendix G2: REG-EP-036-G2

Rev 2

May 2024

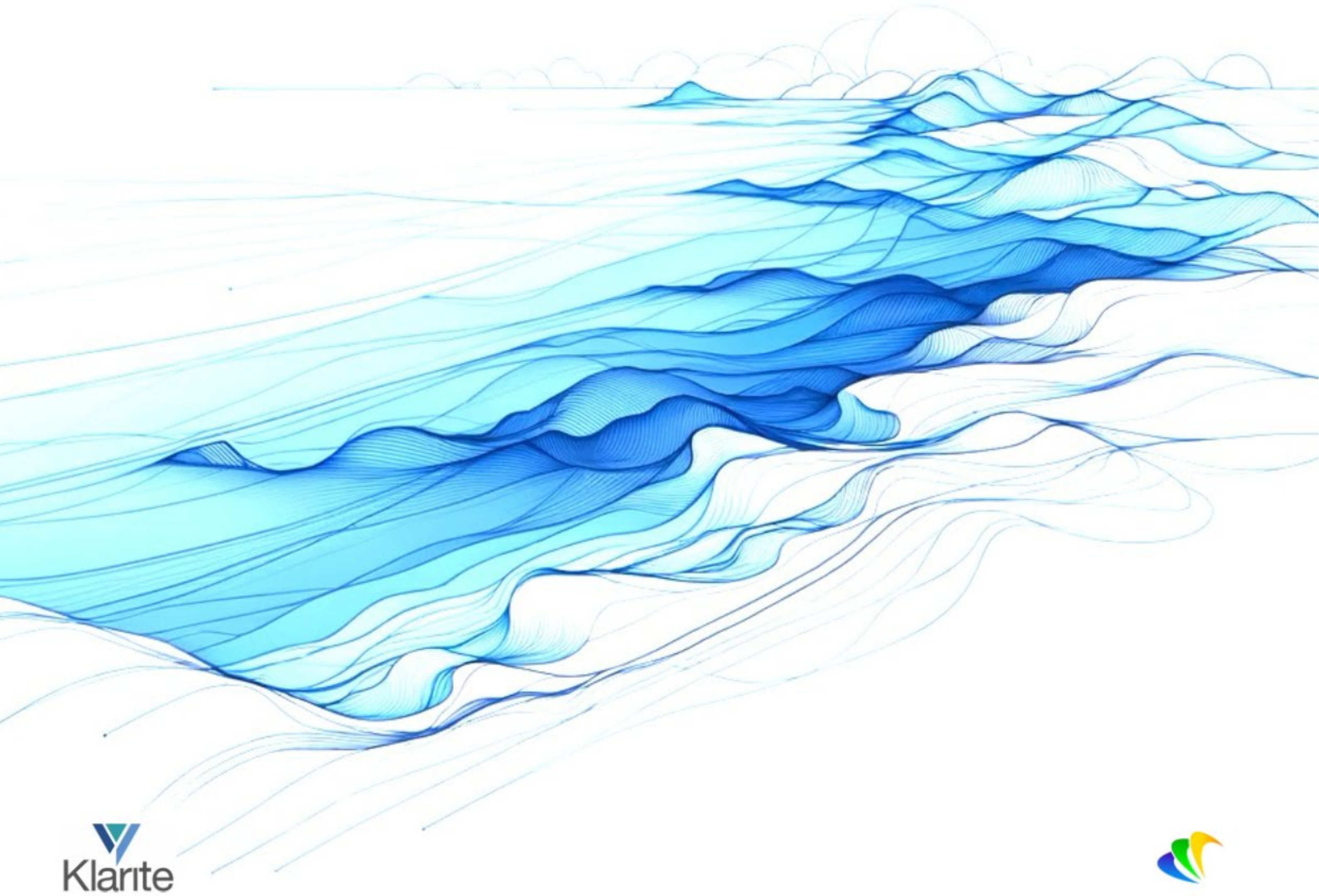

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Table of Contents

1 Introduction

The purpose of this Fauna Management Plan (**FMP**) is to provide details about how the Regia Marine Seismic Survey (Regia MSS) will be carried out in a manner by which the environmental impacts from underwater sound and the risk of a collision to fauna will be reduced to as low as reasonably practicable (**ALARP**) and be of an acceptable level.

This FMP is a control measure to manage impacts to fauna from the following environmental aspects associated with the Regia MSS:

- Vessel collision with fauna
- Underwater sound emissions

This FMP will ensure that the Environmental Performance Outcomes (**EPO**s) from the Regia MSS Environment Plan (**EP**) relevant to fauna will be achieved, such that:

- EPO2: No death or injury to fauna, including listed threatened or migratory species, from the activity.
- EPO3: Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area.
- EPO4: Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.
- EPO7: To ensure that the seismic acquisition activity adheres to the specified boundaries and technical requirements outlined in the sail line plan, minimizing the impact on the environment.

Prior to commencement of the Regia MSS, an FMP Implementation Plan will be developed to facilitate the implementation of this FMP.

2 Assumptions

Assumptions have been made in the development of this FMP with important assumptions detailed below to make them explicit to users to assist in interpretation and implementation. If an aspect of this FMP is unclear, users should consider these assumptions in determining what action, if any, to take.

1) At all times and without exception, safety to personnel, other marine users and vessel management takes priority over the requirements described in this FMP.

2) Vessel Masters, CGG Site Representative. Party Chief and Survey Environmental Advisor (**SEA**) will work together to minimise impacts to fauna if the safety of operations can be maintained.

3) Conservatism has been built into how the Activity Action Zone (**AAZ**) as relevant for management of vessel and marine fauna collision risks and Shut Down Zone (**SDZ**) distances have been determined to address management of underwater sound emission risks taking account of detection accuracy, weather conditions, uncertainty in the impact assessment, and whale behaviour.

4) Acoustic modelling was undertaken for several different survey line locations and a number of different underwater sound effect criteria (**TTS**, **PTS**, behavioural response) were used to interrogate model outputs. The SDZ distances are based on the furthest distance to the underwater sound effect criteria from the acoustic modelling utilising revised survey layouts for the Regia MSS and species-specific behavioural characteristics (Stephan et al. 2024).

5) Policy Statement 2.1 details if the likelihood of encountering whales is low, the chance of a seismic survey having a significant impact on a whale species should be minimal, provided that the proponent and the operator of the seismic survey adopt the measures outlined in Part A Standard Management Procedures.

Every attempt has been made to limit ambiguity in the FMP, however, if there is a lack of clarity, or residual uncertainty, about the instructions in this FMP users are required to take actions in a manner that manages impacts to fauna, are precautionary, and will ensure impacts and risks are within the defined acceptable levels specified in the Regia MSS EP.

3 Glossary of Acronyms and Terms

Table G2-3-1 - Glossary of Acronyms and Terms

Acronym or Term	Description
Acoustic detection	Detection of whales via in water systems such as: • Passive acoustic monitoring (PAM) • Acoustic detection monitoring (ADM) on gliders or fixed buoys
ADM	Acoustic Detection Monitoring
ALARP	As Low As Reasonably Practicable
AAZ	Activity Action Zone
BW	All blue whale sub-species, pygmy blue whales, and Antarctic blue whale.
Cetaceans	Whales and dolphins.
Detection	Detection is used to mean detection of whales which may occur via MFO observation or via acoustic detection methods.
EP	Environment Plan
EPO	Environmental Performance Outcome
FMP	Fauna Management Plan
MFO	Marine Fauna Observer
PAM	Passive Acoustic Monitoring
Policy Statement 2.1	EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales
PTS	Permanent Threshold Shift
Regia MSS	Regia Marine Seismic Survey
SDZ	Shut Down Zone where the seismic source will be shut down.
SEA	Survey Environmental Advisor
SRW	Southern Right Whale
Soft start	Gradually bringing on each acoustic source over a 30 min period.
TTS	Temporary Threshold Shift

4 Implementation

4.1 Roles and Responsibilities

Figure shows the Regia MSS organisation structure relevant to the FMP with responsibilities for each role detailed in Table G2-4-1.

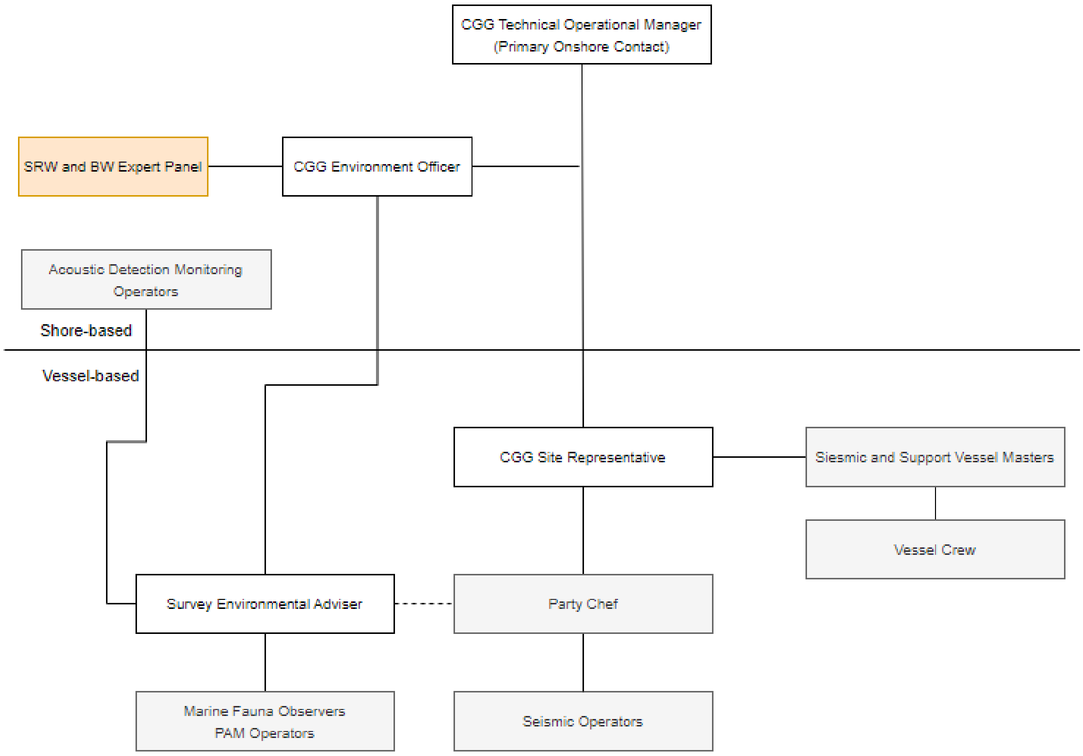


Figure G2-1: Regia MSS Organisation Structure Relevant to the FMP

Table G2-4-1 details the roles and responsibilities for the implementation of the FMP and Table G2-4-2 details the records and reporting requirements.

Table G2-4-1 - Roles and Responsibilities for the FMP

Role	Responsibility
CGG Technical Operations Manager	Provide sufficient resources to implement the FMP. Ensures the Regia MSS is undertaken as per the WMP.
CGG Environment Officer	Coordinate the SRW and BW Expert Panel and provide updates daily when SRW and BW detections and associated shutdowns occur.
	Develop the FMP Implementation Plan with input from SRW and BW Expert Panel, CGG Site Representative, SEA, Party Chief, MFOs, PAM and ADM Operators.
	Collection and review of new relevant research, if any, will be completed within one month of the commencement of the Regia MSS. A risk assessment and management of change process will be instigated if outcomes of relevant research suggest that there has been a significant change to the context of the Regia MSS that may lead to an update to the FMP.
	Ensure the requirements for the implementation of the FMP are in place prior to the commencement of the Regia MSS.

Role	Responsibility
	Coordinate and document the review of effectiveness and compliance with the FMP.
	A review of the effectiveness and compliance with the FMP will be undertaken within one week of commencement of the Regia MSS and thereafter every four weeks while the Regia MSS is being undertaken.
	Develop training material (PowerPoint or video presentation) to communicate the requirements of the FMP to those who have responsibilities to implement the plan. Ensure the Regia MSS induction provides an overview of the FMP.
	Review the FMP Daily Report to ensure detection and actions meet the requirements of the FMP.
	Provide support to the Survey Environment Adviser as required.
SRW and BW Expert Panel	Consists of a minimum of three experts: • SRW expert with experience with SRW in southern Australia. • BW expert with experience with BW in southern Australia. • Marine mammal expert with experience with whale observations/detections in southern Australia. • A CGG representative with experience and understanding of seismic surveys, and EP requirements.
	Provide advice on the FMP Implementation Plan prior to commencement of the survey such that any recommendations can be adopted, as appropriate.
	In considering the FMP Implementation Plan prior to commencement of the survey, the SRW and BW Expert panel will: • Provide advise to optimise flight path and observer effort for detection of BW and SRW during aerial survey(s) to be instigated prior to commencement of the Regia MSS. • Determine criteria for when aerial surveys are to be instigated during survey acquisition. • Determine positioning of fixed buoy acoustic detection system. • Consider daily reports on SRW and BW detections and associated shutdowns, if they occur, and recommend further management actions, as required. • Determine whether deployment of a spotter vessel with a further two MFOs for any part of the Regia MSS is appropriate.
	Provide advise to CGG in relation to actions to take in connection with SRW and BW detections and associated shutdowns.
CGG Site Representative	Accountable for implementation of this procedure.
	Provide records of FMP training and activity-specific environmental induction to SEA.
Survey Environment Adviser	Cooridinate MFO, PAM and ADM observations/detections and provide advise to the Party Chief of required actions.
	Provide advice to the Party Chief and Vessel Masters (or delegate) on the requirements of the FMP.
	Develop daily FMP Report of MFO, PAM and ADM observations/detections and actions taken.
	Liase with CGG Environment Officer to determine when aerial surveys are triggered and SRW and BW Expert Panel input required.
Party Chief	Maintain open communication with SEA.
	Communicate the status of the siesmic activities (i.e. deployment, testing, soft start, shut downs) to the SEA.
	Decide whether actions within the FMP can safely be implemented and take action accordingly.

Role	Responsibility
	Document reasons for not following the FMP Plan, if required.
	Provide input into the review of effectiveness and compliance with the FMP.
Vessel Masters	Maintain open communication with SEA.
	Decide whether actions within the FMP can safely be implemented and take action accordingly.
	Document reasons for not following the FMP, if required.
	Provide input into the review of effectiveness and compliance with the FMP.
	Provide records of FMP training and activity-specific environmental induction for vessel crew to SEA.
Marine Fauna Observers (MFOs) PAM Operators ADM Operators	Provide input into the development of the FMP Implementation Plan.
	Undertake observations/detections and immediately report whale and other fauna (MFO only) observations/detections to the SEA.
	Provide input into the review of effectiveness and compliance with the FMP.
	Submit daily reports to the SEA.
Seismic Operators and Vessel Crew	Undertake Regia MSS induction that provides an overview of the FMP.
	Communicate whale sighting to SEA immediately, supported by relevant information where available (e.g. latitude and longitude, time of sighting, no. of whales).

4.2 Records and Reporting Requirements

Table G2-4-2 - Records and Reporting Requirements

Records and Reporting Requirement	Responsible	Description
Pre-Regia MSS FMP implementation review	CGG Environment Officer	Documentation and records of evidence of outcomes of engagement with the SRW and BW Expert Panel. Documentation and records of evidence to show that the FMP implementation requirements are in place prior to the commencement of the Regia MSS.
Regia MSS Induction records	CGG Site Representative Vessel Masters	Regia MSS induction records.
MFO, PAM and ADM operator qualifications	CGG Environment Officer	Resumes Training certificates
Communication of the FMP Plan to to those who have responsibilities to implement the plan.	CGG Environment Officer	Signed record that roles responsible for implementation and actions in this plan have read and understand.
Daily obseration/detection report.	MFO PAM Operator ADM Operator	Report detailing marine fauna observations and whale detections. ons taken as per the WMP, and reasons actions not taken.
Daily FMP Report	SEA	Report detailing marine fauna observations and whale detections and actions taken as per the FMP, and reasons actions not taken.
Review of effectiveness and compliance with the FMP	CGG Environment Officer	Documentation of efforts for collection and review of new relevant research. Documentation of risk assessment performed, and management of change process instigated, if any new research

Records and Reporting Requirement	Responsible	Description
		outcomes suggest that there has been a significant change to the context of the Regia MSS. Documentation of daily reports to the SRW and BW Expert Panel of SRW or BW observations and detections and associated shutdowns, if they occur. Documentation and any actions from the review of effectiveness and compliance with the FMP.
End of Survey Report	SEA	Report detailing marine fauna observations and whale detections. ons taken as per the WMP, and reasons actions not taken.
Compliance and Sighting Reports	SEA	Sightings and observations from all detection methods used as well as survey information are to be recorded within the DCCEEW Cetacean Sightings Application (CSA). Upon completion of the survey the information entered into the CSA is to be exported as a text file and provided to the CGG Environment Officer.
	CGG Environment Officer	Submit CSA text file to sightingsdata@aad.gov.au within two months of survey completion.

5 Detection of Whales

In the context of the Regia MSS, it is acknowledged that there are inherent challenges in detecting whales. Whales, with their vast range of species, behaviours, and habitats, require a multifaceted approach to detection.

5.1 Visual Observers

MFOs will be stationed on the survey vessel to undertake observations for marine fauna during daylight hours.

MFOs conduct their observations using binoculars and the unaided eye, primarily from the bridge of the vessel or, ideally, from an elevated vantage point. In optimal weather conditions, visual observations are effective up to ~3 km from the survey vessel.

The MFOs will be experienced in whale and other marine fauna observation, distance estimation, data gathering, mitigation procedures and reporting.

Start-up protocols for the sound source have been built out to include a pre-start detection criterion that require 24 hrs to have passed since a confirmed visual observation of a SRW or BW. This represents a precautionary approach relative to the EPBC Policy Statement 2.1 Part A measures and acknowledges that visual observations are not possible during night-time start-ups.

5.2 Acoustic Detection

CGGs whale detection strategy includes the integration of acoustic detection systems, recognising the dynamic nature of whale behaviour and the crucial factor that whales must vocalise to be detected. Acoustic detection systems will consist of passive acoustic monitoring (**PAM**) and the use of fixed buoy acoustic detection monitoring.

Acoustic detection methodologies adopted will have 24-hour operation and near real time reporting of whale species and location. The system to be engaged will be able to detect low-frequency whales such as BW and SRW, subject to a successful test deployment prior to the commencement of the survey.

Start-up protocols for the sound source have been built out to include a pre-start detection criterion that require 48 hrs to have passed since confirmed acoustic detection of a SRW or BW. This represents a precautionary approach relative to the EPBC Policy Statement 2.1 Part A measures and acknowledges that visual observations are not possible during night-time start-ups.

