ConocoPhillips

Sequoia 3D MSS Environment Plan

ABU2-000-EN-V01-D-00001

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1. Executive Summary

This Executive Summary gives an overview of what a marine seismic survey is and describes the environmental assessment processes and outcomes that have been applied. ConocoPhillips Australia is seeking acceptance from the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) to carry out a three-dimensional (3D) marine seismic survey (MSS) associated with exploration permit T/49P in the Otway Basin. The purpose of the 3D MSS is to gather geophysical information about gas prospects within the title. The activity is named Sequoia MSS. Figure 1-1 shows the operational and acquisition areas within T/49P.

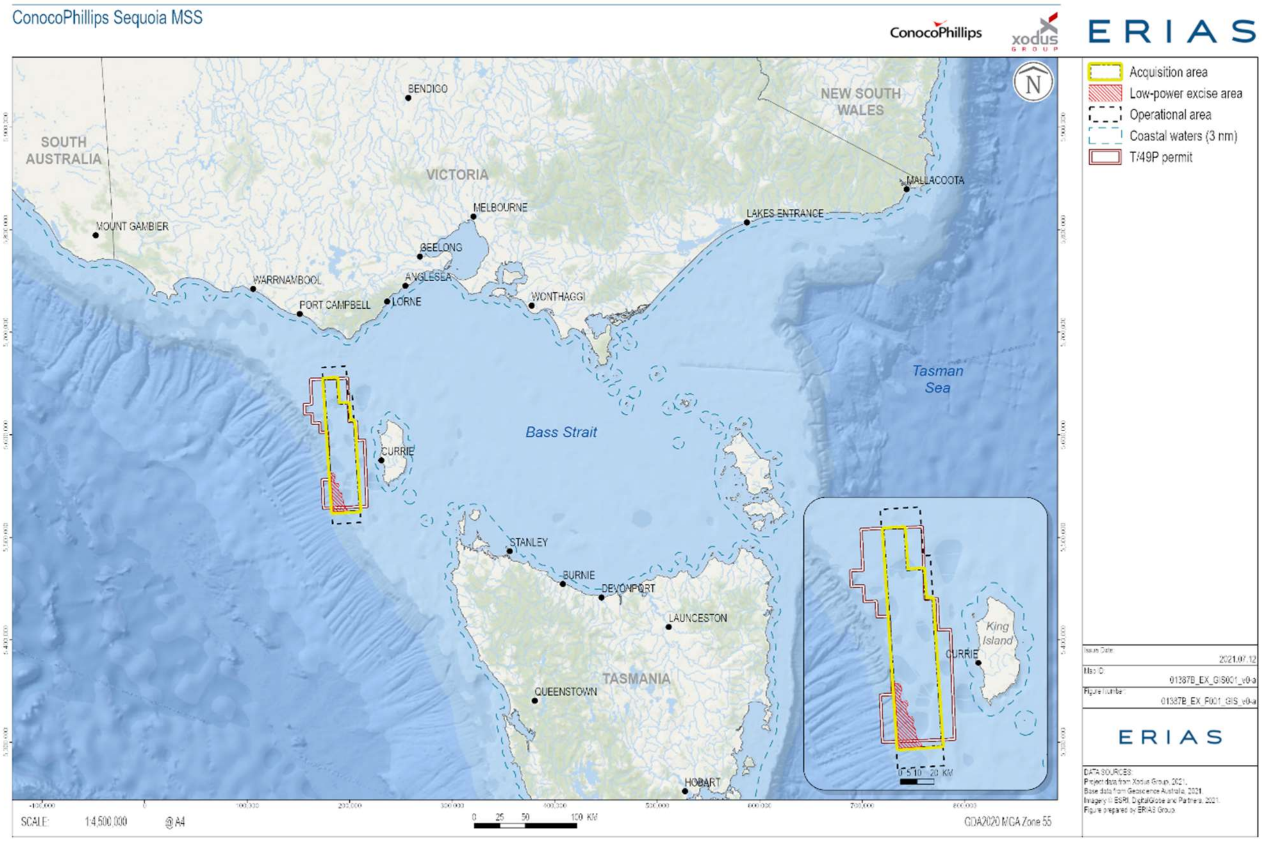
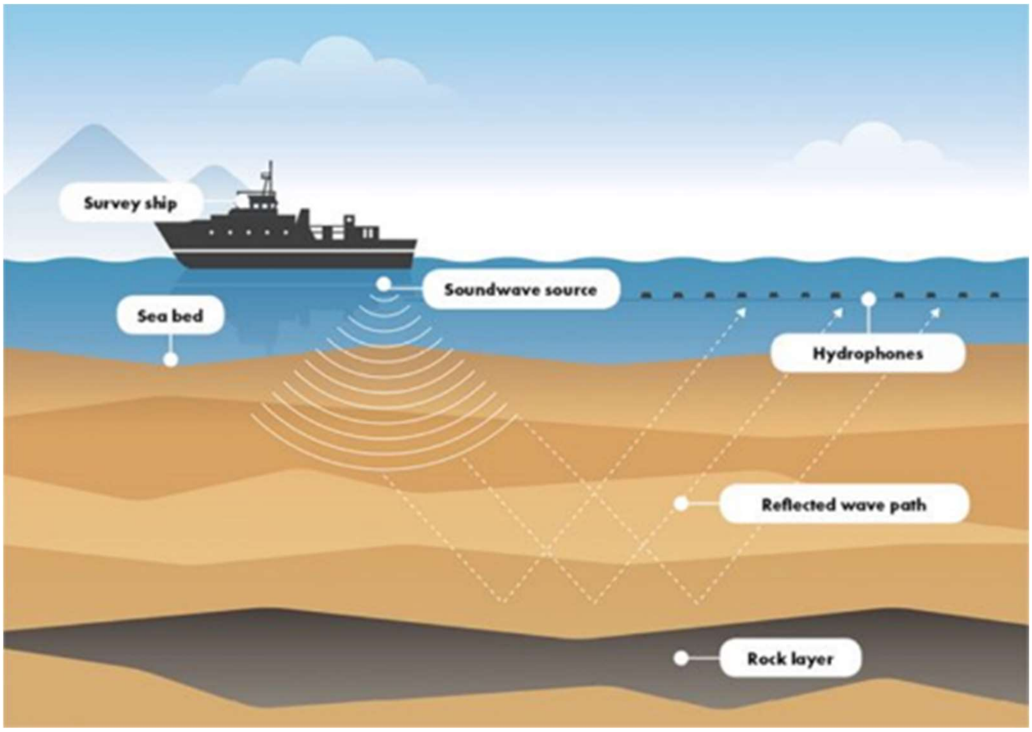


Figure 1-1: Operational and Acquisition areas within T/49P

1.1. What is a Marine Seismic Survey?

A marine seismic survey is a method of determining geological features below the sea floor, using a technical process which involves sending sound waves into the rock layers beneath the sea floor and then recording the time is takes for each wave to bounce back as well as measuring the strength of each returning wave. It is the most reliable form of initial exploration for oil and gas and is an essential process in identifying geological features that could contain oil or gas deposits.



Source: Energy Information Australia

Figure 1-2: A basic depiction of a marine seismic survey

The process of collecting seismic data is known as 'acquisition'. A marine seismic survey takes place along a series of pre-defined acquisition lines (normally several hundred metres apart) within an overall acquisition area. Marine seismic surveys are carried out by specialised vessels that tow an array of acoustic sources and receivers (hydrophones) across a defined acquisition area.

1.2. Objective of the EP

The objective of the Sequoia MSS Environment Plan (EP) is to demonstrate that the proposed activity meets the criteria of acceptance as defined by Regulation 10A of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E) Regulations). To achieve this the EP contains the information required by the regulations.

The content of the EP shows that:

- The activity is clearly scoped and bounded and the environment that may be affected is suitably understood.
- The legislative and other requirements that apply to the activity will be met.
- The impacts and risks are suitably understood based on detailed analysis of how the activity and environment interact.

The environmental assessment processes have been systematically followed and applied thoroughly to ensure that:

- Acceptable levels of environmental impact and risk have been defined and justified
- Environmental impact and risk levels have been predicted and compared to the defined acceptable levels of impact such that information uncertainties can be identified
- Control measures for treating environmental impacts and risks will be effective
- Additional and alternative control measures and improved environmental performance have been considered and, where costs are not grossly disproportionate to their predicted environmental benefit, adopted
- Environmental performance can be easily monitored and are clearly connected to the control measures and their management of the predicted levels of impact or risk
- Appropriate action has been taken in the presence of scientific uncertainty
- The outcomes of the assessments are defensible and reproducible.

The EP contains an implementation strategy (Section 6) that ensures that the conduct of the activity can be managed consistent with the outcomes of the environmental assessment process. This includes an environmental management system which includes a planning cycle to manage change, errors, deviations, and uncertainties. The EP includes response arrangements and systems in place to manage oil pollution risks.

The EP contains a report on the consultation with relevant persons and through the public comment period (Appendix C – Consultation Report; and Appendix D – Sensitive Information Report). This report shows how stakeholder feedback has been incorporated throughout the environmental assessment process to ensure environmental impacts and risks can be managed to the legislated criteria.

1.3. Environmental Assessment Process

To develop the content for this EP, a systematic and thorough environmental assessment processes have been followed. The processes can be found in Section 6 and are consistent with the following standards and guidelines, which have been adapted to meet the requirements and language of the OPGGS(E) Regulations:

- ConocoPhillips Australia Risk Matrix Standard
- AS/NZS ISO 31000:2018: Risk Management – Principles and Guidelines
- AS/NZS ISO 17776:2016: Petroleum and natural gas industries — Offshore production installations — Major accident hazard management during the design of new installations
- AS/NZS ISO 14001:2016: EMS – Requirements with guidance for use
- The UK offshore oil and gas industry guidance on risk-related decision making (Oil & Gas UK, formerly UKOOA, 2014)
- NOPSEMA's Environment Plan decision making guideline (GL1721, Rev 6, November 2019).

A full description of the ConocoPhillips Australia policy and process for impact and risk assessment with supporting information is provided in Section 6.3. An outline of the environmental assessment process is provided in Figure 1-3 to enable readers to reproduce the assessment undertaken in this EP.

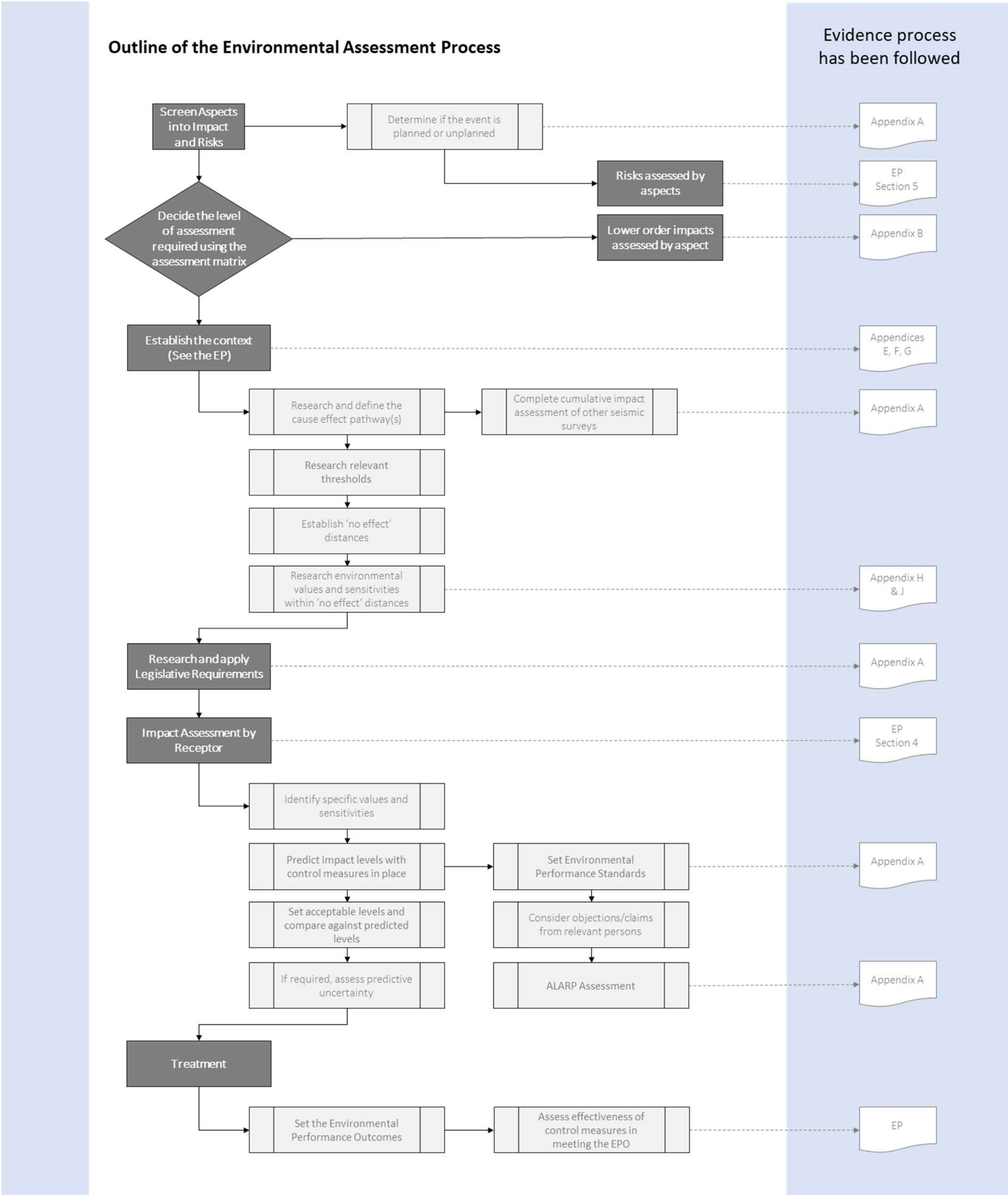


Figure 1-3: Outline of Environmental Assessment Process

The core steps of the ConocoPhillips Australia environmental risk assessment (ERA) process are summarised in 6.3 and described in detail throughout this chapter.

1.3.1. Summary of the Environment Impact Assessment Process and Outcomes

The EP identifies planned events that result in environmental impacts to receptors and these sections follow an environmental impact assessment (EIA) process built around consideration of a receptor group (e.g. invertebrates, marine mammals). This way of presenting the impact assessment was chosen because the content is more accessible to stakeholders who may only want to focus on the content that matters to them.

This process mandates that the predictions of impacts are made with legislative and other requirements in place. The legislative and other requirements are assumed to be effective to the extent of their scope and application to the activity. They act as a minimum level of environmental management and control measures have been adopted to ensure that relevant environmental management laws are complied with. Also, key to the impact assessment is that it is completed with full consideration of the existing pressures on the receptor. In this way, the impact assessment represents a cumulative impact assessment.

A summary of the EIA processes is in Appendix A. There were 11 receptor types assessed. The environmental impacts from planned aspects to water quality, air quality, and benthic assemblages were ranked as Negligible. Environmental impacts to plankton, birds, fish, marine reptiles, commercial fishers, and other marine users were ranked as Minor. Environmental impacts to invertebrates and marine mammals were ranked as Moderate. Control measures were adopted to ensure that actual environmental impacts remain with the predicted levels.

There were two impact assessments where there was enough uncertainty in the prediction such that there may have been unacceptable impacts if this uncertainty were not managed. As a result, a literature review and identification of research priorities will be undertaken by the University of Tasmania for the impacts of impulsive sound on giant crab and giant crab populations in the Otway region. Also, there will be a monitoring program developed to confirm the presence/absence of southern right whales and cow-calf pairs in the Otway region that will inform an adaptive management procedure to ensure that impact from impulsive sound will remain of an acceptable level (captured as control measures in the Environmental Performance section, Appendix A).

1.3.2. Summary of the Environment Risk Assessment Process and Outcomes

The EP identifies unplanned events that result in environmental risks to multiple receptors and these sections follow an environmental risk assessment (ERA) process built around consideration of the environmental aspect (e.g. introduction of IMS). The key differences in the presentation of this information is that there is a likelihood associated with unplanned events and there are multiple receptors. This necessitates a different means of presenting the information, but the ERA process followed remains consistent with the international standards and guidelines reference above.

Like the EIA process, the ERA process predicted risk levels assuming the relevant legislative and other requirements were in place and effective. They act as a minimum level of environmental management and control measures have been adopted to ensure that relevant environmental management laws are complied with.

A summary of the ERA processes is in Appendix A. In total five risks were assessed. The worst-case environmental risks from a loss of materials/waste overboard, vessel collision with marine fauna, introduction of invasive marine species, and oil spill response activities were ranked as Low. The worst-case environmental risks of a Marine Diesel Oil (MDO) release was ranked as Medium. There was no uncertainty in the predicted risks.

1.4. Demonstration that environmental impacts and risks are reduced to as low as reasonably practicable and to below an acceptable level

The demonstration that acceptable levels of impact and risk have been meet is made within each impact assessment or risk assessment.

ConocoPhillips Australia has defined a set of criteria to demonstrate the acceptability of its activities which includes consideration of the Principles of Ecological Sustainable Development defined in Section 3A of the EPBC Act. This should not be confused with the criteria for acceptance of an Environment Plan, nor the define acceptable

Table 1-1 describes:

- ConocoPhillips' acceptability criteria
- the process checks applied to show impacts and risks against acceptability criteria; and
- the method of evaluation of the acceptability criteria within the EP.

Table 1-1: Acceptability criteria, process checks, and method of evaluation in the EP

Acceptability Criteria	Process Check	Method of Evaluation in the EP
Principles of Ecologically Sustainable Development		
(a) decision-making processes should effectively integrate both long-term and short-term economic, environmental, social, and equitable considerations	Has the decision-making processes integrated long-term and short-term economic, environmental, social, and equitable considerations?	The ConocoPhillips Australia assessment processes within this EP includes provision for understanding the long-term and short-term impacts associated with its activities. Specifically, each receptor and aspect have acceptable levels of impact and risk set for biological, ecological, and economic features which are compared against predicted levels of impact/risk in each chapter. The ALARP process inherently balances the economic cost against environmental benefit.
b) 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.	If impacts/risks are considered serious/irreversible, is there enough appropriate information available to understand the risk?	This principle is assessed for each receptor and aspect within the impact and risk assessments. See the various assessments and specifically the conclusions in the demonstration of acceptability tables at the conclusion of each assessment. Activities where impacts are temporary / reversible, small scale, and/or low intensity environmental damage are deemed to be of an acceptable level.
	If significant scientific uncertainty exists, has the precautionary principle been applied? Have additional measures been assigned to address uncertainty?	The EP process requires a comparison of predicted levels of impact against relevant acceptable levels of impact. This is done in the context of the legislative and other requirements that apply to the activity and considers the effectiveness of control measures adopted to manage impacts and risks. At the conclusion of each assessment a level of predictive uncertainty is assigned. If there is residual uncertainty this is assessed, and measures implemented to either remove the uncertainty or apply the precautionary principle.

Acceptability Criteria	Process Check	Method of Evaluation in the EP
c) the principle of inter-generational equity – the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	Do activities have the potential to result in permanent/irreversible, medium-large scale, and/or moderate-high intensity environmental damage?	Each impact and risk assessment consider whether there is potential for permanent/ irreversible, medium-large scale, and/or moderate-high intensity environmental damage. This has been completed for each receptor/aspect by using this criterion as one of the defined acceptable levels against which acceptability is assessed.
d) the conservation of biodiversity and ecological integrity should be a fundamental consideration in decision making.	Is there the potential to affect biological diversity and ecological integrity? Does the EP align with the aims and objectives of EPBC Management Plans and Recovery Plans?	ConocoPhillips Australia has applied a methodology for assessing impacts and risks where if ranked below Major (4) the impact/risk is of an acceptable level. Details of this process and a definition of the levels of impact/risk are provided in section 6.3. Following the application of legislative and other requirements, adoption of all reasonably practical control measures, assessment of effectiveness of those control measures, and assessment of any predictive uncertainty shows that biological diversity and ecological integrity have been fundamental to decision-making. The EP must not be inconsistent with EPBC Management Plans and Recovery Plans. Evidence that a full search of EPBC protected matters is shown in the PSMT search results and the subsequent consolidation of all EPBC data in Appendix A – Receptor Values and Sensitivities.
e) improved valuation, pricing, and incentive mechanisms should be promoted.	Not considered relevant for petroleum activity acceptability demonstrations.	
Internal Context		
COP policies	Is the proposed management of the hazard aligned with ConocoPhillips' HSEMS and EIA and ERA Process?	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks. Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).
External context		
Relevant Persons engagement	Have stakeholders raised any concerns about activity impacts or risks? If so, are measures in place to manage those concerns?	Consultation with relevant persons has been carried out over the 12 months prior to the activity in accordance with the specific process defined in the OPGGS(E)R. Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP. Evidence of the management of claims and objections is provided in section 3, Appendix C, and Appendix D.
Other Requirements		
International Standards, Industry best practice	Have relevant international, national, and industry standards have been considered and applied?	Relevant international, national, and industry standards have been considered and where relevant applied in the EP. Evidence of this assessment is provided in Appendix A – Environmental Performance.

Acceptability Criteria	Process Check	Method of Evaluation in the EP
Legislative Requirements	Have all legislative requirements been identified and applied to the activities within the Environment Plan such that the expectations of existing legislation can be met?	A process of identifying any environmental management laws that apply to petroleum activities has been completed. An assessment of which receptors, aspects, and activities the requirements apply to has also been completed. Evidence of this assessment is provided in Appendix A – Legislative requirements. Each assessment uses this information to scope the assessment.

A tabulated process is shown for each receptor and aspect in Section 4 and Section 5 respectively. Each section applies a standard method of setting acceptable levels of impact/risk and comparing the predicted impacts/risks against those levels. Where there was uncertainty in the prediction that resulted in the possibility for unacceptable impacts the uncertainty has been identified and managed.

ConocoPhillips Australia demonstrates risks are reduced to as low as reasonably practicable (ALARP) when the cost and effort required to further reduce risk is grossly disproportionate to the risk benefit gained.

The demonstration that all reasonably practicable control measures have been adopted is made in Appendix A – Environmental Performance. A systematic process of considering alternative and additional control measures and performance standards is shown along with consideration of improving the performance of adopted control measures and performance standards. Justification for control measures or improved performance standards that have been rejected is also provided.

The effectiveness of control measures is evaluated in a tabulated process for each receptor and aspect, showing an iterative process to assign additional measures, if environmental performance outcomes are not met.

1.5. Definitions

The definitions provided for the in the OPGGS(E) Regulations take precedence throughout the EP. Important terms used throughout the EP which warrant definition and are not defined by the OPGGS(E) Regulations are provided in Table 1-2.

Table 1-2: Definitions

Term	Definition
Receptor	Relevant natural, socio-economic or cultural feature of the environment
Environmental aspect	Parts of ConocoPhillips Australia activities that can interact with the environment.
Event	An occurrence of a set of circumstances. An event can be one or more occurrences and can have several causes.
Consequence	A result, effect, or outcome of an event.
Likelihood	A measure of the chance of an event happening usually expressed as a frequency or probability.
Environmental risk	The combination of the likelihood and consequence of an event leading to environmental harm.
Uncertainty	The degree or lack of confidence in a statement, prediction, or position.

1.6. Titleholder Information

ConocoPhillips Australia SH1 Pty Limited is a subsidiary company of ConocoPhillips Company (United States entity). Further information about ConocoPhillips is available at its website: www.conocophillips.com.

In accordance with the OPGGS(E)R Regulation 15(1) & (2) details of the titleholders and liaison person for this EP are provided below.

The titleholder for this activity is:

ConocoPhillips Australia SH1 Pty Ltd

Level 1, 33 Park Road, Milton, QLD 4064

Phone: 07 3182 7122

ABN: 18 116 771 450

The nominated liaison person for this EP is:

Aaron Burt

Exploration Manager - Australia

Email: sequoia@conocophillips.com

Phone: 07 3182 7122

ConocoPhillips Australia, as operator, will notify NOPSEMA of any change in titleholder, a change in the titleholder's nominated liaison person, or a change in the contact details for either the titleholder or the liaison person as soon as practicable after such a change takes place.

1.7. Environment Plan Summary

Table 1-3 provides a summary of this EP as required by Regulation 11(4) of the OPGGS(E).

Table 1-3: EP Summary requirements and section

EP Summary requirement	EP section
The location of the activity	Section 2
A description of the receiving environment	The receiving environment is described in each section as it is relevant to that receptor/aspect. Section 4 for planned aspects; and Appendix H Existing Environment for the Spill EMBA.
A description of the activity	Section 2
Details of the environmental impacts and risks	The details of impacts and risks are described in each section as it is relevant to a receptor or aspect. (Sections 4 and 5)
The control measures for the activity	Environmental Performance section of Appendix A
The arrangements for ongoing monitoring of the titleholder's environmental performance	Section 6
Response arrangements in the oil pollution emergency plan (OPEP)	Appendix I
Consultation already undertaken and plans for ongoing consultation	Section 3, Appendix C and D
Details of the titleholder's nominated liaison person for the activity	Section 1 (this section)

2. Description of Activity

2.1. Introduction

This chapter provides a description of the Sequoia Marine Seismic Survey (Sequoia MSS) (***the activity***) compliant with Regulation 13(1) of the *Offshore Petroleum and Greenhouse Gas Storage* (Environment) *Regulations 2009*. It contains a comprehensive description of the matters specified by the regulation. It also contains additional details about the activity relevant to consideration of the environmental impacts and risks.

The aim of this chapter is to clearly scope and bound the activity. To achieve this the chapter specifies the extent and duration of the activity by setting an 'operating envelope' for the activity to be undertaken as planned. In recognition that activities may not proceed as planned a broader 'design envelope' has been created. All activities will be conducted within the design envelope. The environmental assessment has been carried out on the design envelope. An amendment to the design envelope will require submission of a revised Environment Plan (EP).

Any contradiction to the activity description in other areas of the EP is unintentional and information in this chapter takes precedent.

2.2. Location of the activity

The activity will be carried out in Commonwealth waters west of King Island. Two areas limit the activities that occur; an Acquisition Area and a larger Operational Area. They are differentiated by when the sound source can be used at full power and when it cannot be used at full power. These two areas are shown in the context of the underlying petroleum permit T/49P in the figure below.

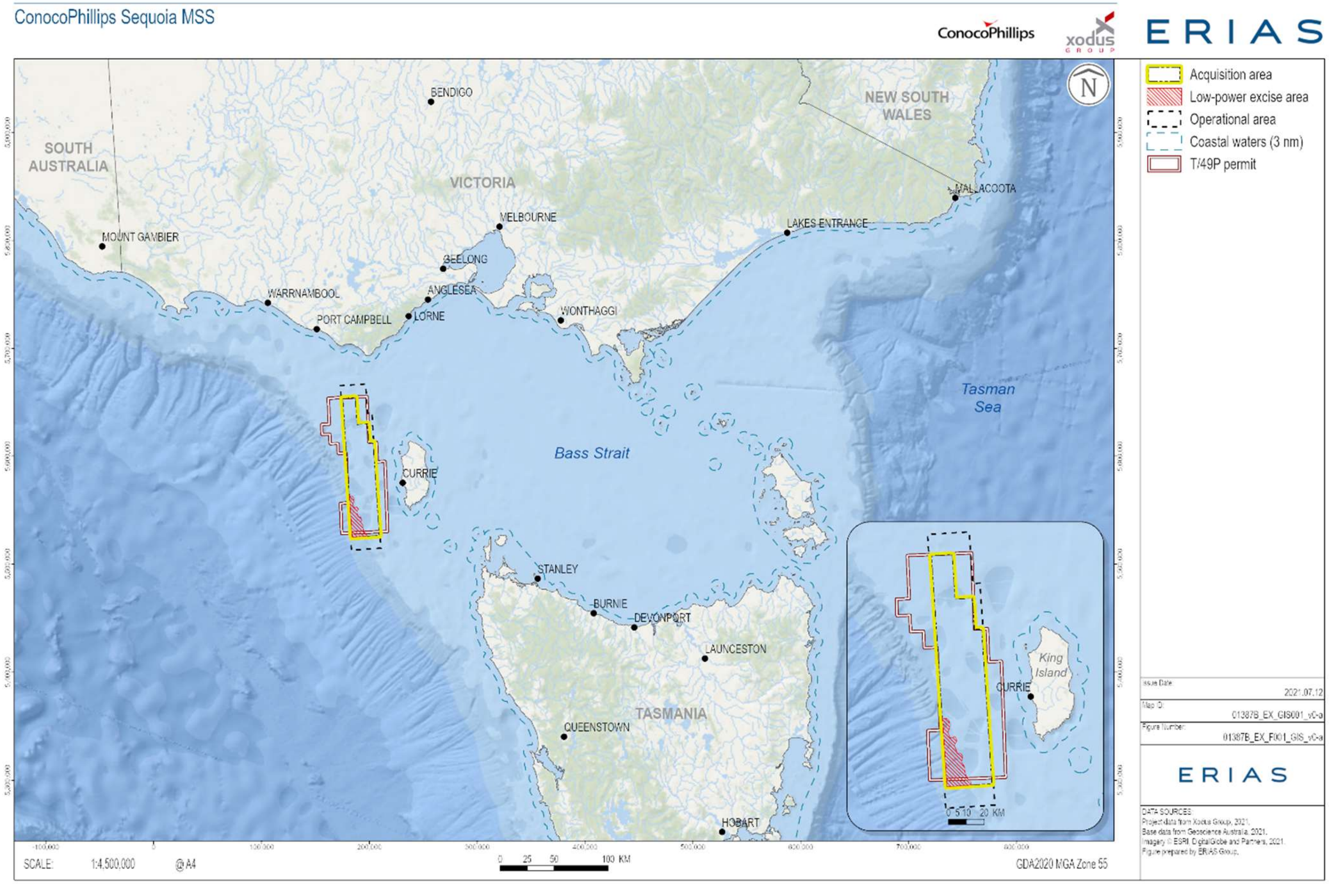


Figure 2-1: Location of the Activity

2.2.1. Operational Area

All activities occur within the Operational Area. It is larger than the Acquisition Area which it entirely overlaps. The Operational Area is 4,089 km^2. It measures 153 km north to south and 26.5 km east to west at its widest point. Table 2-1 provides coordinates of the Operational Area. Activities in the Operational Area include line turns, equipment maintenance and testing, and ad-hoc vessel movements. Activation of the sound source in the operation area will be minimised. Activation of the sound source in the Operational Area will not be at full-power.

Table 2-1: Coordinates of the Operational Area

Point	Degrees, minutes, seconds	
	Latitude	Longitude
A	40° 28' 31.82" S	143° 15' 54.00" E
B	39° 05' 52.85" S	143° 13' 12.91" E
C	39° 05' 33.17" S	143° 29' 26.23" E
D	39° 21' 09.79" S	143° 29' 59.41" E
E	39° 21' 06.07" S	143° 32' 50.56" E
F	40° 28' 07.30" S	143° 35' 20.83" E

2.2.2. Acquisition Area

All seismic surveying activities can occur within the Acquisition Area. It is located entirely within the Operational Area. The Acquisition Area is 2,703 km^2. It measures 129 km north to south and 25 km east to west at its widest point. Table 2-2 provides the coordinates of the Acquisition Area. The Acquisition Area is where the sound source can be activated at full power.

Table 2-2: Coordinates of Acquisition Area

Point	Degrees, minutes, seconds	
	Latitude	Longitude
1	40° 22' 01.68" S	143° 16' 44.52" E
2	39° 12' 20.64" S	143° 14' 27.64" E
3	39° 12' 11.14" S	143° 22' 26.74" E
4	39° 25' 41.42" S	143° 22' 54.19" E
5	39° 25' 32.86" S	143° 29' 42.47" E
6	39° 35' 01.96" S	143° 30' 02.85" E
7	39° 34' 58.38" S	143° 32' 47.44" E
8	40° 21' 39.26" S	143° 34' 32.05" E

2.3. Outline of the operation details of the activity

The activity is the acquisition of geophysical data (a seismic survey) and any other activities (support activities) carried out within the Operational Area prior to and after the acquisition that are required to support acquisition. The seismic survey and support activities have been designed to have the least amount of environmental impact and risk.

2.3.1. Seismic Survey

Seismic surveying is a widely used exploration method used 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 by a vessel. This activity is a marine seismic survey and includes the towing of a sound source and towing of multiple streamers along sail lines during day and night.

2.3.1.1. Streamers and Sail Lines

The vessel will tow streamers back and forth through the Acquisition Area along a series of sail lines. The streamers will contain the sound sensors that detect pressure and velocity of sound levels reflected from the geophysical structures being targeted. Details relevant to environmental management about the streamers and sail lines are provided in Table 2-3.

Table 2-3: Environmentally relevant details of the streamers and sail lines

Parameter	Details	Environmentally relevant information
Streamers & Sail lines		
Maximum number of streamers	18	Using more streamers lessens the acquisition time. Highest number of streamers will be used that meet geophysical objectives of the survey and vessel recording capability.
Maximum length	6,100 m	
Maximum depth below sea surface	25 m	
Maximum streamer horizontal separation	100 m	Separation distance will be maximised whilst meeting survey objectives and vessel capability to lower the acquisition time.
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 race track survey design	42	Number of sail lines will be minimised to reduce acquisition time.
Sail line orientation	North to south	Decreases acquisition time and decreases sound levels received at King Island due to increased sound profile forward and aft of the sound source.
Minimum line separations	500 m	Line turns will occur outside the acquisition area and within the Operational Area.

The survey is planned to be carried out in two sections; a western and an eastern section. The western section is approximately 55% of the overall survey. 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.

2.3.1.2. Sound Source

The survey vessel will acquire the seismic data by towing two acoustic source arrays with three sources per array operating alternatively, one array discharging as the other recompresses. Details relevant to environmental management about the sound source are provided in Table 2-4. These details provide the limits upon which predictions of sound attenuation in the marine environment have been made. Sound attenuation was modelled by an independent consultant and their full report is included in the appendices.

Table 2-4: Environmentally relevant details of the sound source

Parameter	Details	Environmentally relevant information
Sound source		
Number of source arrays	Two sub-arrays	
Maximum tow depth	6 m	
Frequency range	0 to 200 Hz	

Parameter	Details	Environmentally relevant information
Low-power mode	50 cui	Used during line turns and in excise areas to minimise impacts.
Maximum total volume	3,480 cui	Minimised to achieve survey objectives.
Maximum operating pressure	2,000 psi	Minimised to achieve survey objectives.
Shot point interval	18.75 m	Maximised to achieve survey objectives.
Towing speed	4 knots (7.4 km/hr)	

2.3.2. Support Activities

These activities are movements of aircraft and vessels. The support activities include:

- Seismic vessel approaches, line turns, run-ins, and run-outs of the sound source.
- Support vessel operations for safety, resupply, staff transfers, and maritime observations.

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

2.3.2.1. 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. Environmentally relevant details of the vessel are included in Table 2-5.

Table 2-5: Environmentally relevant details of the vessel

Parameter	Survey Vessel	Environmentally relevant information
Vessel length	90 to 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, RO brine, 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.
Diesel fuel tank size	1,200 m3 (with worst case oil spill volume 343m3)	Results in a worse-case credible oil spill risk.
DP	Yes	Inform expected level and sound source of continuous sound
Propulsion and power	Main engines, generators and bow thrusters	Results in discharges of cooling water and bilge water.
Vessel lighting	For safe navigation	Mandatory indication of the 'restricted ability to manoeuvre.'
	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 seismic survey vessel to provide logistical, safety and equipment management duties. At least one vessel will be rigged and capable of towing the seismic survey vessel in the case of an emergency. The vessels will also mobilise to and from the mainland to undertake re-supply, refuelling and other support functions for the activity. The support or escort 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 vessel/s transit between the Operational Area once every 2 weeks.

The seismic survey vessel will have a small on-board workboat, which may be launched from the seismic survey vessel to assist with equipment deployment and retrieval, or to carry out streamer maintenance activities. The seismic survey vessel will also have a fast rescue craft (FRC) on-board.

2.3.2.2. 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 will occur once every 3-4 weeks.

2.3.3. Design Envelope

The design envelope is the broadest timeframe within which all activities can occur. Preparation for the activity can occur anytime from the 00:01 on the 1st of August 2021. The activity commences when the vessel enters the Operational Area and acquisition commences. Acquisition is expected to commence between 00:01 on the 10th of August 2021 and the 15th of August 2021 and will not continue beyond 23:59 on the 31st of October 2021. This is a period of 82 days. All activities may occur at any time, day and night, during this period (subject to complying with other requirements in the EP).