The underwater area is not a constant symphony of whale songs, and the likelihood of vocalisation can vary. Whales are known to communicate using a diverse range of vocalisations, from intricate songs to simpler clicks and whistles, depending on their species and circumstances. Therefore, the effectiveness of our acoustic detection methods can be influenced by factors such as species presence, behaviour, and environmental conditions that may affect vocalization patterns.

This variability underscores the importance of our multifaceted approach to whale detection. While acoustic detection adds a valuable dimension to detection capabilities, it is inherently dependent on whales vocalising. Consequently, the use of multiple detection methods, including visual and aerial observations and acoustic detections systems, enhances overall confidence in detecting whales, both above and below the water surface, regardless of their vocalisation patterns.

5.2.1 Passive Acoustic Monitoring

Two PAM operators will be stationed on the survey vessel to detect whales 24/7. The PAM system can detect cetaceans across all frequency hearing groups including low-frequency hearing group whales such as BW and SRW. Thus, the PAM system, which has a detection distance range of ~10 km from the survey vessel, will be the primary whale detection method at night and during low visibility, operating alongside the fixed buoy detection system.

The PAM operators will be experienced in whale detection, data gathering, mitigation procedures and reporting. Prior to deploying acoustic detection systems, they are subjected to rigorous testing to validate their reliability. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls.

Based on public comment feedback (Table G2-2-2) in Appendix G1, CGG will include further resources for detection of whales, namely an additional qualified person who can provide relief, as required, across both visual observation and acoustic detection monitoring tasks. This will address concerns relating to fatigue management among the MFO, PAM and ADM operators and associated reduced effectiveness of monitoring outcomes. In total, the Regia MSS will be resourced with five qualified personnel to perform 24/7 visual observations as well as acoustic detection monitoring and operations (PAM and ADM). In addition to the two MFOs on the seismic vessel, two dedicated, trained and experienced MFOs will be onboard a dedicated spotter vessel at all times. In addition, officers of the watch on the attending support vessels will be trained to identify whales during daylight hours to support the visual detection of marine mammals. [Sentence added in response to Matters M43, M45 and M49].

5.2.2 Fixed Buoy Acoustic Detection

Subject to a deployment test showing the fixed buoys utility, CGG will implement a fixed buoy detection system of no less than 3 buoys fitted with near real time equipment for near real time reporting of whale species and location. Prior to deploying acoustic detection systems, they are subjected to rigorous testing to validate their reliability and effectiveness. These tests are specifically designed to confirm the systems' capability to detect whales, including those emitting low-frequency calls. Testing will also be undertaken of the performance of data streaming, information management and delivery systems.

The fixed buoy detection system has a detection distance range of ~14 km. Their location is intended to optimise data collection coverage of the shutdown zone and will be determined based on recommendations from the SRW and BW Expert Panel. Coverage of the multiple fixed buoys will be determined by the expert panel such that the 23 km detection zone for BW is covered, particularly in the western half of the survey. This is because the secondary modelling report (Appendix B7b) showed that these furthest detection distances were required at these sites.

Signals from the fixed buoy acoustic detection system will be monitored in near real-time by qualified personnel tasked with acoustic detection of whales.

5.3 Aerial Surveys

Complementing vessel-based observations and acoustic monitoring, aerial surveys are another component of CGG's multifaceted approach for detecting whales and will be used to detect all whales with a focus on the movement of SRW into and out of the coastal reproduction BIA and the movement of BWs into and out of the Otway area.

At least one (1) aerial survey will be undertaken prior to commencement of the Regia MSS and optimising flight path and observer effort for detection of SRW and BW will be subject to the recommendation of the SRW and BW Expert Panel. Aerial survey(s) will be undertaken to identify if SRWs are moving into or out of the reproductive BIA and if BWs are moving into or out of the Otway area.

The further use of aerial surveys once the Regia MSS is underway will be guided by the SRW and BW Expert Panel. Specifically, the panel will determine criteria for when aerial surveys are to be instigated during survey acquisition. To inform their recommendations, the panel will be provided with daily reports of SRW and BW detections and associated shut downs, if they occur.

Experienced operators, with a proven track record of conducting aerial surveys for BW and SRWs in the waters offshore Victoria, will be contracted to undertake aerial surveys. In collaboration with the SRW and BW Expert Panel, their expertise and knowledge of local whale populations is instrumental in supporting detection efforts.

5.4 Adaptive Approach to Monitoring

In addition to described approached to visual observations, acoustic detections and aerial surveys to ascertain the presence of whales, additional and adaptive approaches may be deployed subject to the recommendation of the SRW and BW Expert Panel, namely, deployment of additional aerial surveys adaptively during the Regia MSS (in addition to a minimum of one (1) aerial survey prior to commencement of the Regia MSS).

Any marine fauna observations from additional aerial surveys or spotter vessel MFOs will contribute to monitoring of pre-acquisition detection criteria and soft start procedures that will affect sound source operations, if not met.

The panel will be engaged prior to commencement of the Regia MSS and will be informed of any SRW or BW-related shutdowns within 24 hrs of occurrence during the survey. This will provide the panel with timely opportunity to provide advice and recommendations for ongoing and adaptive management of the activity.

6 Vessel and Marine Fauna Collision Management

The AAZ is the operational area where an activity is undertaken, and a control action is required to be taken to meet the Environmental Performance outcomes described in Section 1 of this FMP as well as in Appendix G1 of the EP (Environmental Performance).

6.1 Whales

This section details the procedure and actions to be implemented to ensure collision between vessels and whales, which may result in injury to the whale, does not occur.

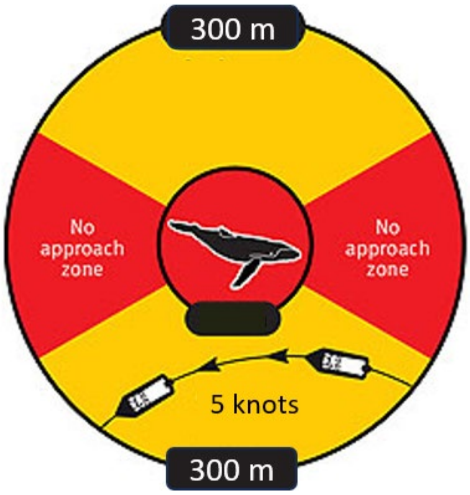
This procedure applies to:

- All support vessels;
- Seismic vessel when streamers or other equipment are not deployed or being deployed.

When streamers or other equipment are deployed the seismic vessel does not have the capability to move direction in a timely manner. CGG has, however, committed to operating at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to whales.

The Activity Action Zone is the area where action is required to be taken as detailed in Figure G2-2.

Activity	Action Zone Distance
Vessel movements	300 m
Justification for Action Zone Distance	
All vessels at all times must comply with the Environment Protection and Biodiversity Conservation Regulations 2000 Part 8: Vessel and Operating Procedures, which stipulates a 300 m caution zone for whales. CGG has committed to M#01: Activity Limitations where the seismic and support vessels will operate at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to whales.	



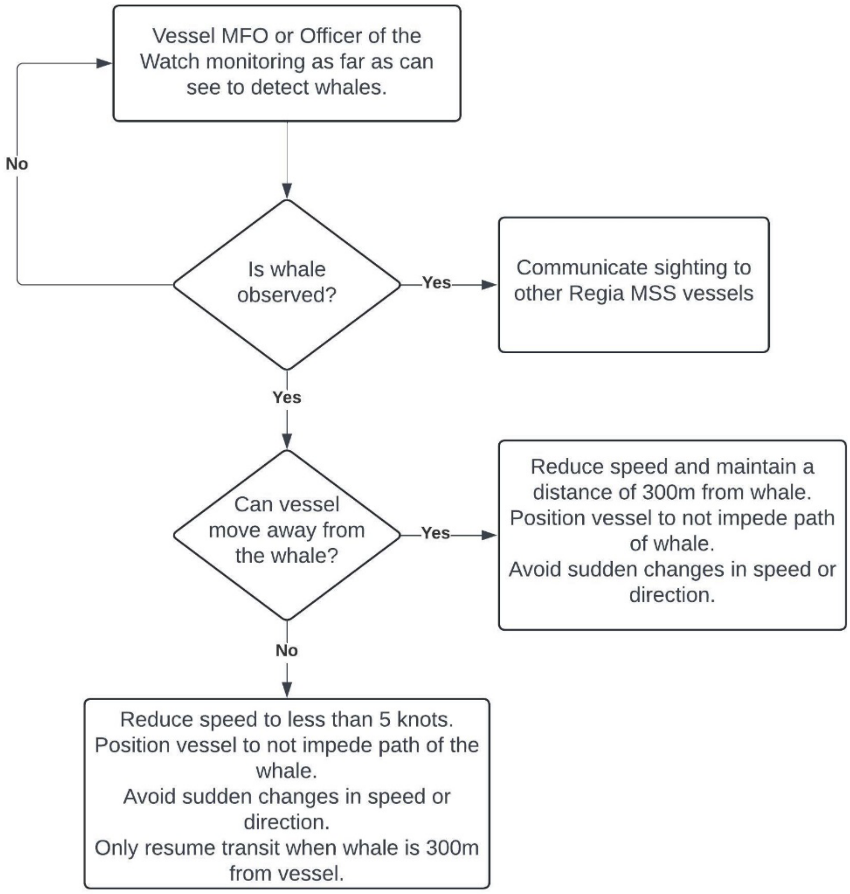


Figure G2-2 – Whale Management Actions – Vessel Collision

6.2 Dolphins

This section details the procedure and actions to be implemented to ensure collision between vessels and dolphins, which may result in injury to the dolphins, does not occur.

This procedure applies to:

- All support vessels
- Seismic vessel when streamers or other equipment are not deployed or being deployed.

When streamers or other equipment are deployed the seismic vessel does not have the capability to move direction in a timely manner. CGG has, however, committed to operating at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to dolphins.

The Activity Action Zone is the area where action is required to be taken as detailed in Figure G2-3.

Activity	Action Zone Distance
Vessel movements	150 m
Justification for Action Zone Distance	
All vessels at all times must comply with the Environment Protection and Biodiversity Conservation Regulations 2000 Part 8: Vessel and Operating Procedures, which stipulates a 150 m caution zone for dolphins. CGG has committed to M#01: Activity Limitations where the seismic and support vessels will operate at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to dolphins .	

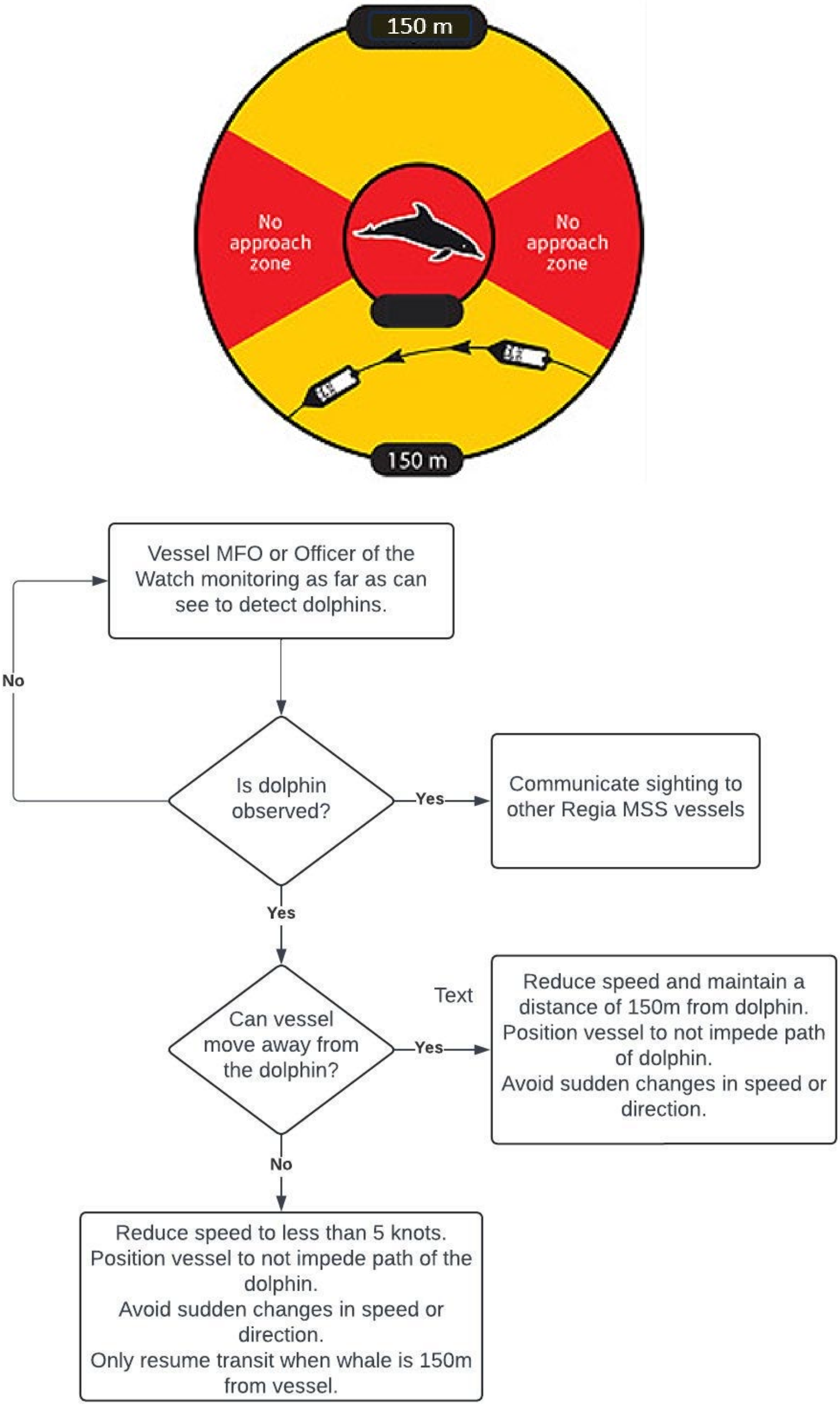


Figure G2-3 -Dolphin Management Actions – Vessel Collision

6.3 Pinnipeds

This section details the procedure and actions to be implemented to ensure collision between vessels and pinnipeds, which may result in injury to pinnipeds, does not occur.

This procedure applies to:

- All support vessels
- Seismic vessel when streamers or other equipment are not deployed or being deployed.

When streamers or other equipment are deployed the seismic vessel does not have the capability to move direction in a timely manner. CGG has, however, committed to operating at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to pinnipeds.

Activity	Action Zone Distance
Vessel movements	150 m
Justification for Action Zone Distance	
The EPBC Regulations 2000 Part 8: Vessel and Operating Procedures of 150 m will be applied to dolphins. This distance will also be applied to pinnipeds, as it is feasible that they can be detected by MFOs at 150 m. CGG has committed to M#01: Activity Limitations where the seismic and support vessels will operate at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to pinnipeds.	

6.4 Birds

This section details the procedure and actions to be implemented to ensure collision between vessels and flocks of rafting or feeding birds, which may result in injury to birds, does not occur.

This procedure applies to:

- All support vessels
- Seismic vessel when streamers or other equipment are not deployed or being deployed.

When streamers or other equipment are deployed the seismic vessel does not have the capability to move direction in a timely manner. CGG has, however, committed to operating at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to pinnipeds.

Activity	Action Zone Distance
Vessel movements	150 m
Justification for Action Zone Distance	
The EPBC Regulations 2000 Part 8: Vessel and Operating Procedures of 150 m will be applied to dolphins. This distance will also be applied to flocks of rafting or feeding birds, as it is feasible that they can be detected by MFOs at 150 m. CGG has committed to M#01: Activity Limitations where the seismic and support vessels will operate at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to flocks of rafting and feeding birds.	

6.5 Turtles

This section details the procedure and actions to be implemented to ensure collision between vessels and turtles, which may result in injury to turtles, does not occur.

This procedure applies to:

- All support vessels
- Seismic vessel when streamers or other equipment are not deployed or being deployed as at this time the seismic vessel does not have the capability to move direction in a timely manner.

Activity	Action Zone Distance
Vessel movements	150 m
Justification for Action Zone Distance	
The EPBC Regulations 2000 Part 8: Vessel and Operating Procedures of 150 m will be applied to dolphins. This distance will also be applied to turtles as it is feasible that they can be detected by MFOs at 150 m. CGG has committed to M#01: Activity Limitations where the seismic and support vessels will operate at low speed of no more than 5 knots during acquisition to reduce the risk of vessel collision to turtles.	

7 Helicopter Disturbance to Cetaceans Management

This section details the procedure and actions to be implemented to ensure helicopters do not disturb cetaceans (whales and dolphins).

This procedure applies to:

- Helicopters used for the Regia MSS

The Activity Action Zone is the area where action is required to be taken as detailed in Figure G2-4.

Activity	Action Zone Distance
Helicopter movements	500 m
Justification for Action Zone Distance	
The Environment Protection and Biodiversity Conservation Regulations 2000 Part 8: Vessel and Operating Procedures detail helicopters will not fly lower than 1650 ft when within 500 m horizontal distance of a cetacean except when landing or taking off and will not approach a cetacean from head on.	

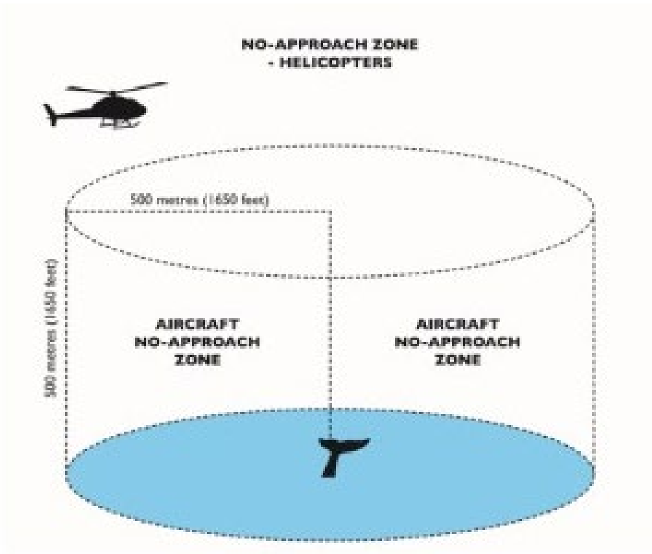


Figure G2-4 – Cetacean Approach Distances for Helicopters

8 Underwater Sound Emission Management

This section details the procedures and actions that will be implemented for seismic acquisition.

8.1 Relevant Species

This procedure applies to **ALL** whale species; however, some specific considerations have been given to endangered species such as blue whale and southern right whales.

This procedure also applies to dolphins, seals, and turtle species, as well as flocks of rafting or feeding seabirds.

8.1.1 Whales

The Regia MSS acquisition area is within the PBW foraging (annual high use) biologically important area (BIA) and SRW migration BIAs. There is the possibility that other low frequency cetaceans including fin and sei whales, may also be undertaking biologically important behaviours in the area, as identified by the EPBC Act Protected Matters Search Tool (PMST). This procedure applies to these species during the Regia MSS. [Sentence added in response to Matter 36].

The procedures outlined in this section for management of impacts to whales from underwater noise associated with seismic acquisition was developed as a control measure for the Regia MSS activity. These procedures will ensure that the activity can be carried out in a manner by which the impacts to BWs and SRWs as well as other whales undertaking biologically important behaviours will be minimised to an acceptable level.

8.1.2 Other Species

Is it possible that underwater sound emissions will impact dolphins, seals, turtles, and birds. These are mitigated to ALARP and Acceptable levels through soft start procedures.

Impacts to birds will also be mitigated through a low power procedure.

8.2 Observation and Detection Zones

As detailed in Section 5, CGG will implement several marine fauna observation and detection methodologies including deployment of MFOs, PAM and ADM operators as well as a minimum of one (1) pre-activity aerial survey. Subject to further advice from the SRW and BW Expert Panel, additional aerial surveys and a spotter vessel with another two (2) MFOs may also be deployed adaptively during the Regia MSS (Section 5.4).

Figure G2-6 details the observation and detection distances for each observation and detection method. This approach ensures that information on the presence of whales and other species can be obtained at relevant distances. Figure G2-6 also illustrates deployment of aerial surveys that may provide additional information on the movement of SRW into and out of reproduction BIA and BW into and out of the Otway Region.

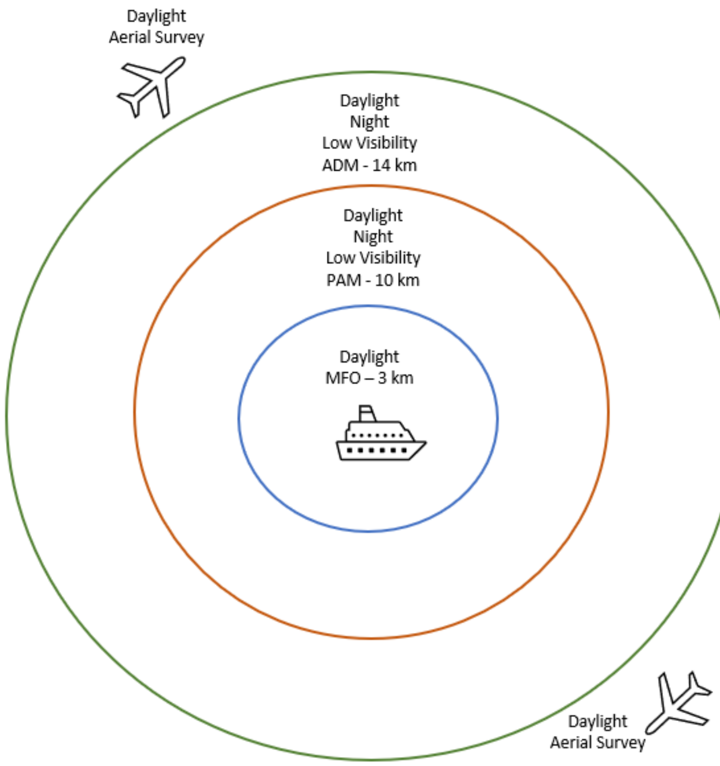


Figure G2-5 - Observation and Detection Zones

8.3 Pre-Acquisition and Acquisition Process and Actions

Policy Statement 2.1 proposes that a 30 min observation window is undertaken prior to any start-up of the sound source during the day, and a two-hour observation window within the preceding 24 hrs if starting up in low visibility or during nighttime operations.

For the Regia MSS, this has been extended with the following pre-acquisition criteria:

- MFOs have not observed an SRW/BW in the preceding 24 hrs;
- PAM operators have not detected an SRW/BW in the SDZ in the preceding 48 hrs;
- ADM operators have not detected an SRW/BW in the SDZ in the preceding 48 hrs;
- No whales have been observed or detected in a shutdown zone by any observation or detection method in the preceding one (1) hour;
- At least one (1) aerial survey prior to commencement of the Regia MSS activity confirms that there are no SRW or BW observed that are at risk from the start-up of the sound source.
- Any aerial surveys or spotter vessel that have been deployed adaptively have not observed whales in relevant shutdown zones in the preceding 48 hrs (for SRW/BW), or in the preceding one (1) hour for other whales.
- The seismic source will only be discharged the in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. The definition of ‘low numbers’ of BWs will be decided by the Expert Panel.

In addition to above, no start-up of the sound source will take place if there have been three (3) or more shut down situations during the preceding 24 hr period. It should be noted that if an SRW or BW is detected within their respective BIAs and not in the SDZ soft starts can commence.

Based on satisfying all pre-acquisition criteria, the survey can commence using soft starts if no whales are seen within or are likely to enter the SDZ.

CGG acknowledges that there are less methods available for marine mammal detection during hours of darkness and low visibility. The precautionary design of the pre-acquisition criteria has addressed the temporary inability to acquire visual observations by MFOs during these times by integrating observations and detections over a longer period for SRW and BW.

The precautionary design has also addressed the inability to visually observe whales by extending the visual observation window in the daytime to beyond typical dive times (~30 min) of deep diving species such as blue whales.

The design of pre-acquisition criteria has also been expanded to address concerns and insights raised by interested persons (see EP Appendix G1 Environmental Performance Outcomes).

Overall, CGG is satisfied that this pre-acquisition regime of criteria represents a precautionary approach relative to the EPBC Policy Statement 2.1 Part A measures and are more than commensurate with the nature and scale of the activity.

8.4 Soft Start

A soft start will be implemented in the following circumstances:

1. When the sound source is turned on initially after all pre-acquisition criteria have been met;
2. When the sound source is in low power mode due to the presence of flocks of foraging birds within 500 m of the sound source; or
3. When the sound source is in low power mode during line turns or otherwise transiting the Operational Area.

In the instance of 1): The soft start will be undertaken by gradually increasing the seismic source over a 30-minute period. For mobile species including dolphins, seals, and turtles it is anticipated that they would move away from the sound source before it is at full power, providing them a level of protection. Once the source passes, animals will be free to move back into the habitat that they departed from.

In the instance of 2) or 3): As the sound source is already in low power mode, the soft start will be undertaken by increasing the seismic source to full power mode.

If a whale is detected in relevant SDZs during soft start procedures, the acoustic source will be shut down and another soft start cannot commence until all pre-acquisition criteria have been met again.

If flocks of foraging birds are detected within 500 m of the sound source during the soft start or at any time during the Regia MSS, the acoustic source will be set to low power mode and will not be ramped up until all pre-acquisition criteria have been met again. [Paragraph added in response to Matter B15].

8.5 Shut Down Zone

Based on previous seismic surveys, CGG has chosen to only implement a shutdown zone and not a low power zone to provide another level of protection to all whale species.

Once the seismic source is at full power, if any species of whale is observed or detected within or is likely to enter relevant SDZs, the seismic source will be shut down.

CGG commissioned two sound modelling reports reflecting the iterative nature of testing revised survey layouts to inform the risk assessment of the activity. Using an agent based 'ANIMAT'[1] modelling approach, initial modelling resulted in a shutdown zone of 12 km for SRWs. Revised modelling reduced the acquisition area by ~40% and brought it away from waters shallower than 50 m. This resulted in a revised shutdown zone for SRW of 15 km.[2] For the purpose of management of impacts to SRWs from seismic acquisition, CGG will operate with a shutdown zone of 15 km. Further, the sound source will not operate within 15 km of the SRW reproduction BIA. [Sentence added in response to F17].

[1] *ANIMAT modelling is intended to provide a more realistic representation of animal behaviour as it is known, than to use a cumulative effect criterion that assumes that the animal remains passively within the sounds source for a period of 24 hrs. EP Appendix B7a. Koessler MW, Muellenmeister AM, Connell SC & McPherson CR. 2023. Regia Marine Seismic Survey: Initial Acquisition Area. Initial Acquisition Area. Document 03076, Version 1.0. Technical report by JASCO Applied Sciences for Klarite.
[2] EP Appendix B7b. Stephen T.J., V.E. Warren, S.C. Connell, M.W. Koessler and C.R. McPherson. 2024. Regia Marine Seismic Survey: Acoustic Modelling for Assessing Sound Exposures. Document 03301, Version 2.0. Technical report by JASCO Applied Sciences for Klarite.

Table G2-3 - Shut down zones for blue whales, southern right whales, and other whales.

<table>
<tr><th>Species</th><th>Shut Down Zone Distance</th><th>PTS 24 hr</th><th>TTS 24 hr</th><th>Behavioural Response</th></tr>
<tr><td>Blue Whales</td><td>23 km*</td><td>1.98 km*</td><td>22.5 km*</td><td>9.83 km*</td></tr>
<tr><td>Southern Right Whales</td><td>15 km*</td><td>1.4 km*</td><td>14.2 km*</td><td>9.51 km*</td></tr>
<tr><td>Other whales</td><td>2 km</td><td colspan="3">Not applicable</td></tr>
<tr><th colspan="5">Justification for Shut Down Zone Distance</th></tr>
<tr><td colspan="5">For blue whales (BW) and southern right whales (SRW) the Shut Down Zone Distances are based on the underwater sound modelling and the predicted distance from the sound source at which sound effect criteria for these species are exceeded. Further, the sound source will not be operated within 15 km of the SRW reproduction BIA. These control distances allow the activity to be conducted in a manner that meets the actions of the:
• Conservation Management Plan for the Blue Whale of “Anthropogenic noise in biologically important areas will be managed such that any blue whale continues to utilise the area without injury, and is not displaced from a foraging area”.
• Draft National Recovery Plan for the Southern Right Whale of “Actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any Southern Right Whale from utilising the area or cause injury (TTS and PTS) and/or disturbance”.
For other whales that do not have a management plan or recovery plan in place a 2 km Shut Down Zone is adopted. This is based on the low power zone for whales as detailed in the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales (Policy Statement 2.1).</td></tr>
</table>

*Revised survey plan designed to reduce the acquisition area and discharge the sound source in no shallower than 50 m was used for the secondary modelling report. This modelling predicted the maximum distances to the Permanent Threshold Shift (PTS) 24hr cumulative effect criteria, Temporary Threshold Shift (TTS) 24hr cumulative effect criteria and behavioural effect criteria for Southern Right Whales is 1.4km, 14.2 km and 9.51km, respectively for SRW and the predicted maximum distances to the PTS 24hr cumulative effect criteria, TTS 24hr cumulative effect criteria and behavioural effect criteria for Blue Whales is 1.98 m, 22.5 km and 9.83 km, respectively.

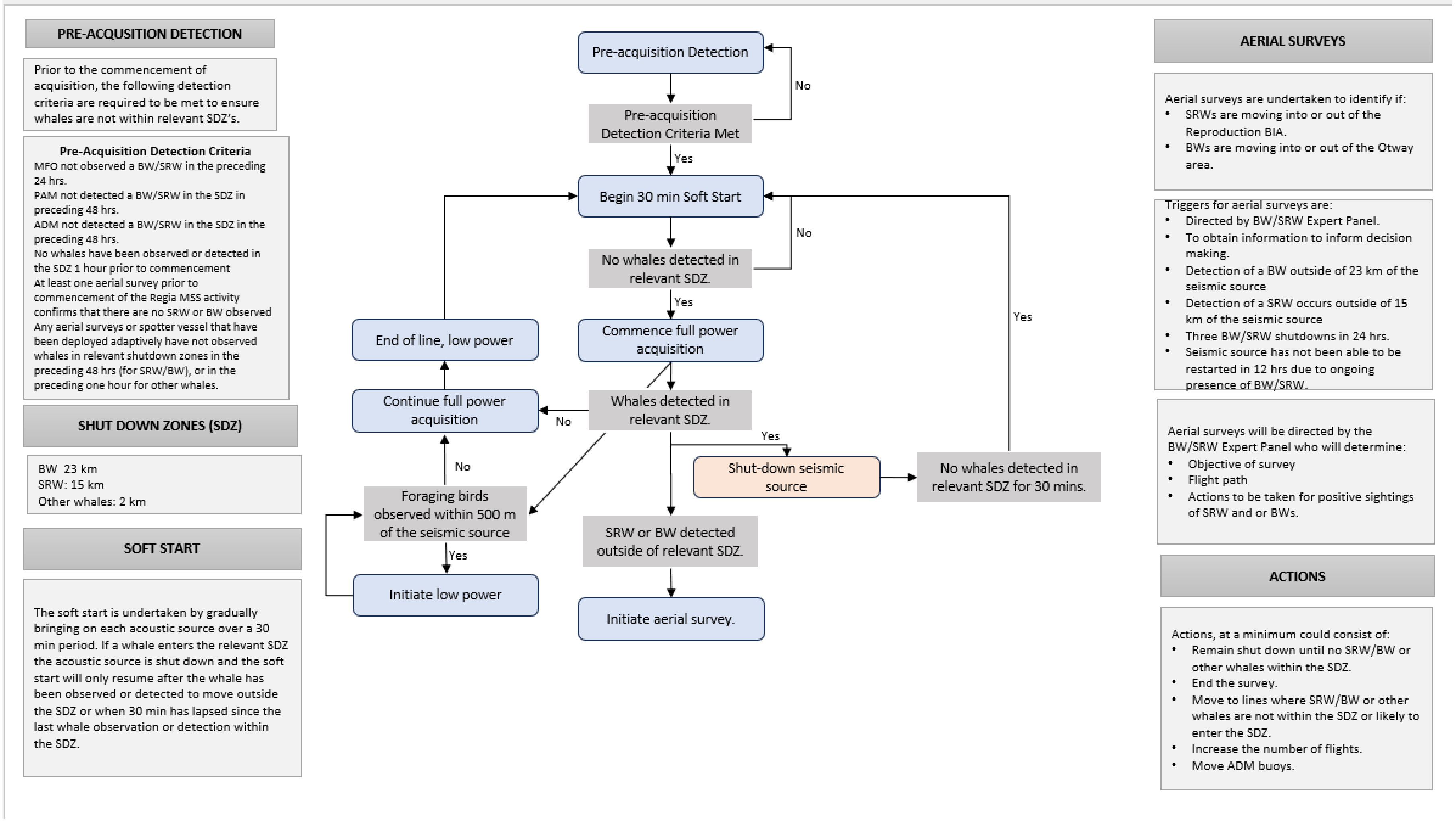


Figure G2-6 - Seismic Pre-Acquisition and Acquisition Process and Actions

9 Document Control

Table G2-9-1 - Revision History

Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	2 November 2023	MS	Document created.
0.1	19 Novmber 2023	SJ	Updates to include all fauna, not just marine mammals.
0.2	2 January 2024	SJ	Updated following completion of assessments.
1	5 January 2024	MS	Accepted all tracked changes and formatted for public comment.
1.1	10 May 2024	CT/KC	Rework of document to ensure alignment with outcomes of the consultation process, public comment, and the updated environmental assessments.
2	**14 May 2024**	**MS**	**Review and update ready for resubmission.**

10 References

Koessler MW, Muellenmeister AM, Connell SC & McPherson CR. 2023. Regia Marine Seismic Survey: Initial Acquisition Area. Initial Acquisition Area. Document 03076, Version 1.0. Technical report by JASCO Applied Sciences for Klarite.

Stephen T.J., V.E. Warren, S.C. Connell, M.W. Koessler and C.R. McPherson. 2024. Regia Marine Seismic Survey: Acoustic Modelling for Assessing Sound Exposures. Document 03301, Version 2.0. Technical report by JASCO Applied Sciences for Klarite.

Annex 1: Blue Whale Diving Summary

Diving behaviour of blue whales associated with feeding at depth was observed by Gill and Morrice (2003) in the Otway region, who note that blue whales dived steeply, submerging for 1 – 4 minutes, then returned to the surface. Tagging of a pygmy blue whale at the Perth Canyon identified 1677 dives over the tag duration (7.6 days) (Owen et al. 2016). The duration of dives was:

- Feeding - mean of 7.6 minutes, maximum of 17.5 minutes.
- Migratory – mean of 5.2 minutes, maximum of 26.7 minutes.
- Exploratory – mean of 8.6 minutes, maximum of 22.05 minutes.

Tagging of 13 pygmy blue whales (five of which had tags that monitored dive depth and duration) in the Bonney upwelling identified (Möller et al. 2020):

- Whales predominantly carried out area-restricted search (presumably foraging) with generally shallow and short dives. However, dives were generally deeper at night compared to during the day.
- Whales performed mostly square shaped dives that were shallow in depth and short in duration.
- Dives recorded to a maximum of 492 m (mean = 59.5 m ± 94.3), and for a maximum duration of 112 minutes (mean = 6.1 minutes ± 5.2).

Although the maximum recorded dive time was 112 minutes, the mean dive time of 6.1 minutes ± 5.2 provides confidence that the typical dive time is less than 30 minutes (Möller et al. 2020). Tagging of eight blue whales off California (Irvine et al. 2019) identified that dive durations were as long as 30.7 minutes, and no feeding lunges were recorded during dives > 20 minutes in duration.

References:

Gill, P. and M. Morrice. 2003. Cetacean Observations. Blue Whale Compliance Aerial Surveys. Santos Ltd Seismic Survey Program Vic/P51 and P52. November – December 2002. Report to Santos Ltd.

Irvine, L.M., D.M. Palacios, B.A. Lagerquist, and B.R. Mate. 2019. Scales of Blue and Fin Whale Feeding Behaviour off California, USA, With Implications for Prey Patchiness. Frontiers in Ecology and Evolution 7(338).

Mölle LM, Attard CRM, Bilgmann K, Andrews-Goff V, Jonsen I, Paton D and Double MC. 2020. Movements and behaviour of blue whales satellite tagged in an Australian upwelling system. Scientific Reports 10:21165.

Owen. K., Jenner CS., Jenner. M-NM. And Andrews. RD. 2016. A week in the life of a pygmy blue whale: migratory dive depths overlaps with large vessels draft. Animal Biotelemetry. 4:17. DOI 10.1186/s40317-016-0109-4.

Annex 2: First Nations Whale Songline Values

Table added in response to Matter FN05.