2.3.4. Operating Envelope

The operating envelope is the narrowest timeframe within which the activities can occur. There will be no more than 38 full days of acquisition at full power within the Acquisition Area. There will be a maximum of 5,000 km of sail lines where the sound source is operating at full power. Acquisition days may occur back-to-back but are more likely acquired separately at unspecified intervals due to time for equipment deployment, weather delays, fauna instigated shutdowns, contractor downtime, line turns, and equipment retrieval.

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

2.4.1. Environmental aspects arising from the activity

Environmental aspects are elements of the activities that can interact with the environment. They arise from events that are planned and unplanned. Planned events lead to environmental aspects which cause environmental impacts. Unplanned events lead to environmental aspects which introduce environmental risks.

The Activity-Aspect Tool section in Appendix A categorises the environmental aspects that have been identified for this activity in a workshop attended by a multi-disciplinary team of company representatives and contracted experts.

2.4.2. Survey Design

The survey has been designed to ensure the least amount of time is spent acquiring data. This keeps costs lower and ensures environmental impacts and risks are kept to a minimum. Increasing visits would result in a doubling of ancillary activities. Associated environmental impacts and risks, including stakeholder interference, would be doubled. Therefore, the survey has been designed to determine gas prospectively in the title (T/49P) in one visit, rather than two or more separate visits.

2.4.3. Timing of activities related to environmental values and sensitivities

The Temporal Presence and Absence section in Appendix A shows the key ecological processes and species presence in the southern Otway region throughout the year including the:

- Closure of the Victorian Southern Rock Lobster (SRL) and giant crab fishery;
- Closure of the Tasmanian SRL fishery;
- Low catch season for the Tasmanian Giant Crab fishery;
- Low likelihood of presence for of the Pygmy Blue Whale, Southern Right Whale and/or Humpback Whales in the Operational Area.

The timing of the survey has been selected to minimise the overall impact and risk arising from the activity. This included consideration of trade-offs between different environmental receptors and their values and sensitivities (i.e. critical life-stages) and the effectiveness of management measures that can be adopted to reduce environmental impacts and risks. Reasons supporting the selection of the activity timing can be found in the appendices.

2.4.4. Additional surveys relevant to consideration of cumulative impacts

Cumulative impacts to receptors may occur from the Sequoia MSS and other seismic surveys in the region that have recently been completed or may be completed concurrently or after the Sequoia MSS period. This assessment is completed as part of establishing the context of the activity.

Appendix A Cumulative Impact Assessment details the seismic surveys within the Otway and Gippsland areas on the NOPSEMA website that have been recently been completed or planned to be undertaken. No concurrent surveys were identified.

The Otway and Gippsland location were used to identify seismic surveys that may have an impact on receptors that have a broad distribution.

It is highly likely that the Beach Energy Prion 3D MSS will be conducted after the Sequoia MSS using the same seismic survey vessel. As this would be the worst-case scenario, in terms of receptor recovery, this timing is used to identify cumulative impact to receptors in Appendix A Cumulative Impact Assessment. The timing in considers an estimated minimum 10-day period between surveys to allow for equipment recovery, movement, and deployment.

As a result of the cumulative impact assessment the following measures are adopted by ConocoPhillips Australia to ensure that impacts remain of an acceptable level:

- No survey in same location in repetitive years.
- No surveys with overlapping area of impact.
- SRW monitoring program and adaptive management to ensure cow-calf pairs migrate unimpeded.

2.4.5. Measures adopted because of the consultations

In response to information obtained through consultations in preparation of the EP and through public comment ConocoPhillips Australia has adapted the description of the activity in the following ways.

2.4.5.1. Excise of some key natural values in the Zeehan Marine Park

Following consultation with the Director of National Parks rock lobsters have been identified as a key natural value of the Zeehan Marine Park. Coordinates of areas thought to be of increased value have been provided and are shown in Figure 4-6. There are six areas. The largest and most eastern area partially overlaps the Sequoia MSS. This area will be excised from the acquisition area, plus a 750 m buffer on the western edge of the polygon. There will be no full power acquisition in the excise area. The sound source will remain at low-power across the excise area except for soft-start procedures.

The remaining five areas shown in Figure 4-6 are overlapped entirely by the Sequoia MSS. The characteristics and significance of these 5 areas has not been validated. They cannot be excised partly due to operational complexity because of their size, and predominantly due to untenable compromises to survey objectives. Alternative measures have been agreed with the Director of National Parks to further the understanding of the key natural values of the Zeehan Marine Park. These measures are addressed at the appropriate points in the EP.

2.4.5.2. Excise of Giant Crab Habitat

ConocoPhillips Australia has determined that an excise area over the giant crab habitat is possible despite it compromising survey objectives. The excise area which extends over the reported fishing depths (140m - 300m), plus a distance buffer, and extends to the south western limit of the acquisition area to ensure there are no effects on giant crab.

Elimination of the seismic source over the excised area would result in ‘hard-starts’ of the sound source once the vessel has traversed the excise area. This increases sound impacts to marine mammals and would be inconsistent with best practice. Therefore, the seismic source will be operated at low-power over this area except for soft-start procedures to reduce the sound discharged in the excise area whilst also applying best-practice.

2.4.5.3. Measures inherent to the activity that manage environmental impacts and risks

Table 2-6 identifies several features of the equipment used during the activity that contribute to the environmental management of the activity.

Table 2-6: Features of Equipment used during the activity

Item of Equipment	Details	Environmentally relevant information
Streamers	Tail buoys	Historically turtles have been recorded as being trapped in the streamer tail buoys. Tail buoys are now of a design that eliminates entrapment risk to turtles or turtle guards are used as standard equipment if the tail buoy is not of the newer design. Thus, there is no cause effect pathway for entrapment of turtles in streamer buoys.
Streamers	Tail buoys	The tail buoys on the seismic streamers will have flashing lights and radar reflectors so they are visible to other marine users.

3. Stakeholder Consultation

3.1. Stakeholder Engagement

3.1.1. Summary

In the course of preparing the Environment Plan (EP), ConocoPhillips Australia is required to consult with the persons specified in the OPGGS(E) 2009 Regulations.

ConocoPhillips Australia has developed and followed a 'Stakeholder Engagement Process for Regulatory Approvals' to assist in consistently engaging with Relevant Persons across its approvals. This provides a strategic and systematic approach to Relevant Person consultation aiming to foster an environment where ongoing, open dialogue and two-way communication is undertaken to build positive relationships. This approach is in line with the International Association for Public Participation (IAP2) spectrum. The process followed is summarised in Figure 3-1.

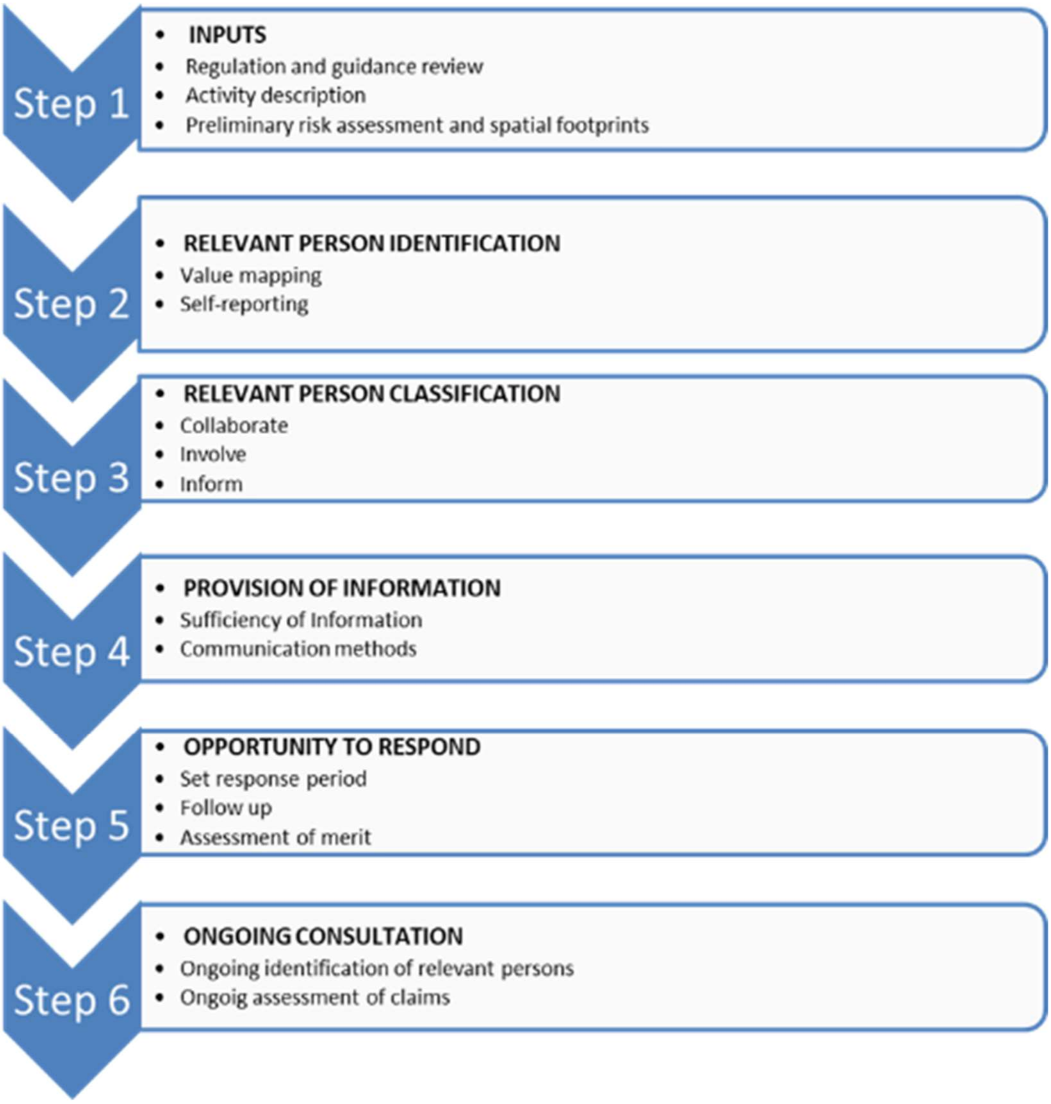


Figure 3-1: Summary of the ConocoPhillips Relevant Person Engagement Process

3.1.2. Fulfilment of Regulatory Requirements

The *Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009* stipulate a number of requirements in relation to consultation associated with an EP (Table 3-1).

ConocoPhillips Australia also undertook a review of consultation guidance provided by relevant government agencies and industry bodies to ensure effective consultation; this is listed in Table 3-2.

Table 3-1: Regulatory Requirements

Regulation	Description	Fulfilment
11A(1)	In the course of preparing an environment plan, or a revision of an environment plan, a titleholder must consult each of the following (a relevant person): (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, being limited to the conduct of the activity that is authorised under the environment plan and not extending to a hypothetical, remote or speculative consequence from an activity such as a major oil spill; (e) any other person or organisation that the titleholder considers relevant.	Section 3 of the EP outlines the process (as per ConocoPhillips Australia Stakeholder Engagement Process for Regulatory Approvals) that was used to identify relevant persons in each of the five groups required under the regulations. A list of the relevant persons can be found in Table 3-4. Records of engagement with each of the relevant persons identified is provided in the Sensitive Information Report (not published for privacy reasons).
11A(2)	For the purpose of the consultation, the titleholder must give each relevant person sufficient information to allow the relevant person to make an informed assessment of the possible consequences of the activity on the functions, interests or activities of the relevant person.	For key stakeholders (particularly government agencies and industry groups) email and phone discussions between staff were undertaken on specific issues. In addition to this all stakeholders were provided with targeted information fact sheets and follow-up information as required (Appendix C).
11A(3)	The titleholder must allow a relevant person a reasonable period for consultation.	To every extent possible, ConocoPhillips Australia has allowed 30 days for relevant persons to review and respond to new information regarding the proposed activity.
14(9)	The implementation strategy of the environment plan must provide for appropriate consultation with: (a) Relevant authorities of the Commonwealth, a State or Territory; and (b) Other relevant interested persons or organisations.	The implementation section (Section 6) includes notification and ongoing consultation triggers.
16(b)	A report on all consultations between the titleholder and any relevant person, for regulation 11A, that contains:	a) A log of all engagement undertaken with relevant persons is provided in Appendix C (not published for privacy reasons).

Regulation	Description	Fulfilment
	(a) A summary of each response made by a relevant person; (b) An assessment of the merits of any objections or claim about the adverse impact of each activity to which the environment plan relates; (c) A statement of the titleholder's response, or proposed response, if any, to each objection or claim; and (d) A copy of the full text of any response by a relevant person.	b) An assessment of merits including ConocoPhillips Australia's response to all claims is provided in Table 3-7. c) Full text of correspondence can be found in Appendix D (not published for privacy reasons).
27	Storage of records: • Records must be stored in a way that makes retrieval reasonably practicable; • Records must be kept for five years; and • Records generated through preparation of the environment plan, demonstrating environmental performance, incidents, emissions and discharges, calibration and maintenance, and in relation to the implementation strategy arrangements must be kept.	The ConocoPhillips Australia Stakeholder Engagement Process stipulates internal requirements for the storage of records.

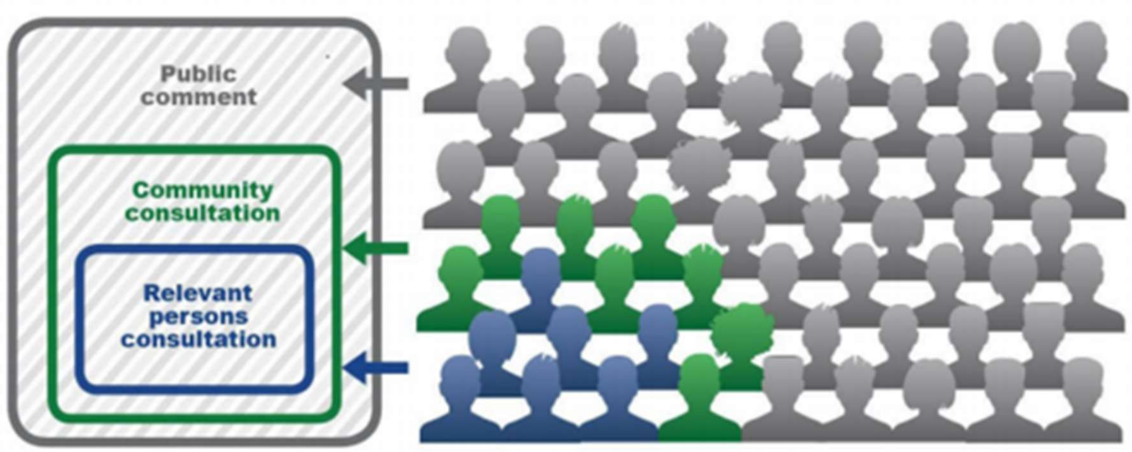
Table 3-2: Consultation Guidance for Sequoia MSS

Agency	Guidance	Requirements	Fulfilment
COMMONWEALTH			
NOPSEMA	Clarifying statutory requirements and good practice consultation (nopsema.gov.au)	This Bulletin describes NOPSEMA's regulatory interpretation of relevant persons, provides clarification on definitions and advice on public comment, community engagement and relevant persons consultation.	ConocoPhillips Australia has used the descriptions of relevant persons to categorise stakeholders and also provided information within this section.
	Consultation with agencies with responsibilities in the Commonwealth marine area (nopsema.gov.au)	This Guideline provides insight into determining which agencies may be considered relevant for the purposes of statutory consultation.	ConocoPhillips Australia has considered the identified agencies per the guide as part of relevant person identification.
AMSA	Offshore Petroleum Industry Advisory Notice	To assist offshore petroleum industry titleholders, address their oil spill preparedness and response requirements.	ConocoPhillips Australia has used this guidance to guide the development of the OPEP.
Parks Australia - Director of National Parks (DNP)	Petroleum activities and Australian marine parks (nopsema.gov.au)	This guidance document outlines process for engaging with the DNP throughout all stages of petroleum activity. For the preparation of a MSS EP this includes considerations prior to consultation, timing of consultation, what constitutes sufficient information, and expectations of ongoing consultation.	ConocoPhillips Australia has ensured that the consultation with DNP and the information included in the EP is in accordance with this guidance.
STATE			
VFA	Undertaking seismic surveys in Victorian Managed Waters – Policy for Victorian Fisheries	Guidelines provide the expectations of the VFA when undertaking consultation including ecological, economic and social impacts considering the sustainability of the location, suitability of timing of surveys, historic catch prior to MSS, suitable mitigation measures to protect against detrimental impacts and up-to-	ConocoPhillips Australia obtained catch and effort data. ConocoPhillips Australia worked with the Seafood Industry of Victoria under their Mining, Gas and Petroleum Consultation Policy to ensure Victorian fishers received sufficient information of the

Agency	Guidance	Requirements	Fulfilment
		date scientific advice on impact of seismic surveys to relevant species.	proposed activity, including proposed control measures.
EPA Tasmania	EPA Tasmania – Offshore Petroleum Industry Guidance Note	Guidelines provide details for incident management for petroleum activities undertaken in Commonwealth waters which may impact Tasmanian waters. Relevant information provision requirements to consult on oil spill arrangements are provided	ConocoPhillips Australia provided marine diesel spill information to EPA Tasmania.
INDUSTRY			
SIV/ TSIC	Mining, Gas and Petroleum Consultation Policy	Consultation process set out to address and where possible mitigate environmental and access issues.	ConocoPhillips Australia agreed that SIV and TSIC would engage and disseminate Sequoia 3D MSS information to sub-industry groups and members and to obtain their feedback in an effort to reduce consultation fatigue. This arrangement was fee for service.

3.2. Relevant Person Identification

Central to ConocoPhillips's business is maintaining a positive and constructive relationships with a comprehensive group of stakeholders in the community, government, non-government, other business sectors and other users of the marine environment. ConocoPhillips Australia has targeted its EP engagement to those defined as a relevant person under the NOPSEMA guidance (Clarifying Statutory Requirements and Good Practice Consultation (A696998)) and ensured that it is clear that this is distinct from the NOPSEMA-led public comment process (Figure 3-2). In addition to the legislated engagement, ConocoPhillips Australia has undertaken more general engagement with those who ConocoPhillips Australia deems necessary to keep up to date with the activities in the Otway Basin, such as King Island residents. Distinct from this, the EP has also been through the NOPSEMA 30-day public comment period over December 2020/Jan 2021.



Source: NOPSEMA

Figure 3-2: Targeting of EP consultation process to relevant persons

ConocoPhillips Australia used standardised identification methods (in accordance with its Stakeholder Engagement Process for Regulatory Approvals ABUE-000-CE-N05-C-00005) to compile a list of relevant persons across these categories.

To identify relevant persons, ConocoPhillips Australia utilised the largest spatial extent whereby persons may be affected by the planned operational activities (either the Operational Area or the Sound EMBA).

For each of the five groups of relevant persons identified in Regulation 11A (1) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, four pathways were used to identify contacts:

1) **Beneficial Use/Value Mapping:** This process involved listing the potential receptors (with a focus on socio-economic receptors) that may be affected by the proposed activity, then determining relevant persons that may have functions, interests or activities. This process is captured in Appendix C, Table 1.3.
2) **Regulatory Review**: This process involved undertaking a review of Ministers of regulatory portfolios of relevance and for region.
3) **Benchmarking:** This process involved identifying persons through benchmarking with other similar in-house or external projects, including cross referencing the stakeholder identification process for this EP with a review of the consultation undertaken as part of the Dorrigo 3D MSS EP preparation.
4) **Self-reporting:** This process made available and encouraged opportunities for self-reporting, including the provision of contact details on ConocoPhillips Australia's website and information sheets and holding community drop-in sessions on King Island. Stakeholders who submitted as part of the NOPSEMA public comment period were also assessed to determine if they should be considered a relevant person (Appendix C).

Relevant persons identified for the Sequoia MSS activity, categorised according to the OPGGS(E)R Regulation 11A, are listed and assessed in Table 3-4. A detailed description of the assessment underpinning this process can be found in (Appendix C).

In undertaking an assessment of the relevant persons, and to inform what constitutes sufficient information under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009, each relevant person was classified according to the categories in Table 3-3 based on the combination of potential for impact and the level of interest of the person or group. A summary table of all relevant stakeholders and their classification is found in Table 3-4.

Table 3-3: Classification and Associated Levels of Engagement

		Goal	Strategies
	**Category 1:** **Regulatory agencies who have legislated requirements or decision making powers**	**Consult** Aim is to work directly with relevant persons to ensure their concerns and needs are understood and considered.	**Targeted consultation material specific to relevant persons, legislation, regulations or guidance.** **Follow up to ensure receipt and seek feedback**
	**Category 2:** **Relevant persons with response actions** **Or** **Relevant persons with high interest**	**Involve** Aim is to ensure information on the project is conveyed and to obtain feedback on alternatives or outcomes where possible with follow-up to ensure any required actions are undertaken.	**Targeted consultation material specific to relevant persons.** **Follow up to ensure receipt and seek feedback**

	**Category 3:** **Relevant persons with low interest** **Or** **Any other person identified with ongoing interest**	**Inform** The level of engagement is primarily aimed at conveying information, rather than seeking input.	**Generic consultation material meeting the minimum requirements** **No follow up to ensure receipt or seek feedback**

ConocoPhillips Australia identified that commercial fishing operators and fisheries would form a significant component of consultation for EP development. As such, further detail on the assessment and engagement with fishers is covered in Appendix C.

Stakeholders that were not identified as relevant persons were engaged with as part of a broader community engagement process.

Table 3-4: Assessment of Relevance of Identified Stakeholders

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement	Relevant Person Category
Commonwealth government departments/ agencies			
Australian Hydrographic Office (AHO)	Considered relevant persons under Regulation 11A(1) (a)	AHO is the part of the DoD responsible for publication and distribution of nautical charts, including Notice to Mariners. The Operational Area is in commonwealth waters.	2
Australian Fishers Management Authority (AFMA)	Considered relevant persons under Regulation 11A(1) (a)	AFMA is responsible for the management of Commonwealth fisheries. The Operational Area is in commonwealth waters. AFMA guidance is to engage through representative bodies and individual licence holders but will still keep them informed.	3
Australian Maritime Safety Authority (AMSA)	Considered relevant persons under Regulation 11A(1) (a)	AMSA is the statutory and control authority for maritime safety and vessel emergencies in Commonwealth Waters. The Operational Area is in commonwealth waters.	1
Department of Defense (DoD)	Considered relevant persons under Regulation 11A(1) (a)	There are 4 sites located close to the survey area with a likelihood of UXO within them, and ADF activities occur within the region.	2
Department of Agriculture, Water and the Environment – Biosecurity and Compliance	Considered relevant persons under Regulation 11A(1) (a)	DAWE (marine pests) has primary policy and regulatory responsibility for managing biosecurity for incoming goods and vessels, including biosecurity for marine pests. The Department is a relevant agency when an offshore activity has the potential to transfer marine pests. The Operational Area is in Commonwealth waters.	1
Department of Agriculture, Water and the Environment – Fisheries, Forestry and Engagement (Fisheries)	Considered relevant persons under Regulation 11A(1) (a)	The activity has the potential to impact fishing operations and/or fishing habitats in Commonwealth waters.	1
Director of National Parks (DNP)	Considered relevant persons under Regulation 11A(1) (a)	The DNP is the statutory authority responsible for administering, managing and controlling Commonwealth marine reserves (CMRs). The Operation Area is in a section of an Australian Marine Park and is adjacent to another.	1
State Government Agencies – Tasmania			
Department of Primary Industries, Parks, Water and Environment (DPIPWE) – Marine Resources (Wild	Considered relevant persons under Regulation 11A(1) (b)	Coordinates Tasmanian wild fisheries legislation, management plans, rules, regulations and ministerial guidelines and Fisheries Advisory Committees	1

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement	Relevant Person Category
Fisheries Management Branch)			
Department of Primary Industries, Parks, Water and Environment (DPIPWE) – Tasmania Parks and Wildlife Service (PWS) – King Island Office	Considered relevant persons under Regulation 11A(1) (b)	Local office of DPIPWE closest to proposed activity site.	3
Environment Protection Authority (EPA) Tasmania	Considered relevant persons under Regulation 11A(1) (b)	EPA is supported by staff of EPA Tasmania, a Division of the Department of Primary Industries, Parks, Water and Environment (DPIPWE). No legislated role but included at request of DPIPWE.	3
Mineral Resources Tasmania (MRT)	Considered relevant persons under Regulation 11A(1) (b)	Responsible for the regulation of mineral and petroleum exploration in Tasmania, including offshore waters administered by the State, and the promotion of vacant areas available for onshore and offshore exploration.	2
State Government Agencies – Victoria			
Department of Environment, Land, Water and Planning (DELWP)	Considered relevant persons under Regulation 11A(1) (b)	Administers the *Marine and Coastal Act 2018* which manages planning and management of the marine and coastal environment in Victorian waters.	2
Victorian Fishing Authority (VFA)	Considered relevant persons under Regulation 11A(1) (b)	The Victorian Fisheries Authority (VFA) is an independent statutory authority established to effectively manage Victoria's fisheries resources.	1
Department of Jobs, Precincts and Regions (DJPR) – Marine Pollution	Considered relevant persons under Regulation 11A(1) (b)	Victoria's lead agency for response to incidents including biosecurity incursions.	2
State Government Agencies – New South Wales			
Port Authority of NSW	Considered relevant persons under Regulation 11A(1) (c)	Port Authority of NSW acts as the harbor master for NSW's six commercial seaports. It manages shipping movements, safety security and emergency response. Port Authority NSW is relevant as they are the lead state agency for an oil spill and the MDO EMBA identifies potential impact.	3
Transport NSW	Considered relevant persons under Regulation 11A(1) (c)	Transport NSW is the lead agency for transport and road in NSW.	3
Commonwealth fisheries			
Commonwealth Fisheries Association	Considered relevant persons under Regulation 11A(1) (d)	Peak representative group for Commonwealth fisheries. The Operational Area is in commonwealth waters. CFA advice was to engage through state representative bodies but will still keep them informed.	3
South East Trawl Fishing Industry Association (SETFIA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for south east trawl fishery including quota owners, fishermen and sellers.	1
Tuna Australia – Eastern Tuna and Billfish Fisheries Industry Association (EBTA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Tuna fishery	1
Australian Southern Bluefin Tuna Industry Alliance (ASBTIA)	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Bluefin Tuna fishery (upwelling of interest to the fishery in vicinity of operations area).	1

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement	Relevant Person Category
Sustainable Shark Fishing Inc.	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Shark fishery.	1
Southern Shark industry Alliance	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Shark fishery.	1
Bass Strait Scallop Industry Association	Considered relevant persons under Regulation 11A(1) (d)	Representative body for Commonwealth Scallop fishery.	1
Lakes Entrance Fisherman's CoOp	Considered relevant persons under Regulation 11A(1) (d)	Fishing cooperative supporting south east trawl fishery.	1
• Southern and Eastern Scalefish and Shark Fishery (SESSF) - Shark Gillnet and Shark Hook individual licence holders • Southern and Eastern Scalefish and Shark Fishery (SESSF) -Commonwealth • Trawl Sector (CTS) individual licence holders Southern and Eastern Scalefish and Shark Fishery (SESSF) - Scalefish Hook Sector (CGS/CSHS) individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Consulted through • SETFIA • Sustainable Shark Fishing Inc • Southern Shark Industry Alliance Inc	1
Australian Southern Rock Lobster Limited	Considered relevant persons under Regulation 11A(1) (d)	Serves as the peak nation body to further the interests of the Australian Southern Rock Lobster Industry	1
Southern Bluefin Tuna (SBTF) individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Consulted through ASBTIA.	1
Tasmanian fisheries			
Tasmanian Seafood Industry Council (TSIC)	Considered relevant persons under Regulation 11A(1) (d)	Primary representative body for Tasmanian fisheries.	1
Tasmanian Association for Recreational fishing (TARFish)	Considered relevant persons under Regulation 11A(1) (d)	Under TSIC engagement policy was consulted through TSIC.	1
Tasmanian Abalone Council Limited	Considered relevant persons under Regulation 11A(1) (d)	Under TSIC engagement policy was consulted through TSIC.	1
Tasmanian Rock Lobster Fisherman's Association	Considered relevant persons under Regulation 11A(1) (d)	Provided feedback distinct to TSIC and was engaged with in conjunction with TSIC.	1
Tasmanian Scallop Fisherman's Association	Considered relevant persons under Regulation 11A(1) (d)	Under TSIC engagement policy was consulted through TSIC.	1
Giant Crab Fishery individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under TSIC engagement policy was consulted through TSIC.	1
Commercial dive fishery individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under TSIC engagement policy was consulted through TSIC.	1
Victorian fisheries			

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement	Relevant Person Category
Seafood Industry Victoria (SIV)	Considered relevant persons under Regulation 11A(1) (d)	Primary representative body for Victorian fisheries.	1
Victorian Rock Lobster Fishing Association (VRLA)	Considered relevant persons under Regulation 11A(1) (d)	Provided feedback distinct to SIV and was engaged with in conjunction with SIV.	1
Southern Rock Lobster individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under SIV engagement policy was consulted through SIV.	1
Bass Straight Scallop Fishery (Victorian Zone) individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under SIV engagement policy was consulted through SIV.	1
Giant Crab (Western Zone) individual licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under SIV engagement policy was consulted through SIV.	1
Ocean Access (or Ocean General) Fishery licence holders	Considered relevant persons under Regulation 11A(1) (d)	Under SIV engagement policy was consulted through SIV.	1
Warrnambool Professional Fishermen's Association	Considered relevant persons under Regulation 11A(1) (d)	Major fishing port and cooperative for fishers utilizing the operational area and surrounds.	1
Port Campbell professional Fisherman's Association	Considered relevant persons under Regulation 11A(1) (d)	Major fishing port and cooperative for fishers utilizing the operational area and surrounds.	1
Apollo Bay Fishing Cooperative	Considered relevant persons under Regulation 11A(1) (d)	Major fishing port and cooperative for fishers utilizing the operational area and surrounds.	1
VRFish	Considered relevant persons under Regulation 11A(1) (d)	VRfish is the peak body representing recreational fishing in Victoria. Low likelihood of recreational fishing from Victoria base in the area but included for comprehensiveness.	2
Titleholders			
Beach Energy	Considered relevant persons under Regulation 11A(1) (d)	Titleholder of several exploration permits, production licences and retention leases to the east and northwest.	3
TGS (formerly Spectrum Geo)	Considered relevant persons under Regulation 11A(1) (d)	Seismic survey service provider with an approved EP in nearby waters.	3
Local Government			
Colac Otway Shire	Considered relevant persons under Regulation 11A(1) (e)	Victorian local government authority (LGA) council adjacent to the MSS. Contains fishing ports.	3
Corangamite Shire Council	Considered relevant persons under Regulation 11A(1) (d)	Victorian shire council near the survey area. Contains fishing ports.	3
King Island Shire Council	Considered relevant persons under Regulation 11A(1) (d)	Tasmanian shire council in closest proximity to the survey area.	2
Conservation and Research			
Blue Whale Study	Considered relevant persons under Regulation 11A(1) (d)	Organisation concerned with conservation and research outcomes for blue whales.	2
Deakin University – School of Life and Environmental Sciences	Considered relevant persons under Regulation 11A(1) (d)	Marine conservation research.	2
University of Tasmania (UTAS) - Institute for Marine and Antarctic Studies (IMAS)	Considered relevant persons under Regulation 11A(1) (d)	Cooperative teaching and research institute between various marine and Antarctic agencies who may have activity research in the area	2

Stakeholder	Relevant to Activity	Relevance/ Reason for Engagement	Relevant Person Category
Recreation			
Ocean Racing Club of Victoria (ORCV)	Considered relevant persons under Regulation 11A(1) (d)	Conducts ocean/offshore and bay yacht races and events in Victoria.	3
Others			
Indigo Communications Cable (SULO)	Considered relevant persons under Regulation 11A(1) (d)	Operator of the ‘superloop’ subsea telecommunications cable.	3
King Island Chamber of Commerce (KICC)	Considered relevant persons under Regulation 11A(1) (d)	Association supporting business on King Island.	2
King Island Shire Council – Brand Management	Considered relevant persons under Regulation 11A(1) (d)	Committee of King Island Council tasked with protecting and promoting the King Island brand.	2
Colac and District Chamber of Commerce	Considered relevant persons under Regulation 11A(1) (d)	Association supporting businesses in Colac and surrounds due to base for some fishing operations.	3
Tourism Industry Council of Tasmania	Considered relevant persons under Regulation 11A(1) (d)	Peak body representing Tasmania's tourism industry.	3
Charter Operators			
Apollo Bay Fishing Charters	Considered relevant persons under Regulation 11A(1) (d)	Tourism operator with activity in the operational area	1
King Island Recreational Divers	Considered relevant persons under Regulation 11A(1) (d)	An informal group of divers on King Island	1
King Island Boat Club	Considered relevant persons under Regulation 11A(1) (d)	Recreational boating and fishing club with activity in the operational area	1

3.3. Engagement

The engagement process adopted by ConocoPhillips Australia is in line with the International Association for Public Participation (IAP2) spectrum, which is considered best practice for stakeholder engagement. In order of increasing level of public impact, the elements of the spectrum and their goals are:

- Inform – to provide the public with balanced and objective information to assist them in understanding the problems, alternatives and/or solutions.
- Consult – to obtain public feedback on analysis, alternatives and/or decisions.
- Involve – to work directly with stakeholders throughout the process to ensure that public concerns and aspirations are consistently understood and considered.
- Collaborate – to partner with the public in each aspect of the decisions, including the development of alternatives and the identification of the preferred solution.
- Empower – to place final decision-making in the hands of the stakeholders.

The inform, consult and involve elements are of key relevance to the Sequoia MSS and have been implemented as part of relevant persons consultation. The collaborate element has been implemented where conflicts or issues between ConocoPhillips Australia and relevant persons have required resolution. Under the regulatory regime for the approval of EPs, the decision maker is the regulator. This being the case, the empower element has not been adopted.

COVID-19 restrictions placed significant constraints on the ability for ConocoPhillips Australia to implement a best-practice engagement process with relevant persons, primarily by preventing face-to-face visits which would otherwise have been undertaken. ConocoPhillips Australia adopted different approaches to remove this as a barrier, including:

- Increased use of video-conference platforms for meetings;
- Increased time allowance for response recognising increased business pressure on some relevant persons; and
- Utilising windows in COVID restrictions to set up face-to-face community engagement where possible (including King Island visit).

ConocoPhillips Australia took an 80 percent interest in and become the operator of Exploration Permit T/49P from 3D Oil T49P Pty Ltd. 3D Oil T49P had previously undertaken consultation with relevant persons for a similarly scoped 3D Oil Dorrigo Marine Seismic Survey activity approved by NOPSEMA in May 2019. ConocoPhillips Australia reviewed and built on this previous work but has independently re-engaged with relevant persons.

The OPEP includes ConocoPhillips Australia's emergency response plans. Pursuant to the environment regulations, state and federal government departments and agencies have been, and will continue to be, consulted on response preparedness for an uncontrolled discharge of oil from vessels or the well. All consultation associated with a spill response is outlined in the OPEP.

3.3.1. Sufficiency of Information

ConocoPhillips is committed to ensuring adequate and open information with relevant persons and its investors. Table 2-1 provides a summary of the information provided to stakeholders.