Objections/Claims	Feedback ID	Assessment of Merit	Measures Adopted Because of the Consultations
Koontapool (Southern Right Whale) songlines being disrupted by seismic sounds	265	This objection relates to the adverse effects of the activity.	No discharge of the sound source within 15 km of the Southern Right Whale reproduction biologically important area (BIA) at any time. A commitment to undertake a minimum of one (1) aerial survey with a focus on the movement of SRW into and out of the coastal reproduction BIA to help determine presence and behaviour of Koontapool as relevant to the activity. An immediate shut-down zone of 15 km radius from the seismic acoustic source for Koontapool. Further risk assessment of SRW should new relevant research become available prior to the activity.
Koontapool (Southern Right Whale) birthing and calving disrupted at Logan's Beach whale nursery.	266	This objection relates to the adverse effects of the activity.	No discharge of the sound source within 15 km of a Southern Right Whale reproduction BIA or Habitat Critical to Survival (HCTS) while Southern Right Whales are present in the BIA and HCTS. No discharge of the sound source at full power in water depths of less than 50 m. A commitment to undertake a minimum of one (1) aerial survey with a focus on the movement of SRW into and out of the coastal reproduction BIA to help determine presence and behaviour of Koontapool as relevant to the activity. An immediate shut-down zone of 15 km radius from the seismic acoustic source for Koontapool. Further risk assessment of SRW should new relevant research become available prior to the activity.

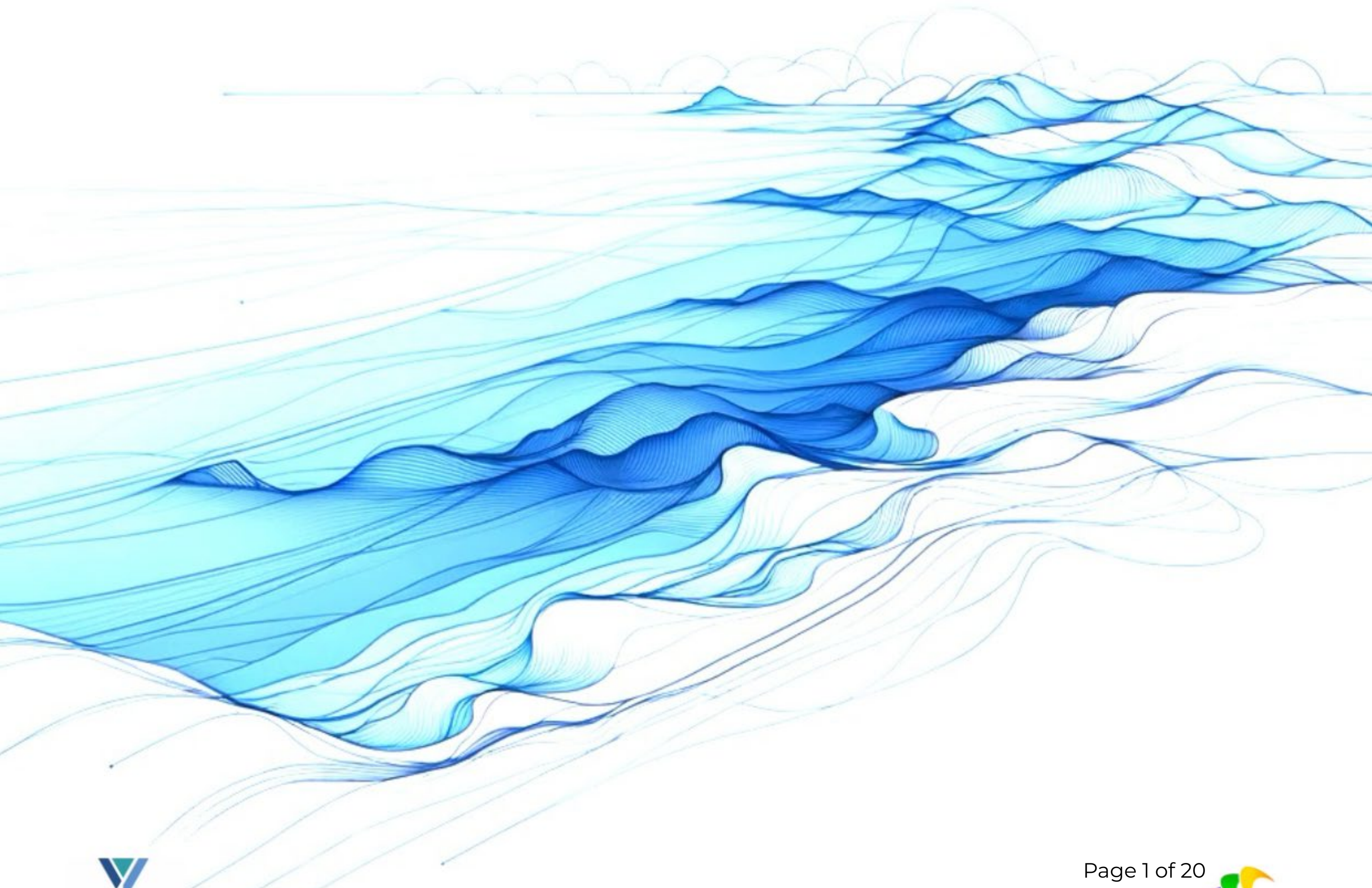
Objections/Claims	Feedback ID	Assessment of Merit	Measures Adopted Because of the Consultations
Disruption to Wuulok (Blue Whale).	267	This objection relates to the adverse effects of the activity.	Only discharge the sound source in the Pygmy Blue Whale foraging BIA when low numbers of Pygmy Blue Whales and other foraging whales are in the BIA off Otway. A commitment to undertake a minimum of one (1) aerial survey with a focus on the movement of BWs into and out of the Otway, as relevant to the activity. An immediate shutdown zone of 23 km radius from the seismic acoustic source for Wuulok. Further risk assessment of BW should new relevant research become available prior to the activity.
Cultural significance of Deen Maar.	268	This objection relates to the adverse effects of the activity.	Project vessels will not traverse between Lady Percy Julia Island / Deen Maar and the mainland. No discharge of the sound source within 17 km of Lady Percy Julia Island / Deen Maar.
General effects on marine ecosystem from seismic survey activities.	269	This objection relates to the adverse effects of the activity.	Reduced source size and acquisition areas. Fauna Management System. Further risk assessment should new relevant research become available prior to the activity.

Oil Pollution Emergency Plan and Operational and Scientific Monitoring Plan

Appendix G3: REG-EP-037-G4

Rev 1

January 2023



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First Response Actions

In the event of a hydrocarbon release, first call the AMSA Rescue Co-ordination Centre Australia (JRCC Australia) via:

Phone:	02 6230 6811, 1800 641 792 (24 hours)
Fax:	02 6230 6868
Telex:	62349
AFTN:	YSARYCYX

The following information should be provided wherever possible:

- ☐ Name and contact details.
- ☐ Where and when the spill occurred.
- ☐ A description of the pollutant.
- ☐ The size of the area where the oil is visible.
- ☐ The source of the spill including vessel registration numbers if known.
- ☐ Any photographs of the incident.

Victoria

If the spill is in, or is likely to move into Victorian State waters, the spill must be reported using the contact details below. If the spill occurs outside port jurisdictions, relevant port authorities will be notified as defined in the relevant State response plan. In the case of a Level 1 release within or close to State waters Portland Port will be the Control Agency. Contact the Port of Portland via:

Reporting (24-hour) Port of Portland +61 3 5525 2450.

For a Level 2 or 3 spill, or where a spill originates in Commonwealth waters and is likely to enter State waters (and where AMSA hand over Control Agency role), DJSIR will be the Control Agency.

Contact DJSIR via: DJSIR State Duty Officer on 0428 863 564.

In the event of a spill in one of the Victorian ports to be used by the Regia MSS seismic vessels, the relevant Port Authority must be notified immediately.

Tasmania

If the spill is in, or is likely to move into Tasmanian State waters, the spill must be reported using the contact details below.

In the case of any spill within State waters the Environment Protection Authority Tasmania is the Control Agency. TasPorts is the control agency for oil spills within Port waters.

For a Level 2 or 3 spill, or where a spill originates in Commonwealth waters and is likely to enter State waters (and where AMSA hand over Control Agency role), the Tasmanian Environment Protection Authority (EPA) is the Control Agency.

Ship's masters, owners, charterers, and agents must provide notification in accordance with statutory requirements (under Marine-related Incidents (MARPOL Implementation) Act 2020).

Telephone: Control Officer (SOPCA): +61 (0)3 6165 4599 or 1800 005 171 (within Tasmania only)
Radio: TasPorts Vessel Traffic Services

VHF radio channel 16/14/12, Call sign “relevant port name VTS" (e.g. Grassy VTS)

Email: incidentresponse@epa.tas.gov.au
EPA: Pollution Incidents: 1800 005 171

General enquiries: +61 3 6165 4599 enquiries@epa.tas.gov.au

The name, IMO number and radio call sign of the vessel must be provided, along with a written report commencing with the code letters “POLREP”. The report must include key basic information, including location, nature and scale of the spill, and contact details. A detailed written report may also be required. Notify the relevant party when injured/oiled wildlife is confirmed or could potentially occur.

1 Introduction

Welcome to the Regia MSS Oil Pollution Emergency Plan (OPEP). The Regia MSS OPEP serves as a blueprint for responding effectively to potential oil and chemical spill emergencies that may arise during our operations at sea.

The development of an Oil Pollution Emergency Plan (OPEP) is required by Regulation 14(8) of the OPGGS(E) Regulations. This OPEP for the Regia MSS comprises relevant components of the CGG seismic vessel or contractor's Shipboard Oil Pollution Emergency Plan (SOPEP) and the National Plan for Maritime Environmental Emergencies (NATPLAN) (AMSA 2014).

2 Purpose of the Document

The primary purpose of the Regia MSS OPEP is to establish a clear and systematic framework for preventing, managing, and mitigating oil pollution incidents on the vessels deployed during the Regia MSS. By outlining specific procedures and responsibilities, this document can be followed to ensure that our crews address environmental emergencies swiftly and efficiently.

3 OPEP Objectives

The Regia MSS OPEP strives to achieve the following objectives:

Environmental Protection: Our commitment to safeguarding the marine environment is paramount. This document is designed to prevent and minimize the impact of oil and chemical spills on aquatic ecosystems, marine life, and coastal regions.

Compliance: The Regia MSS OPEP is developed in accordance with the Offshore Petroleum and Greenhouse Gas (Environment) Regulations. It is also designed to be consistent with the Australian national system for oil spill preparedness and response.

Safety: The safety of our crew members and the vessels themselves is of paramount importance. This plan outlines measures to protect our personnel while responding to pollution emergencies and prevent accidents that could lead to such incidents.

Reputation Management: Recognizing that environmental responsibility is a core value of CGG, this OPEP reinforces our commitment to stakeholders, partners, and the broader community. Effective pollution response measures help safeguard our reputation as a responsible and conscientious maritime operator.

4 Scope of the OPEP

The Regia MSS OPEP applies to all vessels and operations under the jurisdiction of the Australian Maritime Safety Authority (AMSA). The scope of this document encompasses:

Response Protocols: Clear and decisive steps to be followed in the event of a pollution incident, including containment, clean-up, and notification procedures.

Personnel Responsibilities: Allocation of roles and responsibilities to crew members, ensuring a coordinated and effective response to emergencies.

Documentation and Reporting: Requirements for maintaining records, reporting incidents, and cooperating with relevant authorities and organizations.

This document does not include the testing arrangements for this OPEP can be found in the Regia MSS Implementation Strategy and are not part of this document.

The Regia MSS OPEP is a dynamic and evolving document, subject to periodic reviews and updates to reflect changes in technology, regulations, and best practices. It is our collective responsibility to implement and uphold the principles outlined in this plan, ensuring the continued success of our operations while preserving the integrity of our oceans and marine ecosystems.

This document is not a Shipboard Oil Pollution Emergency Plan (SOPEP). The SOPEP is part of the response arrangements for the Regia MSS as it is a critical document and preparedness measure required for vessels operating at sea. Each SOPEP is designed to outline the procedures and responsibilities that the crew of a vessel must follow in the event of an oil spill to minimize environmental damage and respond effectively to such emergencies. SOPEPs are a mandatory requirement under the International Maritime Organization's (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL).

5 The National System for Preparedness and Response

NATPLAN is the framework that integrates Commonwealth and State Government(s) response, facilitating an effective response to marine pollution incidents via Australian Emergency Management Arrangements. AMSA manages NATPLAN and is the control agency for vessel spills in Commonwealth waters. As such, AMSA works with State Governments, emergency services and relevant industries (shipping, oil and gas, exploration, and chemical industries) to maximise Australia's response capability.

NATPLAN applies to all spills from vessels in Commonwealth waters. The SOPEP recognises the divisions of responsibility to provide effective response to marine pollution incidents, as defined under NATPLAN. The SOPEP is the principal response document that will be implemented in the event of a marine oil spill, which provides specifics and provision for guiding management response to mitigate oil spills from vessels.

NATPLAN applies to Commonwealth waters seaward of the boundary of State Waters (3 NM offshore) and integrates with State response plans. NATPLAN identifies several of the roles that are fulfilled by State agencies as defined in the relevant State contingency plan.

5.1 Jurisdictional Authority (JA)

A JA is a statutory responsibility required to ensure that an adequate spill response plan has been prepared. In the event of a spill, the JA also ensures that a satisfactory response can be implemented by the Control Agency. In Commonwealth waters, the JA for petroleum activities is NOPSEMA, and AMSA for vessel spills.

5.2 Control Agency (CA)

The CA is responsible for operational control and response to an oil spill in the marine environment. The Commonwealth waters CA for the Regia MSS is AMSA. AMSA may request that State CAs assume the lead CA role, even where the spill has occurred in Commonwealth waters (but where there is a likelihood that spill hydrocarbons may impact State resources/shorelines).

National Plan response equipment and resources are managed and controlled by AMSA's Marine Environment Protection (MEP) Division, and include:

- Maritime Emergency Response Commander (MERCOM)
- Oil spill response equipment managed via the Marine Oil Spill Equipment System (MOSES)
- Oil Spill Response Atlas (OSRA) which identified sensitive receptors (e.g. marine and shoreline ecosystems and biological resources)
- Oil Spill Trajectory Modelling (OSTM).

In addition, the Australian Marine Oil Spill Centre (AMOSC) is an oil spill response organization funded by industry membership fees that can be contracted as an oil spill response agent.

5.3 State Waters

If a hydrocarbon release occurs in state waters (or if it is likely to move into State waters), the following relevant state oil spill contingency plans will apply:

The Victoria state plan is the State Maritime Emergencies (non-search and rescue) Plan (Emergency Management Victoria 2016). The State Jurisdictional Authority (JA) and Control Agency (CA) is the Department of Economic Development, Jobs, Transport and Resources (DEDJTR).

The Tasmania state plan is the Tasmanian Marine Oil Spill Contingency Plan (TASPLAN) (EPA Tasmania January 2022). The State JA is the Environmental Protection Authority Tasmania, and the State CA is the Tasmanian Environment Protection Authority (EPA).

The deployment of state resources in Commonwealth waters will be requested and coordinated by AMSA.

5.4 Roles and Responsibilities

AMSA is the Control Agency and hence responsible for managing response to all oil spills in Commonwealth waters under NATPLAN. Both MARPOL 73/78 and the vessel's SOPEP require the vessel master to report to the nearest State whenever there is an incident involving actual or probably discharge. The vessel SOPEP is implemented to initiate clean up resources and control discharges.

The following roles will also provide key support:

> Prior to commencement of the survey **the Survey Vessel Master will ensure that all relevant personnel have undergone relevant inductions and are familiar with the SOPEP** (and oil spill response arrangements therein) and are appropriately trained to undertake their responsibilities under the SOPEP.
>
> **The Seismic Survey Vessel Master will be responsible for notifications and reporting all spills to the sea to the AMSA JRCC**, via a POLREP form included in the vessel SOPEP. Further reports will be sent at regular intervals to inform relevant stakeholders and agencies (AMSA, NOPSEMA, CGG, survey contractors, etc.).
>
> **The Survey Vessel Master will continue to provide situation reports (SITREPs)** throughout the response activity, at the direction of AMSA. AMSA will maintain the response until relevant termination criteria are achieved.
>
> **The Survey Vessel Master will make the area safe (protect human life) and to make reasonable efforts to stop the leak** to prevent further spillage, for example by transferring fuel to another tank.
>
> **The Survey Vessel Master will be responsible for ensuring that the spill containment and recovery kits are serviced and in-date** (where relevant), and appropriately always stocked.
>
> **The CGG Client Site Representative on board the vessel is responsible for reporting directly to CGG**. The CGG Technical Operations Manager (shore-based) is then responsible for notifying NOPSEMA of any spills in Commonwealth waters.

AMSA will appoint the MERCOM, who is supported by statutory powers under the Protection of the Sea (Powers of Intervention) Act 1981. The responsibilities of the MERCOM include the management of emergency intervention issues during a response to maritime casualty incidents where there is a real (or even potential) risk of significant pollution.

6 Assessment Of Spill Scenarios

The level of hydrocarbon release is used to identify the level of resources required to respond to the spill. This approach allows scaling of response in line with the evolving nature and scale of the incident. Incident classification (Levels 1 to 3) are defined in NATPLAN as follows:

> **Level 1 incidents with a release of 0 to 10 m^3**, and where sensitive species or habitats are not at risk. These incidents are generally resolved through a First Strike response (i.e., local, or initial resources only).
>
> **Level 2 incidents with a release of 10 to 1000 m^3** may require deployment of jurisdictional resources supplementary to the initial response due to the more complex size/duration/resource management/risks involved. A Level 1 release may be escalated to a Level 2 where sensitive environmental/socio-economic receptors may be at risk.
>
> **Level 3 incidents with a release of greater than 1,000 m^3** may require national and international resources, and where the incident controller must delegate all management functions and focus on strategic leadership and response coordination. A Level 2 release may be escalated to a Level 3 where sensitive environmental/socio- economic receptors may be at risk.

The following spill scenarios have been identified for the Regia MSS:

> Level 1 (<125 L): The complete loss of hydrocarbons from a transfer hose during refuelling operations.
>
> Level 2 (286 m3 of Marine Gas Oil (MGO)): The complete loss of inventory from the largest fuel tank of an example wide-tow capable survey vessel resulting from collision or grounding. Note that should a release of this volume pose a significant risk to key sensitive receptors, then escalation to Level 3 may be triggered.

7 Environment That May Be Affected (EMBA)

The Environment That May Be Affected (EMBA) is the sea surface area, water column, seabed and any relevant shorelines that could be impacted by oil spilled from a petroleum activity. The EMBA for a Level 1 bunkering incident is expected to be limited to the immediate vicinity of the release point due to rapid spreading, evaporation, and dilution of the spilled MGO and the actions taken under the vessel SOPEP.

The EMBA for a Level 2 spill is based on the outcomes of weathering modelling in SIMAPs for 286m3 MGO.

Protection priorities within the EMBA

The NATPLAN protection priority hierarchy has been used to define protection priorities and response objectives within the EMBA:

> PRIORITY 1: protection of human health and safety remove marine users and any potential casualties from areas considered to be a safety hazard.
>
> PRIORITY 2: protection of habitat and cultural resources.
>
> PRIORITY 3: protection of rare and/or endangered fauna prevention of oil exposure to threatened fauna that are or may be present in (or near) the operational area.
>
> PRIORITY 4: protection of commercial resources prevent exposure to commercial fisheries in (or near) the operational area.

8 Spill Response Preparedness

8.1 Oil Spill Resources

Typical oil spill resources expected to be carried onboard the survey vessel are listed in the vessel's SOPEP. The vessel will carry spill containment and recovery kits with sufficient absorbent booms and materials to contain small to medium-scale deck spills. Minor spills will be managed through good housekeeping practices and the use of absorbent materials. Deck spills will not be discharged into the ocean. Spill clean-up materials will be retained on board the survey vessel and stored in covered containers for subsequent disposal at an appropriate onshore facility.

8.2 Proposed Spill Response Strategies

Spill response strategies for the credible scenarios identified (<125 L and 268 m3 MGO) are presented in Table G3-1. In the unlikely event of a spill, the potential use of each spill response strategy would be assessed for feasibility with the recommended responses subject to a Net Environmental Benefit Analysis (NEBA) or Spill Impact Mitigation Assessment (SIMA) by the CA (e.g., AMSA in Commonwealth waters). Any rejected response strategy may be adopted if directed by the CA.

Table G3-1 - Assessment of Spill Response Strategies

Response Strategy	Assessment	Recommendation
Monitor and evaluate	Vessel observation is the easiest and most available option available in all spills. Information gathering for spills is critical for situational awareness and supporting a coordinated spill response. Visual operations of surface hydrocarbons are limited to daylight. Understanding of entrained or dissolved hydrocarbons distribution is limited to spot-point water column sampling using suitable equipment (e.g., fluorometer).	Adopt
Mechanical dispersion	Undamaged vessels in the area can be used to breakup surface slicks if safe to do so. This strategy may be effective in sheltered/near shore areas and is unlikely to be effective in open ocean conditions where wind and wave energy will naturally disperse the slick.	Reject
Containment and recovery	The wind and wave conditions are likely to breakup any surface slicks and limit the operational window of this strategy to port or nearshore areas. The relative thickness and spreading of MGO renders this strategy ineffective.	Reject
Shoreline protections and shoreline clean-up	The spreading and relative thickness of MGO slicks on shorelines would mostly be below the 10 g/m^2 impact threshold. This along with the exposed and high energy shorelines of the Otway coast make this strategy ineffective.	Reject

Response Strategy	Assessment	Recommendation
Chemical dispersion	Due to the spreading and relative thickness of MGO slicks on water, chemical dispersants would not be used as they are unlikely to be effective on an MGO spill (CSIRO 2016). This along with the exposed and high energy shorelines of the Otway coast make this strategy ineffective.	Reject

8.3 Oil Spill Response Run-sheet

Given the location of the proposed Regia MSS, the preferred strategy for MGO spills will be to allow small spills to disperse and evaporate naturally, and to monitor and evaluate the position and trajectory of any surface slicks. This passive response and reliance on natural processes greatly reduces the potential for impacts associated with spill response activities.

For Level 1 fuel spills in Commonwealth waters, initial actions will be undertaken by the survey vessel in accordance with the vessel SOPEP (See Page 1), with subsequent actions determined in consultation with AMSA (under NATPLAN). In such situations, the Survey Vessel Master (or delegate) will monitor the spill and notify AMSA of the situation status. AMSA will monitor and continue to assess this level of spill.

For Level 2 spills, AMSA is the responsible CA for oil spills from vessels within the Commonwealth jurisdiction and will respond in accordance with its Marine Pollution Response Plan, as approved by the AMSA Executive. Upon notification of an incident, AMSA will assume control of the incident (AMSA 2014). CGG and the vessel contractors will support the response as required.

After ensuring the safety of the crew and fire prevention (and notifying AMSA), the Survey Vessel Master will implement the SOPEP and consider relevant actions (e.g., tank lightering) to reduce the oil volume released to the environment. AMSA will determine the appropriate response strategies depending upon the protection priorities at risk within the EMBA.

AMSA will determine the potential need for oil spill trajectory modelling (OSTM) and possible sea/aerial surveillance to confirm/inform trajectory predictions, depending on the location, prevailing weather conditions, available vessel responses and volume released.

Recognising that there is potential for impacts associated with spill response activities, these risks would be assessed as part of any NEBA/SIMA coordinated by AMSA, to which CGG would contribute if requested by AMSA.

The NEBA/SIMA process requires several data and information inputs to allow a robust and transparent assessment. AMSA will require CGG to provide this information in a timely manner. Information requirements will likely include:

- The oil spill risk assessment in the accepted EP.
- Vessel observations obtained immediately prior to and following the spill.
- On water capability information to support spill response.
- Any available baseline data.

Where hydrocarbons from the spill are likely to cross from Commonwealth to State waters, AMSA will undertake the NEBA/SIMA in conjunction with representatives from the relevant State CAs.

8.3.1 Oiled Wildlife Response

If AMSA identify that an oiled wildlife response is required in Commonwealth waters, this will be based on the Oiled Wildlife Response Plan (AMSA 2017). Responses in State waters will be implemented by or under the direction of State CAs and align with current State oiled wildlife response plans. The accumulation of hydrocarbons on shorelines is considered unlikely based on the credible scenarios; however, to allow for an adaptable response, consideration will be given to migratory shorebird feeding and roosting sites/nesting colonies and any seal colonies in and adjacent to the EMBA (e.g., on the northern coast of King Island). In addition, species protected under Part 3 of the EPBC Act will be given particular attention, with consideration of information provided in relevant plans, guidelines, and policies (e.g., NOPSEMA 2016a).

8.3.2 Communication with Other Marine Users

Commercial and recreational fishers and other users that operate in the area would be advised of any large spill and associated response activities via CGG's 24-hour 'look-ahead' correspondence. This would minimise the potential for interaction with their activities or unnecessary risks to personnel or property.

Subsequent actions will be determined in consultation with the Control Agency and regulatory authorities (AMSA and NOPSEMA) under NATPLAN, with regards to the low potential for impacts posed by the spill. AMSA has indicated that it does not require titleholders to directly consult on OPEPs for seismic surveys or those addressing the operations of offshore supply vessels (AMSA 2014). Such operations are already covered by existing NATPLAN arrangements.

Any reportable fuel or oil spills will be reported using CGG's Event Reporting Management Procedure (GRP_HSE_GEI_17E).

9 Operational And Scientific Monitoring Plan (OSMP)

The specific operational and scientific monitoring program undertaken following an oil spill would be developed based on the following information:

- location of the spill
- nature and scale of the spill, and likely evolution
- types of values and assets within the EMBA
- potential for impact upon sensitive resources
- review of available baseline data.

An assessment of gaps in available baseline data and potential/requirements for post-spill/pre-exposure baseline data collection will be considerations in the monitoring design. AMSA will direct and lead any monitoring requirements in the event of an oil spill, supported by CGG.

All monitoring personnel will be suitably experienced and qualified for their role. A pre-mobilisation assessment of experience and certifications will be used to allocate specific roles to personnel. Multiple personnel will be allocated to monitoring roles to allow for shift rotations (where multiple shifts per day are required) or survey rotations (where staff are rotated from the field as part of effective fatigue management planning). The availability of personnel with in-date certificates (e.g., offshore medical, TBOSIET and MSIC) will then identify which personnel will support immediate mobilisation or comprise the second rotation.

9.1 Operational Monitoring

In the event of a hydrocarbon release, CGG would implement Operational (Type I) Monitoring in consultation with AMSA, and where appropriate, relevant State agencies. This monitoring will be implemented to;

- determine the extent and character of a spill.
- track the movement and trajectory of surface MGO slicks.
- identify areas/ resources potentially affected by surface slicks.
- determine sea conditions/ other constraints.
- identify the efficacy and potential impacts of spill response strategies and tactics (to inform any remediation activities and any subsequent NEBA assessments).

Oil Spill Trajectory Modelling (OSTM), used in conjunction with water quality monitoring, will help determine the potential extent and direction of travel of the plume of entrained MGO, and to determine the risk of hydrocarbon toxicity impacts to sensitive receptor locations.

This monitoring will be instigated by AMSA and will enable CGG to provide the necessary information to AMSA, to assist in planning appropriate response actions under NATPLAN. Specific monitoring and data collection would include aspects of the following, as agreed with AMSA:

- immediate monitoring (approximately 0 to 6 hours):
- estimate of sea state
- estimates of wind direction and speed
- characteristics of the surface MGO slicks (thickness and areal extent)
- GIS mapping
- OSTM triggered for a Level 2 spill or greater.

Modelling, if triggered, will be used in conjunction with other field observation/monitoring data to identify the likely direction, spread and potential speed of the slick. This will be used as a guide to support the planning for other operational monitoring scopes (e.g., water quality, sampling and fluorometry). This information will allow initial identification sites for sampling, which may also provide information on the subsurface distribution of hydrocarbons via vertical profiling of the water column (should sufficiently levels of hydrocarbons remain to be detectable).

Water column profiling data will be used to identify the sites and depths at which water samples will then be taken for laboratory analysis. Water sampling for hydrocarbons should be undertaken using suitable equipment by personnel trained in the relevant procedures. "Improvised" approaches will not be used as the samples obtained may result in inaccurate results or a failure or a delay in confirming the credible source of the spill (as described in NOPSEMA 2017c).

The following operational monitoring techniques must be mobilised once immediate response actions have concluded:

- aerial surveillance for Level 2+ spills (if aircraft available offshore).
- GPS tracking using satellite drifter buoys (if available).
- measuring concentrations of entrained hydrocarbons through the water column (e.g., from water samples or using fluorometers calibrated to an appropriate hydrocarbon type).
- stochastic modelling predictions for Level 2+ spills (requires up to two weeks to receive results).

Field-based operational monitoring will be restricted to daylight hours only when surface slicks will be visible from either vessels or via aerial surveillance. Where available and practicable, remote sensing (e.g., using satellite-mounted optical imagery and Synthetic Aperture Radar (SAR)) may be used to provide situational awareness of the spatial distribution of the surface slick(s) during daylight, at night, or during overcast days.

The information gathered from this monitoring will be passed on to AMSA is it becomes available and via ongoing SITREP reports. Where GPS tracking using satellite drifter buoys, real-time spill modelling, aerial surveillance, water quality sampling and/or visual slick estimation is required, CGG can engage RPS under existing contractual arrangements to provide urgent specialist response services.

Should there be the need to implement field response activities using external parties, a response logistics plan would be developed and initiated immediately on notification of the spill. The plan would detail logistics, equipment personnel and detailed OSMP plans. CGG will implement, assist with, or contribute to (including funding if required) any other operational or scientific monitoring as directed by AMSA.

9.2 Scientific Monitoring

Scientific (Type II) Monitoring would be triggered and implemented if there is a reasonable expectation that there may be adverse impacts to marine biota or habitats in the area. The scientific monitoring likely to be implemented includes the programs listed in the sections below. The key receptors for which scientific monitoring studies would be considered are:

- benthic sediments (particularly soft sediments able to retain hydrocarbons, infauna)
- subtidal marine benthos (filter-feeders, macroalgae)
- seabird populations (foraging individuals)
- non-avian marine wildlife (cetaceans, marine reptiles, and fish).
- intertidal sediments and habitats.
- fisheries and aquaculture operations.

9.2.1 Scientific Monitoring Program 1

SMP1 is about monitoring for hydrocarbons in benthic sediments. The aims of SMP1 are to understand the characteristics, persistence, and fate of hydrocarbons in sediments to provide data for the assessment of potential impacts on seabed sediments and to understand the effect of hydrocarbon concentrations on infaunal macrobiota.

The objectives of SMP1 are to:

- Quantify hydrocarbon concentrations at locations within the EMBA.

- Quantify change in sediment hydrocarbon concentrations at sampling locations over time (considering seasonal and inter-annual change).
- Provide sediment hydrocarbon data to support determination of potential cause-effect relationships between spill hydrocarbons and changes in benthic communities.
- Identify potential areas of benthic impact based on sediment hydrocarbon concentrations and impacts to benthic acroinfaunal assemblages.

SMP1 will start in the event of a Level 2 or 3 spill and where modelling and/or operational monitoring (e.g., water quality) indicates likely exposure to benthic sediments.

SMP1 will end when sediment contamination results showed recovery to a point where hydrocarbon concentrations are no longer demonstrated to be a primary driver of infauna assemblage composition.

9.2.2 Scientific Monitoring Program 2

SMP2 is about monitoring and surveys of shoreline and intertidal benthos to determine impacts of oil spill and recovery. The aim of SMP2 is to determine and monitor the impact of the spill, dispersants or response activities and potential subsequent recovery for intertidal benthos at both individual (species) and community (habitat) levels.

- The objectives of SMP2 are to:
- Monitor the spill and spill management operations on intertidal marine coastal habitats (like tidal seagrass, tidal mud flats, mangroves, intertidal saltmarsh, and saltpans).
- Monitoring associated organisms (like fishes, crustaceans, arboreal mangrove biota, microphytobenthos, macroalgae, mangrove/saltmarsh plants, seagrass)
- Establish necessary responses.
- Quantify the biological and ecological effects of the spill and response activities.

SMP2 will start in the event of a Level 2 or 3 spill and if modelling predicts possible shoreline/intertidal contact or there are any reports of shoreline/intertidal contact.

SMP2 will end when all reasonable and practical measures have been taken to assess the impact of the spill on intertidal benthos and affected intertidal benthos has returned to baseline (or reference site) conditions or oil pollution impacts on critical intertidal benthos species and taxa are no longer identifiable.

9.2.3 Scientific Monitoring Program 3

SMP3 is about monitoring of subtidal marine benthos to determine impacts of oil spill and recovery. It aims to enable assessment of impacts and potential for subsequent recovery of benthic marine habitats (soft and hard substrate habitats) and associated macro-epibenthic organisms (e.g., macroalgae, seagrass, sponges and other filter feeders, motile invertebrates, and associated fishes) in response to a spill event and associated response activities. It also aims to document recovery of affected biota and habitats.

The objectives of SMP3 are to:

- characterise and quantify habitat composition and coverage/abundance of macro-epibenthic organisms and site-associated demersal fish.
- allow comparison with historical (baseline) data and seasonal/interannual surveys.
- define recovery in macro-benthic and demersal populations and recovery/change in habitat type.

SMP3 will start in the event of a Level 2 or 3 spill and where modelling and/or operational monitoring (e.g., water quality) indicates likely exposure to benthic habitats or if there are any reports of subtidal contact.

SMP 3 will end when reasonable and practicable scientifically robust measures have been taken to assess the effects or impact of the spill on benthic habitats / communities and oil pollution effects / impacts on benthos are no longer detectable, or impacts shown to be within accepted protection limits (to be defined in Sampling and Analysis Plan) and when a trend towards post-impact recovery or alternate developmental trajectory has been demonstrated (in comparison with control/reference sites) at sites that were exposed to elevated concentrations of hydrocarbons.

9.2.4 Scientific Monitoring Program 4

SMP4 is about undertaking wildlife surveys to determine impact of oil spill on seabird and shorebird populations and recovery. It aims to assess any short-term or longer-term environmental effects on seabird and shorebird populations within the study area that may have resulted from the oil spill (i.e., damage extent and recovery). It also aims to document recovery of affected biota and habitats.

The objectives of SMP4 are to:

- Quantify foraging seabird and shorebird populations.
- Quantify foraging, nesting or breeding shorebird populations.
- Quantify records of oiled birds and bird mortalities.
- Allow comparison of changes in populations over time (seasonal and inter-annual).

SMP4 will start in the event of a Level 2 or 3 spill and where post-spill observations indicate possible contact with foraging seabird populations and/or any reports of oiled or dead seabirds and/or shoreline oil indicates possible contact with shoreline bird habitats or populations.

SMP4 will end when the extent of damage and rate of recovery of key seabird/shorebird behaviour and breeding activities has been quantified using scientifically robust methods and the affected environment or natural resource has returned to baseline conditions (taking into account natural variability) in terms of breeding population (for seabirds) or counts (for shorebirds), with regard to reference sites and/or baseline data and oil pollution effects/impacts on critical species and taxa are no longer detectable.

9.2.5 Scientific Monitoring Program 5

SMP5 is a desktop study and survey about occurrences of oiled/mortalities of non-avian marine wildlife to determine impacts of oil spill and recovery. SMP5 aims to assess any short-term or longer-term environmental effects on non-avian marine wildlife that may have resulted from the oil spill (i.e., damage extent and recovery). It also aims to document recovery of affected biota and habitats.

The objectives of SMP5 are to:

- quantify records of sightings of dead or oiled marine wildlife.
- allow seasonal or inter-annual comparison of records of dead or oiled wildlife.

SMP5 will start in the event of a Level 2 or 3 spill and where modelling indicates possible contact with populations and/or any reports of oiled or dead non-avian marine wildlife.

SMP5 will end when reasonable and practical measures have been taken to assess the effects or impact of the spill on non-avian marine wildlife and restoration or resumption of key biological processes (e.g., abundance, distribution, breeding) necessary to ensure post-impact recovery have been identified and oil pollution impacts on non-avian marine wildlife are no longer detectable.

9.2.6 Scientific Monitoring Program 6

SMP6 is about monitoring of intertidal receptors to determine impacts of spill hydrocarbons and recovery. SMP6 aims to understand the behaviour, persistence, and fate of hydrocarbons in intertidal sediments, and enable assessment of potential impacts and recovery to intertidal habitats. It also aims to identify the potential implications of changes in intertidal communities to other biota (e.g. shorebirds).

The objectives of SMP6 are to:

- Quantify hydrocarbon concentrations at locations within the EMBA.
- Characterise and quantify habitat composition and coverage/abundance of epibenthic and infaunal organisms.

- Quantify change at sampling locations over time (considering seasonal and inter-annual change).
- Define recovery/change in habitat type and epibenthic and infaunal organisms.
- Provide sediment hydrocarbon data to support determination of potential cause-effect relationships between spill hydrocarbons and changes in benthic communities.