Table 3-5: Summary of information provided to stakeholders

Form of Information Provided	Summary of Information Provided
Letters	Formal letters were used to communicate with relevant persons throughout engagement. Appendix C contains all letters sent to relevant persons as part of this process.
Fact sheets	Eight fact sheets used to support this EP were developed with sub-regulation 11A(2) and associated guidance in mind to ensure it adequately described the activity – including the risks associated with the activities. Copies of all information sheets provided can be found in Appendix C. The fact sheets were issued to relevant persons and made available for stakeholders. • Project Summary fact sheet (ABU2-000-EX-R01-D-00001) and personalised letter of introduction – issued to all relevant persons between 7 and 17 August 2020. This fact sheet provided a high-level overview of ConocoPhillips Australia's intention to undertake the Sequoia 3DMSS and outlined the proposed survey design, location and timing. It also included some question and answers and contact details that stakeholders could use to provide feedback. This fact sheet was also posted on the ConocoPhillips Australia's website • Proposed Survey Area Summary fact sheet (ABU2-000-EX-R01-D-00002) – issued to peak fishing industry associations and identified Commonwealth fishers on 17 September 2020. This fact sheet provided geographic coordinates of the proposed Sequoia 3DMSS operational area and seismic acquisition area. A simplified version of this fact sheet was posted on the ConocoPhillips Australia website. • How we will undertake a 3D seismic survey fact sheet (ABU2-000-EX-R01-D-00003) – issued to peak fishing industry associations and identified Commonwealth fishers between 15 and 17 September 2020. This fact sheet provided information on MSS and ConocoPhillips Australia's proprietary CSI technology. This fact sheet was also posted on the ConocoPhillips Australia website. • Vessel-based MDO spill modelling and controls fact sheet (ABU2-000-EX-R01-D-00004) – issued to various stakeholders between 23 and 27 October 2020. This fact sheet presented the results of the

Form of Information Provided	Summary of Information Provided
	vessel MDO modelling undertaken and identified controls to support the survey. This fact sheet was also posted on the ConocoPhillips Australia website. • Underwater sound modelling and controls fact sheet (ABU2-000-EX-R01-D-00005) – issued to various stakeholders on 27 October 2020. This fact sheet presented the results of the underwater sound modelling undertaken and identified controls to support the survey. This fact sheet was also posted on the ConocoPhillips Australia website. • Project Update (ABU2-000-EX-RO1-D-00006) – issued to various stakeholders on 27 October 2020. This fact sheet presented changes made to the acquisition area reducing impact on fishing grids and complete avoidance of the Apollo Marine Park. This fact sheet was also posted on the ConocoPhillips Australia website. • Proposed Survey Area Summary (ABU2-000-EX-RO1-D-00007) – updated map of proposed acquisition area posted to the ConocoPhillips Australia website. Removed on 9 February 2021 when acquisition area changed (see below). • Project Update (ABU2-000-EX-R01-D-00008) – issued to various stakeholders on 9 February 2021. This fact sheet presented changes made to the acquisition area excising the giant crab habitat from the south west acquisition area. This fact sheet was also posted on the ConocoPhillips Australia website. • Fisheries Information Sheet (ABU2-000-EX-R01-D-00009) – issued to various commonwealth fisheries stakeholders on 31 May 2021. This fact sheet collated a range of fisheries information presented in the EP. • Project Update (ABU2-000-EX-RO1-D-00010) – issued to all relevant persons on 13/7/2021 • Commercial Fishing Adjustment Protocol – DRAFT – issued to SETFIA, SIV, SSIA and TSIC for review on 8 July 2021. As this document is still in draft it has been included in Appendix D
Online meetings and project briefings	Project briefings were provided to relevant persons. Briefings were facilitated/attended by the project team, technical experts and senior management. The purpose of these briefings was for ConocoPhillips Australia to provide activity information and updates, listen to issues and concerns, gain feedback on the project and to identify further opportunities for engagement. Information was tailored to accommodate the different levels of stakeholder understanding. Appendix D contains all individual responses provided to stakeholders as part of this process, including records of formal project briefings undertaken.
Individual Responses	ConocoPhillips Australia provided written responses to all written enquires received from stakeholders to address their specific concerns throughout the duration of EP development. Appendix D contains all individual responses provided to stakeholders as part of this process.
Email and Telephone	Email and telephone were used to consult with relevant persons as part of the development of the Sequoia MSS. Appendix D contains all individual email records captured as part of relevant person consultation.
ConocoPhillips Australia website	All project updates and factsheets outlined above are also exhibited on ConocoPhillips Australia external website.
Media	A media release was made regarding the purchase, ongoing responses were provided to media enquiries, and media advertisements were used to promote community sessions.
Consultation and fee for service arrangements with peak fishing bodies	A fee for service arrangement was entered into with peak fishing bodies (SIV and TSIC) to undertake engagement with their members on behalf of ConocoPhillips Australia. In line with their consultation guidance this approach was supported by the fishing industry to reduce stakeholder fatigue. A fee for service arrangement with Fishwell Consulting was entered into to compile a Fisheries Data Report. Consultation was undertaken by the same representative on behalf of SETFIA.
King Island visit/community drop in session	Representatives travelled to King Island for community meetings (which had been pre-advertised) to meet with any members of the public that may be interested in the project.

3.3.2. Reasonable Period

ConocoPhillips Australia commenced consultation with relevant persons on 14 July 2020, 212 days before the first submission to NOPSEMA. This process commenced with initial consultation of peak fishing industry associations and was followed by a general notification to all relevant persons identified by the process outlined in Section 3.2. This initial notification occurred between 7 and17 August 2020, 178 and188 days before the first submission to NOPSEMA.

ConocoPhillips Australia provided additional information and remained engaged with relevant persons to help assess all feedback, objection or claims provided or made. A summary of information provided to relevant persons and the period they had to consider that information is provided in (Appendix C).

3.4. Assessment of Relevant Persons Objections and Claims

Prior to engaging with relevant persons, ConocoPhillips Australia reviewed the comments, objections and claims raised through the Dorrigo 3D MSS EP and independently assessed the merit of these to determine whether to adopt the same management controls for Sequoia (Table 3-6). ConocoPhillips Australia was then able to clearly articulate to stakeholders how their previous concerns were being addressed and then work from that starting point with new or unresolved issues.

For all responses received by ConocoPhillips Australia during the Sequoia MSS engagement, the merit of each of these responses was assessed. For minor/administrative changes these are noted in Appendix C Response log. Assessment of merit for all other responses is found in Table 3-7.

The Stakeholder Engagement Process for Regulatory Approvals process helped to guide the assessment of merit process.

Relevant persons were encouraged to provide comment within a 30-day period from receipt of any update or information. Comments provided outside of this time were still considered and incorporated into the approvals process. The criteria used to determine if engagement was sufficient and no more follow up was required included:

- If no response was received following this period from Category 1 stakeholders were followed up via telephone and if no further response was received, then it was considered that no comment was to be provided and it was closed out.
- If a response was received from a category 1 stakeholder, it was assessed for merit and then a response provided to the relevant person.
- If no response was received this was then closed out.

For other categories of relevant persons, direct follow up was undertaken even if no response was received following initial engagement. Criteria to determine if engagement was sufficient included:

- The relevant person acknowledged ConocoPhillips Australia’s response and they were satisfied with the way their concerns had been addressed.
- The relevant person was not satisfied with how the comments were addressed but were made aware of how their views were being reflected to NOPSEMA and how ConocoPhillips Australia was responding to them.

For many relevant persons the engagement will continue prior to, during and after the acquisition activity.

Table 3-6: Management measures adopted due to feedback during Dorrigo engagement and retained by ConocoPhillips Australia

Theme (Feedback/Objections/Claims)	Associated Relevant Persons	Measures adopted because of the consultations See Appendix A – Environmental Performance tab for control measures and performance standards	
		3D Oil	**ConocoPhillips Australia**
Damage to the wider marine environment and resources (fish, plankton, invertebrates from acoustic sound)	DNP, DPIPWE, SIV, TSIC, SETFIA and other fishing industry stakeholders	3D Oil has assessed the impacts to the marine environment, and via current science, impacts to environmental resources are localise, temporary and recoverable. High productivity periods have been avoided to reduce possible impacts to as low as reasonably practicable. For all stakeholders who expressed a concern associated with marine resources relevant assessment, literature has been provided to act as a basis for further discussion on this issue. No feedback has been provided from stakeholders on this information. Of particular importance there has been no concern raised about this theme from the fishing regulators (VFA and DPIPWE). 3D Oil notes that there are some stakeholders opposed to the survey and do not want to engage on discussions around scientific studies however do not want the MSS to proceed at all. 3D Oil has respected their explicit instructions not to be contacted.	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to avoiding high productivity periods. See Appendix A – Environmental Performance section of the Sequoia EP. Excise areas have been adopted as per consultation requests. Where excise could not occur additional measures have also been adopted to further knowledge.
Communications during survey and notification of completion of survey should be immediate and not within 10 days	SETFIA (Stakeholder #12) SSF (Stakeholder #13) (Stakeholder#41) (Stakeholder #42)	3D Oil has modified the 'completion notification to fishermen' so that this occurs immediately rather than within 10 days as a result of this feedback (refer Section 7.8 and Section 8.11 of Dorrigo EP). Fishermen will be advised by SMS (a service to be carried out by SETFIA during the survey) so they know the status of the survey. It has been important during consultation to obtain mobile phone contact numbers so this measure can be effective. The control worked well during the Flanagan MSS in 2014. 3D Oil will also contact TAMAR Radio 4533 to provide daily updates during survey activity as a backup to the SMS provision (refer Section 7.8 of Dorrigo EP).	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to notifications.
Cumulative impacts of multiple surveys	SETFIA (Stakeholder #12) SSF (Stakeholder #13)	3D Oil identified that it is liaising with other titleholders who may undertake seismic at the same time as the Dorrigo MSS. A simultaneous operations protocol will be established to ensure that a buffer of at least 40 km is maintained between surveys. There will be no overlap of MSSs within the T/49P permit area (i.e. no third-party ingress). 3D Oil will monitor the NOPSEMA website for any potential surveys which arise after submission of the EP (refer to Section 7.2 of Dorrigo EP). No response has been provided from this information provided.	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to adopting a buffer around the survey area. .

	(Stakeholder #35)	Liaisons with and future development of a simultaneous operations program if survey activities are occurring at the same time (refer to section 7.2 of Dorrigo EP)	ConocoPhillips Australia adopted the feedback provided to 3D Oil and will continue to liaise with other operations.
Reduction in MSS area over trawl grounds	SETFIA (Stakeholder #12)	3D Oil and SETFIA reviewed the geological targets covered by the survey. Given the presence of a potential large reserve in the southern section of the survey area, if the current survey does not cover the area, a future survey would be probable. SETFIA agreed that one survey was preferable to two surveys in the area.	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to survey area.
Ship refuge during heavy weather needs to consider fishing equipment	SSF (Stakeholder #13)	3D Oil and SSF agreed that within the survey vessel tender the available options during heavy weather are to stand out to sea or to pull in training equipment to prevent damage to fishing equipment in shallower waters (refer Section 7.8 Dorrigo EP)	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to high weather situations.
Adoption of relevant EPBC Policy 2.1 Controls to protect cetaceans	DPIPWE (Resource Conservation) (Stakeholder#17)	3D Oil has adopted all relevant controls from EPBC Policy Statement 2.1 (refer Section 7.2 Dorrigo EP).	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to EPBC policy 2.1. For Southern Right Whales and Blue Whales ConocoPhillips Australia has adopted increased shut-down distances and is implementing a Southern Right Whale monitoring program. See Section 4.5 (Marine Mammals) and Appendix A of the Sequoia EP.
Notification, liaison and support in the event of an oil spill	EPA Tasmania (Stakeholder #18) DNP (Stakeholder #30)	3D Oil has adopted the suggested notification, liaison and support requests from EPA Tasmania (refer Section 7.14 & Appendix 2 & 3 Dorrigo EP)	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to support in the event of a spill.
Significant vessel movement in the northern section of the Dorrigo MSS Area	AMSA (Stakeholder #23)	3D Oil has adopted all the control measures suggested by AMSA to prevent vessel impedance and the potential for oil spills (refer Section 7.8 of Dorrigo EP)	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to vessel movements.
Timeframe of MSS overlapping periods where the blue whale may be present and foraging	Blue Whale Study (Stakeholder #25)	3D Oil originally positioned the Dorrigo MSS over a broader period to understand stakeholder issues with the proposed period. After feedback, 3D Oil refined the survey period to between Sept1-Oct 31 to eliminate overlap with high productivity periods and blue whale presence. This was agreed with BWS as the optimum timeframe (refer Section 7.2 of Dorrigo EP).	ConocoPhillips Australia adopted the feedback provided to 3D Oil pertaining to timing of the survey which is proposed for Aug to Oct.

Table 3-7: Assessment of Merit for Sequoia MSS

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
Australian Hydrographic Office (AHO)	**Stakeholder Engagement** • Please ensure liaison with the Australian Hydrographic Service (AHS), in particular ensure that the AHS is notified three weeks prior to the actual commencement of activities.	Comment has merit and has been actioned through changes to the EP.	• The Implementation section of the EP (Section 6) has been updated to include a requirement to notify the AHS 3 weeks prior to the commencement of activities.
Australian Maritime Safety Authority	**Stakeholder Engagement** • To notify AMSA's JRCC (rccaus@amsa.gov.au, Ph 1800 641 792) 24-48 hrs prior to operations commencing and at cessation of operations • Australian Hydrographic Office (datacentre@hydro.gov.au) to be contacted no less than 4 working weeks prior to operations commencing for the promulgation of related notices to mariners. • To plan to provide updates to both the Australian Hydrographic Office and the JRCC on progress and, importantly, any changes to the intended operations	ConocoPhillips Australia considers this comment has merit and has been actioned through changes to the EP.	• Item included in implementation section of EP (Section 6) to ensure notification 48 hrs prior to operations commencing and at cessation. • Item included in implementation section of EP (Section 6) to ensure notification 4 working weeks prior to commencement. • Item included in implementation section of EP (Section 6) to ensure notification to AHO and JRCC.
	General advice and information • Suggest ConocoPhillips Australia may request a vessel traffic plot of the area.	Comment has merit and has been actioned.	• ConocoPhillips Australia utilised the Dorrigo vessel traffic plot for the purposes of the EP.
	• To take into account Australian marine parks, titleholders are expected to consider the impacts and risks of activities in the context of the management plan objectives and values. This includes the representatives of the relevant values and the activity footprint on the representative area of the Australian marine park.	Comment has merit and has been actioned through changes to the EP.	• ConocoPhillips Australia has developed and provided DNP with information in relation to AMP in accordance with "Petroleum activities and Australian Marine Parks Guidance Note" Document No: N-04750-GN1785 A620236 2020. • This information has also been included in the EP as part of the risk assessment.

	• You should ensure that the EP:
	  • Identifies and manages all impacts and risks on Australian marine park values (including ecosystem values) to an acceptable level and has considered all options to avoid or reduce them to as low as reasonably practicable.
	  • Clearly demonstrates that the activity will not be inconsistent with the management plan.
		Comment has merit and has been actioned through further information provision to relevant person and update to the EP.	• The EP outlines the values of the AMP that could potentially be impacted by the activity in Appendix H.
			• The EP recognises that potential impacts on the AMP include:
			• Unplanned spill risk (Section 5.5)
			• Underwater noise (Section 4, included in each receptor section where applicable)

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			The risk assessment sections of the EP (Section 5) note the risks to the AMP values and how these will be managed and reduced to ALARP.
	Stakeholder Engagement • DNP should be made aware of oil/gas pollution incidences which occur within the marine park or are likely to impact on a marine park as soon as possible. Notification should be provided to the 24 hour Marine Compliance Duty Officer on 0419293465. • The DNP requests notification to marineparks@awe.gov.au if the EP is approved by NOPSEMA. If the EP is approved, the DNP also requests notification at least 14 days prior to all activities occurring within the marine park (excluding transiting) and at the conclusion of that activity.	Comment has merit and has been actioned through changes to the EP.	• Item included in implementation section of EP (Section 6) to ensure notification of oil/gas pollution incidences which occur within the marine park or are likely to impact on a marine park as soon as possible. • Item included in implementation section of EP (Section 6) to ensure notification to marineparks@awe.gov.au if the EP is approved by NOPSEMA and notification at least 14 days prior to all activities occurring within the marine park (excluding transiting) and at the conclusion of that activity.
	Access to data • The DNP also requests that bathymetry data collected during the survey is contributed to AusSeabed.	Comment has merit and has been actioned through changes to the EP.	• Item included in implementation section of EP (Section 6) to provide AusSeabed with bathymetry data at the conclusion of that activity.
Australian Southern Bluefin Tuna Industry Association (ASBTIA)	**Survey timing** • ASBTIA's concerns relate primarily to the timing of the proposed activity – the operating window ConocoPhillips Australia has identified covers the period in which the upwelling system is undergoing all of the pre-surface-expression processes, this sub-surface enhancement of ecosystem productivity is a necessary stage for attracting SBT to the region for the fishing season that runs from 1st December to 31st March. • We request that ConocoPhillips Australia prioritises consideration of undertaking the survey over the 60-day period AFTER the 31st March. • Adopting an August to October operating window, we would consider to satisfy ALARP related to our fishery	Comment has merit and update has been made to the EP and response provided to relevant person.	• In deciding the optimal time to undertake the Sequoia MSS, ConocoPhillips Australia has balanced the ecology of these species with those of key threatened cetaceans known to occur in the region, particularly for the migration and foraging seasons of the pygmy blue whale and southern right whale and key periods for target fishery species. (Temporal Presence and Absence section in Appendix A). This figure clearly demonstrates that there is no one period of time through the year where critical life stages for species of concern to stakeholders can be entirely avoided by the survey, though peak migration times for whales are avoided. ConocoPhillips Australia has aimed to undertake the survey that best protects threatened whale species and avoids overlap with peak periods of commercial fishing for the Giant Crab and Southern Rock Lobster. The 60-day period after the 31 March represents the peak migration period for the Humpback Whale and general periods of activity for other threatened whale species. It would also

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	operations (Southern Bluefin Tuna surface and purse seine fishery).		overlap with peak fishing periods for the Southern Squid Jig and the Southern Rock Lobster fisheries.
Blue Whale Study	**Potential Impacts to marine life (cetaceans)** • Proposed timing of survey is one of the better times for blue whales. • Blue whales use the Bonney Upwelling continental shelf • Interested in speedy process to minimise disruption to marine life. • Will forward a 3-year old report by Rob McCauley about the effect on krill by seismic.	Comment has merit and response has been provided to relevant person.	• ConocoPhillips Australia notes the timing of the survey has been set to limit impact on Blue Whales • ConocoPhillips Australia has reduced the duration of the activity to reduce the potential impact window on marine life.
	Cumulative impacts • Lots of uncertainty. • Climate change is also an issue	Comment has merit and has been noted.	• ConocoPhillips Australia has utilised best available information to reduce the level of uncertainty. Where uncertainty remains, control measures have been implemented to reduce any risk to ALARP. • Climate change is considered as part of the assessment as a sensitivity where appropriate.
	Research • Hard to get funding for aerial surveys. No surveys have been undertaken for 6 years.	Comment has been noted.	• ConocoPhillips Australia is committed to supporting research in a targeted and effective manner. ConocoPhillips Australia has engaged UTAS to determine research priorities and will then explore funding for these arrangements. This may include aerial surveys.
Colac and District Chamber of Commerce (CCC)	**Stakeholder engagement** • Highlighted opportunity to develop ongoing relationship to partner and benefit both CCC, Colac Otway Shire and ConocoPhillips Australia. • Flagged interest in learning more about ConocoPhillips Australia appetite in providing services in the region. Mentioned COVID-19 recovery in the region and potential for ConocoPhillips Australia to support initiatives. • Asked if COP could share slides and if CCC can share that they met with ConocoPhillips Australia. • Recommended checking in with new councillors and committed to sending details.	Comment noted and has been actioned through further provision of information.	• Ongoing engagement will be undertaken with the relevant person. • ConocoPhillips Australia provided recent information fact sheet and confirmation of disclosure on 17 December 2020. • Colac and District Chamber of Commerce provided details of councillors on 17 December 2020.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	General advice and information • What potential benefits could be realized by the community during this initial phase? • If operational, what employment level do you anticipate?	Comment noted and has been actioned through further provision of information.	• The seismic operations will not have a land-based component. There is not expected to be any economic impact, positive or negative on King Island community. • ConocoPhillips Australia is yet to determine if development of the field will proceed and if it does what infrastructure would be utilised and how this would be placed. This would be subject to a separate approval process and ongoing engagement.
Colac Otway Shire	**Stakeholder Engagement** • Queried how the general community will be engaged with. • Queried if ConocoPhillips Australia had consulted with Tasmanian Rock Lobster Association. Queried what the feedback has been like. • Local concerns to exploration in the area commenced 12 months ago and is ongoing. The proposed survey will add more stress. Provided feedback that there was ongoing opposition to seismic surveys in the region. Flagged that community is likely more accepting of gas industry due to ongoing and historic operations in the region. Agreed there has been a misunderstanding about re-surveying information in the community.	Comments have merit and noted and actioned through provision of additional information to the relevant person.	• The general community is being engaged with in accordance with ConocoPhillips Australia 's Stakeholder Engagement for Environmental Approvals Process. This focusses on engagement with Relevant Persons i.e. with an interest, activity or function in the impacted area. The focus therefore is on fishers, charters, and others who may utilise the area. Council or representative bodies where these persons may base themselves have also been included. Beyond this ConocoPhillips Australia has also undertaken more general community engagement through: ○ Media ○ Website updates Should drilling activities go ahead a further engagement with the community will be undertaken. • ConocoPhillips Australia has engaged with the TRLA (Refer to assessment of Merit TRLA). Colac Otway Shire provided with a summary of concerns raised by the rock lobster sector and how these are being addressed on 25 January 2021. • Community concerns noted. ConocoPhillips Australia will consider strategies in its communications to correct the mis-information regarding re-surveying.
	Adjustment Package • Has compensation had been considered. Seeks assurance on how the fishers will be looked after. • Permits to survey should not be issued until an agreement about appropriate and proportionate compensation is reached between the company proposing the exploration and impacted commercial fisheries stakeholders.	Some of the comments have merit and response to Relevant Person provided	• There is no provision in the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations ('OPGGS(E)') for compensation. ConocoPhillips Australia has gone beyond regulatory requirements and committed to compensating affected commercial fishers if losses are incurred. • ConocoPhillips Australia is committed to providing an adjustment package and the details of this will be agreed to through ongoing consultation with the representative fishing bodies.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	Impact to marine life • Asked if it was workable to consider removing marine life and replace once work was complete. • Impacts, both direct and indirect, should be looked at and considered, not just within the survey area, but rather the natural distribution area of the relevant marine fauna species (i.e. Southern Rock Lobster) when assessing environmental impacts of the proposed seismic survey. Impacts to the whole of the potentially impacted marine fauna and flora species' life cycle, both direct and indirect, should be looked at and considered when assessing environmental impacts of the proposed seismic survey.	Some of the comments have merit and where appropriate updates have been made to the EP.	• This is not considered a feasible control measure from a cost, safety and effectiveness point of view. • The EP will be updated to include additional information in the impact assessment section based on stakeholder feedback. It is extremely difficult to assess direct and indirect effects to particular fauna over their natural range, especially when such ranges are often not clear or could be Australia-wide or across several oceans (e.g., plankton moving with currents). Regulation 13(5)(b) of the OPGGS(E) states that the EP must include an evaluation of all the impacts and risks appropriate to the nature and scale of each impact and risk. Regulation 13(6) states that the evaluation must evaluate the environmental impacts and risks arising directly or indirectly from the activity (and emergency conditions). ConocoPhillips Australia believes it has addressed indirect effects. The impact assessment for particular fauna with regard to underwater sound in Section 4 of the EP considers indirect effects (e.g., impacts to whales also considers impacts to plankton).
	Cumulative impacts • Expressed concern that permit holders don't share data results. • Asked if multiple permits can be issued for work in the same area.	Comments have merit and response to relevant person provided.	• Data acquired during seismic surveys is considered commercial in confidence and of commercial value. It is therefore not appropriate for it to be freely shared in the public domain. Where bathymetry or other non-commercial data is acquired ConocoPhillips Australia is committed to ensuring this is shared and in the public domain. • A control measure has been implemented a 40 km separation between the survey and other operating seismic vessels of concurrent / simultaneous surveys in the region of the OA during data acquisition.
	General advice and information • Advised the Colac Herald had an article in today's paper re: a toxic weapons dump in the Otway Basin and asked if ConocoPhillips Australia was aware of this. Seeks strong assurance re: toxic dump. • Requested the slide pack presentation.	Comments have merit and response to relevant person provided.	• ConocoPhillips Australia sought advice from the Department of Defence to confirm the risk of unexploded ordinance in the area. The Department of Defence advised that the key area of risk lies 30km to the west. UXO in the area being acquired pose a low explosive risk and are not toxic in nature. • Slide pack provided on 7 September 2020.
	• Suggestion to remove the catch prior to acquisition and replace after or undertake a translocation project.		• ConocoPhillips Australia does not support this option as it would not contribute to measurement or mitigation, with any reasonable level of reliability, of any long-term impacts from the Sequoia MSS.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			The funding provided to UTAS will allow help identify research priorities.
	Research funding • Commercial entities proposing seismic surveying should be required to contribute funds to enable research into the environmental impacts of their activities to ensure that direct and indirect environmental impacts of offshore gas and oil exploration are better understood and based on independent scientific research.	Some of the comments have merit and response to relevant person provided.	• ConocoPhillips Australia has engaged UTAS as a relevant person (refer to Assessment of Merit – UTAS below). • ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact on giant crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
Corangamite Shire Council	**Potential impacts to Commercial Fishing Operators** • Flagged main issue/impact is likely with commercial fishing industry and likely fishers with larger vessels (Launching from Apollo Bay). • Provided advice on consulting directly with fishers and not just with fishing industry associations.	Comment has been noted and responded to.	• ConocoPhillips Australia has undertaken an extensive engagement process with both State and Commonwealth commercial fishers and recreational fishing bodies as part of the development of the EP (Section 4.7 in EP). • The industry policy regarding consultation with fishers is outlined in “Policy in Relation to Mining, Gas and Petroleum Sector Consultation with the Professional Seafood Industry”. Recognising issues around stakeholder fatigue and coordination of effort, ConocoPhillips Australia has followed this guidance and not engaged with individual fishing licence holders but rather entered a fee for service arrangement with TSIC and SIV to ensure adequate engagement.

	Stakeholder Engagement
	• Identified that they would like to receive updates and fact sheets as the project progresses so they can share them with their networks.
	• Highlighted that main issues would be:
	  ○ Community not accepting of fossil fuels
	  ○ Visibility of platforms from mainland
	  ○ Identified that they would be keen to discuss where ConocoPhillips Australia would land gas onshore if the project successful.
		Some of the comments have merit and response to relevant person provided	• Corangamite Shire Council to remain as a relevant person and will continue to receive updates.
			• ConocoPhillips Australia is yet to determine if development of the field will proceed and if it does what infrastructure would be utilised and how this would be placed. This would be subject to a separate approval process and ongoing engagement.

Commonwealth Fisheries Association (CFA)	**Stakeholder Engagement** • Happy to leave the main discussions with the relevant sector bodies but would appreciate ConocoPhillips	Noted and actioned through update to	• CFA will remain category 3 to receive updates and noted to include CFA in invitations to workshops/meetings.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	Australia forwarding an invitation to any future online meetings or workshops they may have planned. Would also appreciate communications on progress and developments just so that the CFA are aware of what is happening.	relevant person category.	• TSIC, SIV and SETFIA (and other sector bodies) noted as the major means for engagement with Commonwealth fisheries.
Department of Defence (DoD)	• DoD don't anticipate activity will have an impact. Key areas 30km to the west. UXO in the area being acquired low explosive risk		• ConocoPhillips Australia provided DoD with assessment of potential impact on UXO's on 20 May. DoD confirmed ConocoPhillips Australia's assessment of potential impact was consistent with advice provided on 24 May. This assessment is detailed in Section 4.8.3 – Other Marine Users – Defence Activities.
Department of Industry (DoI) or Department of Industry, Science, Energy and Resources (DISER)	**General advice and information** • Encourage ConocoPhillips Australia to review EP's accepted by NOPSEMA for the Great Australian Bight and the conditions placed on these plans.	Comments have merit and has been noted.	• ConocoPhillips Australia has reviewed other EP's as part of the development and revision of the EP to ensure it is following best practice. This has resulted in significant updates to the layout and information contained in the EP between the first and second submissions of the EP to NOPSEMA.
	Stakeholder Engagement • Flagged potential issue of running consultation over the Christmas break. • Also noted they would like to receive the CSI Technology fact sheet.	Comment noted.	• ConocoPhillips Australia recognised the timing of the NOPSEMA run public submission process over the December/January period presented issues for many stakeholders. The timing was driven by business and regulation requirements. ConocoPhillips Australia ran ongoing engagement with identified relevant persons outside of this period.
Department of Primary Industries, Parks, Water and Environment (DPIPWE)	**Potential impact on commercial fishing operators** • Advised complications between State and Commonwealth waters. Whilst the project is proposed in Commonwealth waters state fisheries overlap. The expectation is that fishers need to be considered as part of the assessment. <u>Giant crab and Rock Lobster</u> • Main concern in the project are the Rock Lobster and Giant Crab. Reiterated their concerns based on the emerging research regarding the impacts of seismic acquisition on rock lobster. • Historically catch of Giant Crab in TAS has been spilt fairly evenly across east and west coast. Giant Crab fishery covers significant portion of the SW corner of proposed acquisition area. However, in recent years	Comments have merit and has been actioned through changes to the EP.	• ConocoPhillips Australia has undertaken an extensive engagement process with both State and Commonwealth commercial fishers as part of the development of the EP (Chapter 4.7 in EP). <u>Giant Crab and Rock Lobster</u> • Rock lobster and giant crab fisheries have been a focus of engagement through TSIC, SIV, SETFIA and the TRLA. • In recognising the reported catch in the Operational Area DPIPWE suggested the SW corner of the acquisition area be excised, ConocoPhillips Australia recognised this comment had merit and on investigation concluded that the key commercial catch areas mostly targeted by the giant crab fishery was at water depths of 140-300m, which is in the southwestern corner the acquisition area and over the southernmost lead. To manage this ConocoPhillips Australia excised the giant crab fishery area (140-300m plus buffers) from the acquisition area.

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	with the contraction of the industry and Currie's proximity to the fishing grounds, there has been a shift to west coast predominance in catch. The Sequoia operational area covers a significant portion of the Tasmanian giant crab fishery and the outer margins of the southern rock lobster fishery in that region. The area of the giant crab fishery covered by the proposed survey accounts for 39% of the total catch for the whole fishery as reported in the EP. Whilst the total area of the fishery covered by the operational area is small, quite clearly from the level of reported catch from the area is a significant. In considering the likely impact on the Tasmanian giant crab fishery, DPIPWE requests that the south west corner of the operational area be excised from the survey. This will remove the impact of the seismic activity from a significant part of the Tasmania giant crab fishery while having minimal impact on the overall Sequoia survey area. Acknowledged that excising to an 800m buffer significantly reduced ConocoPhillips' ability to meet the objectives of the survey as there was a significant prospect in the southwest corner. Proposed considering reducing the number of lines acquired over this additional buffer area, such as only acquiring every second line to reduce sound density in GC habitat If there are adequate reasons for not being able to excise the whole area, the next solution would be to study what the impacts area (e.g., ROV). ROV monitoring has been conducted previously (2007 shelf break habitat study). • Shared concerns that Giant Crab exist outside excise depths (from 100 - 800m), specifically the migration of juveniles/ smaller crabs from deeper regions to shallower regions as they mature. Identified that shelf break was an area of habitat and that deeper waters are the greater concern. Also highlighted that ConocoPhillips Australia should consider impacts to rock lobster habitat in shallow water. Reiterated his		• DPIPWE provided outline of ConocoPhillips Australia approach to the design of the excise and buffer based on available literature, including: ○ The design of the excise 'ribbon' is based on literature assessments of Giant Crab habitat from papers such as Assessment of Giant Crab Fishery (2014) and the VFA Giant Crab Fishery Management Plan (2010) ○ Based on the papers ConocoPhillips Australia reviewed established an excise ribbon between the 140m – 270m water depth. ○ Additional noise modelling was run from the extent of the buffer area to understand the distance to 'no affect'. Based on this modelling an additional 425m and 450m was added to north eastern and southwestern extents, respectively. ○ Provided context for seismic objectives and highlighted that the excise region represents part of a significant prospect and outlined the objective to acquire as much data as reasonably possible in this area while having as low an impact as possible on the marine environment. • ConocoPhillips Australia has considered and assessed the feasibility of excising a greater area from 100m to 400m. In order to appropriately assess the perceptivity of the permit, seismic acquisition is required over these water depths. It is acknowledged that Giant Crab adults may be present in the deeper waters of the south-west corner of the acquisition area. Giant Crab in these areas have less exposure to sound from the increased distance from the sound source. There is an absence of fishing effort in deeper waters. Anecdotal feedback from fishers and UTAS shared knowledge of the sparsity of adults and supporting habitat at increasing depths. Weighing these against the Sequoia MSS objectives an increased or total excise of the southwest corner is not justified. ConocoPhillips Australia has considered reducing the number of lines in the buffer area. This was rejected as a control as it provides no reduction in environmental impact if survey objectives are to be met. ROV monitoring of the impact area has not been included because there is no cause/effect pathway

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	recommendation that COP consider excising entire southwest corner of the acquisition area to minimise impacts to the giant crab fishery (140m-800m depth range). • The Tasmanian giant crab fishery is classified as depleted according to an assessment under the Statutes of Australian Fish Stocks Reporting process, and has shown little sign of recovery despite significant reductions in the Total Allowable Catch over the past 20 years (105t to 20.7t). DPIPWE is concerned that any additional impacts and increased mortality imposed on the population through the Sequoia seismic survey is likely to be significant and further hamper the ability of the fishery to recover or possibly further suppress the population. • Flagged that the excise area (DPIPWE deeper area) is about protecting the fishery and distribution of GC as a whole not about the early life stages. Acknowledged that area does have a concentration of smaller giant crabs that recruit into the fishery. Acknowledged that understanding larval stages gets more difficult. Shared that it is known what the distribution of the crab is once they settle but that distribution of larvae is not understood. GC is very different to SRL with free swimming stage of days and is about flow of larvae from west to east particularly down through the area via the currents. Advised that main concern was actual adult stock on the seabed floor and level of impact of seismic array would cause due to level of uncertainty. Shared that CG are very different to SRL in a range of ways like size, surface areas, interactions with sea floor. Advised that whilst they're big they are more fragile than SRL. Advised he would like to see research on the impacts of seismic array on giant crab undertaken to help address uncertainty. Shared belief that impact of seismic on GC is far greater than on SRL. <u>Abalone</u>		between seismic sound and benthic habitat. An ROV survey to monitor for impacts from seismic sound on Giant Crab would not be a reliable method for determine sub-lethal effects (no lethal impacts are predicted). • In addition to the engagement with DPIPWE, ConocoPhillips Australia has engaged with UTAS and IMAS as relevant persons (refer to Assessment of Merit for these stakeholders) to assist in identifying research opportunities to reduce the uncertainty that remains for the giant crab. As a result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. • Advised that ConocoPhillips Australia are looking at how we lower impact but trying to be clear about our current view of the literature is that the physiological impacts to individuals are of acceptable nature – acknowledging some uncertainty. Acknowledged uncertainty of impact and advised it was an area in the EP where ConocoPhillips Australia believed the precautionary principal is most applicable. Reiterated that anything the Department might be able to share around early life cycle stages of GC would be greatly appreciated as it would help ConocoPhillips Australia better understand potential impact to long-term sustainability of the fishery. Clarified that ConocoPhillips Australia did not have the same concerns for SRL as there is considerable research available. <u>Abalone</u> • Outlined current notification plans including notice to mariners. Flagged potential to placing notifications in waters like Beach commitment. • ConocoPhillips Australia has connected with TSIC to commence engagement with Tas Abalone Council. <u>General</u>

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	• Abalone fishery is open at the time of acquisition and anyone is able to fish there and flagged need for notification to both commercial and recreational users. • Suggested contacting Tasmania Abalone Council that could support in connecting with the approx. 140 abalone divers. General • In the past, titleholders have minimized economic impacts to fishers by using their vessels for survey scouting.		• Where appropriate ConocoPhillips Australia will seek to engage with fishers to utilise their vessels to support the activity.
	Stakeholder Engagement • Appropriate ongoing communication requested. Researchers and Stakeholders should be kept in the know including blue whale study. Advised DPIPWE have no jurisdiction but want to be involved (during EP review process). • Suggested including Karen Evans (CSIRO) and Mandy Watson (DELWP) be included in future communications. • Suggested Helen Crawford be included in future correspondence regarding threatened species. • DPIPWE's Liaison Officer needs to be considered for future inclusion (Claire Longcorp)	Comments have merit and have been actioned through changes to the EP.	• DPIPWE, researchers and other stakeholders have been identified as a relevant person through the EP process. Ongoing engagement and updates will be provided in line with ConocoPhillips Australia Stakeholder Engagement Process. • Karen Evans (CSIRO) not engaged, DELWP engaged through Rodney Vile • DPIPWE threatened species feedback will be undertaken through Helen Crawford if required. • Clare Lond-Caulk (DPIPWE) included in future communications representing DPIPWE - sent fact sheets and updates on 17 August 2020, 27 October 2020, 20 November 2020, 9 December 2020 and 9 February 2021.
	Potential Impacts to marine life (birds, seals and whales) • Expressed concern about the Shy Albatross which is endangered under the EPBC. Birds track through the survey area at proposed time of survey. • Expressed concern about seismic impacts on marine mammals and seabirds throughout the life cycle. • The proposed seismic timing is at the peak of whale migration. • Expressed concern that the Fur seals, which are protected, will be lactating at the time of the survey.	Comments have merit and have been actioned through changes to the EP.	• The potential for birds, including the Shy Albatross to occur in the Operational Area, has been described in Section 4.4. The EPBC-listed albatross and other migratory seabirds may have foraging habitat within the Operational Area. Albatross have widespread distribution through the southern hemisphere and feed mainly on cephalopods, fish and crustaceans, using surface feeding or plunge diving to seize their prey mainly at the edge of the continental shelf. Albatross are colonial, usually nesting on isolated islands and foraging across oceans in the winter months. No breeding colonies or nesting areas are in proximity to the Operational Area. Further detail on the seabirds present in the Operational Area can be found in Section 4.4. The causal pathway from seismic activities that may impact on birds are:

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			○ Light emissions ○ Noise ○ Unplanned hydrocarbon spill. The potential for risks and impacts to birds, Including the shy albatross, as a result of these is hypothermia, dehydration, drowning and starvation in the event of a slick or other sub-lethal impact. However, given the rapid spreading and weathering of a spill; and the limited time and spatial area of the surface slick at 10µm; it is considered very unlikely that significant numbers of marine seabirds will be exposed to harmful thresholds prior to the natural weathering of a slick. Further detail on the potential risks and impacts on migrating birds as a result of the activity have been considered and reduced to ALARP (Environmental Performance section in Appendix A). • The Temporal Presence and Absence section of Appendix A shows the migration times for different cetacean species. It shows that there is no period in the year that can avoid cetacean activity. The August to October period selected avoids the peak periods for migration of the species with the highest protection levels. Recognising the residual risk ConocoPhillips Australia have added a Southern Right Whale monitoring program as a control measure which will include: ○ Undertake an aerial survey of known breeding areas and the east coast of King Island once a week for four weeks prior to the commencement of the survey to try and identify the locations of cow/calf pairs. ○ Undertake an aerial survey of King Island waters searching for Southern Right Whales to try to identify the start of the migration season and cow/calf pairs within the critical habitat once a week during the survey until confirmed absence of southern right whales around King Island. ○ Liaise with the Curtin University Southern Right Whale Study to understand the presence of southern right whale in the Otway and Tasmanian waters in the 2021 winter season.