SMP6 will start in the event of a Level 2 or 3 spill and where modelling or operational monitoring indicates likely exposure to intertidal habitats.

SMP6 will end when the results of the monitoring tasks achieved the objectives and appropriate, meaningful, and defensible scientific monitoring results have been achieved and sediment contamination results have shown recovery to a point where hydrocarbon concentrations are no longer demonstrated to be a primary driver of habitat composition.

9.2.7 Scientific Monitoring Program 7

SMP7 is about impacts to fisheries and aquaculture. SMP7 aims to understand the potential short and long-term impacts and recovery of fisheries (should they be closed), and aquaculture facility/operation that have been exposed to spill hydrocarbons.

The objectives of SMP7 are to:

- quantify hydrocarbons in tissue of organisms targeted by fisheries or aquaculture.
- determine potential effects on population size/structure.
- identify potential impacts to organism health.
- determine potential risks to human health.

SMP7 will start in the event of a Level 2 or 3 spill and where fisheries have been closed in response to a hydrocarbon spill and/or where modelling or operational monitoring indicates likely exposure to aquaculture operations or key brood stock collection locations.

SMP7 will end when the results of the monitoring tasks achieved the objectives and appropriate, meaningful, and defensible scientific monitoring results have been achieved and sediment contamination results have shown recovery to a point where risks to human health are understood and data on population structure have shown that recovery is possible through retention of sexually mature adults and demonstrated recruitment of juveniles.

9.3 Initiation Of Scientific Monitoring

CGG will implement scientific monitoring in the event of a Level 2 spill (or greater), in accordance with initiation criteria described in Table G3-2. A detailed OSMP Implementation Plan based on commonly used, scientifically robust and easily accessible methods would be developed to ensure an efficient and technically defensible response. This approach builds time efficiencies into development of the OSMP as existing RPS documentation (e.g., Health and Safety Plans) can be adapted to meet the requirements of the OSMP. Potential suppliers of available survey equipment would be identified as a priority, with a preference for those with existing contracts.

Relevant permit applications (e.g., for sediment/biota sampling) will be identified and submitted as soon as reasonably practicable. This approach does not work from the base assumption that permit requirements will be waived by relevant authorities to minimise potential delays in mobilisation and permit approval should permit requirements not be waived.

The OSMP Implementation Plan will detail the equipment required for each study, travel and freight arrangements, notifications, vessel support, HSE planning, and the sampling and analysis plan. Within 12 hours of RPS being notified, a teleconference will be held between the CGG, AMSA, the nominated scientific personnel, and the Vessel Master to finalise the requirements for implementation. Scientific teams can be on site within 48 to 72 hours of the implementation plan and budget being approved (and where permits are not required or have been approved). It is recognised that MGO is only likely to remain measurable on the water surface for a few days, and that realistically a response team would not be on site until it had dispersed.

Given the extremely low probability of a catastrophic spill and MGO subsequently contacting sensitive biota, and the rapid weathering and likely dispersal of spill hydrocarbons before a response team could be mobilised, CGG considers the costs associated with pre-emptive development of the Implementation Plan and full assembly and preparation of the response team to be grossly disproportionate to the benefit of a more rapid response.

The area of potential impact to be targeted in the scientific monitoring plan would be based on observations of the slick trajectory, water quality data collected during the operational phase, and available modelling. Due to the nature of the spill, potential for spread/dispersion, constrained spatial area of the EMBA, and likely field team mobilisation period, it is considered that post-spill pre-impact baseline data collection will likely not be feasible (but will remain a consideration for planning purposes).

Scientific monitoring would focus on determining potential short and long-term environmental impacts of the spill and response actions, and subsequent recovery). Scientific monitoring may continue for some time following the termination of the operational monitoring response (NOPSEMA 2016c).

9.4 Scientific Monitoring Team

In the event of the requirement to undertake scientific monitoring, CGG would engage a specialist subcontractor such as RPS to rapidly finalise response plans and to deploy the required resources to undertake the monitoring activities. Primary scientific monitoring studies could include some, or all, of the elements described in Table G3-2 depending on the size, timing, and location of the spill.

An adaptable scientific monitoring response must allow for the potential for operational monitoring or situational awareness obtained during a spill to indicate exposure to additional sensitive receptor types, depending on the nature and scale of the actual release. Where such an occurrence is identified, additional optional SMPs may be implemented, following agreement with AMSA.

9.5 Study Template

For each SMP described above, a detailed study template would be developed following implementation. This is summarised in Table G3-2.

Table G3-2 - Scientific Monitoring Studies Template

Study Heading	Description
Monitoring objective and rationale	Details the monitoring objectives for the study to focus sampling design.
Natural resource description and/or importance	Provides background information relevant to the context of the study; distribution, temporal patterns, life-stages present, critical habitats, and processes.
Activation trigger for monitoring tasks	Criteria to initiate the scientific monitoring study, based on likely exposure to harmful concentrations (acute and/or chronic)
Potential sensitivity to spilled MGO at exposure levels	General context of possible impacts associated with the spill, exposure pathways and effects concentrations. Range of measurable responses.
Spatial awareness	Outcomes of operational monitoring that support survey design
Monitoring methods / sampling and analysis plan	
Overview of the monitoring method	Provides a scientific and practical context for the monitoring methods to be used. Includes consideration of statistical methods and sampling effort required to achieve the monitoring objectives.
Details of the survey design, methods, standards and techniques to be utilised	Provides the information required to collect samples in a defined geographic area (based on operational monitoring data) as part of a robust scientific study program. Includes relevant specifications, standards, and requirements of the study.
Permits	Details any permit requirements and/or exemptions.
Data collection, analysis, and reporting requirements	Provides details on the necessary data requirements including baseline information, analytical parameters and detection limits, and metadata. Details the deliverables from the study.
Personnel resourcing requirements, qualifications, and skills	Provides minimum skill/experience, qualifications/certifications, and resourcing requirements to deliver the study safely and robustly. Considers shifts and survey rotations for effective fatigue management. Includes contingency resource planning.

Field equipment, survey platforms and logistics	Details equipment and logistics requirements to fulfil the study requirements.
Recommended procedures for data collection, sampling, storage, transport, and analysis	Provides the necessary sampling and analytical techniques, and standards to ensure data quality and ensure consistency throughout the study (including Chain of Custody (CoC) forms).
Risk assessment, occupational health, and safety considerations	Describes the risks and mitigation controls associated with undertaking the study.
Data management, QA/QC, transmittal, and archiving	Provides QA / QC requirements for all data obtained as part of the study.
Supporting documents, standards, and references	Identifies the relevant guidelines and high-level references required to implement the study.
Reporting requirements	Provides description of reporting of the scientific outcomes of the survey(s), including identification and qualification/quantification of potential impacts and subsequent recovery. Each survey report identifies the need for any further scientific monitoring based on the survey outcomes.
Termination criteria	
Criteria for the terminating the monitoring activity	Completion criteria to be met to demonstrate that study objectives have been achieved to terminate the study.

10 Document Control

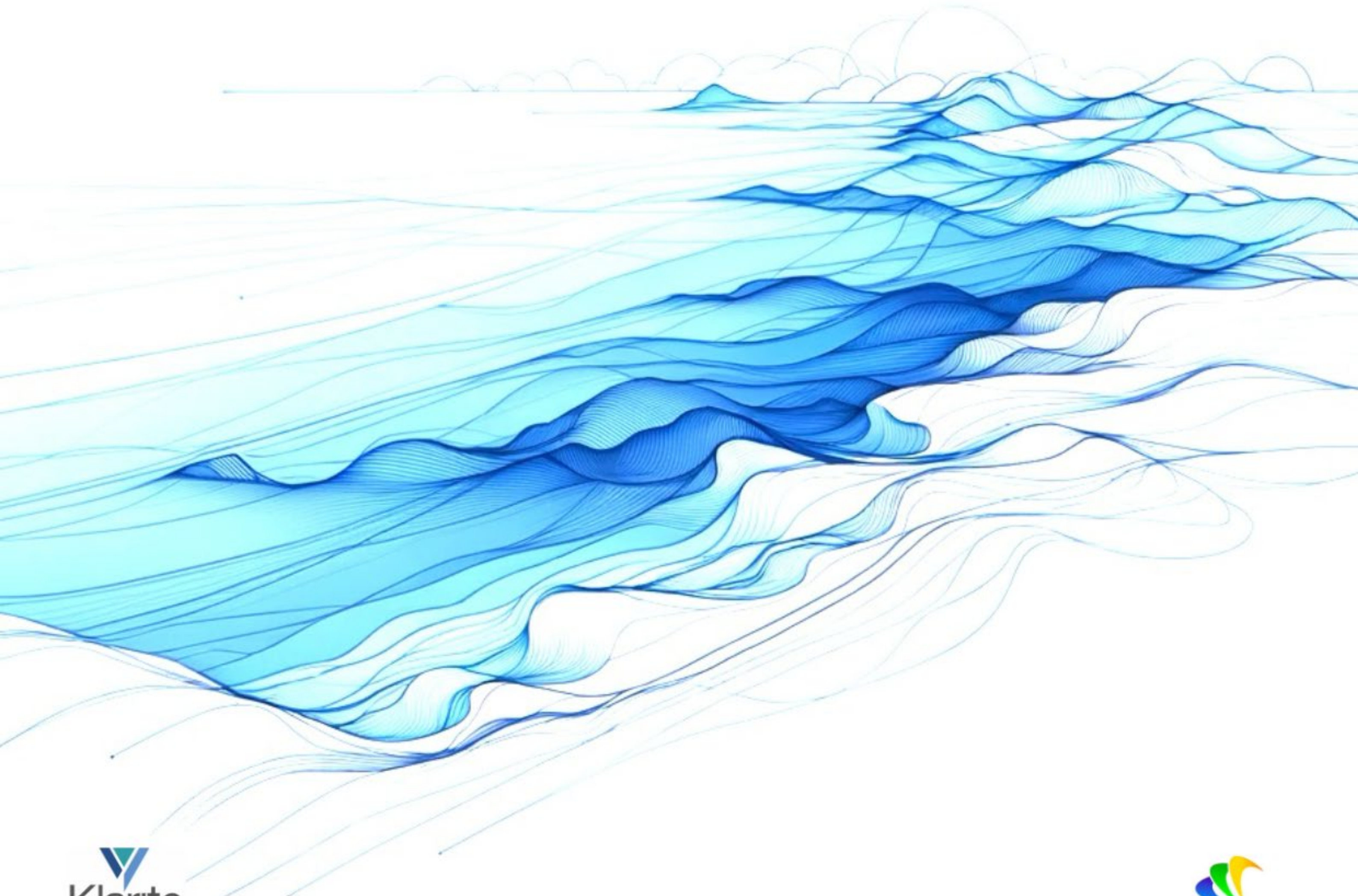
Version	Date of Revision	Author/Reviewer	Summary of Changes
0.0	21 September 2023	MS	Document started.
0.1	27 September 2023	MS	Sent to Tasmanian and Victorian Control Agencies for review.
1.0	28 September 2023	MS	PDF published online.
1.1	4 December 2023	MS	Updated following review from Tasmanian EPA.
2.0	6 December 2023	MS	Update published online.

Sea Country Protection Program

Appendix G4: REG-EP-038-G4

Rev 1

January 2024



1 Introduction

Considering the regulatory environment governing offshore petroleum activities and the increasing emphasis on cultural heritage protection, CGG Services (Australia) Pty Ltd (**CGG**) propose the implementation of a Sea Country Protection Program (**SCPP**). Offshore petroleum activities can affect cultural values on Sea Country and they should be identified and protected when appropriate. This should be done with input from First Nations peoples who decide to be part of the program to ensure the outputs of the program align with the objectives they may have for Sea Country protection.

2 Sea Country Protection Program (SCPP) Overview

The SCPP will be a comprehensive program designed to identify, preserve, and protect cultural heritage sites and values within areas of operations off the Otway coast. It will start with a process of consultation that canvasses Traditional Owners in with Sea Country values in the Otway area to find mutually beneficial outcomes between First Nations communities and the petroleum titleholders who make up the program's funders.

This draft plan is framed in accordance with the provisions of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023 (**the Regulations**). The SCPP is a control measure that will be included in the Regia Marine Seismic Survey (**Regia MSS**) Environment Plan (**EP**). This will use the environmental performance metrics from this framework to govern the outcomes, content, and monitoring of the SCPP.

2.1 Environmental Performance Outcomes (EPO)

An environmental performance outcome is a measurable level of performance required of cultural heritage protection to ensure that environmental impacts and risks from petroleum activities in the Otway will be an acceptable level. The EPO for the SCPP is:

- To establish and maintain a framework for Sea Country protection that manages the interaction of the activity with First Nations cultural values and sensitivities.

2.2 Environmental Performance Standards (EPSs)

Environmental performance standards are the statements of performance from the program funders (signatory titleholders) about how the program will be effective and meet the EPO's. The following Environmental Performance Standards (EPSs) form the specific requirements and expectations of the SCPP:

Environmental Performance Standard
Indigenous Community Consultation The SCPP shall be established through a robust consultation process with indigenous communities, seeking their input and consent regarding cultural heritage protection measures.
Cultural Heritage Identification and Documentation The SCPP shall offer the opportunity to participants to systematically identify, record, and document cultural heritage sites, stories and songlines within the project area, complying with applicable regulations and best practices.
Cultural Heritage Preservation The SCPP shall implement effective measures to preserve cultural heritage sites, artifacts, and values within the project area, minimizing impacts from petroleum activities.
Mitigation and Response The SCPP shall develop and implement mitigation strategies in response to identified cultural heritage risks, addressing potential impacts promptly and comprehensively.
Collaboration

The SCPP shall be open to investment from other parties to further the growth and scope of the program if it continues to be effective.

2.3 Measurement Criteria

The measurement criteria for assessing progress toward achieving the EPO and meeting the EPSs are as follows:

ID	Indicator	Target
MC 1	Percentage of regulatory compliance achieved concerning cultural heritage protection within the project area.	100% compliance with relevant regulations.
MC 2	Level of engagement and satisfaction of indigenous communities with the cultural heritage protection program.	High levels of satisfaction and constructive engagement.
MC 3	Extent to which cultural heritage sites and values are preserved and protected.	Minimal to no adverse impacts on cultural heritage values.
MC 4	The effectiveness of mitigation measures in addressing potential cultural heritage risks.	Timely and comprehensive mitigation responses.
MC 5	Additional funding partners grow and extend the program.	Secured funding for years 2 and 3 at the end of the 12 months.

3 Consultation

This document has been shared with First Nations peoples and organisations during the consultation process in preparation of the Regia MSS EP. The opportunity to participate in this program is available to all First Nations peoples and organisations whose functions, interests, or activities may be affected by the Regia MSS. This can include a connection to Sea Country or other cultural values and sensitivities.

Otway Marine Industries Coexistence Cooperative (OMICC)

April 2024

OTWAY ADJUSTMENT PROTOCOL
(Consultation Draft)

Displacement |Loss of Catch | Fishing Gear Loss or Damage

Contents

1 Protocol Overview

1.1 Purpose

This protocol establishes a baseline environmental standard to underpin petroleum activity adjustment for displacement, loss of catch, and fishing gear loss or damage, between petroleum titleholders and commercial marine operators including fishers.

The purpose of this protocol is to provide a practical, evidence-based process and reasonable monetary adjustment to licensed commercial fishers for displacement, loss of catch, and fishing gear loss or damage. Adjustment is available during a petroleum activity and will remain available for a specified period after the completion of a petroleum activity conducted under an Environment Plan (**EP**) that references, and is therefore subject to, this protocol.

This protocol also serves as the mechanism for other marine operators (e.g. fishing co-operatives, fishing charters, dive schools) to initiate discussions with titleholders on evidence-based monetary adjustment if they could potentially be impacted by petroleum activities.

1.2 Background

In 2018, National Energy Resources Australia (**NERA**) in consultation with an industry consortium, established the Collaborative Seismic Environment Plan (**CSEP**) Project, to seek approval from the National Offshore Petroleum Safety and Environmental Management Authority (**NOPSEMA**) for seismic survey activities in an area in Commonwealth waters off Western Australia and the Northern Territory from 2021 and beyond. The CSEP Project was aimed at achieving fundamental and long-term improvements to the way that seismic activities were planned with consideration for commercial fishing activities.

As part of this project, an adjustment protocol (the NERA Protocol) was developed by the CSEP Project Steering Committee in consultation with State, Territory and Commonwealth commercial fishing license holders as well as relevant fishing associations, regulators, and petroleum industry associations.

In recent years the NERA Protocol has become a petroleum industry standard for all types of activities and has been used as the basis of this Otway Commercial Marine Operators Adjustment Protocol (Otway Adjustment Protocol (OAP)).

1.3 Commitment

Recognising the collaborative benefits the NERA Protocol has provided where it has been adopted, petroleum titleholders in the Otway offshore region (refer **Appendix 1**) commit to minimising impacts on commercial marine operators, including commercial fishing and the fish stocks that support the industry primarily through avoidance of other activities.

However, petroleum titleholders recognise that their activities may, from time-to-time, take place in the same area and at the same time as commercial operations of others who have a history of using that area. Minimising interference with each other's rights and interests is also reflected in primary petroleum and fishing legislation[1].

Best endeavours will be made to avoid, minimise, and mitigate potential impacts on other marine operators, including the commercial fishing industry, before the adjustment processes contained in this protocol are applied.

1.4 Definitions

Activity – A petroleum activity or greenhouse gas storage activity and includes, where the context permits, a reference to a proposed activity or any stage of an activity.

[1] For relevant statutory information refer to section 280 Offshore Petroleum and Greenhouse Gas Storage Act 2006, section 124 Petroleum (Submerged Lands) Act 1982 (Vic), section 124 Petroleum (Submerged Lands) Act 1982 (Tas), and section 171 Fish Resources Management Act 1994.

Adjustment Area – An area extending 10 kilometres[2] around the perimeter of a seismic survey Acquisition Area or an area extending 4 kilometres for a drilling activity (refer Figure 1 for explanatory diagram)[3].

Acquisition Area – The area of a petroleum activity in which seismic data is acquired (as opposed to a permitted Acquisition Area in an Environment Plan).

Active Source Area – An area including and around the Acquisition Area in which the seismic energy source (airgun array) can be active. This includes survey line run-ins and run-outs.

Catch Per Unit of Effort (CPUE) – For the purposes of this protocol the catch will be defined in kilograms of landed catch and the unit of effort will be defined in hours (decimal hours where available) fished for trawl, hours fished or kilometres of line set or number of hooks per kilometre for line fishing, or number of trap lifts, resulting in the landed catch e.g. CPUE = kilograms per (trawl/line) hour or trap lift.