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			This will complement the Marine Mammal Adaptive Management Procedure and the Marine Mammal Observers and Passive Acoustic Monitoring (PAM) operators control measures that will be implemented. • The potential for marine mammals, including whales and fur seals to occur in the Operational Area has also been considered (Section 4.5). The causal pathway from seismic activities that may impact on mammals are: ○ Noise ○ Vessel interactions ○ Unplanned hydrocarbon spill The closest breeding colonies to the survey area are located at Cape Bridgewater (145 km northwest of the survey area) and Lady Julia Percy Island (130 km northwest of the survey area). The potential impact from noise on seals (pinnipeds) was modelled as part of the assessment. At the closest breeding and haul out sites to the acquisition area listed above, the noise modelling predicts that no behavioural, Temporary Threshold shift (TTS) and Permanent Threshold Shift (PTS) thresholds will be reached. Behavioural impacts for seals may extend 11.1km horizontally from the sound source. Seals are known to forage in areas far from their breeding colonies and haul-out sites so it is possible that seal feeding grounds may be subject to sound levels that result in behavioural changes. However, given the abundance of foraging habitat for seals throughout Bass Strait, and the fact that the acquisition area does not represent limiting habitat, any temporary exclusion from feeding grounds is expected to be of minor consequence even for lactating females. As such, impacts to breeding success will not occur. Fish, benthic invertebrates and cephalopods (being the key prey of pinnipeds) are not likely to be impacted in the long-term by the MSS (see 'Impacts to Fish'). Fish displacement around the operating sound source will occur but is generally temporary and localised. Cephalopods are likely to have a shorter distance to displacement than fish, and the threshold for behaviour for cephalopods is greater than that for pinnipeds, meaning that cephalopods are expected to displace to a lesser extent than

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			pinnipeds when exposed to an equivalent level of sound. Benthic invertebrates are restricted in their ability to rapidly move away from seismic sound. This, and the literature suggesting that mortality of benthic invertebrates from MSS is unlikely, means that benthic prey will remain available to seals. As such, the consequence to the foraging habits of fur-seals is assessed as negligible and impacts on lactating females is not expected. The Australian and New Zealand fur-seals are highly agile species that haul themselves onto rocks and oil and gas platform structures (jackets). As such, it is likely that they will be able to avoid seismic streamers and are unlikely to become entangled within them (especially with horizontal separation between the streamers being approximately 75 m). The risks of unplanned hydrocarbon spills are described in Section 5.4 of the EP.
	General advice and information • Suggested ConocoPhillips Australia follow the submission to the Senate Enquiry. • Asked whether the use of technology like 'popcorn 'seismic or eSource were potential alternatives to conventional seismic surveying as they may reduce the frequency and acoustic intensity throughout the habitat. Suggested that ConocoPhillips Australia gets involved with the comparative technology study (popcorn and vibriosis that Beach are testing with IMAS/ NOPTA. • Flagged issues, specifically in Australia, between fishing and oil and gas industries and need to maintain SLO. Highlighted need for oil and gas industry to support animal impact studies of technology vs geophysical impacts etc.	Comment has merit and has been noted.	• ConocoPhillips Australia is aware of the Senate Enquiry. The Senate Inquiry on the Impact of seismic testing on fisheries and the marine environment is independent of the NOPSEMA assessment and approvals process for MSS EPs. ConocoPhillips Australia is following the current process under the Offshore Petroleum and Greenhouse Gas Storage Act 2006. • ConocoPhillips Australia acknowledged that there were a range of options currently being tested but not yet commercially deployed. Advised that as their efficiency in reducing impact hadn't yet been proven, ConocoPhillips Australia wouldn't consider their use. ConocoPhillips Australia is aware of the Beach work but not currently involved due to commercial constraints. • ConocoPhillips Australia acknowledges feedback.
	Potential impacts to fish • Read recently how flathead and Whiting have been severely impacted and compensation will need to be structured.	Comment has merit and has been noted.	• ConocoPhillips Australia has reviewed the available data related to the FRDC/CGG funded research at Lakes Entrance and associated reporting of impacts to flathead and whiting. • Flathead and whiting are not a commercially targeted species in the Operational Area.

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			• The development of a commercial fishing adjustment protocol in conjunction with the fishing industry peak bodies recognises any impact to fish that are commercially targeted.
	Scientific basis for assessment of impacts • The statement in the EP concerning "the water depth for the experiment (10-12 m) and the distance between the sound source and the seafloor (5-7 m) is not representative of the majority of MSS (and is not representative of the Sequoia MSS, where there will be no less than 60 m of water between the acoustic source array and the seafloor)". This statement/conclusion does not recognise or give appropriate credence to the results of the Day et al 2016 and 2019 study where a model of a hypothetical full-scale commercial array was developed to serve as a comparison for the calculated received levels of the lobsters in the IMAS/Curtin study. Thus, the exposures experienced during the experiments can be considered to be equivalent to a commercial approximately 3100 inch^3 seismic source passing within 100–500 m range adjacent to the lobsters. This has been ignored in this EP and instead very small ranges are used to indicate that there will be minimal to no impacts unless at very close range. Collectively these results indicate that air gun exposure may negatively influence the lobster's nutritional condition and immunological capacity (see Fitzgibbon et al. 2017. Fitzgibbon et al. 2017 The impact of seismic air gun exposure on the haemolymph physiology and nutritional condition of spiny lobster, Jasus edwardsii. Mar Pollut Bull. 125(1-2):146-156. doi: 10.1016/j.marpolbul.2017.08.004). Analysis of righting time showed that both pueruli and juveniles exposed to seismic signals took longer to right themselves compared control lobsters when assessed immediately after exposure (time 0) and following moulting for juveniles, with these results being statistically significant. This is a similar result as that for	Comment has merit and has been noted.	• The majority of surveys, and in particular the Sequoia 3D MSS, have a significantly greater separation distance between the source and receivers at the seafloor. In the case of this survey, the distance is approximately always greater than 55m. The hypothetical commercial survey design in Day et al 2016 was developed to provide comparison to typical surveys. Limited information was provided in the Day et al papers to support the derivation or use of the transmission loss function used to equate the experimental surveys to a hypothetical commercial survey. The referenced supplementary paper provides information already within Day et al. 2016 relevant to the FRDC experiments, but no additional or different information to that included in the FRDC report relevant to the full-scale commercial array comparisons. The hypothetical survey design presented in Day et al is noted, however the exposure scenario relevant to the Sequoia MSS is different, as demonstrated by the modelling conducted and presented in the EP. The hypothetical survey in the Day et al design uses five lines, all only 4km long, with no time window presented for the survey design, therefore it is assumed all exposures happen within a short period of time. This is significantly different to the lines within the Sequoia MSS modelling study, which were approximately 90 km long for Scenario 1, and 107 and 70 km long for Scenario 2, with a turn estimated to take 2.7 hours. The sequential lines considered are 12.6 km apart, with the vessel not acquiring an adjacent line within a 24-hour period. The maximum single impulse exposure levels (either pressure or particle motion) are predicted in the modelling study, and then used to inform the EP. These predictions have been developed using acoustic models which have been extensively benchmarked, and account for the specific environmental parameters of the survey location. Therefore, the modelled levels are considered more applicable for this assessment than the approximated levels presented in Day et al (2016) and McCauley et al (2016). As noted in the EP and the modelling report, available literature suggests particle motion, rather than sound

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	adults exposed to a single airgun. This report indicates an impairment in the ability of the animal to co-ordinate its movement, and in the adults was correlated with damage to the statocyst (removal of hair cells), the mechanosensory organ responsible for the detection of gravity, position, and movement. • Recommended ConocoPhillips Australia talk to Prof. Caleb Gardner at UTAS/ IMAS to better understand physiology and habitat of Giant Crab. Provided feedback from Prof Caleb Gardner that moulting of Giant Crab occurs from April to November. Highlighted that it is rare and knowledge on this life cycle stage is limited. Advised that seasonal movement up and down the slope frequency changes with moulting depending on life cycle stage also.		pressure, is a more important factor for crustacean and bivalve hearing. The responses identified in Day et al (2016), including changes in reflex responses, in the statocysts, in behaviour, in haemolymph composition and in condition are thought to have implications for the health and survival of these animals. In considering the severity of effects, it is necessary to keep in mind that this study did not investigate ecological impacts. For example, it was not possible to determine whether the reduced number of haemocytes might compromise the immunity of lobsters (the other subject of interest in the study) in the wild rather than in well maintained tanks receiving filtered seawater (as was the case in the study). It was also not possible to examine how the observed impairment of reflexes or damage to the balance organ might translate to the complex environment in the wild, such as reducing the ability to avoid predators or compete with other lobsters for food or reproduction. Until the full scope of these changes and their ecological effects can be more thoroughly investigated, caution must be taken against extrapolating the results of this study to situations that were not within its scope, such as real-world seismic surveys. This caution is suggested in part through considering the results presented in the Canadian Department of Fisheries and Oceans (DFO) snow crab studies. Given the limited number and scope of the studies conducted, 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 (2016), 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, there are currently no authoritative thresholds to inform the impact assessment. As it is likely that particle motion is the more relevant metric for impacts on lobster and crabs (based upon their physiology), this is the metric that is of most relevance for undertaking EIA. As such, particle motion (acceleration) predictions for the Sequoia MSS can be presented for comparison to literature such as Day et al (2016), although this is complicated when considering the entire body of work presented for lobster

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			and crabs compared to that for scallops. While Day et al (2016) found that waterborne acceleration magnitude was well predicted by the sound pressure level, and a cumulative waterborne acceleration was well predicted by SEL, this is not always the case in different environments. Different environments will have different relationships between ground roll (be that seabed acceleration due to waterborne sound energy, or that from interface waves such as Scholte waves) and pressure metrics: • Different water depths will lead to different levels of acceleration from waterborne sound energy at the seafloor. • Different substrates will support different levels of acceleration within it and have different decay rates over range. Therefore, caution is recommended with regard to extrapolating relationships between metrics (such as SEL and particle motion) observed for one specific scenario of source and environment to other scenarios (i.e., different sources and different environments). During the trials in Day et al (2016), each animal was exposed to a sequence of sounds from the moving array. Describing the exposure history is especially important for comparing exposures from different patterns of firing when the array is moved around. The authors recognised the importance of accounting for exposure history from multiple array signals or even the time history during a single airgun signal, where a sequence of pulses may impinge upon the animal from direct sound transmission through the water, transmission through the substrate and from interface waves. However, there are yet no standard techniques for measuring and describing the particle motion that impinges upon the animal. There is no standard methodology for reporting the particle acceleration exposure history for benthic marine fauna. There is a need to develop full exposure measures to compare the aggregate sound fields created by different configurations of seismic surveys, so that they can be properly compared in terms of their possible impacts on marine organisms. Due to these considerations, the assessment of potential effects of impacts using particle acceleration exposure history is not currently recommended. However, the consideration of potential effects of impacts using

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			pressure metrics is less appropriate due to the physiology of benthic fauna such as crabs and lobsters. Regarding the referenced measurements made by Robert McCauley in 40 m of water using the same sensors as the measurements reported in Day et al (2016), the measurements were fit to a regression equation of the form a*log10(R) + b*R + c where a, b and c are constants. A summary of the issues associated with applying acoustic propagation regressions are: Acoustic propagation has at least three propagation zones where different values of 'a' are appropriate: 1) The spherical spreading zone out to one water depth where a=-20; 2) A transition zone from ~1 water depth to 5 water depths where -20 < a < -10; and 3) A far-field cylindrical-spreading zone for ranges greater than 5 water depths a = -10. Interactions with the seabed and sea surface also attenuate sound, which are represented by the b*R term. If the measurements used to fit the regression were made in a single zone, then the regression equation is expected to be well suited to predicting sound levels anywhere inside that zone but are inappropriate for the other zones. This is especially true for predictions for zone 1 made from an equation fit to data from zones 2 and 3. The measurement ranges used to develop the equation provided were not described, however, it is our experience that making measurements inside zone 1 is extraordinarily difficult and therefore did not likely occur. Thus, the higher levels from our numerical model, which accurately represents all three zones, are expected to be more reliable than those from the empirical model. • The theoretical values of a given above are strictly true only for a hard seabed and flat bottom. The value will increase when the bottom is not hard, which is the case for most sediments such as sand, silt and mud. Hard seabeds that support shear waves also result in higher losses. Sloping bottom and uneven seabeds also result in different values of a, b and c. Thus, the equations obtained in one location are

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			only applicable in another if the bottom type and bathymetry are similar. The attenuation of sound has depth dependence that needs to be considered in different scenarios. Especially important is the low-frequency cut-off effect that limits how well low frequencies can travel in shallow waters. For 10 Hz to propagate well, water depths of at least 70 m are required (assuming a requirement of at least two modes). This affects the regressions in two ways: a. if water depth is less than 70 m, then 10 Hz, which contains a substantial proportion of seismic airgun energy, will not propagate well, which means an equation from 40 m will not translate well to depths of 20 or 100 m; b. frequency dependent values for a, b and c should be considered. • It is important to understand that the value of c is NOT the source level of an airgun array, rather it is the value that best fits the measurements. This effect can be seen by the wide spread of values for c (as well as a and b) in Table 6 of Day et al (2016). In deep waters, this value may be useful for understanding the radiated noise level of the source, but it can never be used for modelling the received sound pressure level using an acoustic propagation model. In summary, the equation in Day et al (2016) indicates that the numerical acoustic propagation model employed by JASCO for the proposed Sequoia 3DMSS produces values that are compatible with real-world measurements, however, the numerical modelling approach (VSTACK) is likely more accurate for the current project than the empirical equations presented in Day et al (2016). In terms of the accumulated sound levels during the survey, the hypothetical scenario significantly differs from the Sequoia MSS scenarios assessed in the modelling study. • The UTAS/IMAS submission to the Senate Inquiry on the Impact of Seismic Testing on Fisheries and the Marine Environment notes that quantification of the ecological impacts of the FRDC 2012/008 project is not possible and that the lobster population in the Derwent River with existing damage to their mechanosensory organ (similar to what may be observed after exposure to MSS) is

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			thriving, suggesting that the damage to the mechanosensory organ is not causing any obvious impairment. An EP prepared in 2017 for the CarbonNet Pelican 3D marine seismic survey incorporated the findings of this research and was accepted by NOPSEMA. This seismic survey was undertaken in shallow waters (15-40 m) in February 2018 with known southern rock lobster habitat present. A post-seismic survey investigation of known southern rock lobster reef habitats found no decrease in southern rock lobster abundance. • ConocoPhillips Australia met with Prof Caleb Gardner
	Research funding • The seismic survey and exploration industry needs to work cooperatively with our research partners and contribute financially to the necessary research projects that are undertaken or need to be undertaken. • Flagged that submission outlined areas where felt research was under-represented (eg. Impact of giant crab rated as X). Queried if baseline survey work had been considered given so many unknowns. It would be proactive but short notice to proceed	Comment has merit and has been noted.	• ConocoPhillips Australia has engaged UTAS as a relevant person (refer to Assessment of Merit – UTAS below). • ConocoPhillips Australia has engaged with DPIPWE, UTAS and IMAS as relevant persons (refer to Assessment of Merit for these stakeholders) to assist in identifying research opportunities. As a result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. Timeframes would likely preclude baseline surveys however ConocoPhillips Australia has requested DPIPWE feedback on what a fit-for-purpose design could look like that could be undertaken in the next few months.
Director of National Parks (DNP)	**General advice and information** • The class approval requires an accepted Environmental Plan (EP) under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009. You need to be aware of your obligations under the class approval (including conditions).	Comment has merit and has been noted.	• ConocoPhillips Australia is aware of its requirements under the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.
	Impact on Southern Rock Lobster habitat in Zeehan Marine Park • That the seismic surveys avoid the significant rock lobster habitat in Zeehan Marine Park, which have been identified as a Key Natural Value in the SE network	Comments have merit and changes have been made to the activity.	• Given the identification of rock lobster as a key natural value of the Zeehan Marine Park ConocoPhillips has agreed to: 1. Excise the largest and eastern most polygon in Figure 4-6 with a 750 m buffer on the western edge of the polygon.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	• If avoiding the rock lobster habitat isn't possible, then we request that the proponent undertakes monitoring to understand the impact of seismic surveys on rock lobster populations in the park, with survey design to be agreed in consultation with Parks Australia.		2. Not excise the remaining 5 smaller polygons and instead agreed to: ▪ Provide the bathymetry data available from the survey once processed. ▪ Provide all geotechnical and geophysical data gathered from any future surveys in the title, if they are carried out. ▪ Carry out a desktop study of SRL population characteristics within the marine park. The objectives and design of this study will be decided in consultation with the DNP. ▪ Carry out an in-field characterisation survey of the five un-excised areas of natural value after completion of the survey. The objectives and design of this study will be decided in consultation with the DNP. ▪ Contribute to a field-based impact study to further understanding about the ecological sustainability of rock lobster populations in the Zeehan Marine Park. 3. Ongoing discussion on the above points to determine what may or may not be achieved within the timeframe of the Sequoia MSS. 4. Ongoing consultation in relation the Sequoia MSS and potential future ConocoPhillips activities on the title. • To date ConocoPhillips has assessed the impact to southern rock lobster (SRL) populations to be acceptable primarily due to the broadly distributed and connected characteristics of the SRL population. This assessment is supported by scientific literature, the SRL populations resilience to fishing, and the proven absence of lethal effects from the Sequoia activity. We have a high degree of confidence in the assessment because of the independent modelling we have conducted and the significant literature available on seismic effects on SRL.
Eastern Tuna and Billfish (ETBF)	**Impact on Commercial Fishing Operators** • Expressed general concerns on the impacts of a seismic survey on marine ecology and biology and subsequent	ConocoPhillips Australia considered the	• ConocoPhillips Australia has considered the biological impacts of its activity and any potential cause effect pathways that may cause these to affect fisheries. There is no cause effect pathway

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	flow-on impacts to commercial fishers and communities. • Identified that although his fishery does cover the permit area, Tuna is generally not caught in T/49P, so doesn't currently believe there is direct impact to his stakeholders.	comment and has noted	identified through the assessment process that could have a stock level impact on the sustainability of the fishery. • Noted that ETBF fishery not active in T/49P area
	Adjustment protocol • Believed a compensation protocol should be part of our approach and should be fair and reasonable based on any reduction of catch. He would appreciate receiving updates as the project continues.	ConocoPhillips Australia considers this comment has merit	• ConocoPhillips Australia agrees with this comment and negotiations have commenced with SIV, TSIC and SETFIA on the adjustment package, with feedback sought on the draft adjustment package.
	Research • Identified preference would be for a base level survey of ecology to be undertaken prior to seismic to inform assessment and better understand any impact.		• Timing does not allow for a base level survey of the ecology to be undertaken prior to the seismic activity and ConocoPhillips Australia believes it has sufficient information to undertake its assessment. ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact on giant crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
Victorian Fisheries Authority (VFA)	**Survey timing** • The company has acknowledged that no formal or defined exposure criteria is available to measure temporary or permanent injury or mortality for crustaceans. Therefore, the VFA recommends that a precautionary approach is taken when designing the survey. Particular care should be given to avoiding undertaking activity during the period when the species is at its most vulnerable. That is, the spawning/moulting period between June to November. This is in addition to minimising disruption to the key fishing period which is from November through to March.	Comment has merit and update has been made to the EP.	• ConocoPhillips Australia examined these claims and included additional information on the ecology of Southern Rock Lobster and Giant Crab to the EP (Section 4.2). Key life phases for these species is as follows: ○ Southern Rock Lobster (*Jasus edwardsii*) – mate from April to July, fertilized eggs carried for 4-6 months before being released between September and November. The larvae (phyllosoma) then live in the plankton and undergo 11 developmental stages over 12-24 months while being carried by ocean currents, often far beyond the continental shelf. The phyllosoma then moult and metamorphose into a puerulus larvae, still living in the water column and then settle on reef in shallower waters, moulting again into pigmented juvenile lobsters. In adults, moulting generally occurs in September and

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			October. Southern Rock Lobster reaches commercial fishing size after 3 to 10 years. ○ Giant Crab (*Pseudocarcinus gigas*)– this species is endemic to the waters of southern Australia, living along the upper slope of the continental shelf. Giant crabs breed in June and July, with the females carrying eggs for about four months. After the eggs hatch between October to November, the larval duration is about 50 days. This species can live up to 30 years and is slow growing (reaching 12-14 cm at maturity, but up to 20 cm and 10 kg in weight). Juveniles moult their carapace every 3-4 years and adult females about once every nine years. Mating is only possible when the new shell is still soft. • ConocoPhillips Australia acknowledges the optimal timing for the fishing industry based on VFA feedback is March to June. In deciding the optimal time to undertake the Sequoia MSS, ConocoPhillips Australia has balanced the fishing season with the peak times of key threatened cetaceans known to occur in the region, particularly for the migration and foraging seasons of the Pygmy Blue Whale and Southern Right Whale and key periods for target fishery species. (Temporal Presence and Absence section in Appendix A). This figure demonstrates that there is no one period of time through the year where critical life stages for target SRL and Giant Crab species can be entirely avoided by the survey, though peak migration times for whales are avoided. ConocoPhillips Australia has aimed to undertake the survey that best protects threatened whale species and avoids overlap with peak periods of commercial fishing for the Giant Crab and Southern Rock Lobster. Recognising the uncertainty around the Giant Crab fishery, ConocoPhillips Australia has reduced the overall size of the acquisition area, including excising a section in the SW corner based on the Giant Crab target fishing depth. Further research, as described below will also be undertaken by ConocoPhillips Australia.
	Research funding • The Project Summary suggests that research indicates that impacts to invertebrates (rock lobster and giant	Comment has merit and EP has been updated.	• ConocoPhillips Australia P has engaged with DPIPWE, UTAS and IMAS as relevant persons (refer to Assessment of Merit for these stakeholders) to assist in identifying research opportunities. As a

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	crab) are 'temporary and localised'. This contradicts existing research that indicates long lasting decreased immunity and damage to the rock lobster statocyst (Day et al. 2019). The VFA would therefore advocate for further funding to be directed to better understanding the impact on key commercial species within the survey area, particularly Southern Rock Lobster and Giant Crab		result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
Minister for Resources (Federal) – Dale Rentsch	**Stakeholder Engagement** • Suggested ConocoPhillips Australia engage Gavin Pearce MP and Assistant Minister Duniam.	Comment has merit and has been actioned through addition of Relevant Persons and further provision of information.	• ConocoPhillips Australia met with Gavin Pearce MP and Assistant Minister Duniam and were sent fact sheets and updates.
	General advice and information • Advised of interest in time frames to production assuming all goes to plan.	Comment has merit and has been actioned through and further provision of information.	• Minister for Resources (Federal) Chief of Staff was provided with an estimated timeframe to production.
	Stakeholder engagement • We note the Fact Sheet 1, distributed through August – emphasises the use of CSI technology. Can you please provide more detail of this technology, how it varies from conventional methods including information related to the air gun array and discharge, shot interval, sound profile, sound transmission and literature supporting any ecological benefit of its use. • Please keep us informed as part of the EP process and on the distribution list for vessel activities while the survey is underway.	Noted and actioned through update to relevant person.	• ASBTIA provided with further details regarding CSI technology on 12 October 2020 via formal letter. • ABSTIA retained as a relevant person and will be informed throughout the EP process.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
SETFIA	**Stakeholder engagement** • Stakeholder advised he was aware emails had been released as SIV representative had contacted him. Stakeholder's expectation was that this would happen but flagged that SIV had different expectations. Was advised that stakeholder was working directly with SIV. • Stakeholder requested a copy of the fact sheet to be sent. Also requested shape files of operational and survey area to progress fishing report.	Comment has merit and response provided to relevant person.	• SETFIA retained as a category 1 relevant person with direct engagement in addition to the engagement with SIV. • Email sent to stakeholder on 7 Aug 2020 with formal letter and project information, including GIS shape files of the operational and acquisition area.

	Adjustment protocol
	• Fishers should not be refused compensation if they had reduced catches but then left the area.
	• Consider payment for relocation
	• Best practice to average each price of fish that will be paid out in compensation
	• Advised ConocoPhillips Australia to use standardised pricing instead of:
	  ○ Producing documents with prices.
	  ○ Weighing catches by agents.
	  ○ Calculating sales to all different places.
	  ○ Calculating kilograms of fish and revenue.
	• Standardised pricing can be based on a yearly average or a recent average.
	• Advised when talking about units of measurement, do be specific with catch per unit and the effort its focused on. Advised ConocoPhillips Australia to determine the most appropriate unit of effort.
	  ○ Trawlers – per shot
	  ○ Gillnetters – per shot
	  ○ Crab pots – per pot haul
	• Flagged not to use day or month because fishermen could fish more or less.
	• Flagged COVID-19 catches and prices as a barrier as the price and demand has never been greater. Flagged issues esp. for crab.
		Comment has merit and considered in development of adjustment package, and response provided to relevant person.	• Any commercial fisher who experiences a reduction of catch, displacement of fishing activity or fishing gear loss or damage in line with the finalised protocol would be eligible.
			• Reduction in catch, loss or damage to equipment and displacement are the potential claims considered within the scope of the project as it is a temporary activity.
			• ConocoPhillips Australia recognises that a standardized approach presents challenges when needing to demonstrate previous fishing data and evidence.
			• Noted, it is proposed 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 by the fishing method resulting in the landed catch. Fishing method examples include trawl hour, kilometre of line set, number of hooks per kilometre for line fishing, or per trap lift e.g. CPUE=kilograms per trawl hour.
			• It is proposed that the current price is defined as that received by a commercial fisher at the point of first landing, excluding any price margins for marketing, transport, sales commissions, value adding or packaging. Market price would be taken as the most recent price received prior to the start of the Sequoia survey which should account for the increased prices noted through COVID.
			• Noted, ConocoPhillips Australia will consider this in the refinement of the protocol.
			• Noted, it is proposed that Statutory Government Catch records will be required to be submitted to support claims.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	• Advised ConocoPhillips Australia to ensure a protocol is made for no payment to be made for vessels being paid by 3rd party • If required, suggest statutory declaration instead of affidavit • Request that process is timely and no significant delays in processing • Request for simple, clear forms. Request that claim process does not account for freight, handling and other charges which can be unnecessarily detailed. • How to account for changes to market conditions (e.g. speculative fishing) due to COVID-19 and Chinese trade restrictions. • The costs / time requirements that Associations incur by supporting their members with the application process • Provide clear, easy to read information to SIV, TSIC, SETFIA, SSIA members on the Protocol and with a relevant scenario/ example of a claim. • The requirement for a national approach to the potential impacts from seismic.		• ConocoPhillips Australia will aim to provide the claimant with an assessment report within 30 days of claim lodgement. • ConocoPhillips Australia has taken this feedback on board and has aimed to keep the proposed process as simple and clear as possible while still providing procedural rigour. • ConocoPhillips Australia acknowledges this concern. The basis for ConocoPhillips Australia's Adjustment Protocol is evidence-based; comparing historic fishing catch with the August – October 2021 fishing catch in the survey's operational area. Without historic fishing catch data, the methodology used for consistency of assessment cannot be applied. However, ConocoPhillips Australia has extended adjustment eligibility to fishers who have historically fished in the operational area and are compelled to fish outside of the operational area due to the survey. • ConocoPhillips Australia agrees. As such, ConocoPhillips Australia has incorporated the below into the Protocol: • If a claimant incurs costs in preparing and lodging a claim under this protocol, then those costs up to a value of $2000 may be reimbursed upon provision of invoices/receipts. This is applicable for fully documented, eligible claim applications, whether successful or not. • To reduce time requirements by the claimant or the person/business acting on their behalf, an option has been included to provide ConocoPhillips Australia with authorisation (on a confidential basis) to directly access the claimant's catch and effort information strictly relevant to their application from the government department/authority with jurisdiction over their fishery. This will save time and effort by the claimant in preparation of a claim. • A draft fact sheet has been developed. This includes an example of a claim by a Southern Rock Lobster fisher. • ConocoPhillips Australia acknowledges this concern; however this is outside the scope of the Adjustment Protocol for the Sequoia survey. Along with the Fishing Associations, ConocoPhillips Australia is actively engaged with the current national

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			departmental workshops aimed at developing a framework for co-existence between fishers and seismic operators.
Tasmanian Seafood Industry Council (TSIC)	**Stakeholder Engagement** • On Monday 2 November 2020, TSIC received correspondence through the Sequoia Project email address. This correspondence included ConocoPhillips Australia response to specific issues and concerns raised by TSIC members during the consultation process. Amongst dealing with the rock lobster market disruption, the TSIC CE commenced responding to TSIC concerns and issues within this correspondence as part of the ConocoPhillips Australia consultation report. Given the significant Chinese market and other seafood issues, progress was slow. On the 9 December, the TSIC CEO was very surprised to receive communications from ConocoPhillips Australia saying they had submitted the EP to NOPSEMA, and that the Public Consultation process closes on the 4 January 2021. ConocoPhillips Australia did not make communication with TSIC to say they would submit the EP. They did not formally request the report they knew I was working on prior to submitting the EP. No final date for input was provided, instead the EP was submitted. It is TSICs view that ConocoPhillips Australia did not provide a reasonable period to consider this information and provide a response, including any objections or claims about potential adverse impacts of the activity, as required under the environmental regulation. • Furthermore, to drive a public consultation period during the busy Christmas seafood trade period and Christmas break (10 days), whilst the most significant issue for the Tasmanian rock lobster fishery in recent history is playing out, could be viewed as dishonest. • Throughout the ConocoPhillips Australia consultation process, several fishers expressed their frustration at 'yet another' seismic survey consultation process. There was confusion as to who ConocoPhillips Australia's	Comment has merit and has been actioned through response to relevant person.	• ConocoPhillips Australia has been continuing to engage with TSIC and update the EP (particularly the adjustment package) following the submission of the original EP to NOPSEMA. • The timing of public exhibition was not designed to intentionally coincide with the Christmas and New Year period. The EP preparation and assessment schedule was timed in order to meet a survey period that ConocoPhillips Australia believes meets the right balance between protecting cetaceans and fishing interests. • ConocoPhillips Australia is cognizant of 'consultation fatigue' felt by many fishers. To manage this wherever practical, ConocoPhillips Australia liaised directly with fisheries associations rather than individual fishers to reduce consultation fatigue. ConocoPhillips Australia also took up TSIC's suggestion of consulting in accordance with the SIV/TSIC policy (Policy in Relation to Mining, Gas and Petroleum Sector Consultation with the Professional Seafood Industry) and engaged both SIV and TSIC in a fee for service arrangement. • Relationship with TRLA noted and direct response to comments already received will be provided to TRLA but going forward all communications will be through TSIC • Offer of attendance at consultations noted and appreciated.

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	were, and why they were doing more surveys in an area where there had also been seismic. People thought 3D oil had already conducted work and there was confusion around the location of the previously completed seismic by Schlumberger. This 'consultation fatigue' resulted in many participants providing relatively brief comments compared to previous seismic consultations. Further disengagement and frustration has occurred due to the significant financial and mental strain placed on the Tasmanian seafood industry as a consequence of COVID-19. • Rock lobster fishing association has working agreement with TSIC to lead engagement. • TSIC able to attend port visits with ConocoPhillips Australia.		
	Scientific basis for assessment of impacts • Instead of criticising and selectively using science, the oil and gas industry should be supporting the collection of new science to gain a better understanding of the impacts of seismic on the marine environment. • Page 384 of the ConocoPhillips Australia EP states: [Plankton] cannot take evasive behaviour to avoid seismic sources. However, the potential for population level noise effects is limited due to their widespread distribution and rapid population growth rates. This statement is incorrect for the larval component of the zooplankton. This life stage requires adults to mate, eggs to develop then spawn and the larval life cycle to be undertaken. In the case of rock lobster this can be >2 year period. This is not rapid population growth. • Page 385 of the EP states: In a study of the effects of seismic acoustic source exposure on early-stage embryonic (entirely soft tissue) SRL (*Jasus edwardsii*), Day et al (2016) found that exposure to seismic sound did not result in a decrease in fecundity (either through a reduction in the average number of hatched larvae or	Comment has merit and has been actioned through response to relevant person.	• ConocoPhillips Australia has engaged with DPIPWE, UTAS and IMAS as relevant persons to assist in identifying research opportunities. As a result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities • ConocoPhillips Australia will update Section 4.2.2 of the EP that assesses impact to eggs, early life-cycle stages, juvenile and adult SRL to make it clear in the assessment that a 2-year larval life cycle has been considered. If TSIC is aware of any scientific literature regarding the impacts of seismic surveys on southern rock lobster larvae additional to that already presented, ConocoPhillips Australia will review this and incorporate it into the EP as relevant. • ConocoPhillips Australia agrees with TSIC that there have been no studies of impact from seismic sound on free swimming SRL eggs and larvae. There is, and there will likely continue to be, disagreement on the implications of the data and literature available on the impacts of seismic to SRL eggs. ConocoPhillips

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	as a result of high larval mortality) and did not result in compromised larvae or morphological abnormalities. TSIC finds this statement misleading as it does not clearly articulate that the 'exposed' SRL eggs are in fact protected under the hard tail of an adult female rock lobster. Connected to this is the statement: These results [above] are aligned with those of Pearson et al (2014) that indicate early life stage crustaceans may be more resilient to seismic acoustic source exposure than other marine organisms. TSIC finds this quote very misleading (even false) as it infers that free floating eggs and early free-swimming larvae are more resilient to the direct impacts of seismic. There is no scientific evidence to show that seismic will not impact early stage, free swimming SRL eggs and larvae as the research has not been conducted. • TSIC accepts that some parts of the scientific community have raised issues and concerns around the methodology and interpretation of the McCauley study. Regardless, the study poses questions around our knowledge and understanding of the impacts of seismic on zooplankton. Furthermore, statements and quotes made by ConocoPhillips Australia do not adequately explain or justify impacts to the larval component of zooplankton. Instead there is considerable attention to the rapid recovery of zooplankton through self-recruitment and mixing. This argument does not hold for larvae. For example, late-stage rock lobster larvae have been in the water column for up to 24 months post hatching from eggs; and eggs are kept under the tail of an adult female lobster prior to hatching. Furthermore, egg production requires a viable female and male lobster. Therefore it takes up to 2.5 years before that stage larvae can be expected to reenter the marine system. In amongst the dot points highlighted above is the following dot point. • The survey will be inconsequential when compared to natural mortality		Australia have communicated to TSIC that the results of our impact assessment showed that within 170 m of the sound source there could be mortal effects to SRL eggs. ConocoPhillips Australia has also shared the information that shows recruitment into the Tasmanian Rock Lobster Fishery occurs from eggs distributed across the whole Otway bioregions and that the SRL biomass is a single, connected population. Based on these facts, there is no cause effect pathway between SRL egg mortality within 170 m of the sound source and a change in recruitment into the fishery (see Section 4.2.2.2 for the full assessment). • The rapid recovery of zooplankton through self-recruitment and mixing is relevant to impacts to zooplankton – if recovery is rapid, then impacts at a population level are lessened. These statements are for zooplankton in general and not specific to Southern Rock Lobster. The impact assessment in the EP contends that the impacts of the survey will be acceptable and ALARP to Southern Rock Lobster and its fishery, based on the literature available. The EP acknowledges that based on the available knowledge there will be some impact on larval stages, however there is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are predicting mortal effects on early life cycle stages limited to approximately 200 m from effect. Given the widespread distribution of larval stages due to the current based dispersion this distance of impact can be considered localised. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of impact is determined and accepted by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact especially on giant crabs and in applying the precautionary principle it will:

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	rates of fish eggs and larvae, which are generally very high. Tang et al (2014) notes that plankton mortality can exceed 50% per day in some species and commonly exceeds 10% per day. A review of mortality estimates by House and Zastrow (1993) found that the average mortality rate for marine fish larvae was equivalent to 21.3% per day. Again, this statement is misleading and does not address the fundamental issue or concern of the Tasmanian seafood industry – will seismic impact current and future stocks? The EP does not clearly articulate there is no scientific studies looking at the impact of seismic on SRL larvae. Even if seismic induced mortality is lower than natural mortality, the scientific literature and understanding of rock lobster recruitment patterns is minimal. We do not know if early stage and/or late-stage larvae 'aggregate' before dispersal or settlement. Hence, we do not understand if extra mortality due to seismic will have recruitment level impacts. ConocoPhillips Australia have not mitigated this significant risk. Unfortunately, any evidence of recruitment failure will not be detected for 5+ years, when lobster are large enough to appear as legal size recruits in the fishery. • Page 390 Table 7.10 – Demonstration of acceptability for potential impacts to plankton. External context – ConocoPhillips Australia states Commercial fisheries associations have raised concerns about the impacts of MSS on plankton, noting that papers they have read indicate mass mortality. These concerns have been addressed through ConocoPhillips Australia providing stakeholders with detailed responses to their concerns and mapping, which illustrates the overlap between the survey area and the fishing grid cells relevant to the fishery in question. ConocoPhillips Australia have not adequately addressed industry concerns. They have not provided scientific evidence to show that their proposed activity will not result in recruitment level impacts on		◦ Fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. ◦ Excise of the SW corner of key Giant Crab habitat. • No publicly available information exists regarding SRL and Giant Crab source/sink dynamics, and for impact assessment purposes, ConocoPhillips Australia has made the assumption that currents in the region circulate plankton in a uniform fashion. • All available literature on larval impact has been assessed as part of the EP. The following references Houde & Zastrow (1993) (pg 389), Saetre and Ona (1996) (pg 385) and Richardson (2017) (pg 386) were included because they relate to impacts to plankton or fish larvae. They do not specifically call out southern rock lobster or giant crab larvae because there is little to no information on these species in their larval stage (as noted in previous points). Importantly, the Parry and Gason (2006) paper notes that there was no evidence that catch rates of southern rock lobster in western Victoria declined in areas near seismic surveys in the years or weeks following any of the 33 seismic surveys undertaken between 1978 and 2004 (pg 435 of the EP).

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	rock lobster, giant crab and other commercial species. Without knowing the source / sink dynamics of larval dispersal and settlement, saying that impacts to larvae will be highly localised does not mitigate potential unknown recruitment level impacts. • On page 12, ConocoPhillips Australia summarise research papers regarding impact of MSS on larvae and zooplankton. The information provided gives TSIC no comfort that MSS activity will not impact larvae and hence future stocks of rock lobster and giant crab, as well as other commercially targeted species. TSIC notes that ConocoPhillips Australia places most attention of studies that looked at exposure of adult berried lobsters and crabs to seismic, and subsequent survival of eggs and hatched larvae. These papers do not assess the impact of seismic exposure on larvae. The report further states Given the small area of impact from seismic surveys to plankton compared with natural morality rates and then references three papers. • Houde & Zastrow references a paper titled 'Ecosystem- and taxon-specific dynamic and energetics properties of larval fish assemblages'. TSIC cannot understand the relevance. • Saetre and Ona 1996 again looks at 'The effects of seismic surveys on fish eggs and larvae' • Richardson 2017 looks at 'Potential impacts on zooplankton of seismic surveys'. None of these papers have direct relevance to rock lobster and giant crab larvae. From these references, TSIC cannot understand how ConocoPhillips Australia can conclude that the resilience of some species eggs/larvae to acoustic noise, the potential loss of eggs/larvae as a result of seismic sound will be very low compared to expected natural morality rates and directly connect this with survival and impact on rock lobster and giant crab larvae and future stocks.		
	Impacts to Commercial Fishing Operations	Comment has merit and has been actioned	• There is no cause effect pathway identified through the assessment process that could have a stock level impact on the longer-term

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	• It must be remembered that the consequences to the oil and gas industry of the ALARP process not addressing real impacts and risks is negligible, however the consequences for the fishing industry could be significant and result in reduced egg production, recruitment failure and ultimately reduced Total Allowable Catches. It is important to note that these impacts will not be observed until at least 3 to 5 years post seismic survey, well after the oil and gas seismic testing has moved on. Such timeframes are near impossible to monitor and test the impacts of seismic. • It is concerning to TSIC that EPs continually use terms such as 'highly unlikely' in their assessment of impact. Such terms do not sit well in the fishing community, and our concerns are exacerbated by statements made by the authors of the research by the University of Tasmania and Curtin University who state, "there is a significant and unknowledgeable potential for ocean ecosystem function and productivity to be negatively impacted by present seismic technology". • It is important to understand that fisheries catch, and effort data does not reflect the true dynamics of fishing effort and fish stocks. For example: • Fisheries reporting, and assessment blocks are often very large vs the spatial distribution of fishing effort. i.e. oil and gas regularly assume equal distribution of fishing effort within a fishing block to conclude that they will have a lower impact on fishing activities and/or fishers can move to other parts of a fishing block. These assumptions do not hold true. • Some stocks are often not targeted for a range of reasons. For example, there is a known and extensive area of southern rock lobster west of King Island. This stock is located in deep water and is rarely fished as the bigger 'white' lobsters from deep water do not fetch the price of the shallower 'red' lobsters. This resource will not be visible if using only fisheries data	through response to relevant person	sustainability of the fishery. As a result of the activity, we are not predicting mortal affects to adult lobster or Giant Crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). Recognising the uncertainty, particularly around the Giant Crab fishery and the SRL fishery, ConocoPhillips Australia has reduced the overall size of the acquisition area, including excising a section in the SW corner based on the giant crab target fishing depth. ConocoPhillips Australia will also fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. • The use of term 'highly unlikely' aligns with our risk management practice which is consistent with AS/NZS ISO 31000:2018: Risk Management – Principles and Guidelines, and AS/NZS ISO 14001:2016 EMS – Requirements with guidance for use. Unfortunately, it is not often possible to definitely state that there 'will' or 'will not' be an impact of a certain magnitude. This is, in part, why consequence and likelihood ratings are applied to each hazard; so as to provide an overall indication of impact or risk. • ConocoPhillips Australia acknowledges that catch and effort within a reported fishing block may be spatially targeted to locations or not targeted for non-regulated industry stock management reasons. The EP has assumed equal distribution of fishing effort in fishing reporting blocks given that detailed spatial information of fishing effort is not available for confidentiality reasons. ConocoPhillips Australia nots the presence of the deeper 'white' lobster stock and appreciates the additional information. ConocoPhillips Australia is not expecting any adult mortality as a

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	but may be important to the fishery in later years and as a source of egg production
	• ConocoPhillips Australia provides limited or no references to the impacts of MSS on: • Southern Rock Lobster or Tasmanian Giant Crab larvae (any stages) in the water column. • Only one reference to impact of MSS on larvae, with not enough detail to understand the relevance of the study to the Tasmanian situation. • Impact of MSS on newly settled rock lobster or Giant Crab. • Impacts of MSS on juvenile or adult Tasmanian Giant Crab. There is a significant lack of evidence base to support limited or no impact of the proposed MSS on the Tasmanian fishery, and no detail to explain how these knowledge gap concerns will be mitigated to ALARP (noting our concerns RE ALARP). As such, TSIC and the Tasmanian rock lobster and Giant Crab fisheries have significant concerns about the potential impacts of the proposed MSS, especially in light of recent research identifying that MSS activity has a far greater impact on Southern Rock Lobster, scallops and zooplankton than previously reported.
	• ConocoPhillips Australia should not take this concern lightly, and it is appropriate to remind ConocoPhillips Australia of a 2010 case study that supports our concerns. During this MSS planning stages, the survey proponent argued there was no scientific evidence to show that seismic activity would have a detrimental impact on a known and significant bed of commercial scallops within Bass Strait, to the north of Flinders Island. Counter to this argument, there was no definitive scientific evidence to show that MSS activity would not have a negative impact on commercial scallops. Regardless, approvals were granted and the MSS conducted. Some five months after the MSS was conducted, the commercial scallop fishery opened to harvesting to find that approximately 24,000 tonnes of scallops worth an estimated $70 million had died.
			result of the activity so would not expect any impact on this stock. If TSIC is able to provide more information about this Southern Rock Lobster stock, it can be incorporated into the impact assessment.
			• The EP has been updated to include further detail on the larval stage impacts of the activity. The EP acknowledges that based on the available knowledge there will be some impact on larval stages, however there is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are only predicting mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact especially on Giant Crabs and in applying the precautionary principle it will:
			  • Fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
			  • Excise of the SW corner of key Giant Crab habitat.
			• There is sufficient evidence to indicate that seismic surveys do not result in immediate mass mortalities, and that long-term mortalities are in line with natural ranges. Follow up studies indicated warmer waters at the time of the scallop die-off, which may have resulted in their death given that they are known to be temperature sensitive. Nevertheless, scallops are not abundant or commercially fished in the proposed survey area and therefore not a concern.

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	Again, the seismic proponent argued they were not the cause as there was no scientific evidence to show they would have an impact on scallops. Since this case study, our scientific understanding has expanded and we now know that MSS activity can result in delayed mortality of adult commercial scallops (IMAS research), the delay matching the time delay observed in the case study. Perhaps the industry suspicion, although not back by the scientific literature at the time, was in fact correct. • With the proposed ConocoPhillips Australia MSS area overlapping giant crab and deep-water southern rock lobster stocks, and current scientific knowledge gaps for the impact of seismic, TSIC recommends the proposed MSS activity does not overlap any known giant crab or rock lobster habitat		• ConocoPhillips Australia has considered and assessed the feasibility of excising a greater area from 100m to 400m to exclude more known Giant Crab and rock lobster habitat. In order to appropriately assess the perceptivity of the permit, seismic acquisition is required over these water depths. It is acknowledged that Giant Crab adults may be present in the deeper waters of the south-west corner of the acquisition area. Giant Crab in these areas have less exposure to sound from the increased distance from the sound source. There is an absence of fishing effort in deeper waters. Anecdotal feedback from fishers and UTAS shared knowledge of the sparsity of adults and supporting habitat at increasing depths. Weighing these against the Sequoia survey objectives an increased or total excise of the southwest corner is not justified.
	Adjustment Package/Offsets • In light of a limited scientific understanding of the impacts of seismic, and the agreed outcome that seismic is having a level of impact on larvae and adults of many commercially targeted species, it is the firm recommendation of TSIC that ConocoPhillips Australia offset this impact through the establishment of a Community Fund. This fund could be used to rehabilitate the damage caused by the proposed activity. Potential projects that could support rock lobster stocks in the NW of Tasmania could include: • An extension of the current translocation program, where juvenile rock lobsters are caught in slow growing deep water regions in southern Tasmania and relocated to shallow fast growing regions of the NW. • The establishment of a program that collects newly settled rock lobster (puerulus) from marine farm infrastructure, ongrow these within an on land nursery and then releases back into the wild population. This concept is currently being discussed with the Institute for Marine	Comment has merit and has been actioned through response to relevant person	• ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact on giant crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. ConocoPhillips Australia considers this a more appropriate measure then compensation in the form of an offset or marine community fund at a broad fishery level, without any evidence of fishery level impact. ConocoPhillips Australia is committed to the refinement of the adjustment package in consultation with SIV. Through this process any direct impact on fisheries will be managed.

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	and Antarctic Studies as a very viable strategy to support rock lobster stocks in Tasmania.		

	Survey timing
	• Impacts on Marine Invertebrates - Crustaceans Page 439 states: SRL spawning occurs between late winter and early spring (i.e., between August and September) and drift as plankton for up to six weeks before first settlement (see Section 5.5.2) (up to about mid-November). This statement is incorrect. SRL larvae drift as plankton for between 9 months and 24 months – hence the concern around the impact of seismic on SRL larvae.
	• ConocoPhillips Australia have only assessed impact against active fishing activity in the SRL fishery. They have not adequately acknowledged, addressed or assessed other aspects of why the SRL fishery is closed during the proposed "survey window". Notably, they have not addressed or mitigated the following: • The Tasmanian rock lobster fishery is closed to female rock lobster from 1 May to mid-November to support spawning. Consequently, this is the peak period where early-stage larvae are localised in very high densities in the water column. Larvae stay in the water column for the next 9 to 24 months before settlement as pueruli. During this time, there is significant mortality of larvae. The risks posed by seismic during the September / October spawning period, when there is high abundances and densities of vulnerable early-stage larvae in the water column, is not acceptable to TSIC until there is greater understanding of the impacts of seismic on SRL larvae. The same concerns hold for giant crab. Page 440 has the following statements (in italic): Tasmanian fishery… The survey cannot avoid the fishing season for female SRL (open all year). This statement is not correct. The female rock lobster fishing seasons closes on the 1 May and reopens with the start of the season in mid-November. The survey cannot avoid the
		Comment has merit and has been actioned through response to relevant person	• ConocoPhillips Australia examined these claims and included additional information on the ecology of Southern Rock Lobster and Giant Crab to the EP (Section 4.2). Key life phases for these species is as follows:
			  • Southern Rock Lobster (*Jasus edwardsii*) – mate from April to July, fertilized eggs carried for 4-6 months before being released between September and November. The larvae (phyllosoma) then live in the plankton and undergo 11 developmental stages over 12-24 months while being carried by ocean currents, often far beyond the continental shelf. The phyllosoma then moult and metamorphose into a puerulus larvae, still living in the water column and then settle on reef in shallower waters, moulting again into pigmented juvenile lobsters. In adults, moulting generally occurs in September and October. Southern Rock Lobster reaches commercial fishing size after 3 to 10 years.
			  • Giant Crab (*Pseudocarcinus gigas*)– this species is endemic to the waters of southern Australia, living along the upper slope of the continental shelf. Giant Crabs breed in June and July, with the females carrying eggs for about four months. After the eggs hatch between October to November, the larval duration is about 50 days. This species can live up to 30 years and is slow growing (reaching 12-14 cm at maturity, but up to 20 cm and 10 kg in weight). Juveniles moult their carapace every 3-4 years and adult females about once every nine years. Mating is only possible when the new shell is still soft.
			• In deciding the optimal time to undertake the Sequoia MSS, ConocoPhillips Australia has balanced the ecology of these species with those of key threatened cetaceans known to occur in the region, particularly for the migration and foraging seasons of the Pygmy Blue Whale (PBW) and Southern Right Whale (SRW) and key periods for target fishery species. (Temporal Presence and Absence section in Appendix A). This figure clearly demonstrates that there is no one period of time through the year where critical life stages for species of concern to stakeholders can be entirely avoided by the

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	fishing season for male crabs (open all year). SRL male season in the NW is closed from 1 October to mid-November. The table does not reference the unknown impact on larvae. • Both male and female rock lobster molt (shed their outer shell) during the September / October period. The new shell is soft, leaving southern rock lobster more vulnerable to predation, disease and other impacts. The impact of seismic on soft shelled lobster and crabs is currently not known and not addressed in the ConocoPhillips Australia EP. Conducting seismic during this highly vulnerable period is not acceptable to TSIC until further scientific knowledge shows no impacts. The table (and entire EP) does not reference the unknown impact of seismic on newly molted, soft shelled SRL and giant crab. This would be the most vulnerable stage of these commercially important species.		survey, though peak migration times for whales are avoided. ConocoPhillips Australia has aimed to undertake the survey that best protects threatened whale species and avoids overlap with peak periods of commercial fishing for the Giant Crab and Southern Rock Lobster. The 30 period after the 1 May represents the peak migration period for the humpback whale and general periods of activity for other threatened whale species. It would also overlap with peak fishing periods for the Southern Squid Jig and the Southern Rock Lobster fisheries. SIV noted that the Nov-Jan period was the most important period for spawning for their fisheries. Given the long residence time in the water for larval stages (up to 2 years) ConocoPhillips Australia is unable to time the survey to avoid the larval stages entirely. Recognising the multiple constraints, the Aug-Oct period selected tried to minimise impacts across all sectors. • ConocoPhillips Australia recognised there is some uncertainty particularly with regards to the impact on Giant Crab. Applying the precautionary approach ConocoPhillips Australia has managed this by excising the Giant Crab fishery area (140-300m plus buffers) from the acquisition area
	Cumulative impacts • Would like to see cumulative impacts of seismic with Schlumberger added to EP.		• An overlay of the Schlumberger survey (Jan – April 2020) and the proposed Sequoia survey is provided the EP. The Sequoia MSS is scheduled to be conducted during August-October 2021. This means there will be 15 months between the two surveys. In the absence of temporal or spatial overlap between the two surveys, cumulative impacts are unlikely to eventuate. There is no overlap in the acquisition area. Bureau of Ocean Energy Management (BOEM) published a final environmental review of geological and geophysical survey activities off the mid- and South Atlantic coast (BOEM, 2014). To minimise the impacts to marine life by providing a ‘corridor’ between vessels, the environmental impact statement from this review included a requirement for a 40 km (21.6 nm) geographic separation distance (based on worst case scenarios) between the sources of simultaneous MSS. This is now a routinely adopted control in the seismic survey industry. ConocoPhillips Australia has adopted this as a control measure and if it becomes aware of the potential for another MSS to take place in the same

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			area at the same time as this survey, at least a 40 km (21 nm) separation will be maintained between active sources to ensure sound from one source doesn't interfere with sound from the other and to reduce the possibility of cumulative sound impacts). A control measure has been implemented a 40 km separation between the survey and other operating seismic vessels of concurrent / simultaneous surveys in the region of the Operational Area during data acquisition.
	Research • Should ConocoPhillips Australia continue, TSIC recommends that ConocoPhillips Australia funds a comprehensive, independent, long term research monitoring project to improve our understanding of the impact of MSS and to monitor any impacts the proposed activity has on rock lobster and giant crab stocks now and into the future (i.e. impacts on early stage larvae will not be observed for 4 – 5 years). The research should focus on key knowledge gaps including: • Impact of MSS on juvenile and adult Giant Crabs – noting anecdotal reports of good abundances of small Giant Crabs within the proposed MSS survey area. • Impact of MSS on newly settled southern rock lobster (puerulus). • Impact of MSS on early and late-stage free floating larvae. • Impact of MSS on broader ecosystem services. • TSIC notes that the ConocoPhillips Australia report does not mention impacts on squid, which was highlighted in one survey response.	Comment has merit and options investigated	• ConocoPhillips Australia has engaged with DPIPWE, UTAS and IMAS as relevant persons (refer to Assessment of Merit for these stakeholders) to assist in identifying research opportunities. As a result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. • The impacts on squid (cephalopods) is addressed in the mollusc impact assessment in Section 4.2.4 of the EP.
Tasmanian Rock Lobster Fishermen's Association (TRLFA)	**Cumulative impacts** • Consideration of cumulative impacts • Schlumberger has only recently completed a seismic survey in adjacent waters to the ConocoPhillips Australia proposed survey area. This survey will significantly increase the regional footprint of seismic testing in the Otway basin and adjacent waters and put at risk some species that may already have suffered the effects of seismic blasting. The as yet unknown effects	Comments have merit and cumulative impacts need to be considered as part of the assessment process.	• It is a NOPSEMA requirement that cumulative impact assessments are included as part of the EP. For the Sequoia MSS, the EP assesses cumulative impacts as part of understanding the existing pressures on the environment. • The Sequoia MSS is scheduled to be conducted during August to October 2021. This means there will be 15 months between the two surveys. In the absence of temporal or spatial overlap between the two surveys, cumulative impacts are unlikely to eventuate. There is no overlap in the acquisition area. Bureau of Ocean

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	of cumulative testing on various species needs to be quantified and mitigation strategies employed to safeguard them		Energy Management (BOEM) published a final environmental review of geological and geophysical survey activities off the mid- and South Atlantic coast (BOEM, 2014). To minimise the impacts to marine life by providing a 'corridor' between vessels, the environmental impact statement from this review included a requirement for a 40 km (21.6 nm) geographic separation distance (based on worst case scenarios) between the sources of simultaneous MSS. This is now a routinely adopted control in the seismic survey industry. ConocoPhillips Australia adopted this as a control measure and if it becomes aware of the potential for another MSS to take place in the same area at the same time as this survey, at least a 40 km (21 nm) separation will be maintained between active sources to ensure sound from one source doesn't interfere with sound from the other and to reduce the possibility of cumulative sound impacts.
	Potential impacts to Commercial Fishing Operators • Proximity of King Island and important fishing ground for Giant Crab and rock lobster to the proposed survey site • The effects of seismic testing on adult and larval stages of SRL and the possible effects on rock lobster and giant crab larvae that accumulate and disperse through the proposed area and timing of the survey. • The long (18 months -2 years) larval period of lobsters means that up to 2 years class size of lobster larvae may be subjected to the effects of seismic testing at any given time that could, in effect impact on 2 generations of lobsters. • Stock rebuilding strategies are being currently employed for both the giant crab and rock lobster fisheries and negative impacts from seismic testing could jeopardise those strategies.	Some of the comments have merit and where appropriate updates have been made to the EP.	• The easternmost extent of the acquisition area is located 24 km west of the King Island coast. ConocoPhillips Australia acknowledges the potential impact on the Giant Crab and rock lobster fisheries, which has been a focus of its consultation and management measures. King Island representatives have also been engaged in the development of the EP. • ConocoPhillips Australia assessed the potential for the Sequoia MSS to have an impact on adult Southern Rock Lobster and Giant Crab larvae, which includes life-cycles impacts. The EP includes results from the only known study on the impacts of seismic surveys on early-stage embryonic (entirely soft tissue) Southern Rock Lobsters. This assessment was supported by a comprehensive review of scientific literature and informed with the outputs of underwater acoustic modelling. Acoustic modelling applied the seafloor PK-PK threshold of 202 dB as the level of particle motion from sound that could cause an impact to crustaceans. Particle Matter motion is considered to be the most appropriate metric to use as opposed to sound pressure level as it is this element of sound that crustaceans are most sensitive to. The distance from the source to this level varied between 324 m and 414 m depending on water depth. ConocoPhillips Australia's assessment concludes that impacts to the larvae of these species are managed to a level that does not

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			create an unacceptable impact on future recruitment and catch rates productivity because of: 1. The small overlap with the Tasmanian rock lobster fishery (1%) and the absence of suitable rock lobster habitat in the survey area; 2. Limited overlap with the Giant Crab fishery, based on the excise of the key fishing location in the SW corner of the acquisition area; 3. Research conducted to date does not indicate mortality of exposed adult crustaceans (meaning that breeding success may not be affected); and 4. The acoustic modelling undertaken for plankton indicates that crustacean in the drifting planktonic phase are not likely to be impacted by the seismic pulses unless within 210 m of the sound source. • There is no cause effect pathway identified through the assessment process that could have a stock level impact on the longer-term sustainability of the fishery. As a result of the activity, we are not predicting mortal affects to adult lobster or giant crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). Recognising the uncertainty, particularly around the Giant Crab fishery and the SRL fishery, ConocoPhillips Australia has reduced the overall size of the acquisition area, including excising a section in the SW corner based on the giant crab target fishing depth. ConocoPhillips Australia will also fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.

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			• The stock rebuilding activities being undertaken for the Giant Crab and rock lobster fisheries would be subject to the same cause affect pathways as the general fishing stock. Therefore, the assessment applied above will apply. It could be expected that some mortality may occur that will be within the natural variation of the stock levels year on year. This would not expect to have an impact on the stock rebuilding activities.
	Scientific basis for assessment of impacts • The dismissal and misrepresentation of IMAS data by the Oil and Gas Industry • Consideration of the research conducted by IMAS in particular the impact of seismic on: • Health and wellbeing of adult rock lobsters • Impact on rock lobster and giant crab larvae • Broader impact on ecosystems	Some of the comments have merit and where appropriate updates have been made to the EP.	• ConocoPhillips Australia acknowledges that this is a growing and developing area of research with some knowledge gaps still present. To ensure the accurate incorporation of the latest scientific information ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. • ConocoPhillips Australia conducted a review of scientific literature that addresses the impact of seismic sound on crustaceans, including Southern Rock Lobster and Giant Crab. ConocoPhillips Australia presents the findings in Section 4.2 of the EP and does not misrepresent, dismiss or otherwise distort results from the available scientific literature.
	Stakeholder Engagement • Poor consultation Process – consultation needs to be meaningful and supports the TSIC Consultation Framework.	ConocoPhillips Australia considered the comment and has noted	• ConocoPhillips Australia has undertaken an extensive engagement process with both State and Commonwealth commercial fishers and recreational fishing bodies as part of the development of the EP (Chapter 4.7 in EP). • The TSIC industry policy regarding consultation with fishers is outlined in "Policy in Relation to Mining, Gas and Petroleum Sector Consultation with the Professional Seafood Industry". Recognising issues around stakeholder fatigue and coordination of effort, ConocoPhillips Australia has followed this guidance and not engaged with individual fishing licence holders but rather entered a fee for service arrangement with TSIC and SIV to ensure adequate engagement.

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	Adjustment Package/offsets • Apply an offset principle to set up a marine community fund to support rehabilitation projects.	ConocoPhillips Australia considered the comment but does not consider it to have merit.	• Any future claims or agreements regarding compensation would have to be supported by evidence of actual economic loss attributable to the activity before ConocoPhillips Australia could approve. This is a normal and fair approach in approving any claim for loss. Therefore, ConocoPhillips Australia does not support the view that compensation in the form of a marine community fund be considered at a broad fishery level, without any evidence of fishery level impact.

Seafood Industry Victoria (SIV)	**Impact on Commercial Fishing Operators**
	• SIV considers all fishers consulted in this process are 'directly impacted' by this survey as they are licenced to operate in the area – whether they have catch history in the area or not. All are displaced from this area if it a no-go zone during the survey operations. Through the consultation and varied responses, there are a number of fishers who we would determine as potentially impacted by the operation of the 3D seismic survey being proposed. Fishers especially those that target rock lobster and giant crab estimate that a substantial amount of product will be impacted by the proposed survey.
	• The 'impacted stakeholder' evaluation process is flawed and fails to recognise the full impact of this activity. Especially the broader environmental damage that impact on all fishers, not just those that might operate within the boundaries of this survey.
	• Seek to see the Fisheries impact pages of the Environment Plan as soon as possible, noting very little information has been provided on the survey to date.
	• Industry raised significant concerns on the depth of the proposed operations. To meet ALARP in the eyes of Victorian Rock Lobster fishers, seismic surveys must remove all potential RL habitat (<150m) from survey.
	• Questioned actual depths and suggested area excised be extended to 100-400m and instead work at extremes.
		ConocoPhillips Australia considered the comment some of the comments have merit and have been addressed in changes to the EP	• Fisheries were deemed to be relevant persons and potentially affected by ConocoPhillips Australia if they:
			  • Have jurisdiction to fish within the Sound EMBA;
			  • Have recent catch history within the Sound EMBA (within last 10 years); and
			  • Fishing methods would mean it was feasible to operate in the water depth or Operational Area.
			ConocoPhillips Australia felt this was a reasonable criterion to capture those potentially impacted and is in line with industry standards. This process identified rock lobster and Giant Crab as relevant persons and much of the engagement has focused on these groups.
			• The adjustment package is subject to ongoing engagement between ConocoPhillips Australia and SIV. ConocoPhillips Australia has sought feedback on the proposed methodology and feedback on the definition is welcomed through this process. ConocoPhillips Australia's position is that any future claims or agreements regarding compensation would have to be supported by evidence of actual economic loss attributable to the activity before ConocoPhillips Australia could approve.
			• SIV has been provided with project summary, oil spill modelling, underwater sound modelling and project update information sheets and other information on request. A copy of the full EP was available through the public comment period, including the fisheries impact section. ConocoPhillips Australia acknowledges that integrating the EP for public comment into its broader engagement with relevant persons did not provide information to relevant persons in a form that was easily accessible. For a request

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			of this nature however where it was deemed that SIV was seeking detailed information in the context of the overall EP, ConocoPhillips Australia felt that deferring to the overall EP was appropriate. The reference to the Noise Impact Chapter provided SIV with the ability to review the impact assessment and the noise modelling report which was appended to the EP. In recent correspondence with SIV, ConocoPhillips Australia has committed to SIV to provide additional underwater sound mapping and information once the updated impact assessment is completed as part of this resubmission. • The majority of T/49P lies in waters less than 150m. Removing areas of the survey less than 150 min depth removes the majority of (91%) of the acquisition area, making it unviable for the survey to take place. In order to appropriately assess the perceptivity of the permit, seismic acquisition is required over these water depths. In terms of overlap with the rock lobster fishery, there is a 1.7% overlap with the Victorian fishery area and a 1 .1% overlap with the Tasmanian fishery area. In terms of overlap with catch effort, a report prepared by SETFIA/Fishwell indicates that (based on yearly catches averaged for the last 10 years) the operational area represents 5.2% of the Victorian catch and <1% of the Tasmanian catch. • ConocoPhillips Australia has considered and assessed the feasibility of excising a greater area from 100m to 400m. As noted above in order to appropriately assess the perceptivity of the permit, seismic acquisition is required over these water depths. It is acknowledged that Giant Crab adults may be present in the deeper waters of the south-west corner of the acquisition area. Giant Crab in these areas have less exposure to sound from the increased distance from the sound source. There is an absence of fishing effort in deeper waters. Anecdotal feedback from fishers and UTAS shared knowledge of the sparsity of adults and supporting habitat at increasing depths. Weighing these against the Sequoia survey objectives an increased or total excise of the southwest corner is not justified.
	Research	ConocoPhillips Australia considered the	• ConocoPhillips Australia does acknowledge some impact will occur from its activities, however it is important to note that seismic

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	• On the balance of probabilities, there should be some recognition of this damage and some financial contribution by the titleholder to support some form of 'offsetting improvement' to the marine environment or research to better understand how this can be done. Airlines keep burning fossil fuels to fly but offer 'carbon offsets' in an effort to balance out the resulting environmental damage. Why should this damage to the environment be treated any differently? • We seek commitment to undertake a regional study to quantify the spatial and temporal impacts, including pre and post water column testing for eggs & larvae of fisheries resources. ConocoPhillips Australia to consider options for working with industry in a pre/post survey assessment which will contribute scientifically to the knowledge of interaction of seismic operations with fisheries resources.	comment but does not consider it to have merit.	activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact on giant crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities. ConocoPhillips Australia considers this a more appropriate measure then compensation in the form of an offset or marine community fund at a broad fishery level, without any evidence of fishery level impact. ConocoPhillips Australia is committed to the refinement of the adjustment package in consultation with SIV. Through this process any direct impact on fisheries will be managed. • ConocoPhillips Australia does not support these options as they would not contribute to measurement, with any reasonable level of reliability, of any long-term impacts from the Sequioa MSS. The funding provided to UTAS described above will allow help identify research priorities.
	Cumulative impacts • How has ConocoPhillips Australia assessed and addressed the findings of the Curtain - Comparison study of cumulative sound exposure levels (CSELs) from typical 3D seismic surveys? CSELs must be investigated on the already weakened fisheries resources, noting the proposed up and down tracking of the seismic – this will lead to resources being exposed to compounding cumulative sound exposure. To what extent has this been considered by ConocoPhillips Australia? • Therefore, we request immediate insight on the sound reach including the impact buffer and request an independent review of these when this modelling work has been presented. • This is yet another seismic survey in the long line of surveys conducted over decades in this region. The	ConocoPhillips Australia considered the comment some of the comments have merit and have been addressed in changes to the EP.	• It is a NOPSEMA's requirement that cumulative impact assessments are included as part of the EP. For the Sequoia MSS, underwater sound has been assessed where there was a cause effect pathway established between sound and a particular receptor. The method of impact assessment used requires consideration of existing pressures on these receptors. For the type of cumulative impacts referred to in this claim the quantitative sound level modelling undertaken includes consideration of all relevant noise exposure pathways; single pulse, cumulative pulses, and particle motion. • The area that may be affected by underwater sound impacts has been described in the information sheet provided and the EP (including a full copy of the noise report). ConocoPhillips Australia is also willing to facilitate a meeting with stakeholders and the sound consultant to discuss the modelling methodology and results. • An overlay of seismic studies in the region is provided. Given the sub-lethal impacts to individual species predicted from seismic sound,

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	collective impact of these surveys (not just this one) is not recognised or addressed. • Noting the activity undertaken in the close proximity to the Western border of this survey area by Schlumberger in recent times, there is significant and alarming potential that any denuding from the Schlumberger survey will be further compromised with ConocoPhillips Australia Seismic Survey in these waters. How has this been considered in your EP? Asked if we could overlay SW corner that was surveyed by Schlumberger to assess cumulative impact for consideration		the complexity and natural variances of environmental dynamics over such a long period, and the release of petroleum titles in the Otway (including consultation with DAWE) there is little relevance of previous surveys to the Sequoia MSS. • An overlay of the Schlumberger survey (Jan – April 2020) and the proposed Sequoia MSS is provided. The Sequoia MSS is scheduled to be conducted during August-October 2021. This means there will be 15 months between the two surveys. In the absence of temporal or spatial overlap between the two surveys, cumulative impacts are unlikely to eventuate. There is no overlap in the acquisition area. Bureau of Ocean Energy Management (BOEM) published a final environmental review of geological and geophysical survey activities off the mid- and South Atlantic coast (BOEM, 2014). To minimise the impacts to marine life by providing a 'corridor' between vessels, the environmental impact statement from this review included a requirement for a 40 km (21.6 nm) geographic separation distance (based on worst case scenarios) between the sources of simultaneous MSS. This is now a routinely adopted control in the seismic survey industry. ConocoPhillips Australia has adopted this as a control measure and if it becomes aware of the potential for another MSS to take place in the same area at the same time as this survey, at least a 40 km (21 nm) separation will be maintained between active sources to ensure sound from one source doesn't interfere with sound from the other and to reduce the possibility of cumulative sound impacts). A control measure has been implemented a 40 km separation between the survey and other operating seismic vessels of concurrent / simultaneous surveys in the region of the Operational Area during data acquisition.