Commercial fisher – for the purpose of this protocol, a commercial fisher is the entity, person, licence holder, company or affected business who would have received the revenue from the landed catch that is the subject of a claim under this protocol, or who can show they have incurred the cost of lost or damaged fishing gear or displacement.

Displacement – the relocation of commercial fishing activity or other commercial marine operations from an area into other area(s) as a result of a petroleum activity.

Fishing gear – Fishing equipment deployed in the water by a vessel engaged in a commercial fishing activity.

Historical fishing activity, block – A statistical fishing block, or fishing event location (latitude/longitude) plotted within the 10 x 10 nm grid system, with fishing activity detailed in Government catch and effort information or as recorded in a statutory Catch and Disposal Record for at least two out of the previous five years, prior to a relevant petroleum activity conducted under this protocol.

Landed catch – The whole landed weight as detailed in Government catch and effort information provided for the purpose of this protocol, or as recorded in statutory Catch and Disposal Records. Fish that is processed in any way before landing, for example gutted and gilled or headed, should be converted back to whole weight for the purpose of this protocol.

Market price – The price received by a commercial fisher at the point of first landing, excluding any price margins for marketing, transport, sales commissions, value adding or packaging. In respect to a claim under this protocol, the market price should reflect the price at the time the loss of catch was incurred by the claimant.

Other commercial marine operator – means a commercial marine operator who identified they could potentially be impacted by the petroleum activity during relevant persons consultation in preparation of the relevant EP.

Petroleum activity – means operations or works in an offshore area undertaken for the purpose of exercising a right conferred on a titleholder under the OPGGSA by a petroleum title or discharging an obligation imposed on a petroleum titleholder by the OPGGSA.

Statistical fishing block – Government statistical grid/block numbering system used to record commercial fishing activity data and referred to in this protocol as a block.

Titleholder – The registered holder of the Access Authority, Special Prospecting Authority, Exploration Permit, Retention Lease or Petroleum Production Licence over which the petroleum activity will be acquired, as detailed in the EP for the petroleum activity subject to this protocol.

[2] 10 kilometers is proposed as a reasonable distance around the Acquisition Area of a seismic survey and consistent with existing industry standards.

[3] Spatial parameters of an Adjustment Area for a 2D survey will require case-by- case specification due to the differing survey layout.

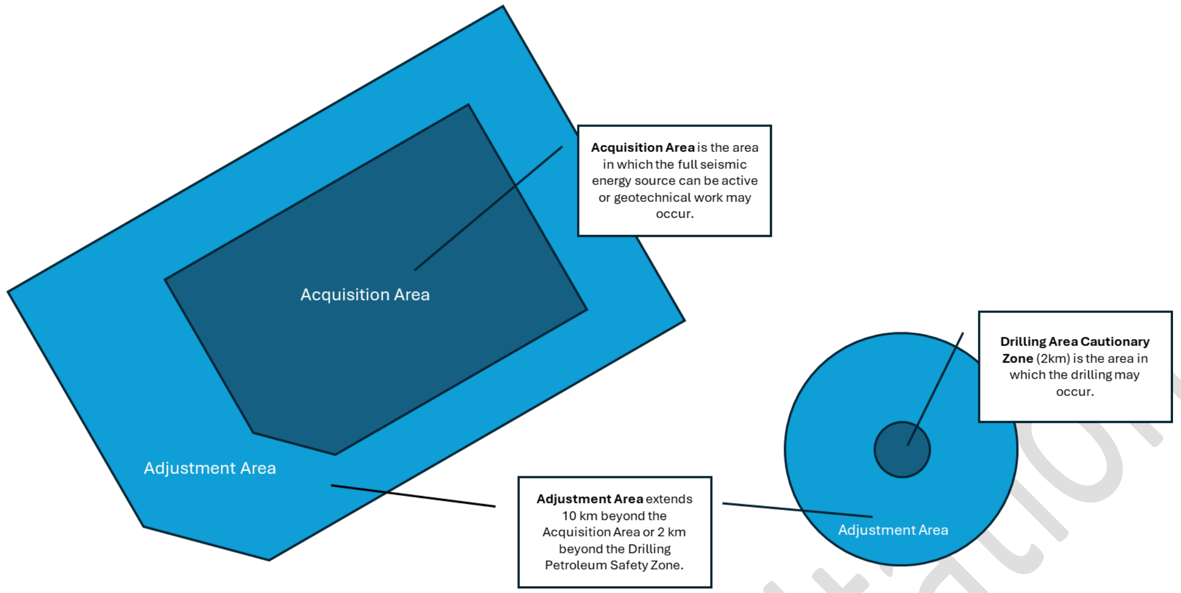


Figure 1 - Representation of defined terms for Acquisition Area and Adjustment Area

1.5 Scope

The OAP is intended to apply to commercial users of the marine environment who are directly affected by petroleum activities, where interference is unavoidable.

This protocol covers:

- A commercial fisher (refer definition) who fishes as a normal part of their commercial fishing activity within an Adjustment Area (refer definition), during and/or for a specified period after a petroleum activity, conducted under an accepted EP that references and is therefore subject to this OAP. Adjustment is also available for fishing outside of an Adjustment Area in some circumstances, if agreed in advance with the titleholder.
- Other commercial marine operators who identified they could be potentially impacted by the petroleum activity during relevant persons consultation, who utilise an area as a normal part of their commercial activity within an Adjustment Area (refer definition) during a petroleum activity conducted under an accepted EP that references and is therefore subject to this OAP.

This protocol applies to fishers with one or more Victorian, Tasmanian, or Commonwealth fishing licences.

1.6 Consultation

This protocol has been founded by TGS, CGG and ConocoPhillips Australia and developed by Klarite Sustainable Ventures (**KSV**) building on the NERA CSEP Commercial Fishing Industry Adjustment Protocol. While preparing EPs for petroleum activities in the Otway, the founding titleholders consulted with fishers, fishing license holders, and fishing associations, which indicated a single method for compensation was desirable. Subsequently, on the request of the founders, KSV has undertaken preliminary consultation with some fishing industry associations prior to publishing this draft protocol for each commercial fisher and other commercial marine users identified during relevant persons consultation, as relevant persons, to provide input.

Each titleholder will continue to consult as per the requirements of the regulations with each relevant person. Consultation on this protocol may also be carried out by KSV on behalf of each titleholder proposing to adopt this protocol. All records of consultation will be treated as confidential in accordance with Section 25(4) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2023.

Consultation on the OAP will include:

- Writing to all commercial fishers (Commonwealth and State) who may have rights within the Otway region providing an opportunity for input into the content and format of the protocol.

- Writing to other commercial marine operators who identified they could be potentially impacted by the petroleum activities during consultation in preparation of the Eps.
- Inviting fishing associations and commercial marine operators, including fishers to nominate appropriately qualified and experienced claims assessors for their industries/fisheries.

1.7 Operation of the protocol

Notification of the establishment of an Adjustment Area will be provided to relevant commercial fishing licence holders and other commercial marine operators in writing no less than 28 days before a petroleum activity starts. Notification is to be provided in the form of a map plus digital files in formats such as KML, GPX or shapefiles.

Fishers (the fishing vessel/licence) must have established previous fishing history, at a minimum of two out of the previous five years, for all block(s) or fishing event(s) for which they wish to make a claim for loss of catch or displacement adjustment under this protocol.

To receive adjustment under this protocol, a commercial fisher must be able to show that they would have received the revenue from the landed catch that is the subject of a claim, incurred additional costs for displacement, or show that they have incurred the cost of lost or damaged fishing gear.

Adjustment under this protocol is dependent on a commercial fisher or commercial marine operator continuing to carry out their activities to the best of their ability and to mitigate and limit financial loss despite the occurrence of a petroleum activity. Titleholders using this Protocol reserve the right to refuse a claim if fishers interfere with a petroleum activity through deliberately operating in properly notified areas, noting that such interference may also be in breach of Section 603 of the Offshore Petroleum and Greenhouse Gas Storage Act 2006 (See Appendix 6).

Note that this protocol will be documented in the EP developed by each titleholder as a control measure to manage potential impacts to commercial fishing licence holders and other marine users, where identified during consultation, and will therefore be subject to inspection under NOPSEMA's environmental inspection program.

2 Commercial Adjustment Available Under This Protocol

2.1 Displacement

If a commercial fisher is unable to fish in their historical fishing area (refer definition) within an Adjustment Area during a petroleum activity and incurs costs over and above the normal running costs for a fishing trip while relocating to another historical fishing area, then additional costs associated with increased distance/transit time, fuel and crewing will be considered under this protocol for monetary adjustment. For displacement, an alternative fishing ground must be within 50 kilometres of the Adjustment Area.

For fishers, displacement will be assessed based on a comparison of the running costs per day at sea against the previous yearly average[4]. A commercial fisher who decides it is necessary to relocate to another fishing ground because of a petroleum activity subject to this protocol and wants to be considered for displacement adjustment must notify the titleholder of the petroleum activity, where possible, prior to undertaking the relocation. When making a claim, evidence must also be provided to substantiate fishing gear in use at the claim time.

For other commercial marine operators, displacement will be assessed on a case-by-case basis through prior agreement with a titleholder on the method of calculation.

A claim for displacement must be made within 6 months of the end of operations of a petroleum activity.

2.2 Loss of Catch Adjustment

Evidence-based loss of catch adjustment under this protocol relates to fish lawfully caught and retained by a fishing vessel under a Victorian, Tasmanian or Commonwealth fishing licence. The adjustment process applies to historical fishing activity over established fishing grounds, and not to speculative fishing activity.

The loss of catch adjustment process applies to commercial fishing activity conducted by a licensed fishing vessel within an Adjustment Area, and other fished areas during a month. For each month where adjustment is claimed, the licensed fishing vessel must conduct fishing within an Adjustment Area, unless a fishing trip spans two months where each month will be considered to have satisfied this requirement.

Loss of catch adjustment is available for the period of an activity and for six months after an activity is completed[5]. This adjustment process assumes that any loss of catch experienced will be evident in a reduced CPUE for that fishing vessel (or license if subject to boat replacement) compared to previous years for the same eligible claim block/fishing event location by species by month.

Loss of catch assessments will be conducted using the petroleum activity period catch and effort data per month plus the previous 10 years (by same block/fishing event location and month) where available.

2.2.1 Method of Assessing Loss of Catch Adjustment

Treatment of catch and effort data to determine eligible fishing events to be included in the adjustment assessment process.

As detailed in this protocol, adjustment is available for fishing activity where it can be shown there is a minimum of two out of the prior five years where fishing activity has taken place in the same block or fishing event location that is the subject of a claim. This requirement applies to the Adjustment Area and for any other block/fishing event location/area for which adjustment is being claimed.

The first step in conducting a loss of catch adjustment assessment will be to determine which fishing activity is eligible for adjustment under this protocol.

[4] The KSV project team is investigating the development of an alternative displacement method using a default nautical mile rate adjustment payment for additional miles covered in a month compared to same month in previous years. The default rate could be set for individual fisheries and/or classes of vessels. This alternate method may be introduced as the default displacement process when available and then included in future revisions to this protocol.

[5] Temporal parameters for a 2D survey will be considered on a case-by-case basis.

Where catch and effort data are provided in 10 x 10 nm statistical grid format, the same block by month will be checked for the five years preceding the activity year to ascertain the minimum requirement of a minimum of two years fishing activity within the previous five years. Where catch and effort data are provided in larger than 10 x 10nm statistical grid format, applicants may be asked for additional positional information for blocks that partially overlap the Adjustment Area, or are outside of the Adjustment Area, to assess the minimum fishing history requirement.

Where catch and effort data are provided by the location of each fishing event by latitude and longitude coordinates the existing Victorian and Tasmanian statistical grid systems will be used to assess the minimum fishing history requirement. The start point of each fishing event will be plotted within the 10 nm grid system to aid the assessment of previous fishing history by allocating each event to a 10 nm block to determine fishing events eligible to be included in the adjustment assessment process. Note that assessors have the flexibility to make judgements that will enhance the statistical accuracy of an assessment and/or provide balanced practical assessment outcomes.

2.2.2 Calculating an average CPUE

Catch and effort history covering the prior 10 years is required to provide an average CPUE value that is subject to minimal influence from fish stock recruitment and environmental fluctuations.

CPUE will be defined in kilograms of landed catch and the unit of effort will be defined in hours (decimal hours where available) fished for trawl, hours fished, or kilometres of line set or number of hooks per kilometre for line fishing or number of trap lifts, resulting in the landed catch, for example CPUE = kilograms per trawl/line hour or trap lift. Average CPUE will be based on the mean catch and effort values of all eligible fishing events per claim month.

It is recognised that in some cases, 10 years of catch history data may not be available and where this occurs an assessor should determine an appropriate historical average CPUE based on the information available in the application and any other information that an assessor deems appropriate.

The use of 10 years prior catch history and the intention of this protocol is that assessments are conducted based on the available catch and effort information. However, an assessor may also consider significant catch trends within a fishery and/or management changes if they are thought to materially affect resulting catch rates or landed catch volumes.

2.2.3 Loss of Catch Adjustment Assessment Method

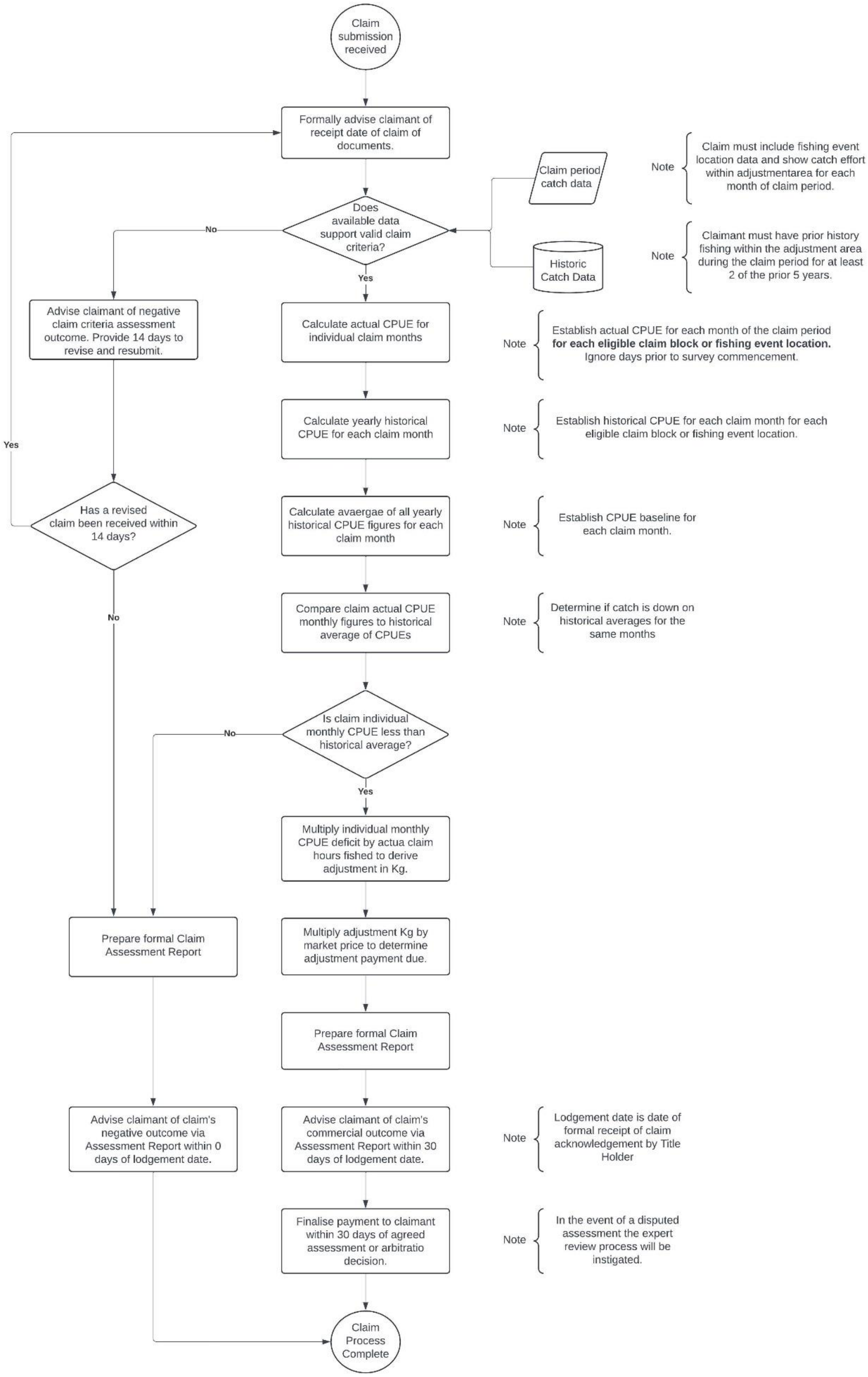
1. Claim month must contain fishing activity within the Adjustment Area, unless a fishing trip spans two consecutive months, where it will be considered that this requirement has been met for both months.
2. Claimant must have historical fishing activity (refer definition) for each block or fishing event location subject to a claim.
3. Yearly historical average CPUEs (up to 10 years) will be calculated for all eligible fishing events fished in the claim month, by species, and then averaged to provide a baseline historical average CPUE for the claim month.
4. The claim month actual average CPUE will be calculated for eligible fishing events by species by month.
5. The actual average CPUE will be compared to the historical average CPUE for the same block/fishing events and month and adjustment will be established where there is a shortfall.
6. The shortfall in CPUE will be multiplied by the unit of effort (hours, kilometres of line set/number of hooks per kilometre, number of trap lifts) fished for that claim month, and then the species market price, to provide the amount of monetary adjustment due for that month.
7. Adjustment may be calculated per individual species or combined as appropriate.

2.2.4 Adjustment Method Loss of Catch Adjustment Calculation Example

Claim period April 2020	Species narrow barred mackerel. Troll hours fished 100. Market price $17 per kg. Total catch 8,200 kgs.
Claimant has historical fishing activity within Adjustment Area prior to April 2020	Condition met
Claimant fished in Adjustment Area during April 2020	Condition met
April historical baseline CPUE	100 kgs per hour
April 2020 CPUE	82 kgs per hour
Shortfall in CPUE	18 kgs per hour
Shortfall multiplied by 100 hours fished in April 2020	1,800 kgs
1,800 kgs multiplied by market price of $17 per kg	$30,600
Monetary adjustment due for April 2020	$30,600

The full loss of catch assessment process is detailed in the flow chart on the following page.