	Adjustment Package
	• The criteria for 'impacted fishers' (and assumptions around what they can do to ameliorate that impact, e.g. by simply 'fishing somewhere else') is flawed. Fishers don't necessarily fish the same grounds every year anyway. There is also an impact by concentrating fishing effort by asking fishers to simply 'fish somewhere else'. Simply making a fisher move from a ground they are fishing (due to exclusion areas from a seismic survey,
		ConocoPhillips Australia considered the comment some of the comments have merit and have been addressed through further engagement with relevant persons.	• Fisheries were deemed to be relevant persons and potentially affected by ConocoPhillips Australia if they:
			  • Have jurisdiction to fish within the Sound EMBA;
			  • Have recent catch history within the Sound EMBA (within last 10 years); and
			  • Fishing methods would mean it was feasible to operate in the water depth or Operational Area.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	etc), does not mean fishing effort will be reduced. Fishing effort remains constant, but moves from area to area, fishery to fishery, therefore if one fisherman is no longer viable in their fisher they move to another fishery/area, adding pressure to that fishery/area. This must be kept in mind as this has the potential to increase the number of potentially impacted people in the fishing industry. The impact of this activity (and areas for considering 'compensation') is too narrow. As outlined above, there should be a mechanism to recognise the broader impact to the marine environment of such surveys and require some appropriate form of remediation. • We would expect negotiations to begin to discuss compensation/quota retirement for displaced fishers. ConocoPhillips Australia to advise SIV of how/when/what information is required to enter negotiations with identified 'potentially affected' persons regarding potential compensation. • Fishers, especially those that target rock lobster and Giant Crab, estimate that a substantial amount of product will be impacted by the proposed survey • The proposed survey area is home to several fish species that are fished at different times of the year • Previous Origin surveys in the Otway basin effectively set a precedent of a $2,000 per square km for exactly this purpose [recognising the broader impacts]. This should become a standard for all titleholders wishing to conduct these surveys. • We would expect negotiations to begin to discuss compensation/quota retirement for displaced fishers" • Seeking only to identify harvesting areas as being potentially impacted by this seismic testing is a fundamental flaw to this 'impacted stakeholder' evaluation…there should be some recognition of this damage and some financial contribution by the		ConocoPhillips Australia felt this was a reasonable criterion to capture those potentially impacted and is in line with industry standards. ConocoPhillips Australia is currently seeking feedback to refine the criteria of who should be considered in the scope of the adjustment package. Any future claims or agreements regarding compensation would have to be supported by evidence of actual economic loss attributable to the activity before ConocoPhillips Australia could approve. This is a normal and fair approach in approving any claim for loss. Therefore, ConocoPhillips Australia does not support the view that compensation in the form of a marine community fund be considered at a broad fishery level, without any evidence of fishery level impact. • Negotiations have commenced with SIV on the adjustment package, with feedback sought on the draft adjustment package. • ConocoPhillips Australia agrees that Rock Lobster and Giant Crab will be considered as part of the Adjustment Package • ConocoPhillips Australia would require more specific information where fishing activity has taken place in the same block or fishing event location that is the subject of a claim • ConocoPhillips Australia is seeking feedback on an adjustment protocol approach which uses a fishery specific market price and historical CPUE to determine the eventual amount paid per square km. A standard price per square km does not recognise the variability in individual catch and effort. • ConocoPhillips Australia has commenced and will continue to engage with SIV and other representative bodies on the adjustment package with a commitment that it will be finalised prior to survey commencement. • There is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are not predicting mortal affects to adult lobster or giant crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	titleholder to support some form of 'offsetting improvement' to the marine environment or research to better understand how this can be done. • How to account for changes to market conditions (e.g. speculative fishing) due to COVID-19 and Chinese trade restrictions. • The costs / time requirements that Associations incur by supporting their members with the application process. • Provide clear, easy to read information to SIV, TISC, SETFIA, SSIA members on the Protocol and with a relevant scenario / example of a claim. • The requirement for a national approach to the potential impacts from seismic.		NOPSEMA, taking into account consultation with stakeholders and the information they provide. • The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). • Notwithstanding this, the widespread distribution and abundance of stock means that it can tolerate a large amount of mortality. • ConocoPhillips Australia acknowledges this concern. The basis for ConocoPhillips Australia's Adjustment Protocol is evidence-based; comparing historic fishing catch with the August – October 2021 fishing catch in the survey's operational area. Without historic fishing catch data, the methodology used for consistency of assessment cannot be applied. However, ConocoPhillips Australia has extended adjustment eligibility to fishers who have historically fished in the operational area and are compelled to fish outside of the operational area due to the survey. • ConocoPhillips Australia agrees. As such, ConocoPhillips Australia has incorporated the below into the Protocol: ○ If a claimant incurs costs in preparing and lodging a claim under this protocol, then those costs up to a value of $2000 may be reimbursed upon provision of invoices/receipts. This is applicable for fully documented, eligible claim applications, whether successful or not. ○ To reduce time requirements by the claimant or the person/business acting on their behalf, an option has been included to provide ConocoPhillips Australia with authorisation (on a confidential basis) to directly access the claimant's catch and effort information strictly relevant to their application from the government department/authority with jurisdiction over their fishery. This will save time and effort by the claimant in preparation of a claim. • A draft fact sheet has been developed. This includes an example of a claim by a Southern Rock Lobster fisher.

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			• ConocoPhillips Australia acknowledges this concern; however this is outside the scope of the Adjustment Protocol for the Sequoia survey. Along with the Fishing Associations, ConocoPhillips Australia is actively engaged with the current national departmental workshops aimed at developing a framework for co-existence between fishers and seismic operators.
	Long term impacts • ConocoPhillips Australia must consider opportunities for 'make good' funding given the scientific uncertainty of the long-term impact. Appropriate precautionary mitigation must be taken to assist in restoring the marine environment following the damage done by seismic air-guns. Rock lobster fishers can (and will) be directly impacted by any activity that significantly and permanently damages rock lobsters and/or kills plankton in the water column (noting that for the first two years following the release of eggs, rock lobsters move through multiple planktonic life stages in the open ocean before settling on reefs, as puerulus - basically miniature lobsters, to grow out to adulthood). So this approach of seeking to only identify harvesting areas as being potentially impacted by this seismic testing (which we now know is an activity that results in the damage mentioned above) is a fundamental flaw to this 'impacted stakeholder' evaluation. So, how much damage to rock lobster stocks and survivability will be caused by this survey? We do not know. But we do know that damage will be done. As such, this is not an issue that can or should be ignored. And it is not good enough to make ambit claims that this somehow 'doesn't matter' in the great scheme of things. That is a cynical and unfounded claim. Pointing to improving (western zone) lobster fishing productivity in recent years (by way of anecdotal evidence that seismic testing does no harm) is also misguided as industry has been investing heavily (through reduced TACCs) to rebuild stocks.	ConocoPhillips Australia considered the comment but does not consider it to have merit.	• There is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are not predicting mortal affects to adult lobster or Giant Crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, considering consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk). • ConocoPhillips Australia acknowledges that there is uncertainty especially around the potential impact especially on Giant Crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	While stocks have been slowly rebuilding, this has not occurred to the level expected • Fishers have highlighted a number of concerns with regards to the proposed survey. Stock levels being impacted during the testing and in some species several months after the survey. "reduced sustainable catch rates during and after the seismic survey has commenced, also after the survey has concluded for up to 6 months." "Seismic testing kills the food the crays eat, and I believe it damages crayfish. I am concerned our catch rate will go down."		
	Survey timing • There are a number of critically important processes that occur in the waters off the Otway Basin during the spring-summer period. Particularly November-January, is the most important period of the year for spawning and larval dispersal of most species. Some species aggregate to spawn and undertake an annual migration to spawning areas, which must occur over a period prior to initiation of spawning. Any disruption of the migration, spawning or larval life cycle while suspended in the water column has every possibility of significantly impacting recruitment and settlement into a fishery. This is a very serious matter that must be considered before any seismic operations occur.	ConocoPhillips Australia considered the comment has merit, but no changes made to EP.	• In deciding the optimal time to undertake the Sequoia MSS, ConocoPhillips Australia has balanced the ecology of these species with those of key threatened cetaceans known to occur in the region, particularly for the migration and foraging seasons of the Pygmy Blue Whale (PBW) and Southern Right Whale (SRW) and key periods for target fishery species. (Appendix A – Temporal presence and absence section). This figure clearly demonstrates that there is no one period of time through the year where critical life stages for species of concern to stakeholders can be entirely avoided by the survey, though peak migration times for whales are avoided. ConocoPhillips Australia has aimed to undertake the survey that best protects threatened whale species and avoids overlap with peak periods of commercial fishing for the giant crab and southern rock lobster. The 60-day period after the 31 March represents the peak migration period for the humpback whale and general periods of activity for other threatened whale species. It would also overlap with peak fishing periods for the Southern Squid Jig and the Southern Rock Lobster fisheries. The proposed timing for the survey will avoid the Nov-Jan period SIV notes as the most important period for spawning.
	Stakeholder engagement • SIV wish to engage directly with ConocoPhillips Australia not a consultant with simple and clear information	ConocoPhillips Australia considered the comment some of the comments have merit and have been	• ConocoPhillips Australia will engage directly with SIV, not through a third party. • ConocoPhillips Australia has noted that SIV represents all seafood licence holders in Victoria except squid fishing.

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	• SIV represents all seafood licences issued by State of Victoria. Advised not peak body for squid fishing but has been picked up by TSIC • Ideal timing to consult Sept to November during spawning season • SIV requested proposal document and information on the project (tech, what, where) noting not all members have emails and messages can take up to 7 days to get to King Island • Impact to larvae means that quota holders (not just active fishers may be interested. TSIC does not represent quota holders but TRLA does. • ConocoPhillips Australia to provide acquisition area maps with depth contours visible to allow industry to better assess the habitat in which the survey is proposed. • ConocoPhillips Australia to provide in depth presentation of sound reach maps and confirm how these will be complied with or measured. Noting the Victorian fishing industry want to know more detail on the 'survey', 'operational' and 'sound reach' areas to further consider impacts and provide further comment. This is not accepted by the seafood industry, and we again seek provision of maps that detail the 'sound reach'. Including provision SIV for distribution to industry maps of the seismic survey, fishing grids and the outermost area of seismic sound exposure to be overlaid on the map.	addressed through further engagement with RP	• ConocoPhillips Australia commenced and had significant consultation during the Sept to Nov timing (when SIV was engaged on a fee for service arrangement). Due to the ongoing nature of the project consultation has extended beyond this period. • SIV has been provided with the proposal document and associated information and ConocoPhillips Australia notes the limitations on communications with King Island. • TRLA was initially notified of the project and their concerns were directly responded to by ConocoPhillips Australia. Subsequent engagement has been through SIV and TSIC. • On 3 March ConocoPhillips Australia provided sail lines and distance to effect sound information. Following the reformatting of the impact assessment ConocoPhillips Australia has committed to providing updated information to SIV.
	Scientific basis for assessment of impacts • There is currently no known safe range for fish resources from seismic operations, i.e. we don't know how far beyond 500 m the array would need to be from a lobster to not see an effect. This raises questions on the use of Day et al. (2016) as the definite limit of sound exposure.	Comments noted and actioned through provision of additional information to the relevant person.	• For crustaceans (lobster, crab), the distance to no impact is predicted to be a maximum of 414 m from the seismic source to the modelled seafloor, applying the PK-PK criteria of 202 dB re 1 µPa (Payne et al. 2008). This criterion is associated with 'no mortality or damage to mechano-sensory systems and recoverable injury' and is considered conservative when compared to PK-PK criteria presented in Day et al., 2016a, 2017 and 2019 of 209, 210, 212 and 213 dB re 1 µPa (see Appendix E – Jasco modelling report).

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			Based on 414 m, the area where SRL may be affected by sound at any point in time is ~0.5 km2 at the seafloor around the source, or less than 0.001% of the Otway bioregion.
King Island Shire Council (KISC)	**Potential impacts to Commercial Fishing Operators** • Identified that Community perceptions that testing might put at risk our Island's seafood industry is a significant issue, especially as the most recent independent analysis in 2015 stated that it was worth around $20-23 million per annum to our Island's economy. • It is important for ConocoPhillips Australia to guarantee that the seismic testing will not harm our seafood industry and that there is robust science to support this position. Providing this information will enable Council to effectively engage in a meaningful dialogue with ConocoPhillips Australia and our community.	Comments noted and response provided to Relevant Person	• KISC provided with additional information regarding the risks to commercial fishing and management on 27 October (Sensitive Information Report REF GEN3). • ConocoPhillips Australia assessed the potential for the Sequoia MSS to have an impact on adult southern rock lobster and giant crab larvae, which would include all life-cycles of the stock rebuilding process. The EP also includes results from the only known study on the impacts of seismic surveys on early-stage embryonic (entirely soft tissue) southern rock lobsters. This assessment was supported by a comprehensive review of scientific literature and informed with the outputs of underwater acoustic modelling (Appendix E). Acoustic modelling applied the seafloor PK-PK threshold of 202 dB as the level of particle motion from sound that could cause an impact to crustaceans. ConocoPhillips Australia's approach is considered to be the most appropriate metric to use as opposed to sound pressure level as it is this element of sound that crustaceans are most sensitive to. The distance from the source to this level varied between 324 m and 414 m depending on water depth. ConocoPhillips Australia's assessment concludes that impacts to the larvae of these species are localised, temporary and managed to a level that does not create an unacceptable impact on future recruitment and catch rates productivity because: Of the small overlap with the Southern Rock Lobster fishery (1%) and the absence of suitable rock lobster habitat in the survey area; No overlap with the Giant Crab fishery, based on the excise of the 140-300 m water depths (plus buffers); Research conducted to date does not indicate mortality of exposed adult crustaceans (meaning that breeding success may not be affected); and The acoustic modelling undertaken for plankton indicates that crustacean in the drifting planktonic phase are not likely to be impacted by the seismic pulses unless within 210 m of the sound source. • ConocoPhillips Australia recognises that there is an impact to the Giant Crab and rock lobster fisheries through the temporary closure to the operations area, potential temporary effects on

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			stock levels and uncertainty. The development of a commercial fishery adjustment protocol in conjunction with the fishing industry peak bodies recognises this.

	Stakeholder Engagement
	• Council would appreciate receiving a copy of statutory approvals so it can be fully informed of the evidence provided to the relevant authorities and the performance obligations these approvals may place on ConocoPhillips Australia.
	• To further assist our dialogue, Council would appreciate your company's advice on how the seismic testing program and your company's plans might directly benefit our Island economy and our community.
		Comments have merit and noted and actioned through provision of additional information to the relevant person.	• KISC was provided a link to the full EP and additional information on 9 December 2020.
			• ConocoPhillips Australia is cognizant of 'consultation fatigue' felt by many fishers. In response, ConocoPhillips Australia released a series of easy-to-digest fact sheets that introduced the company, the project and presented the results of the oil spill modelling and underwater sound modelling. Additionally, ConocoPhillips Australia liaised directly with fisheries associations rather than individual fishers to reduce consultation fatigue. ConocoPhillips Australia also took up TSIC's suggestion of consulting in accordance with the SIV/TSIC policy (Policy in Relation to Mining, Gas and Petroleum Sector Consultation with the Professional Seafood Industry) and engaged both SIV and TSIC to provide a survey to its members to seek its member's views of the survey.
			• ConocoPhillips Australia also arranged a community drop-in style session on King Island to where local community members, including fishers, were able to speak with ConocoPhillips Australia experts on the proposed activity, its impacts and ongoing mitigations and controls. A total of 19 King Island residents attended the drop-in session and signed the registration log.
			• ConocoPhillips Australia representatives attended an in chambers meeting (Sensitive Info REF KISCMM1) with the King Island Mayor, five councillors and General Manager where ConocoPhillips Australia made the following commitments to ongoing engagement:
			  ◦ Send summaries of new research papers that pertain to seismic to the KISC as they become available.
			  ◦ Pending COVD19 travel restrictions, return to King Island post EP acceptance but prior to activity commencement (noting potential time sensitivities) to run an information session on what was committed/ accepted in the EP and how the acquisition will be managed.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			• Continue to provide updates on EP development as milestones are reached. • Share re-formatted relevant chapters with the KISC when available.
	Scientific basis for assessment of impacts • Council raised concern that ConocoPhillips Australia had disregarded studies that identified impacts to Southern Rock Lobster from seismic sound. Council raised concern about impact to early life cycle stages of Southern Rock Lobsters and limited scientific knowledge.	Comments noted and response provided to Relevant Person	• ConocoPhillips Australia acknowledges and accepts that undertaking marine seismic surveys causes impact. ConocoPhillips Australia conducted a review of scientific literature that addresses the impact of seismic sound on crustaceans, including Southern Rock Lobster and Giant Crab. ConocoPhillips Australia presents the findings in Section 4.2 of the EP. ConocoPhillips Australia acknowledges that this is a growing and developing area of research with some knowledge gaps still present. To reduce this uncertainty especially around the potential impact on giant crabs and it will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
	Long term impacts • ConocoPhillips Australia must consider the vulnerability of the King Island Community and any flow on impacts to the commercial fishing value chain when assessing long term impacts • ConocoPhillips Australia must consider the long-term impacts of seismic sound on commercial fisheries, specifically early life cycle stages of Southern Rock Lobster. • Council raised concern to the visual amenity of the Island and its viability as a tourist destination should development of offshore acreages occur.	ConocoPhillips Australia considered the comment and responded to the relevant person.	• ConocoPhillips Australia is cognisant of the vulnerability of the King Island community and the impact any changes to the commercial fishing operations or tourism could have on local businesses. Any impact to fishing operations due to displacement is being managed under the commercial fishing adjustment protocol. ConocoPhillips Australia is committed to the principle that a fisher should not suffer an economic loss as a direct result of the Sequoia Survey. . As described below ConocoPhillips Australia does not anticipate any long-term impact on the fisheries at a stock level. • There is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fisheries. As a result of the activity we are not predicting mortal affects to commercial species including adult lobster or giant crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, considering consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of Giant Crabs where due to increased uncertainty the activity was redesigned to mitigate risk). • ConocoPhillips Australia is cognisant of the King Island tourism brand and acknowledges the concerns raised around visual amenity. Should exploration prove successful, visual amenity/ impact would be a consideration of production facility planning and approval.
	Contribution to scientific research • Council outlined concerns about limited scientific research on long term impacts to fisheries from seismic sound, specifically the early life cycle stages of the Southern Rock Lobster, and the need for titleholders to contribute to this body of work.	ConocoPhillips Australia considered, some of the comments have merit and where appropriate updates have been made to the EP.	• ConocoPhillips Australia considers that there is sufficient scientific available on the impact on SRL to enable an impact assessment to be undertaken with a low level of certainty. ConocoPhillips Australia acknowledged that there is a level of uncertainty in the prediction of impacts to giant crabs from seismic sound. As a result, the survey was redesigned to mitigate risk. ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in of the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
King Island Brand Management	**General advice and information to assist in the development of the EP** • King Island Council recognises the importance of protecting the reputation of our Island for high quality produce as an integral part of maintaining the economic and social sustainability of our Island. • With regard to the Senate Committee on the Environment's report on the impacts of seismic testing on fisheries and the marine environment, our group are concerned that NOPSEMA may approve the environmental plan for the Sequoia Survey before that report is presented to government and consequently the findings and recommendations of that report will not be reflected in the operations of ConocoPhillips Australia.	Comments noted.	• ConocoPhillips Australia is cognisant of the marketability of Tasmania's and particularly King Island's image as a pristine area in which to fish, given the low human population in the region and relative absence of polluting industries. ConocoPhillips Australia takes its environmental responsibility seriously, and its Sustainable Development Position and Biodiversity Position are included in the EP. COP believes these positions are met in the design of the Sequoia MSS, the environmental impact assessment presented in the EP and the controls that will be adopted for the survey. As such, ConocoPhillips Australia believes that the Sequoia MSS will not result in any damage to Tasmania's 'pristine' reputation. • ConocoPhillips Australia is aware of the Senate Inquiry. The Senate Inquiry on the Impact of Seismic Testing on Fisheries and the Marine Environment is independent of the NOPSEMA assessment and approvals process for MSS EPs. ConocoPhillips Australia is

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			following the current process under the Offshore Petroleum and Greenhouse Gas Storage Act 2006.
	Potential impacts to Commercial Fishing Operators • Insufficient research exists to categorically define the long-term impacts of seismic testing on fisheries and the marine environment. • The larval stages of the Southern Rock Lobster take place across the acquisition area proposed by ConocoPhillips Australia. Research points to significant aquatic noise causing obliteration of life at this stage, with chronic impacts in fully grown lobster compounding breeding and stock recruitment, subsequently impeding catch rates and total allowable catch levels. • Given that CSI Technology is not industry standard, we are concerned that the negative impacts of using such an array will be greater than recorded by IMAS. At the very least, the uncertainty of these impacts for King Island and its fishing fleet is greater. • ConocoPhillips Australia must provide more certainty about not having an impact on commercial fisheries.	Comments have merit and noted and actioned through provision of additional information to the relevant person.	• The EP recognised a level of uncertainty in the impact assessment and manages this through controls and management to reduce it to as low as reasonably practical. • ConocoPhillips Australia assessed the potential for the Sequoia MSS to have an impact on adult Southern Rock Lobster and Giant Crab larvae. The EP also includes results from the only known study on the impacts of seismic surveys on early-stage embryonic (entirely soft tissue) southern rock lobsters. This assessment was supported by a comprehensive review of scientific literature and informed with the outputs of underwater acoustic modelling (Appendix E) Acoustic modelling applied the seafloor PK-PK threshold of 202 dB as the level of particle motion from sound that could cause an impact to crustaceans. Particle Matter is doing motion is considered to be the most appropriate metric to use as opposed to sound pressure level as it is this element of sound that crustaceans are most sensitive to. The distance from the source to this level varied between 324 m and 414 m depending on water depth. ConocoPhillips Australia's assessment concludes that impacts to the larvae of these species are localised, temporary and managed to a level that does not create an unacceptable impact on future recruitment and catch rates productivity because: Of the small overlap with the southern rock lobster fishery (1%) and the absence of suitable rock lobster habitat in the survey area; No overlap with the giant crab fishery, based on the excise of the 140-300 m water depths (plus buffers); Research conducted to date does not indicate mortality of exposed adult crustaceans (meaning that breeding success may not be affected); and The acoustic modelling undertaken for plankton indicates that crustacean in the drifting planktonic phase are not likely to be impacted by the seismic pulses unless within 210 m of the sound source. • The acoustic sound source does not increase as a result of using Compressive Seismic Imaging (CSI) technology. The main difference between CSI technology and traditional seismic acquisition technology is how the survey is designed (allowing wider spacing of survey lines) and how the acquired data is subsequently processed.

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			• There is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fisheries. As a result of the activity we are not predicting mortal affects to commercial species including adult lobster or giant crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk).
	Long term impacts • ConocoPhillips Australia must consider the long-term impacts of seismic sound on commercial fisheries, specifically early life cycle stages of Southern Rock Lobster.	ConocoPhillips Australia considered the comment and responded to the relevant person.	• There is no cause effect pathway identified through the assessment process for impact on early life cycle stages of SRL that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are not predicting mortal affects to commercial species including adult lobster or Giant Crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of Giant Crabs where due to increased uncertainty the activity was redesigned to mitigate risk and further research has been committed to).
	Survey timing • While we appreciate the proposed timing of the survey has been set to minimise the impact on the fishing season, that will be of little use if it reduces the quantity and/or quality of the crayfish that can be caught in future fishing seasons. The short-term impacts of this survey are not of huge concern to us–the long-term impacts and the industry-wide uncertainty about the	Comments have merit and noted and actioned through provision of additional information to the relevant person.	• In deciding the optimal time to undertake the Sequoia MSS, ConocoPhillips Australia has balanced the ecology of these species with those of key threatened cetaceans known to occur in the region, particularly for the migration and foraging seasons of the Pygmy Blue Whale (PBW) and Southern Right Whale (SRW) and key periods for target fishery species. (Temporal Presence and Absence section in Appendix A). This figure clearly demonstrates that there is no one period of time through the year where critical life stages

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	scale of those long-term impacts is of most concern to us.		for species of concern to stakeholders can be entirely avoided by the survey, though peak migration times for whales are avoided. ConocoPhillips Australia has aimed to undertake the survey that best protects threatened whale species and avoids overlap with peak periods of commercial fishing for the giant crab and southern rock lobster. As described above all life cycle stages have been considered in the impact assessment, which takes into account risks that could cause long term impacts.
	Adjustment protocol • KIBM believes the proposed adjustment protocol should consider long-term impacts to the sustainability of the fishery caused by the marine seismic survey.	ConocoPhillips Australia considered the comment and responded to the relevant person.	• There is no cause effect pathway identified through the assessment process that could have a stock level impact on the sustainability of the fishery. As a result of the activity we are not predicting mortal affects to adult lobster or Giant Crabs, with the only mortal effects on early life cycle stages limited to approximately 200m from effect. Seismic activities do not operate to a no impact standard. Instead, the acceptable level of risk is determined and permissioned by NOPSEMA, taking into account consultation with stakeholders and the information they provide. The assessment demonstrates that there is limited uncertainty in the prediction of these impacts and ConocoPhillips Australia are confident in the prediction (with exception of giant crabs where due to increased uncertainty the activity was redesigned to mitigate risk and further research has been committed to). The adjustment protocol is in place for demonstrated economic loss to the fisheries. Feedback on the protocol is currently being sought by ConocoPhillips Australia from the relevant fishing associations.
	Stakeholder Engagement • We express our dismay on the timing of this consultation. Opening this consultation in early December to run over the Christmas and New Year break has effectively reduced the consultation period by two weeks. • KIBM believed the EP was a challenging document to understand and find information in. • KIBM would like ongoing engagement with ConocoPhillips Australia.	Comment has merit and response has been provided to relevant person.	• ConocoPhillips Australia recognises the timing of the NOPSEMA run public submission process over the December/January period presented issues for many stakeholders. • ConocoPhillips Australia acknowledges that the original Sequoia MSS EP was difficult to navigate and aims to reformat this in a way that is easier for stakeholders to digest. • ConocoPhillips Australia has committed to providing reformatted chapters to interested stakeholders.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
King Island Chamber of Commerce (KICC)	**Impact to commercial fishing operators** • What impact does this technology have on lobsters/giant crab compared to a standard survey? What is the likely impact of the survey to commercial fishers.	Comment has merit and response has been provided to relevant person.	• The acoustic sound source does not increase as a result of using Compressive Seismic Imaging (CSI) technology. The main difference between CSI technology and traditional seismic acquisition technology is how the survey is designed (allowing wider spacing of survey lines) and how the acquired data is subsequently processed.
	Adjustment package • Will commercial fishers be compensated for loss?	Comment has merit and response has been provided to relevant person.	• There is no provision in the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations for compensation. ConocoPhillips Australia has gone beyond regulatory requirements and committed to compensating affected commercial fishers if losses are incurred. • ConocoPhillips Australia will have a commercial fishing compensation protocol in place prior to the survey commencing.
	General advice and information • What economic benefit will there be for the community as a result of seismic survey? • Can you please send information on CSI Technology and any updates?	• Comment has merit and has been actioned through further provision of information.	• The seismic operations will not have a land-based component. There is not expected to be any economic impact, positive or negative on King Island community. Any members of the fishing community who may be economically affected may apply through the adjustment protocol for compensation. CSI Technology fact sheet sent to KICC on 18 September 2020.
King Island Courier (KIC)	**General advice and information** • The King Island Courier newspaper would appreciate being kept up to date with all additional information on your Sequoia project.	Comment has merit and has been actioned.	• King Island Courier has been added to community engagement list and will be provided updates from the project
TGS	**Cumulative impacts** • TGS have an approved EP to acquire the Otway Deep 3D MSS. The original acquisition proposal was to acquire 3 surveys from the start of October until the end of February between Oct 2019 until end Feb 2022. The first survey in 2019-2020 was not acquired and there are no plans to acquire the second survey in the 2020-2021 window. TGS have not secured 3rd party funding to acquire the third survey between Oct 2021 to Feb 2022. TGS are also planning to submit a separate multi-year EP in Q1 2021 to acquire a 3D marine seismic survey over the 2020 acreage release area in the Otway basin. TGS have submitted an EP to acquire the Capreolus Phase 2	Comment has merit and has been actioned.	• ConocoPhillips Australia has updated the EP with the updated TGS schedule information for consideration in the cumulative impact assessment

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	seismic survey which is expected to be approved in Q4 2020.		
	Adjustment package • The proposed compensation protocol to be included in the EP is likely to be like the protocol defined for the Capreolus Phase 2 seismic survey on the NWS. • TGS have a compensation protocol for damage to equipment but no compensation for displacement and/or loss of catch. The only control measure is to minimise displacement, but there are very few fishers working in the proposed acquisition area.	Comment has been noted	• Adjustment package approach noted for benchmarking development of the ConocoPhillips Australia commercial fishing adjustment protocol.
University of Tasmania (UTAS)	**Access to data** • Access the multibeam sonar data on seabed bathymetry and backscatter that is likely to be collected as part of the survey.	Comment has merit and has been actioned.	• ConocoPhillips Australia will share bathymetry data gathered during the survey with Ausseabed to make it publicly available.
	Complimentary data collection • Possibility of our NESP Marine biodiversity Hub working with ConocoPhillips Australia to undertake a before/after survey of lobster and possibly giant-crab populations in the Zeehan Marine park prior to and following your survey.	Comment has been noted	• ConocoPhillips Australia has engaged with DPIPWE, UTAS and IMAS as relevant persons (refer to Assessment of Merit for these stakeholders) to assist in identifying research opportunities. As a result of these discussions and to address the level of uncertainty, it has been agreed that ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on Giant Crabs, and suitable analogue crabs, to provide information that could inform an increase in the low-power excise area prior to the Sequoia MSS commencing and identify future research priorities.
	Access to research • Current FRDC research working with CGG as part of their recent Lakes Entrance seismic survey. Results are not yet publicly released, but working with FRDC to get them released as soon as possible and happy to discuss in meantime. Important that these results are not released publicly, but DPIPWE felt that it was important that you were aware of these results - refer to DPIRPWE submission that refers to these new results • Publicly released report will be provided once it is available.	Comment has been noted	• ConocoPhillips Australia has met with UTAS and discussed the CGG results.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
Department of Environment, Land, Water and Planning (DELWP)	There is a lack of base-line information on the migration pathways of SE Australian Southern Right Whales. The Fathom Pacific SRW surveillance program does not address this knowledge gap. Robust Southern Right Whale aerial survey methodology, over a much large spatial and temporal scale and including capability for photo-Identification, would be required to improve our understanding of the migratory pathways of the SE Australian Southern Right Whales.	ConocoPhillips acknowledges the low level of base-line information on the SRW.	• The objective of the ConocoPhillips Southern Right Whale (SRW) surveillance program is to support the implementation of an adaptive management procedure specific to minimising impacts from the Sequoia 3D Marine Seismic Survey on this species. Although the objective of this program is not to improve understanding of the migratory pathways of the SE Australian SRW, it has the potential to contribute to knowledge in this area. Consequently, ConocoPhillips is committed to sharing any and all data gathered as part of this program with the Department. • We believe the survey methodology and spatial and temporal scale are appropriate to meet the program objective. • The primary focus of this program is to detect the presence of whales within the area to support adaptive management. The obtainment of photo-IDs is a secondary priority (more information on this is provided below).
	Limitations of the Fathom Pacific SRW surveillance program • Lack of historical data on southern right whale presence and movement offshore	ConocoPhillips believes this comment has merit and again reviewed all available historic data to ensure all this had been assessed.	• Available historical data has been assessed in Section 4.5.3 of the EP. This includes reference to publicly available information from the VBA and the studies provided. Contact was made with the Department on a number of occasions from August 2020 as part of relevant persons engagement. The EP was first made available for public comment between 4 December 2020 and 3 January 2021 and the revised EP, which is currently under assessment, is available via the NOPSEMA website. • Historic data in the VBA along with available distribution trend data has been used to inform the observation stations and aerial routes in the SRW surveillance program, to increase the likelihood of detecting SRW in coastal and offshore waters. • ConocoPhillips thanks DELWP for their offer of assistance to access any new data that is currently in the queue for uploading to the VBA. We are committed to sharing all data generated through this program with the Department to improve the knowledge-base for this species.

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
	• Low detectability of SRW in deeper coastal waters and offshore	ConocoPhillips acknowledges the challenges of detecting SRW and believes this is reflected adequately in the EP and adaptive management procedure.	• Modelling has predicted that noise levels from the seismic survey will be well below levels with the potential to result in Temporary Threshold Shift (TTS) in hearing or behavioural disturbance along the Victorian coast. Females and calves will not be injured or disturbed while in residence along the Victorian coast including in deeper coastal waters (refer to EP Section 4.5.3.2). • In offshore waters, the additional energy impost from behavioural disturbance on migrating cow-calf pairs is considered an unacceptable impact and an escalation in surveillance will occur when they depart coastal waters to improve detectability should they migrate through areas potentially affected by the seismic survey. • As mentioned in our meetings, ConocoPhillips is addressing the low detectability of SRW in deeper waters through a 'multiple-lines of evidence approach' including: ○ Vessel based MMOs supporting real-time detections to at least 3km. ○ Real-time observations from support vessels operating in front of the seismic vessel. ○ Passive acoustic monitoring using the QuietSea™ sentinel module with detection frequencies down to 10 hz (additional information provided below). ○ Notifications from other MMO programs located between the acquisition area and the Victorian coast. ○ A SRW surveillance program that has commenced one month prior to acquisition to locate the occurrence of SRW and establish the presence of cow-calf pairs, generating baseline data specific to this season. ○ A targeted minimum of weekly aerial observations in areas relevant to the seismic activity, namely along the Victorian and King Island coastlines, offshore waters from coastlines and the acquisition area, with mechanisms to escalate flight frequency and spatial focus (e.g. triggered upon movement of cow-calf pairs offshore).

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			○ A minimum of weekly land-based observations along the Victorian coastline and, as a result of recent meetings with the department, access to daily observations from the key aggregation area to support detection of cow-calf pair occurrence and migration onset which would trigger additional surveillance in both the aerial program and in adaption of effort in the land-based program. ○ Harvesting quality-assured citizen science observations along the Victorian coastline. ○ Collation and processing of any SRW photo identification imagery obtained during conduct of the surveillance program to assess the residency and movement patterns of cow-calf pairs.
	Limited spatial scale of the surveys - only cover coastline and seismic acquisition area	ConocoPhillips acknowledges that the survey does not cover the potential distribution of all SRW in all areas but believes it achieves the objective of the program. As such the comment has no merit.	• The objective of the ConocoPhillips SRW surveillance program is to support the implementation of an adaptive management procedure specific to minimising impacts from the Sequoia 3D Marine Seismic Survey on this species. Although the objective of this program is not to improve understanding of the migratory pathways of the SE Australian SRW, it has the potential to contribute to knowledge in this area. Consequently, ConocoPhillips is committed to sharing any and all data gathered as part of this program with the Department. • We believe the spatial scale is sufficient to meet the program objective. • The spatial scale selected is relevant to potential impacts associated with the seismic survey – namely the environment that may be affected by sound (the EMBA) relevant to this species, and areas outside of the EMBA where SRW may migrate towards the EMBA. There is flexibility built into the adaptive management procedure to adapt the flight path and range, and to increase the number of flights to support the location of SRW that are likely to have commenced migration. • This survey is among the most spatially comprehensive SRW surveillance programs to be embarked upon in Victoria. The surveys in the pre-acquisition period have focussed throughout a

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			wide area to provide best possible detection of the occurrence of SRW in the coastal environment. • Should there be, as expected, a progressive concentration of whales into the western Victorian zone, the observation program will adapt effort to provide the best possible information to support the adaptive management procedure (e.g. narrower spatial focus and increased surveillance intensity).
	Limited temporal scale of the surveys - only one (non-typical) season covered, conducted once per week pre-acquisition (weather permitting), 2 x per week during acquisition (weather permitting)	ConocoPhillips acknowledges that the program covers the current season but believes it achieves the objective of the program. As such the comment has no merit.	• The temporal scale of the program targets the pre-acquisition and acquisition period to support adaptive management during the seismic survey. It is considered appropriate that the temporal scale of the program is commensurate with the temporal occurrence of SRW the region. • Given the significant inter-annual variability observed in this species data collection in additional seasons is not expected to provide information relevant to the adaptive management of potential interactions during this season. In addition, mechanism have been put in place to escalate the surveillance program frequency to support decision-making for this particular season. • ConocoPhillips is committed to sharing data at the frequency agreed with DELWP.
	Inability to obtain individual photo-ID's for assessing SRW movement e.g. when flying above the regulated 500m in Victorian waters. Photo-ID requires descent to below 300 m, therefore a permit is required.	ConocoPhillips acknowledges the advantages of being able to fly below 300m and has acted accordingly.	• The aerial surveillance program was originally developed as a research collaboration between Fathom Pacific and the Blue Whale Study, in line with existing collaborations between these two parties. Advice was originally received from the Department that the operating Blue Whale Study's permit, which would allow 300 m altitude flights to support photos-IDs, was acceptable. • On 22 July, a revised decision as to the acceptability of the permit was received from DELWP which triggered reversion to 500m altitude for all surveys. • We will investigate the potential to obtain a separate permit. However, we understand that the local community is highly sensitised to low-altitude flights during the southern right whale calving season (and that the movement of fixed-wing aircraft over this area is considered a potentially threatening process) and that

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			the department is fielding complaints in this regard and may not be supportive of, or able to approve, a permit in the required timeframe. • In all other areas where we conduct surveillance flights (Tasmanian coast, offshore areas and Australian Marine Parks), we are either able to fly at low altitude or have the relevant permit for low-altitude flights to obtain photo-IDs. • The obtainment of photo-IDs is a secondary priority for this project. The primary priority is to detect the presence or absence of whales within the Noise EMBA and broader area to support adaptive management. However, the following points are made: ○ We are currently obtaining individual photo-IDs through the quality-assured citizen science and land-based observation programs and from aerial surveillance (noting we can fly below 500m in the areas listed above). ○ Verifiable photo-IDs have been achieved at 500m altitude – it is more difficult but not impossible (noting the ability to match a photo-ID with other instances is contingent on many factors, not just altitude). ○ The adaptive management procedure has a number of precautionary assumptions that protect against uncertainty around the identity of the animal. These assumptions include, but are not limited to: ○ A temporal sequence that records a reduction in the number of animals recorded in the system, which could potentially indicate the commencement of migration, would trigger an adaptive management response of increased and spatially-focussed surveillance, regardless of the identity of the animals. ○ A large black whale that is unable to be positively identified as a southern right whale is assumed to be a southern right whale

Stakeholder	Stakeholder Concern, Objection or Claim	ConocoPhillips Assessment of merit	ConocoPhillips Response
			○ A southern right whale that cannot be confirmed as without calf, is assumed to be with calf.
	Given the limits of our knowledge, I would be keen to understand the expected ranges for PTS, TTS and behavioural disturbance to SRW from underwater noise sources from the Sequoia MSS, as well as any proposed acoustic monitoring techniques for detecting SRWs both pre and during MSS that might be used to inform an adaptive management approach to the MSS.	ConocoPhillips acknowledges the comment and provides the following response.	• Acoustic modelling conducted for the EP predicted maximum distances to behavioural response for adults of 11.1 km (in all directions) and behavioural response for cow-calf pairs of 15 km towards the Victorian coast, 25 km towards the King Island coast (in the north) and 28 km in the offshore direction. • Modelling also predicted maximum distances to: ○ Permanent Threshold Shift (PTS) PK Criteria of 30 m and SEL 24hr Criteria of 1.18 km (i.e. a whale would need to be within 1.18 km of the survey vessel for 24 hrs to receive PTS); and ○ Temporary Threshold Shift (TTS) PK Criteria of 70 m and SEL 24hr Criteria of 11.7 km towards the Victorian coast, 25.9 km towards King Island (in the north) and 56.6km in the offshore direction. • These areas do not intersect the migration and resting on migration BIA along the Victorian coast (34 km to the north), the aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground or the emerging aggregation area at Port Campbell (~ 34 km to the north). • Passive Acoustic Monitoring (PAM) using QuietSeaTM will be implemented for the full duration of the survey to detect vocalising whales within the frequencies (10 Hz – 96 kHz). QuietSeaTM is designed to detect the presence of marine mammals during seismic operations, has the ability to triangulate to the source of whale calls and estimate distance and bearing, and is integrated within the seismic streamers. The use of this system will allow vocalising whales to be detected when not visible at the surface and during periods of poor visibility and at night, offering additional protection of large whales at times when they would not otherwise be detectable visually.

3.5. Measures Adopted because of the Consultations

Table 3-8 outlines the key themes in the objections and claims presented by relevant persons as part of preparation of the Sequoia MSS EP and the measures adopted by ConocoPhillips Australia as a result of consultation.

It is important to note that these measures are in addition to the measures identified and adopted by 3D Oil as part of the Dorrigo 3D MSS which are summarised in Table 3-6.

Table 3-8: Key Consultation Theme and Measures Adopted

Theme (Feedback/Objections/Claims)	Measures adopted because of the consultations
Survey Timing	• ConocoPhillips Australia has reduced the acquisition time and will be applying for the August to October timeframe for seismic acquisition on T/49P as this represents the window of least impact to the majority. No acquisition will occur before 15 August.
Impacts on Marine Life	• Reducing the operational area from 6500km^2 to 4090km^2. • CSI Technology which significantly reduces the duration of acquiring seismic versus conventional methods. • Using the lowest sound pressure to achieve the desired data quality. • Control Measure – Southern Right Whale monitoring program. The purpose of this control measure is to confirm the location of Southern Right Whale cow/calf pairs by aerial surveillance of known breeding sites so that survey sail lines can be selected to minimise impact of sound to Southern Right Whale cow/calf pairs. • Excise of Giant Crab habitat.
Impact on Commercial fishing	• Reducing the operational area from 6500km^2 to 4090km^2. This has resulted in: o A 27 per cent reduction in Victorian fishing grids affected. o A 19 per cent reduction in Tasmanian Rock Lobster grids affected. • Using the lowest sound pressure to achieve the desired data quality. • CSI Technology which significantly reduces the duration of acquiring seismic vs conventional methods. • Control Measure – Fisheries and community Liaison Program including EPS: o An 'on-water' cooperation and interaction protocol will be in place for commercial fishers prior to the commencement of the activity. o Undertake post-acceptance, pre-survey visits to Portland, King Island, and Northern Tasmania to meet with local fishers and communities to communicate the outcomes of the NOPSEMA assessment, hear additional feedback from relevant persons, and liaise with local government bodies. o Undertake one visit to Portland, King Island, and Northern Tasmania during the survey to meet with local fishers and communities to update on progress of the survey and any changes that may have occurred to the conduct of the activity. • EPS - Operation of the acoustic source array will only occur in water depths >70 m.
Stakeholder Engagement	• Control Measure – Fisheries and community Liaison Program including EPS: o An 'on-water' cooperation and interaction protocol will be in place for commercial fishers prior to the commencement of the activity. o If possible, considering COVID travel restrictions, undertake post-acceptance, pre-survey visits to relevant locations to

Theme (Feedback/Objections/Claims)	Measures adopted because of the consultations
	meet with local fishers and communities to communicate the outcomes of the NOPSEMA assessment, hear additional feedback from relevant persons, and liaise with local government bodies. If restrictions impact travel ConocoPhillips will use virtual means to undertake this engagement. o If possible, considering COVID travel restrictions, undertake one visit to relevant locations during the survey to meet with local fishers and communities to update on progress of the survey and any changes that may have occurred to the design of the activity. If restrictions impact travel ConocoPhillips will use virtual means to undertake this engagement. • ConocoPhillips has opted to excise the largest and eastern most polygon of the rock lobster key natural value in the Zeehan Marine Park that intersects the acquisition area. • ConocoPhillips will continue to consult with the DNP on the objectives and design of the alternative measures agreed to in lieu of excising the remaining areas of natural identified by the DNP.
Commercial Fishing Adjustment Protocol	• Control measure and associated Environmental Performance Standard (EPS) • ConocoPhillips Australia is committed to the principle that a commercial fisher should not be economically impacted as a direct result of the Sequoia Survey. • To achieve the objective, ConocoPhillips Australia has a practical, evidence-based process to provide reasonable monetary adjustment to a commercial fisher who experiences a reduction of catch, displacement of fishing activity or fishing gear loss or damage during the Sequoia survey. • ConocoPhillips Australia undertook consultation in good faith with SIV, SETFIA, TSIC and SSIA fishing associations on behalf of their members in order to receive and include their feedback in the development of this protocol with the principle of two-way and transparent engagement. • ConocoPhillips Australia has had multiple one-on-one and group meetings and emails with the above associations to develop the basis of the Protocol, garner feedback on draft versions of the Protocol and fact sheet and discuss ways to mitigate objections and claims where possible. • At the request of the associations, to support the Protocol, a fact sheet has been developed to simply explain what the Adjustment Protocol covers, an example and how to make a claim. • The draft adjustment application and assessment process includes: o Assessment by ConocoPhillips Australia with the support of qualified consultants with fisheries and statistical analysis expertise and prior experience in the WA Department of Fisheries. o Providing the claimant with an assessment report within 30 days of claim lodgement o The process and forms required to make a claim for reduction of catch, displacement of fishing activity or fishing gear loss or damage during the Sequoia survey and application cost reimbursement. • The process for an independent expert review of a claim outcome. An independent expert review panel has been selected with panellist credentials supplied to associations. If the claimant does not agree with the original assessment report, they can request the review. As part of the independent expert review process, both the claimant and the ConocoPhillips Australia shall be given the opportunity to address the independent expert review panel to state their position, prior to a review decision being reached. The independent expert review panel must

Theme (Feedback/Objections/Claims)	Measures adopted because of the consultations
	provide a view as to whether the claim assessment process has been conducted in line with the requirements of the protocol. The independent expert review panel may also consider any additional information deemed appropriate, including information provided by either the claimant or ConocoPhillips Australia. ConocoPhillips Australia commits to abiding by an independent expert review decision and paying any adjustment amount determined by the independent expert panel.
Research	• ConocoPhillips Australia will share bathymetry data gathered during the survey with Ausseabed to make it publicly available.

3.6. Ongoing Consultation

Relevant Persons consultation for this activity will be ongoing and ConocoPhillips Australia will work with stakeholders before, during and after the activity. Ongoing consultation serves a number of purposes:

- Provisions of updates on activity progress;
- Close out of communication commitments made during pre-start consultation;
- A platform to notify relevant persons of any deviations to the activity details originally provided during pre-start consultation;
- A platform to communicate with relevant persons during an emergency;
- Development of open communication channels with key relevant persons; and
- Provision of broader information relating to ConocoPhillips Australia that is not necessarily company specific.

While ongoing consultation with relevant persons and other stakeholders can be beneficial it is important not to overwhelm with too much information creating stakeholder fatigue.

All feedback received will be captured on ConocoPhillips Australia’s stakeholder database.

Ongoing consultation and triggered consultation (in the event of an unplanned event) are outlined in Section 6.13.3.

4. Receptors

4.1. Plankton

4.1.1. Scoping the Assessment

4.1.1.1. Defining the Aspects that Lead to Impact

Table 4-1 identifies the aspects and impacts that have the potential to impact plankton as a result of the petroleum activity. Aspects and impacts marked 'X' are predicted to have no cause/effect pathway or negligible consequence (less than Minor) and have not been discussed further in this chapter.

Impact to invertebrate and fish eggs and larvae are addressed in Section 4.2 and Section 4.3.

Appendix B provides a summary and justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 - Unplanned).

Table 4-1: Aspects and Impacts - Plankton

Aspects	Impacts	Plankton
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	X
	Change in fauna behaviour	X
Emissions – Underwater Sound (Impulsive)	Change in hearing via permanent and temporary threshold shift	X
	Injury/mortality to fauna	✓
	Change in fauna behaviour	✓
Emissions – Light	Change in fauna behaviour	X
Emissions – Atmospheric	Change in ecosystem dynamics	X
Planned Discharges – Vessels	Change in fauna behaviour	X
	Injury/mortality to fauna	X

4.1.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-2 describes the cause-and-effect pathways / the source of the aspect identified for plankton (Table 4-1).

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 which also includes eggs and larvae.

Table 4-2: Cause and Effect Pathway - Plankton

Emissions – Underwater Sound (Impulsive)
Underwater sound is generated with each pulse from the seismic source that produces high intensity, low-frequency impulsive sounds. Impulsive sound generated by the Sequoia MSS has the potential to result in: • a change in ambient sound. As a result of a change in ambient sound, further impacts may occur to plankton, including: • injury/mortality to fauna.

4.1.1.3. Defining the EMBA

Table 4-3 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact plankton (Table 4-1). A summary of relevant studies supporting the source of the criteria used are provided in the Relevant Studies section; and the sound effect criteria and modelled distances are in the Sound Effect Criteria section.

The source of the aspect-receptor interactions has been described further in subsequent sections specific to receptor groupings. The relevant EMBA for plankton is shown in Figure 4-1.

Table 4-3: EMBA for Plankton

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions – Underwater Sound (Impulsive	Seismic sound (Impulsive) – Plankton	In the absence of accepted threshold criteria for plankton, Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al., 2014) criteria have been adopted. These criteria are extrapolated from simulated pile driving signals that have a more rapid rise time and greater potential for trauma than pulses from a seismic source and are therefore considered conservative.	The maximum distances to the acoustic thresholds for plankton from the acoustic modelling (STLM) is 170 m. This distance was determined based on the Popper et al. (2014) threshold criteria: • per pulse: > 207 dB PK: 170 m • 24 hrs: > 210 dB SEL_{24h}: 80 m	Operational Area + 170 m

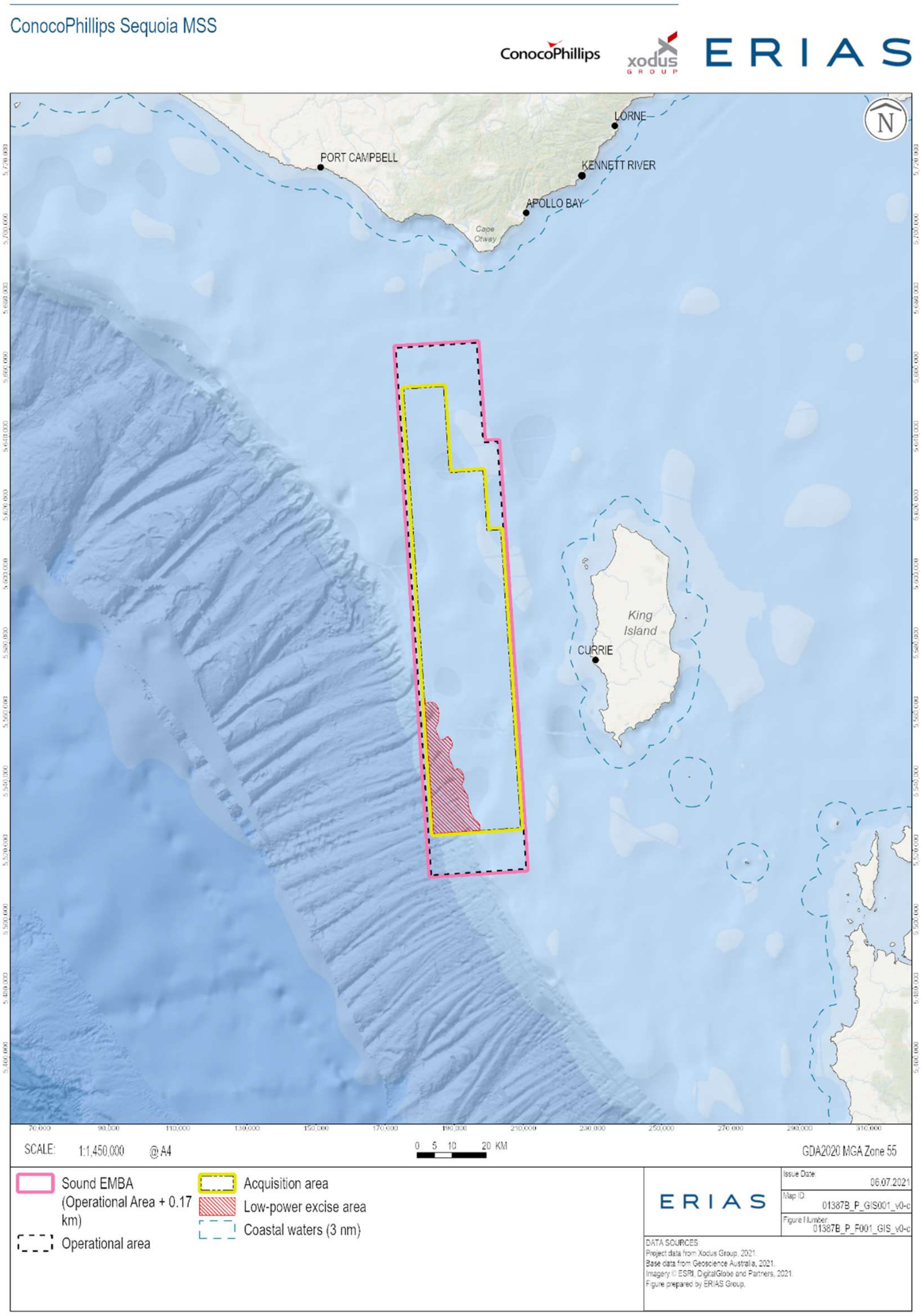


Figure 4-1: Seismic sound (Impulsive) – Plankton EMBA

Relevant Studies

Published studies conducted on the impacts of seismic sound on plankton provide inconsistent findings (Gausland; 2000; Parry et al. 2002; Popper et al., 2014; Day et al., 2016; McCauley et al., 2017; Richardson et al, 2017; CarbonNet, 2018; Fields et al, 2019). However, where mortality and injury effects have been identified they have typically been at close proximity to the seismic source.

Gausland (2000) noted several studies confirming that that signal levels exceeding 230-240 dB PK-PK are necessary for harm to occur and therefore physical damage can only occur within a few metres from the air guns.

Parry et al (2002) undertook studies on the effects of MSS on scallop fisheries in Bass Strait, including on larvae. This study was undertaken in December 2001 and February 2002 during a 3DMSS undertaken by Esso Australia in Gippsland, which used a 3,542 cui 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) postulate 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 MSS, the failure to detect any impacts of MSS occurred because impacts were small. Parry et al (2002) also indicates there is no evidence of mortality-associated population effects such as reduced abundance or catch rates in plankton a few hours after exposure.

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 SELcum. 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.

In the only known study of the effects of seismic acoustic source exposure on early-stage embryonic (entirely soft tissue) Southern Rock Lobster, Day et al (2016) found that exposure to seismic sound did not result in a decrease in fecundity, either through a reduction in the average number of hatched larvae or as a result of high larval mortality, and did not result in compromised larvae or morphological abnormalities, noting that in this study, the embryos were protected by the hard tail of an adult female Southern Rock Lobster (i.e. not free floating in the water column). Pearson et al (1994) that suggest early life stage crustaceans (Dungeness crab, Cancer magister, in the Pearson study) may be more resilient to seismic acoustic source exposure than other marine organisms, and the survival and growth of Dungeness crab larvae was not impacted by airguns discharging within 10m. In Day et al (2016), received levels were ~211 dB PK-PK (~205 dB PK) which are similar to the criteria established by Popper et al. (2014).

A study by McCauley et al. (2017) identified zooplankton mortality and reduction in abundance out to 1.2 km at levels up to 178 dB PK-PK from a seismic source of 150 in^3. The findings of this study have been questioned by several reviews (Richardson et al. 2017; IAGC 2017; Fields et al. 2019) and the results are not supported by other studies undertaken prior to and since Popper et al. (2014) was released.

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 cui 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 MSS 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, 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 MSS. A large-scale MSS conducted on the North West Shelf of Australia was modelled in a hydrodynamic model using the McCauley et al (2017) mortality results. This is reported in Richardson et al (2017). The modelled survey parameters include a survey area of 2,900 km2, 60 survey lines, waters 300 - 800 m deep, an acoustic source of 3,000-3,200 cui 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 bioregion 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 3 days following the completion of the survey for zooplankton biomass to recover to pre-MSS 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 MSS is likely to be slower in colder waters. It is important to note however Fields et al (2019) and IAGC (2017) noted that the findings of McCauley et al (2017) (which form mortality results used in Richardson et al, 2017) may provide an overly conservative estimate of the potential effects of seismic pulses to zooplankton.

Fields et al. (2019) exposed captive zooplankton (copepods) 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 identified an increase in immediate mortality at distance <5 m from the seismic source and a higher cumulative mortality, 7 days after exposure, at a distance somewhere between 10 and 20 m. The increase in cumulative mortality after 1 week, relative to the controls, did not exceed 30% at any distance from the seismic source. No sublethal effects occurred at distances greater than 5 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 other studies.

Day et al., 2021 assessed the impact of seismic sound on Southern Rock Lobster peurulus larvae exposed at the seabed and indicated sub-lethal effects out to the maximum range of the study (500 m). Details specific to critical life-cycle stages for the southern rock lobster are included in section 4.2.

Sound Effect Criteria

Based on the studies detailed above, the Working Group on the Effects of Sound on Fish and Turtles Popper et al. (2014) sound exposure guidelines for fish eggs and larvae have been applied for this impact assessment, in the absence of accepted noise effect criteria for plankton. The sound exposure guidelines from Popper et al. (2014) though based on pile-driving are comparable to other seismic sound studies such as Day et al. (2016) for embryonic lobsters and Fields et al. (2019) for copepods.

For fish eggs and larvae, the guidelines provide sound exposure metrics for:

- Mortality and potential mortal injury.

Within these 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’ is used to assess risk at three distances from the source.

The guidelines and predicted maximum distances from the acoustic modelling (Koessler et al., 2020; Appendix E) are detailed in Table 4-4 for mortality and potential mortal injury. Day et al., 2021 indicated sub-lethal effects out to the maximum range of the study (500 m) from 203 PK (dB re 1µPa). Therefore, a precautionary distance of 750 m has been adopted following advice from UTAS. For recoverable injury, TTS and behavioural effects, a relative risk (low, moderate and high) is given for receptors at three distances from the seismic source defined in relative terms as near (N) tens of metres, intermediate (I) hundreds of metres, and far (F) thousands of metres.

The maximum predicted distance for mortality and potential mortal injury to plankton exposure guideline is 170 m and a conservate distance of 750 m for sub-lethal effects has been applied based on findings for puerulus larvae, noting that these findings could not be statistically analysed due to low sample numbers.

Table 4-4: Sound exposure guidelines and maximum predicted distance for Plankton

Criteria	Sound exposure guideline	Maximum Distance
Mortality and potential mortal injury	207 PK	170 m (maximum over depth) 154 m (maximum seafloor)
	210 SEL 24hr	80 m (maximum over depth) Not reached at seafloor
Sub-lethal effects - Delayed righting time - Increased intermoult period	203 PK	750 m (maximum over depth)
Recoverable injury, TTS and behavioural	(N) Moderate (I) Low (F) Low	NA
Masking	(N, I, F) Low	NA

4.1.1.4. Existing Environment

The description of environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for plankton depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in the relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

Multiple species of plankton and species that have a planktonic phase may occur within the relevant EMBA and the following assessment is limited to these two categories:

- For impacts to juvenile and adult life phases of invertebrates and fish, refer to respective chapters (Section 4.2 and Section 4.3)
- For indirect impacts to marine mammals that feed on krill, refer to respective chapters (Section 4.5).

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). Plankton is most broadly divided into two groups, namely phytoplankton (microscopic plants) and zooplankton (microscopic animals).

Kampf (2015) observed that the West Tasmanian Upwelling forms part of the Great South Australian Coastal Upwelling System and experiences two phytoplankton blooms per annum (refer to Temporal Presence and Absence section of Appendix A):

- Late austral summer bloom – this larger bloom occurring typically between February to April as a result of favourable winds that occur between December to April. Stronger upwelling winds do not always create phytoplankton blooms.
- Spring bloom - occurs in 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 (Figure 4-3). 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.

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 which also includes eggs and larvae.

General Values and Sensitivities

The relevant EMBA overlaps the Zeehan AMP, West Tasmanian Canyon KEF and Western Tasmanian Upwelling system that have noted productivity and biodiversity characteristics linked to plankton abundance and are described further below.

Zeehan AMP and Plankton

The relevant EMBA overlaps the Multiple Use Zone (IUCN VI) of the Zeehan AMP (53.01 % overlap).

Although conservation values of this AMP do not directly identify plankton or spawning values, a significant feature of this reserve is a series of four submarine canyons that incise the continental slope, extending from the shelf edge to the abyssal plain. Biodiversity and productivity on the outer shelf and upper slope in this reserve are influenced by the Zeehan Current and its interactions with the canyons. Concentrations of larval Blue Warehou and Ocean Perch indicate the area is a nursery ground (DNP, 2013).

Additional description of Zeehan AMP can be found in the Existing Environment section (Appendix H). Figure 4-2shows intersection of Zeehan AMP and the relevant EMBA.

West Tasmania Canyons KEF and Plankton

The southern area of the relevant EMBA overlaps the West Tasmania Canyons KEF (1.63% overlap]. The West Tasmania Canyons are defined as a Key Ecological Feature as they are an area of high productivity and aggregations of marine life (CoA, 2015). These canyons can influence currents, act as sinks for rich organic sediments and debris, and can trap waters or create upwellings that result in productivity and biodiversity hotspots (CoA, 2015).

Additional description of West Tasmania Canyons KEF can be found in the Existing Environment section (Appendix H). Figure 4-2 shows intersection of West Tasmania Canyons KEF and Plankton Impulsive Noise EMBA.

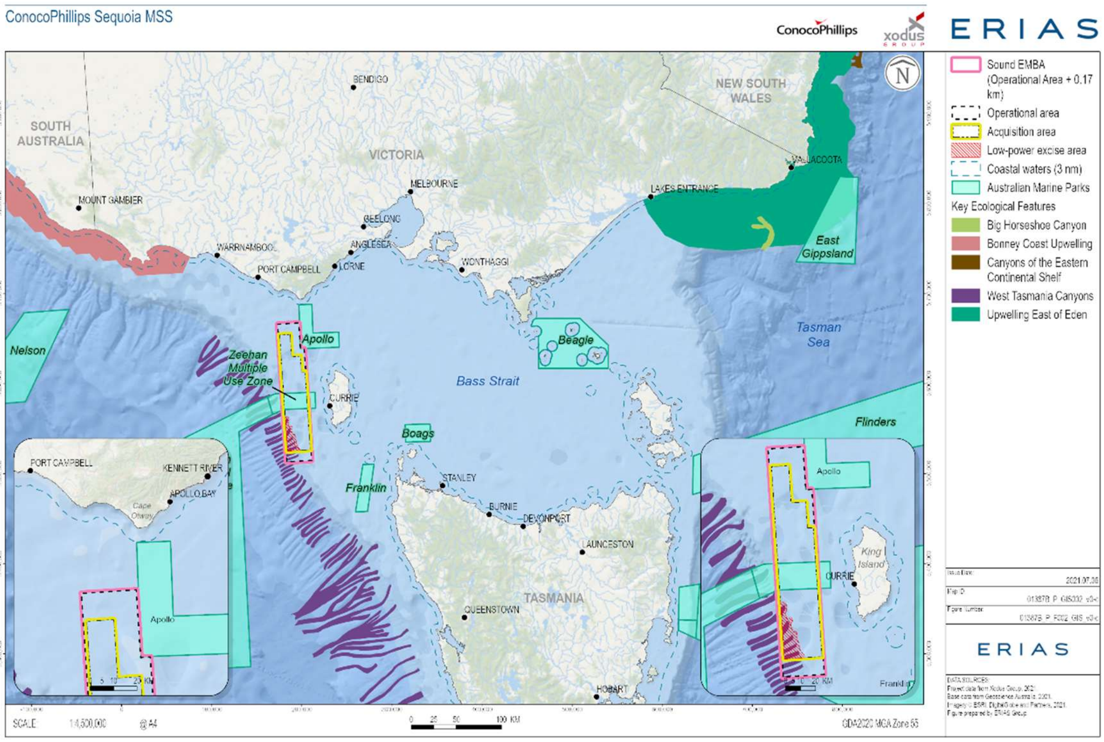
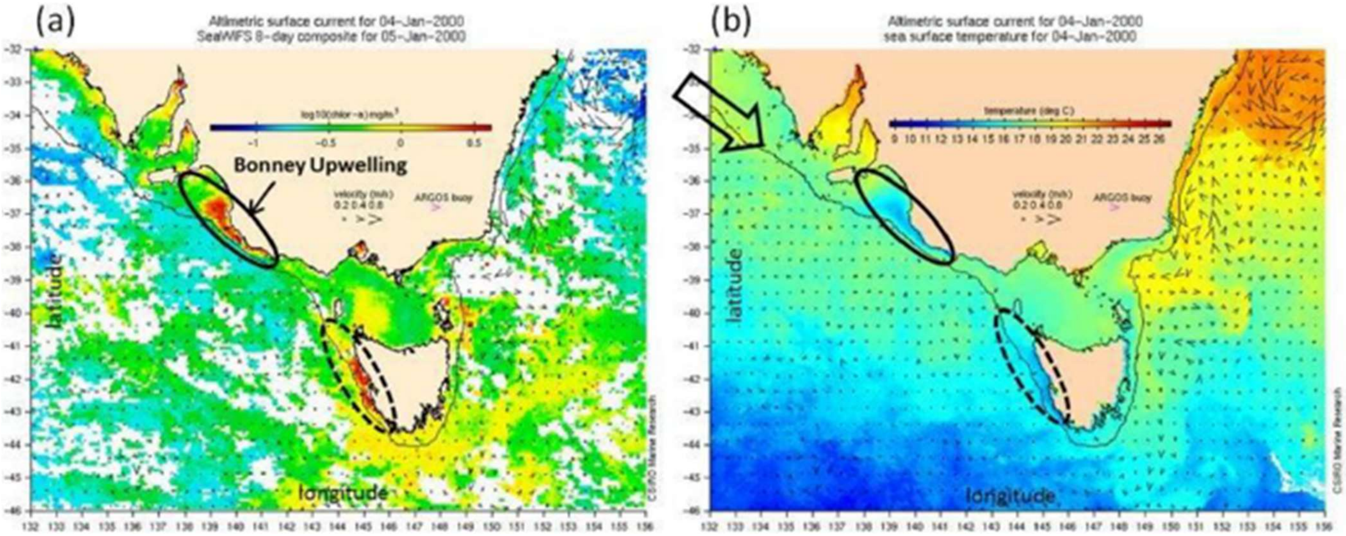


Figure 4-2: AMP and KEF overlaps with the Plankton EMBA

West Tasmania Upwelling System

The Western Tasmanian Upwelling System lies to the west of the Tasmanian mainland and over 130 km south-east of the relevant EMBA (Figure 4-3) and is expected to influence plankton observed in the region. 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 (Figure 4-3).

Additional description of local oceanography can be found in the Existing Environment section (Appendix H).



Source: Kampf (2015)

Figure 4-3: Coastal Upwelling Event in early January 2000 evident in satellite derived distributions of (a) MODIS-OC3 chlorophyll a and (b) sea surface temperature. The large arrow in (b) indicates the pathway of the South Australian Current, while the dashed line shows approximate location of Western Tasmanian Upwelling System

4.1.1.5. Legislative Requirements

Table 4-5 identifies legislative and other requirements that are relevant to the petroleum activity and plankton. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-5: Other Requirements for Plankton

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislative instrument	South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013)	The Plan outlines the management strategies for research and monitoring, assessment and permitting, compliance, community participation, Indigenous involvement and environmental management. The Plan does not identify plankton as a major conservation value for the Zeehan and Apollo AMPs that are overlapped by the sound EMBAs for plankton. The Zeehan AMP general description details that biodiversity and productivity on the outer shelf and upper slope in this reserve are	Environmental impact assessment for underwater sound on plankton has been completed in this EP (Section 4.1.2). Adoption of control measures (refer to Environmental Performance section in Appendix A) (refer to Environmental Performance tab in Appendix A)

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
		influenced by the Zeehan Current and its interactions with the canyons and that concentrations of larval Blue Warehou and Ocean Perch indicate the area is a nursery ground.	

4.1.2. Impact Assessment – Plankton

4.1.2.1. Existing Environment

Values

Zooplankton are comprised of small crustaceans (such as krill), fish eggs and fish larvae. Zooplankton includes species that drift with the currents and those that are motile (i.e., capable of motion). CSIRO (2015) notes that copepods are the most common zooplankton and are the most abundant animals on earth. Watson and Chaloupka (1982) reported a high diversity of zooplankton in eastern and central Bass Strait, with over 170 species recorded. However, Kimmerer and McKinnon (1984) reported only 80 species in their surveys of western and central Bass Strait.

CSIRO's Australian Ocean Data Network contains possibly one data point within the Seismic sound (Impulsive) – Plankton EMBA and five more in the immediate vicinity, all located on the continental shelf. This data (AusCPR - Zooplankton Abundance) shows that zooplankton samples taken at these sites in August 2011 were dominated by copepods, appendicularians, chaetognaths, cnidarians and thaliaceans, with the copepods belonging to the genera *Pleuromamma, Oithona, Clausocalanus* and *Acartia*.

Krill (*Nyctiphanes australis)* is a common coastal species in southern Australian waters endemic to the subtropical convergence zone and play an important role in the ecological significance of upwelling events in the area. The species broods its eggs until they hatch rather than spawning them directly into the water column. *N. australis* reaches sexual maturity after about four months and the female lays several broods of eggs in one season). *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 as well as other abundant fish and seabirds (Nicol and Endo, 1997).

Sensitivities

Plankton distribution is largely determined by local prevailing wind and tide driven current. As such they have limited capacity to avoid damaging environmental stimuli. However, the potential for population level effects is limited due to plankton having a widespread distribution, high natural mortality rate, rapid population growth rates and anticipated mixing from both inside and outside of the impacted region (Huntley and Lopez, 1992; Richardson et al, 2017). Plankton growth rates in colder regions such as Bass Strait, is expected to be slower than warm regions (Richardson et al., 2017).

Biological sensitivities are expected to vary between species and, as such, species-specific sensitivities have been discussed in greater detail within the relevant invertebrate and fish sections (Section 4.2 and Section 4.3, respectively).

Sensitivity to underwater sounds will depend on the species of plankton and life history stages as well as environmental and physical parameters such as proximity to the sounds source, water depth and seabed features and location of plankton due to diel migration (including fish larvae) between the surface and deep water.

Existing Pressures

Threats to plankton including eggs and larvae include climate change and variability. Recent modelling in south-eastern Australia shows the regions marine waters have experienced some of the greatest levels of warming observed around Australia and are expected to continue to warm more than other areas (Hobday and Lough 2011, Lough et al. 2012). The potential impacts of climate variability on zooplankton, are not well known however preliminary research suggest potential for altered phenology, body size reduction, change in global distribution (Bonham et.al., 2015).

Existing pressures or threats are expected to vary between species, as such species-specific threats have been discussed in greater detail within the relevant invertebrate and fish sections (Section 4.2 and Section 4.3, respectively).

The most recent seismic survey undertaken in the vicinity of the Operational Area was completed in April 2020 by Schlumberger (Appendix A Cumulative Impact Assessment). No concurrent surveys in the Otway or Gippsland locations have been identified and the only post Sequoia MSS seismic survey identified is the Prion MSS ~112 km east of the Operational Area in the Gippsland location (Appendix A Cumulative Impact Assessment). Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys in the area.

4.1.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels to plankton from each relevant aspect have been evaluated in Table 4-6; having regard to the legislative and other controls in Section 4.1.1.5.

Table 4-6: Predicted impact level for Emissions – Underwater Sound (Impulsive) to Plankton

Emissions – Underwater Sound (Impulsive)	Consequence
<u>*Injury/mortality to plankton*</u> Predicted maximum distances to sound exposure guidelines relevant to plankton (Sound Effect Criteria section) are: • Mortality and potential mortal injury: 170 m (PK) (maximum over depth). • Sub-lethal effects: 750 m (PK) (maximum over depth) The extent of the area of mortality and potential mortal injury impact is predicted to be a maximum of 170 m and sub-lethal effects to a maximum of 750 m from the sound while the Sequoia MSS acquisition is undertaken. The severity is assessed as Minor (2) based on impacts to zooplankton are predicted to be localised, temporary and recoverable given the following: • Zooplankton, including fish eggs and larvae, present in the water column are abundant in the environment, not spatially restricted and broadly (but not evenly) distributed in the environment. Zooplankton is likely to exhibit spatial patchiness with movement with currents (Richardson et al, 2017). • Based on the Working Group on the Effects of Sound on Fish and Turtles Popper et al. (2014) relative risk there is a low risk of plankton experiencing masking impacts at all distances from the seismic source and a moderate risk of recoverable injury, TTS, behavioural impacts near (tens of metres) from the seismic source. At distances greater than near the risk is low. • The Sequoia MSS will be undertaken from August to October outside of the upwelling period where there is lower zooplankton loadings (Kampf, 2015; Gill et al, 2011; Butler et al, 2002; DoEE, 2018; Hosack & Dambacher, 2012).	Minor (2)

Emissions – Underwater Sound (Impulsive)	Consequence
• Based on an effect range of 170 m it is estimated ~2% of the plankton present within Sequoia MSS Sound EMBA and less than 0.2% of plankton present in the Otway bioregion would be impacted per day[1]. For an effect distance out to 750 m based on peurulis larvae, less than 1% of plankton present in the Otway bioregion would be impacted per day. This is significantly less than zooplankton daily mortality rates of 11.6% (average minimum) to 59.8% (average maximum) reported by Tang et al. (2014) and the mortality estimates by Houde and Zastrow (1993) who detailed that the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day. • Zooplankton has rapid recovery rates (Huntley and Lopez, 1992; Richardson et al, 2017). Richardson et al (2017) found that it took only 3 days following the completion of the survey for zooplankton biomass to recover to pre-MSS levels within the Acquisition Area and within an area of 15 km around the Acquisition Area. Recovery may take longer in the colder waters of the Bass Strait where the Sequoia MSS will be undertaken but it is still likely to be in the order of days post-MSS rather than weeks. • Considering the McCauley et al. (2017) effect criteria of 178 dB re 1 µPa PK-PK (which has been recognised as providing a highly conservative, precautionary approach not considered to be rigorous or represent the best available science), this equates to a modelled minimum distance of 6.48 km and a maximum distance of 12.47 km (depending on the site, see additional modelling results from Jasco below). Even at these distances, subsequent findings (Richardson et at 2017, IACG 2017) confirm zooplankton abundance would not be adversely affected due to the extensive movements of water masses carrying zooplankton through survey areas and the rapid reproductive cycle and high reproductive potential characteristics of planktonic organisms, with the IAGC review concluding that the purported findings of McCauley et al. (2017) were of no ecological consequence, given the life history parameters of zooplankton. In any case, baseline conditions are expected to resume relatively quickly after survey completion (Richardson et al., 2017, IAGC 2017) due to replenishment of zooplankton back into the area.	