2.2.5 Loss of Catch Assessment Flow Chart



2.2.6 Exceptions to loss of catch assessment method information requirements.

Where a fisher is unable to provide 10 years prior catch and effort data due to Government confidentiality requirements or other reason, an assessment may still be conducted subject to the claim assessor being satisfied that an accurate assessment can still be conducted using the volume of data available.

If requested by the claimant, an assessment may be conducted using a fisher's own catch and effort data where a claim assessor forms the view that the data is consistent with Government data accuracy and formatting and that the data is suitable to conduct an accurate assessment.

The loss of catch adjustment process under this protocol does not cover circumstances where there may be discussions and/or agreement reached between a petroleum activity titleholder and a commercial fisher prior to an activity taking place, that it is not appropriate for fishing to occur within the area of a petroleum activity. Likewise, if a commercial fisher feels that they will be disadvantaged by a petroleum activity due to alternative suitable fishing grounds not being available to them during the petroleum activity, then they should engage with the titleholder ahead of an activity commencing.

A commercial fisher wishing to lodge a claim for adjustment should notify the titleholder of their intention to lodge a claim as soon as possible after the conclusion of operations of a petroleum activity and a claim may be lodged up to 6 months after the conclusion of the operations of the petroleum activity.

2.3 Fishing gear loss or damage

A commercial fisher may lodge a claim in accordance with this protocol if they experience accidental loss or damage of deployed fishing gear from physical contact with a petroleum activity vessel and/or its in-water equipment or supporting vessels during a petroleum activity subject to this protocol.

Through pre-activity notifications and communications, titleholders and commercial fishers should have an awareness of activity and fishing activities and make all reasonable efforts to avoid direct interaction and fishing gear loss or damage. It should be noted that petroleum activity vessels/rigs carrying out petroleum activities are limited in their manoeuvrability.

If fishing gear loss or damage occurs, the commercial fisher should immediately notify the titleholder.

When lodging a claim, the claimant should clearly document when, where and how the gear damage or loss occurred and where possible, the name and details of vessel(s) involved in the incident. A claim should include a quote (two where possible) with costs associated with repairing or replacing the lost or damaged fishing gear.

As a result of assessing the claim, by mutual agreement with the claimant, the titleholder may offer to cover the cost of repairing or replacing the damaged fishing gear or providing like- for-like replacement equipment.

In association with a claim for fishing gear loss or damage, the value of any foregone catch from the lost or damaged fishing gear for the duration of that fishing trip may also be included. Adjustment for foregone catch shall be based on the average CPUE for the month that the lost or damaged fishing gear incident took place. If insufficient information is available for that month, then the same month in the previous year can be used. Claims for forgone catch may only be based on the proportionate loss of catch resulting from the lost or damaged fishing gear for the period of the fishing trip where the loss was suffered.

In the event a claim for forgone catch has been submitted, the titleholder may (at their sole expense) enlist the services of an independent person or organisation to assess the claim. If agreement cannot be reached between the claimant and titleholder, then refer to the independent expert review provisions in the *How long will it take to deal with my claim and independent expert review process* section of this protocol.

A claim for fishing gear loss or damage must be lodged within 6 months of the conclusion of the activity.

3 Claim Information and Assessment Process

Titleholders conducting petroleum activities in accordance with an EP subject to this protocol will provide a centralised contact point and online portal to relevant commercial fishers/marine operators relating to lodging a claim or notification regarding displacement, loss of catch, or fishing gear loss or damage, as relevant. Contact information will also be provided to relevant fishing associations as the respective peak commercial fishing industry bodies.

All information provided in an application under this protocol must be kept confidential by the titleholder, an assessor or expert reviewer of a claim and any other person who has access to the information.

Provided a claimant can demonstrate the required previous fishing history within an Adjustment Area, if all the remaining information requirements set out in this protocol are not available to a claimant, then such claims will be considered on a case-by-case basis.

An option for applicants lodging a claim is to authorise an assessor to access the relevant fishing catch and effort information directly with the appropriate Government Department. Alternatively, applicants may provide the required Government catch and effort information with their claim application.

Applicants will receive confirmation of a claim being lodged with the titleholder. If an assessor forms the view that the information lodged with a claim is not sufficient to conduct a meaningful assessment or support the application, then the claimant will be advised in writing and given 14 days to respond to the assessor. If no response is received within 14 days, then the assessment will be completed, and the claimant advised of the outcome.

Claims will be assessed by separate monthly fishing activity, with each month assessment outcome not influencing or impacting on another month assessment outcome. This protocol outlines the adjustment processes in a manner to provide consistent assessments over time. However, assessors have the flexibility to make judgements that will enhance the statistical accuracy of an assessment and/or provide balanced practical assessment outcomes.

For fully documented applications that meet the Adjustment Area historical fishing/usage activity requirement, whether successful or not, clerical costs relating to preparing, submitting, and engaging in the adjustment process under this protocol, up to a value of $2,000 per claim, will be reimbursed by the activity's titleholder as part of the claim process. A statement outlining time and resource costs to support an amount up to $2,000 should be included with an application. Clerical costs that exceed $2,000 may also be included with a claim and reimbursed under this protocol if evidenced by documentation.

3.1 Who can lodge a claim and when?

A commercial fisher (refer definition) who suffers displacement, a loss of catch, or gear loss or damage whilst operating in and around a petroleum activity Adjustment Area, subject to this protocol can lodge an adjustment claim.

Other commercial marine operators (refer definition), identified during relevant persons consultation during the preparation of the relevant EPs, who suffers displacement whilst operating in and around a petroleum activity Adjustment Area, subject to this protocol can lodge an adjustment claim.

A person so authorised may lodge a claim on behalf of a commercial fisher/marine operator. Claims may be lodged by a person, company, or association on behalf of more than one commercial fisher/marine operator, provided that the required individual usage/catch history is provided and there is evidence of the authority to lodge the claim on behalf of others.

Claims can be submitted up to 6 months after the conclusion of a relevant petroleum activity.

3.2 What information is needed to lodge a claim?

Claimants will need to be able to identify the relevant vessel and licence(s) that are involved in the claim, and to provide evidence of the entity that would have received the revenue that is the subject of a claim. For fishers, a key information requirement when lodging a loss of catch claim will be to either authorise access to the relevant Government catch and effort data or provide the catch and effort data with the application. For other commercial marine operators, the information needed for lodging a claim will have been agreed between the titleholder and the entity that would have received the revenue that is the subject of a claim.

Full details on the information required to be lodged with a claim are contained in the application forms at:

- **Appendix 2 - Loss of catch,**
- **Appendix 3 - Displacement,**
- **Appendix 4 - Fishing gear loss or damage.**

Each claim should relate to only one petroleum activity and associated titleholder. If a claimant is not sure which titleholder is undertaking the activity the claim may be delayed whilst a claim assessor confirms the correct titleholder.

3.3 Who will assess the claims and what information will be in the report?

Subject to a claim being lodged, the titleholder of a petroleum activity (at their expense) in consultation with the claimant, will engage a suitably experienced/qualified independent person or organisation as the assessor of the claim.

The titleholder is to provide the assessor with a letter of instruction/project brief, which is to be provided to the claimant as part of the assessment report.

An assessment report prepared by an assessor should include the following information:

- a copy of the letter of instruction/project brief received by an assessor when engaged to carry out the independent assessment,
- confirmation (or otherwise) that the information provided in the claim is sufficient to conduct a meaningful assessment,
- a summary of the claim details (activity, applicant, vessel, month(s)),
- for a loss of catch claim, monthly CPUE assessments as outlined in this protocol including an estimation of any loss of catch (in kilograms) and its market price, and
- any other information, comments, or views relevant to the assessment that the assessor may wish to include.

Upon receiving and considering the assessment report, the titleholder will provide a copy of the report to the claimant and offer to meet with the claimant to discuss/address the claim.

3.4 How long will it take to deal with a claim?

An appropriately documented claim (including relevant catch and effort information) should be assessed, and a report provided to the claimant, within 30 days of the lodgement date of the claim. If an assessor is authorised to access catch and effort data, then the 30 day period begins upon receipt of the necessary catch and effort data. If an appropriately documented claim report cannot be made available to the claimant within 60 days of a claim being lodged or receipt of catch and effort information as appropriate, and no mutual agreement to extend the time-period has been entered into, then the titleholder (at their expense) in consultation with the claimant, shall appoint a suitably experienced/qualified independent person or organisation to provide an expert review of the claim.

Included as part of the settlement of each claim, will be a binding agreement that summarises the claim outcomes and an agreement by the claimant that acceptance of the settlement negates any further claims for the same species and month(s) of that petroleum activity.

3.5 Independent expert review of a claim

If a claimant disagrees with a claim assessment outcome and cannot reach agreement with the titleholder, they may opt to go to an independent expert review (funded by the titleholder of the activity).

If a claim is subject to independent expert review, then as part of that process, both the claimant and the titleholder shall be given the opportunity to address the assessor to state their position, prior to an independent expert review decision being reached.

An independent expert reviewer must provide a view as to whether the claim assessment process has been conducted in line with the requirements of the protocol. The independent expert reviewer may also consider any additional information deemed appropriate by themselves, including information provided by either the claimant or the titleholder. An independent expert review decision is binding on the claimant and the titleholder and may differ from the initial assessment report. A timeline diagram setting out the relevant time frames under this protocol can be found at Appendix 5.

3.6 How long will it take to be paid adjustment?

Once a claimant and titleholder agree with a claim outcome, or an expert reviewer has issued a report, the titleholder will provide monetary adjustment to the claimant as soon as possible and within 30 days.

4 Protocol Review and Maintenance

This protocol will remain in force for the validity period of any accepted EP for any of the titleholders who become members of the OAP, anticipated to be a five-year term from date of acceptance by NOPSEMA. The protocol will be subject to review and update by KSV and the members at least once in each 12-month period. Changes will be considered in consultation with relevant fishing associations (and other stakeholders as appropriate) and subject to agreement by the titleholder members.

The forms in the Appendices will be made available for download through the OMICC Portal, or online forms may be used to submit a claim.

4.1 Revision History

Revision	Date	Notes
0.1	2 February 2024	Creation of document based on the NERA protocol and following consultation inputs from commercial fishing industry consultation in preparation of relevant EPs.
0.2	22 February 2024	Amendments to add other commercial marine operators and prepare for consultation with OMICC founders.
0.3	14 March 2024	Amendments following OMICC founder input and clarifications to scope. Preparation for first legal review by titleholders.
0.4	30 April 2024	Reviewed and updated for distribution and comment.

Appendix 1: Otway Commercial Marine Operator Adjustment Protocol Members

Founding Members

- TGS Pty Ltd
- CGG Services (Australia) Pty Ltd
- ConocoPhillips Australia SH1 Pty Ltd and ConocoPhillips Australia SH2 Pty Ltd
- Klarite Sustainable Ventures Pty Ltd

Appendix 2: Consent and Confidentiality Form

CATCH & EFFORT and CATCH DISPOSAL RECORDS CONSENT

Records from this year and previous years are needed to support your claim. Please complete the following consent form for lodgement with the appropriate fisheries management agency.

I, (insert name) ………………………………………………………………give permission to the Klarite Sustainable Ventures

nominee to have access to my (insert fishery) …………………………………………………. catch and effort records at (fisheries

management agency) …………………………………………………………………..

I affirm that the fishing cooperatives listed below (leave blank if not applicable):

(insert fishing cooperative) …………………………………. receive (insert percentage) …………% of my landed catch.

(insert fishing cooperative) …………………………………. receive (insert percentage) …………% of my landed catch.

(insert fishing cooperative) …………………………………. receive (insert percentage) …………% of my landed catch.

I, (insert name) ……………………………………………………………… do:

(a) Certify that the details and particulars in this application are true to the best of my knowledge, information, and belief; and

(b) Acknowledge that the making of a false statement is unlawful and open to prosecution.

Signed: ……………………………………………………………. Date: ……………………………………………………………………..

Appendix 3: Displacement Application Form

Commercial Fishing Industry Adjustment Protocol - Application Form for Displacement Claim

Application Form - Commercial Marine Operator Adjustment Protocol - Displacement	
Activity Details	
Petroleum activity name	
Activity titleholder	
Claimant Details	
Name of person/company making claim	
Address	
Email	
Contact number	
I am the entity that would have received the revenue from the catch that is the subject of this claim. Please include evidence of above statement	Yes or No
Relevant authorisation holder details (if different from claimant)	
Name	
Address	
Email	
Contact number	
Authorisation/licence(s) name and number	
Claim details	
Evidence of the additional distance, fuel and crew costs incurred by the relocation of the fishing/other marine operation.	Attach receipts/evidence of costs for claim month. Include vessel track data, fuel receipts, transit time, distance travelled etc.
Evidence of previous year daily (at sea) average distance, fuel and crew costs	Attach receipts/evidence of costs for previous year.

Application Form - Commercial Marine Operator Adjustment Protocol - Displacement
Include five years catch data preceding the year of the claim in the following form: • Vessel • Year • Month • Fishery • Fishing event location/blocks fished provided at the highest available block resolution. • Whole weight calculated based on the reported landed weight and listing any relevant conversion factor(s). For other commercial marine operators, include five years historical area usage data preceding the year of the claim in the following form: • Vessel • Year • Month • Location provided at the highest available resolution. Note 5 years of data is required for displacement purposes to show recent operational history has occurred within an Adjustment Area. If less than 5 years data available, then claim assessor should evaluate appropriate method of assessment.
Please list the documents provided with your application
1.
2.
3.
4.

Appendix 4: Loss of Catch Application Form

Commercial Fishing Industry Adjustment Protocol - Application Form for Loss of Catch claim

Application Form - Commercial Marine Operators Adjustment Protocol - Loss of Catch	
Activity Details	
Petroleum activity name	
Activity titleholder	
Claimant Details	
Name of person/company making claim	
Address	
Email	
Contact number	
I am the entity that would have received the revenue from the catch that is the subject of this claim. Please include evidence of above statement	Yes or No
I wish to authorise direct access to my catch and effort history relevant to this application.	Yes/No (If yes then authorisation holder to sign here)
Relevant authorisation holder details (if different from claimant)	
Name	
Address	
Email	
Contact number	
Authorisation/licence(s) name and number	
Claim details	
Months for which loss of catch adjustment is being claimed	

<table>
<tr><td colspan="2">Application Form - Commercial Marine Operators Adjustment Protocol - Loss of Catch</td></tr>
<tr><td colspan="2">Market price information – please include documentary evidence of price received from normal buyer/processor for catch relevant to loss of catch claim.</td></tr>
<tr><td>Catch and effort information for blocks/area by month by species for which loss of catch is being claimed plus previous 10 years. If 10 years Government catch history is not available and/or or you wish to provide your own validated catch history, please indicate here.</td><td>Indicate whether Government or own catch and effort data is being provided and number of previous years of data available.</td></tr>
<tr><td colspan="2">NOTE: If any information is not available from Government and fishers own catch data is being submitted, then copies of the relevant statutory catch and effort fishing returns should be submitted with the claim.</td></tr>
<tr><td colspan="2">Catch and effort information should be provided in the form of:
Vessel
Year
Month
Fishery
Blocks fished provided at the highest (e.g., 10x10nm) available block resolution, or fishing event locations (by latitude and longitude).
Block days including fishing events in identified area/blocks per month.
Fishing hours (in decimal hours) showing the duration of each fishing event at highest available block/fishing event resolution.
Whole weight calculated based on the reported landed weight and listing the relevant conversion factor(s) if applicable.</td></tr>
<tr><td colspan="2">Other relevant information may be submitted with a claim and will be assessed on a case by case basis. Questions regarding the claim process may be directed to a person nominated by the titleholder.</td></tr>
<tr><td colspan="2">Please list the documents provided with your application</td></tr>
<tr><td colspan="2">1.</td></tr>
<tr><td colspan="2">2.</td></tr>
<tr><td colspan="2">3.</td></tr>
<tr><td colspan="2">4.</td></tr>
</table>

Appendix 5: Fishing Gear Loss or Damage Application Form

Application Form - Commercial Marine Operators Adjustment Protocol – Fishing gear loss or damage	
Activity Details	
Activity name	
Activity titleholder	
Claimant Details	
Name of person/company making claim	
Address	
Email	
Contact number	
I am the entity that has incurred the costs of the lost or damaged fishing gear that is the subject of this claim. If claiming for loss of catch, I am the entity that would have received the revenue from the catch that is the subject of this claim. Please include evidence of above statements.	Yes or No and supporting information.
I wish to authorise direct access to my catch and effort history relevant to this application.	Yes/No (If yes then authorisation holder to sign here)
Relevant authorisation holder details (if different from claimant)	
Name	
Address	
Email	
Contact number	
Authorisation/licence(s) name and number	
Claim details	
Evidence of notification to the titleholder of the gear loss and/or damage incident.	
Information describing when, where, and how the gear damage and/or loss occurred.	

Where possible, the name and details of vessel(s) involved in the incident.	
A claim should include a quote (two where possible) with costs associated with repairing or replacing the lost or damaged fishing gear.	
Estimate of any proportionate loss of catch including market price, plus catch and effort information sufficient to calculate CPUE for claim month or same month in previous year.	
Please list the documents provided with your application	
1.	
2.	
3.	
4.	

Appendix 6: Adjustment Protocol Timeframes

Timeframes for making a claim:

1. Titleholder to provide 28-day notice of a future Adjustment Area including a map and coordinates.
2. Titleholder to provide notice of activity start and activity end through the OMICC portal.
3. All claims must be lodged within 183 days (6 months) after the end of an activity.

Timeframes for processing a claim:

1. Claims to be finalised within 60 days of being lodged, or receipt of catch and effort information, unless mutual agreement reached between claimant and titleholder to extend time frame.
2. If agreement cannot be reached between the titleholder and claimant within the prescribed times above then the titleholder, in consultation with the claimant, must appoint an independent expert reviewer to decide the claim.
3. Subject to an independent expert review decision, the titleholder shall settle the claim in accordance with the decision within 60 days.

Appendix 7: Legislation Section 603

Offshore Petroleum and Greenhouse Gas Storage Act 2006

No. 14, 2006

Compilation No. 54

Compilation date: 18 October 2023

Includes amendments up to: Act No. 74, 2023

Registered: 21 October 2023

603 Interfering with offshore petroleum installations or operations

(1) A person commits an offence if:

(a) the person engages in conduct; and

(b) the person's conduct results in:

(i) damage to, or interference with, any structure or vessel that is in an offshore area and that is, or is to be, used in exploring for, recovering, processing, storing, preparing for transport, or transporting, petroleum; or

(ii) damage to, or interference with, any equipment on, or attached to, such a structure or vessel; or

(iii) interference with any operations or activities being carried out, or any works being executed, on, by means of, or in connection with, such a structure or vessel.

Penalty: Imprisonment for 10 years.