PK-PK ($L_{pk\text{-}pk}$; dB re 1 µPa)	Distance R_{max} (km)			
	Site 3 (Depth:102 m)	Site 6 (Depth: 798 m)	Site 7 (Depth: 606 m)	Site 10 (Depth: 106 m)
178	6.5	10.44	12.47	6.48

• Richardson et al (2017) notes that zooplankton communities can begin to recover in number during the MSS, such that a continuous decline in zooplankton throughout the MSS is unlikely and parts of the Sound EMBA would be replenished with zooplankton as the survey progresses. • From a bioregional perspective, the area where zooplankton may be impacted (assessed on most conservative areal basis) is localised within or close to the Operational Area and represents 1% of the Otway bioregion. • As recommended by Richardson et al (2017) to reduced impacts to plankton, the Sequoia MSS runs north to south, perpendicular to prevailing currents, minimising the duration of exposure of plankton to seismic sound, as plankton will be moving away from the seismic source not with it.	

4.1.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-7 compares the predicted impact levels for plankton against the acceptable levels.

Table 4-7: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Plankton

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th colspan="2" rowspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="4">Principles of ESD</td><td rowspan="4">Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.

Environmental impacts and risks have a worst-case consequence ranking less than Major (4).</td><td colspan="2">Impacts to plankton are localised, in line with natural variations in mortality, do not result in long-term impacts to diversity and abundance at the population level, and plankton populations rapidly return to pre-impact levels.
The survey is scheduled to avoid large upwelling events where high plankton levels may be present.</td><td rowspan="4">Yes</td></tr>
<tr><td>Severity</td><td>Injury/mortality</td></tr>
<tr><td>Extent</td><td>170-750 m from the sound source</td></tr>
<tr><td>Duration</td><td>Maximum of 38 days</td></tr>
<tr><td>Principles of ESD</td><td>Enough appropriate information to understand impact/risk of serious/irreversible environmental damage.

Application of the precautionary principle in the presence of scientific uncertainty.</td><td colspan="2">There is high confidence in the prediction of impact which is based on peer reviewed and published literature. No scientific uncertainty presents.</td><td>Yes</td></tr>
<tr><td>Principles of ESD</td><td>EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td><td colspan="2">No relevance to plankton (See Appendix A)</td><td>N/A</td></tr>
<tr><td>Biological</td><td>Localised mortality.</td><td colspan="2">170 m is considered within a local level.</td><td>Yes</td></tr>
<tr><td>Ecological</td><td>No increase in mortal effects beyond natural variances.</td><td colspan="2">There is high confidence in the prediction of impact which is based on peer reviewed and published literature. The absence of data on natural variances of plankton levels within the survey area and the bioregion presents some uncertainty.</td><td>Uncertain</td></tr>
<tr><td>Economic</td><td colspan="4">See Commercial Fisheries 4.7 for assessment of larval forms of commercially valuable species</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.</td><td colspan="2">CM 11 - the sail line plan ensures the activity is clearly scoped and bounded.</td><td>Yes</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).</td><td>Plankton</td><td>Minor (2)</td><td>Yes</td></tr>
</table>

Defined Acceptable Levels		Predicted Impact Level	Is the predicted impact below the defined acceptable level?
Factor	Level		
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to plankton have been considered as detailed in Section 3. No public comments were made in relation to plankton.	Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	There were no specific standards identified that were relevant to the protection of plankton or applicable to the Sequoia MSS.	N/A
Acceptability Summary			
Following completion of the impact assessment process, the environmental impacts to plankton arising from the identified aspects are acceptable because: • Plankton are broadly distributed and abundant in the region, given the survey area overlaps with multiple marine canyons (i.e. both upwelling and downwelling) which contribute to pelagic productivity, manifested in increased regional plankton biomass. • Primary values of plankton are not lost from impacts of seismic i.e. does not remove them from the food web and as such the nutrients and energy they contain are retained within the ecosystem. • High natural replenishment rates of zooplankton and dynamic ocean conditions in the region, suggests impacts are likely to highly recoverable. • Current evidence suggests that any impact from seismic sound is limited to proximity to the seismic source. • The Sequoia MSS does not extent over the entire upwelling season (late summer to spring) or full duration of commercial species spawning. The absence of bioregion-specific data, against which to assess the ecological level of impact, introduces some uncertainty about whether the environmental impacts to plankton are below an acceptable level. However, the weight of evidence suggests that seismic surveys do not have ecologically relevant levels of impact despite localised mortality. No further action is required in the presence of this uncertainty.			

4.1.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Plankton abundance is maintained within variance of natural mortality; and
Impact	• Impacts remain localised and recoverable.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-8 which assesses whether the control measures for plankton are effective to meet the EPO.

Table 4-8: Control Measure Effectiveness – Plankton

Measure	CM 11 - Sail line plan
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.

Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

4.2. Invertebrates

4.2.1. Scoping the Assessment

4.2.1.1. Defining the aspects that lead to impact

Table 4-9 identifies the aspects and impacts to invertebrates as a result of the Sequoia MSS. Aspects and impacts marked 'X' have either a predicted consequence that is Negligible (1) / or no established cause/effect pathway and are not assessed further. Appendix B provides justification for the exclusion of those aspects from further assessment. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 – Unplanned Aspects).

Table 4-9: Aspects and Impacts – Invertebrates

Aspects	Impacts	Invertebrates
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	X
	Change in fauna behaviour	X
Emissions – Underwater Sound (Impulsive)	Injury/mortality to fauna	✓
	Change in fauna behaviour*	✓
Emissions – Light	Change in fauna behaviour	X
Emissions – Atmospheric	Change in fauna behaviour	X
Planned Discharges – Vessels	Injury/mortality to fauna	X
	Change in fauna behaviour	X

** Cephalopods only*

4.2.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-10 describes the cause and effect pathways / the source of the aspect identified for invertebrates.

Table 4-10: Cause and Effect Pathway – Invertebrates

Emissions – Underwater Sound (Impulsive)
High intensity, low-frequency underwater sound is generated with each pulse from the Sequoia MSS source. Impulsive sound has the potential to result in: • A change in ambient sound (both from sound pressure and particle motion) This change in ambient sound may result in: • A change in fauna behaviour (for cephalopods only) • Sub-lethal physiological effects leading to injury/mortality to fauna (inclusive of all life-stages).

4.2.1.3. Defining the EMBA

The EMBA has been defined for the aspects and impacts that have been identified to potentially impact invertebrates. The criteria for physical and physiological effects and behavioural response and the distances at which acoustic modelling estimates they could be reached are provided in Table 4-11. The modelled distances for all single impulse sites are detailed in the acoustic modelling report along with explanations for the sound effect criteria selected (Appendix E). The EMBAs relevant for invertebrates are shown in Figure 4-4 (note for mapping purposes both the crustacean and cephalopod EMBAs are rounded up to 1 km and 4 km, respectively.

Table 4-11: EMBA for Invertebrates

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Crustaceans				
Emissions – Underwater Sound (Impulsive)	Seismic sound – Crustaceans	No mortality or damage to mechano-sensory systems (Payne et al., 2008) identified at 202 dB re 1 µPa PK-PK.	The results for the maximum horizontal distance from the seismic source to modelled seafloor PK-PK pressure levels from three single impulse sites relevant to crustaceans. The results detail a maximum no-effect distance of 414 m. Consultation with relevant persons (UTAS) identified that 750 m would be a more suitable distance and has been adopted as a conservative distance considering findings in Day et al., 2021.	Operational area + 750 m
Molluscs and Cephalopods				
Emissions – Underwater Sound (Impulsive)	Seismic sound – bivalves	Maximum particle acceleration (Day et al., 2016a, b) associated with chronic effects at 37.57 ms^{-2}.	The maximum distance to a particle acceleration 37.57 ms^{-2} occurs at maximum range of 1.5 m.	Operational area
	Seismic sound – sponges and corals	No detectable effect on soft tissues or skeletal integrity or mortality (Heyward et al., 2018) identified at 226 dB re 1 µPa PK	No effect distance is reached within 4 m of each sound pulse at the seafloor.	Operational area
	Seismic sound – Cephalopods	Inking and startle response (Fewtrell and McCauley, 2012) identified at 162 dB re 1 $µPa^2.s$ SEL per pulse for squid and octopus.	The results for the maximum horizontal distance from the seismic source to modelled maximum-over-depth per-pulse SEL from ten single impulse sites relevant to cephalopods. The results detail a maximum distance to the inking and startle response of 3.56 km.	Operational area + 3.56 km

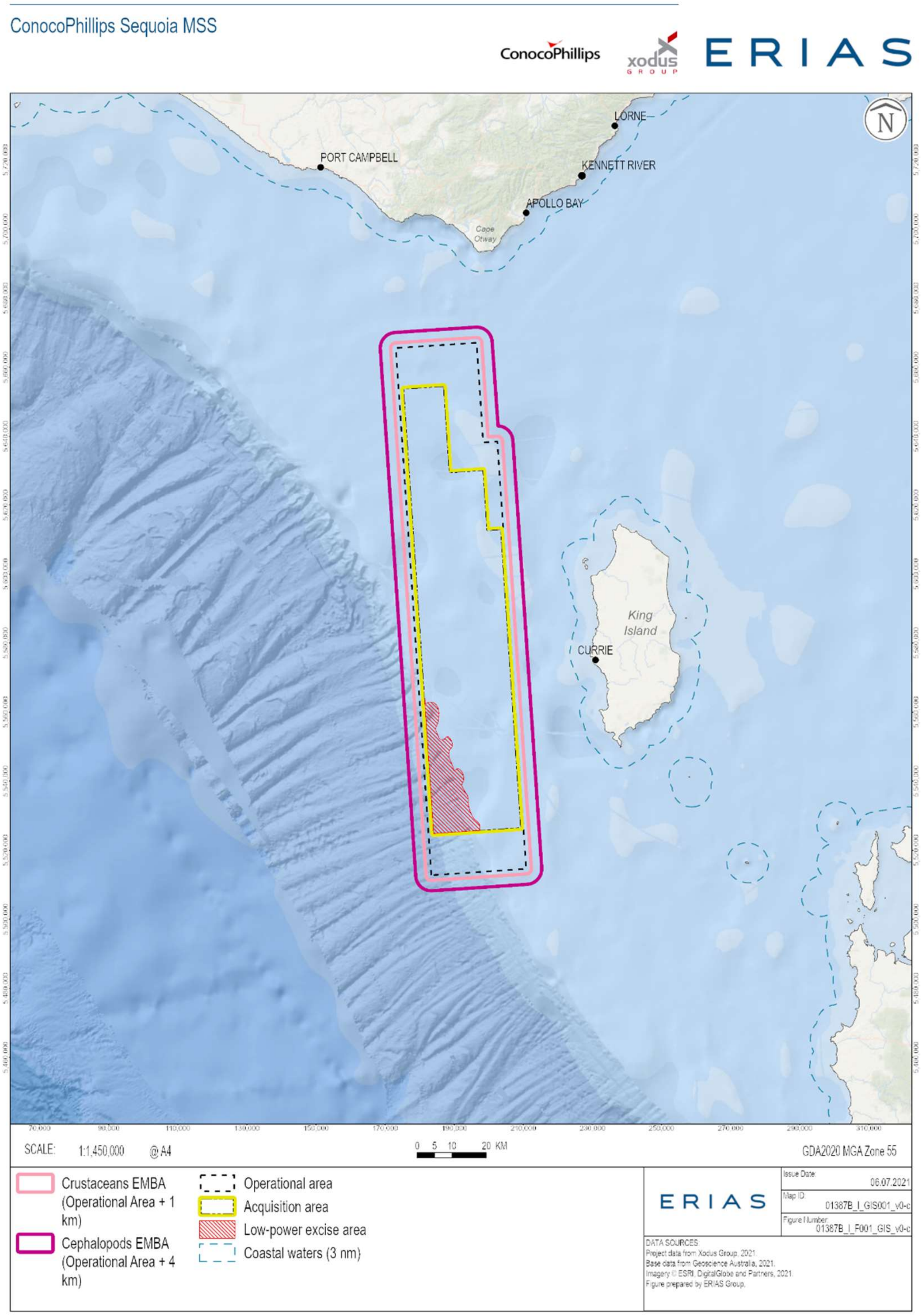


Figure 4-4: EMBAs relevant for Invertebrates

ConocoPhillips is aware of a subsea feature known as 'Big Reef' that is known to be an important SRL fishing ground. Using the 50 m contour as a proxy for the deepest part of the reef, Big Reef is located 10.2 km north of the acquisition area. This is well beyond the effect level distances. Line turns will avoid Big Reef by 200 m. To eliminate impacts to this structure ConocoPhillips has committed to operating the sound source at low-power during line turns.

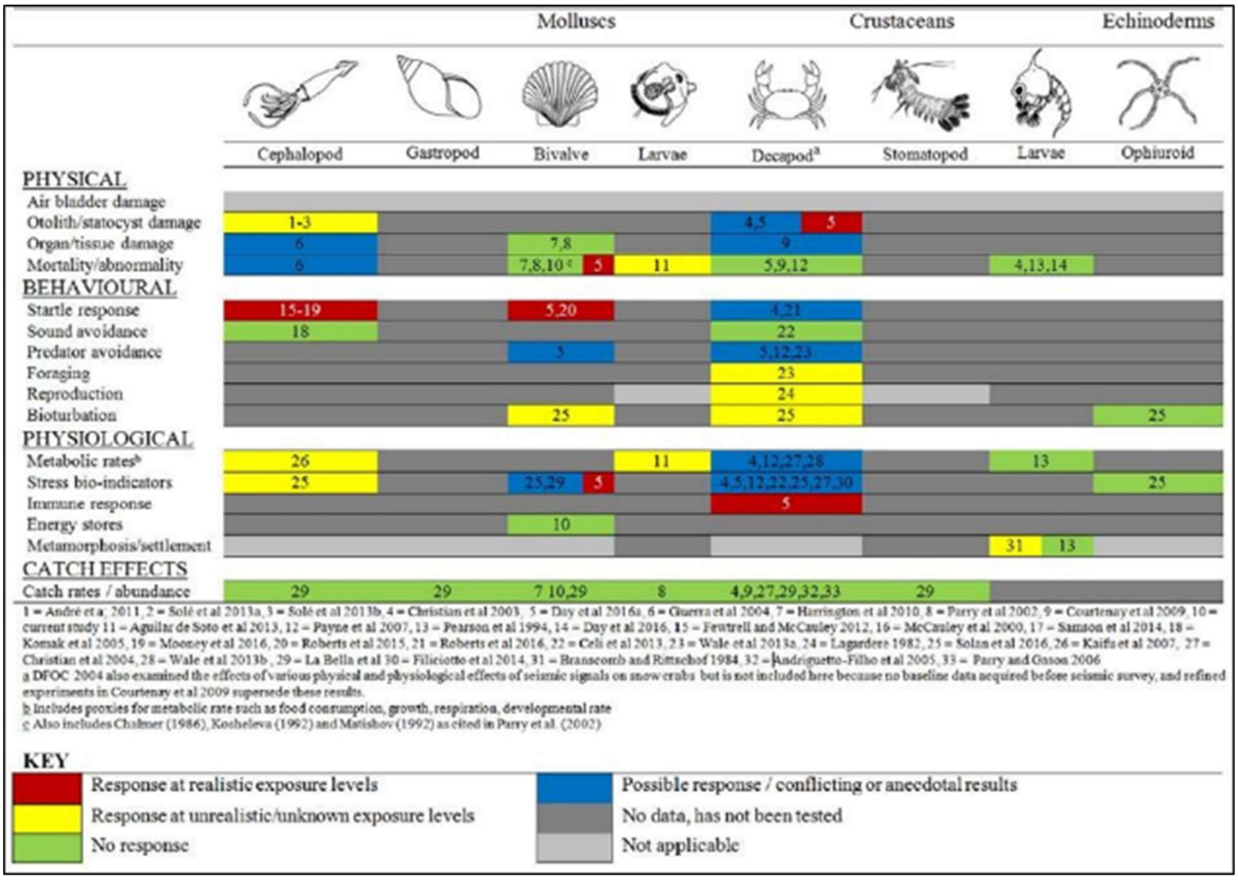
4.2.1.4. Existing Environment

Prideaux (2017) notes that very little is known about the effects of anthropogenic noise on marine invertebrates, despite their ecological and economic importance. Invertebrates detect sound by sensing either the 'particle motion' (Przeslawski et al., 2016b; Carroll et al., 2017), through other external and internal physiological structures such as hairs, statocysts and muscles; or '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). Similarly, Prideaux (2017) notes that marine invertebrates are sensitive to the particle motion component of sound more so than the pressure wave, meaning they are well suited to detecting the low frequency vibrations, which they use to identify predators and prey.

Larval stages are often considered more sensitive to stressors than adult stages, but exposure to seismic sound reveals no differences in larval mortality or abundance for crabs (Pearson et al., 1994) or scallops (Carroll et al., 2017). Some impacts have been observed within a few metres of acoustic sources for some species, and some stages have been shown not to be impacted (Day et al., 2016).

Impulsive sound has different sound effect criteria for different invertebrate groups. A summary of the impacts of low-frequency sound on various marine invertebrates (excluding sponges and corals) is presented in Figure 4-5.



Source: Carroll et al. (2017)

Figure 4-5: A summary of the impacts of low-frequency sound on various marine invertebrates

Invertebrate species (or species habitat) that may be affected by the Sequoia MSS has been identified by PMST searches which identified no threatened invertebrate species protected under the EPBC Act and no BIAs across the relevant EMBAs. The presence of commercial invertebrate fisheries overlapping the EMBAs demonstrates the presence of multiple invertebrate species (or species habitat).

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). Benthic habitat suitable for invertebrate populations occurs within the relevant EMBAs, including rocky reefs, sponge beds, unconsolidated sediment supporting bryozoans (IMAS 2017), canyons and the edge of the continental shelf. Williams et al (2009) notes that in surveys conducted along the shelf edge (150-400 m water depths, where the continental shelf drops away sharply to form the continental slope), the following key habitats occur:

- Bryozoan thickets (dominated by emergent bryozoans and small erect sponges and ascidians), where giant crabs are caught;
- Low and/or encrusting bryozoans and sponges;
- Low microfauna in association with detritus; and
- Absence of epifauna (often with bioturbation).

According to DPIPWE (2020a), very little is known of Tasmania's offshore marine ecosystems as there have only been limited surveys of benthic biota. However, it is known that unvegetated soft sediments (sand, mud and other unconsolidated substrates) are the dominant feature of the subtidal marine environment in Tasmania, comprising around 75% of the seabed in nearshore areas (Parsons, 2011).

Bivalves

Using the particle motion threshold (the most relevant metric given that scallops are attached to the seafloor), physiological impacts to scallops (in the form of increased stress levels and therefore a low risk of mortality in the long-term, but no mass mortality) are restricted to a distance of no greater than 1.5 m from each seismic impulse location at the seafloor. The scientific literature (e.g., Harrington et al., 2010; Przeslawski et al., 2016b; Day et al., 2016) indicates that MSS does not result in immediate mass mortality, and that there are no short- or long- term changes in measured responses to sound, but that low levels of mortality may occur, along with impaired reflexes. Measured mortality rates in some experiments are within the ranges of natural mortality rates. Given the 1.5 m effect distance and the absence of any known commercial or recreational catch in the area bivalves are not assessed further in this EP.

Sponges and Corals

Sponges and corals do not have hearing structures that can be impacted by underwater sound, but their soft tissues or skeletal integrity may be affected. Where present through the survey area (such as the canyons), sponges and corals will not be impacted from the sound pulse at the seafloor. Given the low severity and 4 m effect distance sponges and corals are not assessed further in this EP.

Values and Sensitivities

The relevant EMBAs intersect with the Apollo and Zeehan AMPs, West Tasmanian Canyon KEF and Western Tasmanian Upwelling system. The Apollo and Zeehan AMPs do not identify invertebrates as a conservation value (DNP, 2013). However, Hayes et al., (2021) have recently identified rock lobsters and the Zeehan Upper Slope Reef as key natural values of the Zeehan Marine Park. The South-east Commonwealth Marine Reserves Network Management Plan (2013-23) (DNP, 2013) refers to invertebrates as part of the general description for the Zeehan AMP:

'The reserve includes a variety of seabed habitats, including exposed limestone, that support rich animal communities of large sponges and other, permanently fixed, invertebrates on the continental shelf. There are also extensive 'thickets' of low invertebrate animals, such as lace corals and sponges, on the continental slope. These communities are exceptionally diverse and include species new to science. The rocky limestone provides important habitats for a variety of commercial fish species, including Australia's giant crab.'

The South-east Commonwealth Marine Reserves Network Management Plan (2013-23) (DNP, 2013) refers to invertebrates as part of the general description foe the Apollo AMP:

'The sea floor has many rocky reef patches interspersed with areas of sediment and, in places, has rich, benthic fauna dominated by sponges.'

The West Tasmania Canyons KEF does not recognise invertebrates as a value (DAWE, 2020b).

Table 4-12 identifies those species that have an active fishery within the impulsive underwater sound EMBAs. The stock status for relevant species, that may indicate greater sensitivity to stressors, has been listed below with more information presented in the impact assessment sections for each species.

Table 4-12: Commercial fish species that may occur in the relevant EMBAs

Commercial Fish Species		Stock status	Fisheries
Scientific Name	Common Name		
Jasus edwardsii	Southern Rock Lobster (SRL)	Sustainable	Victorian Southern Rock Lobster Fishery Tasmanian Southern Rock Lobster Fishery
Pseudocarcinus gigas	Giant Crab (GC)	Depleted	Tasmanian Giant Crab Fishery
		Sustainable	Victorian Giant Crab Fishery
Nototodarus gouldi	Gould's squid	Sustainable	Southern Squid Jig Fishery

4.2.1.5. Legislative Requirements

Table 4-13 identifies the minimum legislative and other requirements that are relevant to invertebrates. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-13: Other Requirements for Invertebrates

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislation (TAS)	Living Marine Resources Management Act 1995	The purpose of this Act is to achieve sustainable development of living marine resources having regard to the need to: • increase the community's understanding of the integrity of the ecosystem upon which fisheries depend; and • provide and maintain sustainability of living marine resources; and • take account of a corresponding law; and • take account of the community's needs in respect of living marine resources; and • take account of the community's interests in living marine resources.	These Acts are used to define the acceptable levels of impact to invertebrates - to have no effect on the sustainable development of living resources.
Legislation (VIC)	Fisheries Act 1995 and Fisheries Regulations 2009	The objectives of the Fisheries Act and Regulations are: • To provide for the management, development and use of Victoria's fisheries, aquaculture industries and associated aquatic biological resources in an efficient, effective and ecologically sustainable manner; • To protect and conserve fisheries resources, habitats and ecosystems including the maintenance of aquatic ecological processes and genetic diversity; • To promote sustainable commercial fishing and viable aquaculture industries and quality recreational fishing opportunities for the benefit of present and future generations;	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
		• To facilitate access to fisheries resources for commercial, recreational, traditional and non-consumptive uses; • To promote the commercial fishing industry and to facilitate the rationalisation and restructuring of the industry; and • To encourage the participation of resource users and the community in fisheries management.	
Management Plan (VIC)	Giant Crab Management Plan	The three main objectives of this management plan are: • Sustainability of the giant crab resource • Resource access and utilisation • Cost-effective and participatory management.	
Management Plan (VIC)	Victorian Rock Lobster Fishery Management Plan	The five current objectives of this management plan are: • Ensure the sustainability of the rock lobster resource • Ensure a fair and equitable allocation of the rock lobster resource • Ensure optimal economic utilisation of the rock lobster resource • Cost-effective and participatory management • Maintain the ecological integrity of the fishery ecosystem.	

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia. Therefore, The Southern Rock Lobster, Giant Crab, and Molluscs have been evaluated further because there are commercially valuable species and are considered a high priority by stakeholders.

4.2.2. Impact Assessment – Crustaceans Southern Rock Lobster

4.2.2.1. Existing Environment

Crustaceans include rock lobsters, prawns, crabs, and barnacles. Southern Rock Lobster (SRL) and Giant Crab (GC) are commercially fished in sections of the survey area. Crustaceans possess an exoskeleton that they moult to grow. Their bodies are composed of segments grouped into three parts: the cephalon (head), thorax and the pleon (abdomen). Crustaceans are distinguished from other arthropods by the possession of biramous (two-parted) limbs and by their larval forms. Most aquatic crustaceans are free-living, though some are sessile.

Broadly, the SRL 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 are found to depths up to 150 m (DPI, 2009). In Victoria, the abundance of SRL decreases from west to east reflecting a decreasing area of suitable rocky reef habitat (DPI, 2009). Most adult SRL remain within the same region (moving less than 1 km), though some tagged SRL have moved more than 80 km between inshore and offshore reefs (SRL, 2021). It is expected that where rocky reef is present in the relevant EMBA, SRL are likely to be present.

Values

The Southern Rock Lobster (SRL) (*Jasus edwardsii*) is a commercially important species known to occur within the sound EMBA. It 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 (Figure 4-7). SRL are found to depths up to 150 m (DPI, 2009). In the Gippsland region, SRL habitat occurs as patchy, discontinuous low-profile reef running parallel to the coast.

Although rock lobsters have no formal protection under Australian law Hayes et al. (2021) identified key natural values for the South-East marine park network. The key natural values were identified by subject matter experts using a set of criteria developed from the criteria used to identify equivalent or similar concepts in other national and international contexts. Each key natural value is allocated to an ecosystem within the common language and thereby mapped. Rock lobster and Zeehan Upper Slope Reef were identified by experts as a key natural value on the upper slope reef in the Multiple Use Zone of Zeehan Marine Park. In consultation with the Director of National Parks ConocoPhillips Australia has been provided shapefiles of the key natural values. Figure 4-6 shows these areas in the context of the Sequoia survey.

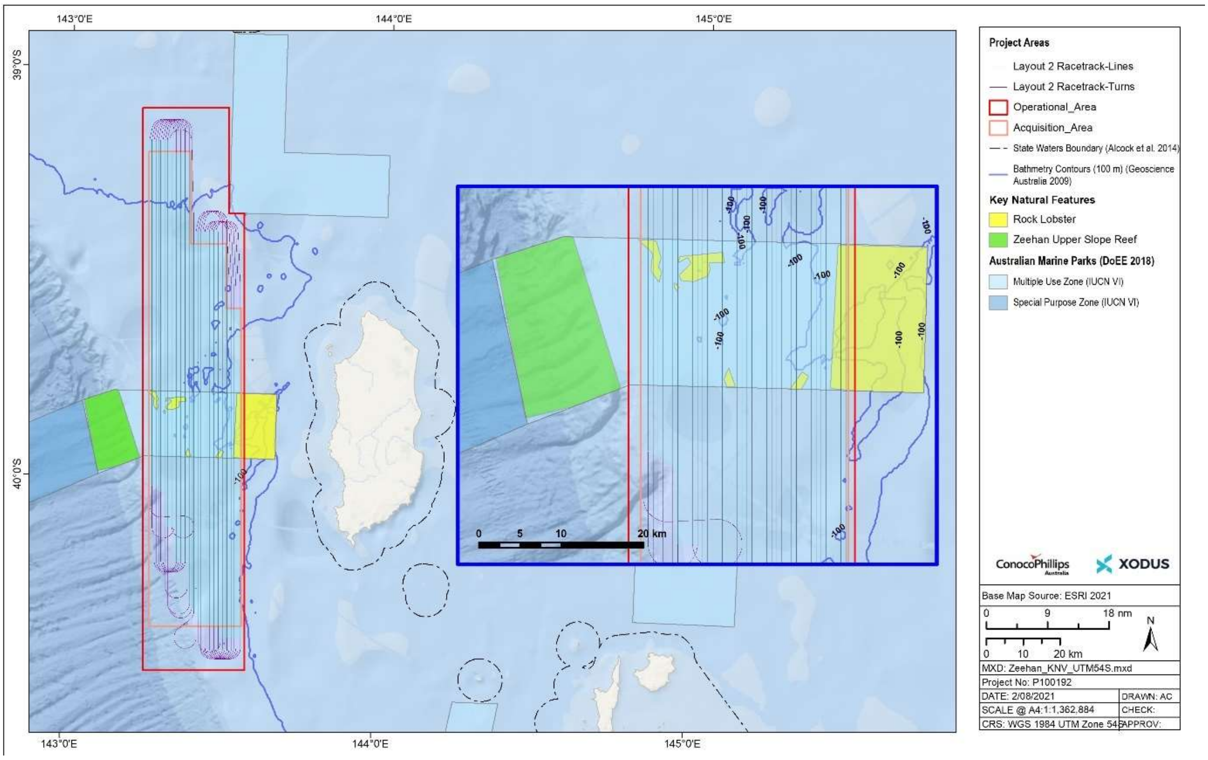


Figure 4-6: Key natural values of the Zeehan Marine Park

The life cycle of the SRL is complex. After mating in April to July (SRL, 2021), fertilised eggs (numbering 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. Larval release occurs across the southern continental shelf, which is a high-current area, facilitating dispersal.

Oceanographic modelling has also indicated that Southern Rock Lobster dispersal occurs over large spatial scales, indicating that there is a single biological stock (Bruce et al. 2007). Genetic analyses also indicate that it is a single stock (Ovenden et al. 1992). This suggests that SRL in the Otway Bioregion present as a connected stock with recruitment into the survey area from upstream subpopulations.

Once released, SRL larvae, or phyllosoma, live in the plankton and undergo 11 developmental stages over a period of between 12 and 24 months (Hartmann et al., 2013; SRL, 2021) while being carried by ocean currents up to 200km offshore far beyond the continental shelf.

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, 2021). 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, 2021). Bruce et al., 2007 reported data for state-maintained puerulus collector sites, which indicates that most puerulus settlement in NW Tasmania occurs June through August, tapering off in September.

SRL grow by moulting or shedding their exoskeleton. Juvenile lobsters moult approximately five times year, declining to once a year for mature adults. Research on temporal moulting patterns in adult SRL in Tasmanian waters including King Island (Gardiner and Mills 2013), which tracked over 4000 tagged individuals, found females mainly moult between February and May while males moult mainly in August and September with the greater majority moulting in August. The Tasmanian Seafood Industry Council (TSIC) advised that moulting for adult males occurs in September and October.

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 (DPI, 2009). It can take between three and ten years for SRL to reach commercial fishing size (SRL, 2021).

Adult SRL are carnivorous and feed mostly at night on a variety of bottom dwelling invertebrates such as molluscs, crustaceans and echinoderms. The main predators of SRL are octopus, sharks and reef fish such as wrasse and ling (SRL, 2021). The Temporal Presence and Absence section of Appendix A shows the likely temporal presence and absence of the Southern Rock Lobster within the relevant EMBAs.

Sensitivities

The SRL does not have an EPBC status or associated recovery or management plans. While there is little scientific data on the population, stock status records indicate that the southern Australia stock is sustainable (Linnane et al 2018).

Victorian and Tasmanian SRL Fisheries close between 1 June and 15 November to protect berried females (SRL, 2021). The stock status of the SRL across South Australia, Victoria, and Tasmania is only marginally above the limit reference point for egg production and any future decline will result in a classification of depleting or depleted (Linnae et al., 2018). The two fishing zones overlapped by the survey are above their egg production limit reference point of 20% (Victoria) and 30% (Tasmanian) of unfished levels, with a 90% probability. According to the latest Stock Assessment reports, the Victorian Western Zone is at 24% and hasn't varied outside of 23%-24% in the last seven years (VFA

2021d) and the Tasmanian Rock Lobster Fishery egg production has increased over the last few years and is well over the 30% reference point (IMAS 2019). The IMAS Stock Assessment of the Tasmanian Rock Lobster Fishery also states that "At current levels there is no clear link between egg production and subsequent recruitment to the fishery. This is due to the high variability inherent in the long larval duration phase (larvae spend up to two years drifting on the open ocean), plus high variability in survival between settlement and recruitment to the fishery."

Fisheries closures also protect moulted juvenile and adult SRL. Gardiner and Musgrove (2004) presented data that shows the new shell remains soft for approximately 20 days. As the pueruli also moult on settlement, there is likely to be a period of vulnerability after settlement. Jernakoff (1990) found that post-puerulus western rock lobster (*Panulirus Cygnus*) shelter in small holes on the face, in ledges and in caves on coastal limestone reefs. This suggests that there may be a natural level of protection from the habitat to predation and other pressures. Professor McCauley (inquiry into the impact of seismic testing on fisheries and the marine environment 2020) stated that lobsters hide under a rock and grow a new exoskeleton. There is also evidence that suggests, before moulting the lobster begins to grow a new layer of exoskeleton beneath the old shell, but this takes a few days to harden, and that during this period the lobster is known to take shelter to avoid predation.

Hinojosa et al, 2016 identified that underwater reef sound, audible in calm conditions, was used by the puerulus as an orientation cue for this migration and that increased ambient sound has the potential to mask this cue, making it difficult for pueruli to detect directionality of reef noise.

There is no evidence of population level impacts on invertebrates from seismic sound. McCauley et al (2000a) extensively reviewed seismic surveys and their effects on marine life, reporting that the amount of exposure to air gun signals for the larvae of a given invertebrate species will depend upon its abundance, spatial distribution, depth distribution, seasonal timing and the persistence of seismic surveys in the region where it occurs. McCauley et al (2000a) concluded that a single seismic survey has a negligible impact on larval supply by comparisons with the size of the larval populations involved. This has been supported by the conclusions of Day et al (2016a) and Przeslawski et al (2016b). Przeslawski et al (2016b) also note that various studies conducted in the 2000s detected no significant differences to marine invertebrates between sites exposed to seismic operations and those not exposed.

Source: Linnane et al. (2018)

Figure 4-7: Distribution of SRL in Australia

Existing Pressures

There are a range of anthropogenic threats that affect SRLs. Key threats identified include:

- Commercial and recreational fishing
- Cumulative impacts from previous and simultaneous activities in the area (i.e. seismic and drilling activities)
- Ecosystem effects as a result of habitat modification and climate change
- Predation

Commercial fishing status reports have identified the SRL at a sustainable stock level throughout southern Australia (Linnane et al, 2018). However, the stock status is only marginally above the limit reference point for egg production.

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys in the area.

4.2.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathways, predicted impact levels from each relevant aspect to SRL have been evaluated in Table 4-14; having had regard to the legislative and other controls (Section 4.2.1.5).

Table 4-14: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for SRL

Emissions – Underwater Sound (Impulsive)
Overview of Injury/mortality to fauna – physiological impacts to adult, juvenile and larval SRL
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., 2019; Carroll et al., 2017; Day et al., 2016a; Przeslawski et al., 2016b; Day et al., 2021), 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’).

In order to further understand interactions between MSS 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 MSS on SRL (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., 2016a).

The research program involved exposure of cohorts of SRL 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 cui acoustic source, 2,000 psi), July 2014 (150 cui acoustic source, 1,300 psi and 2,000 psi) and February 2015 (150 cui 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} (this was likely to be an outlier).

While a regression of particle acceleration versus range for the single 150 cui acoustic source used in the study (minimum range of 6 m) showed that acceleration at 10 and 100 m range were typically 26 and 5 ms^{-2}, respectively, Day et al (2016a) describes findings related to seismic exposure of egg-bearing female spiny lobsters and subsequent larval development, which concludes:

- Exposure to seismic sound did not result in any mortalities of adult lobsters, even at proximity.
- There was no difference in fecundity between control and exposed lobsters.
- A small but significant difference in the length of the larvae was observed in the exposed lobsters. No difference was found in width or dry mass of the larvae and no hatches were found to suffer from high mortality rates or deformities.
- No energy difference was identified between larvae from control and exposed lobsters.
- Larval activity/survival between control and exposed lobster groups was not significant. 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.
- 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. However, it is unclear how significant this finding is, as the warm summer water conditions during this experiment may be 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. The authors rejected the hypothesis that 'exposure to seismic acoustic sources causes immediate mass mortality, defined as an increase in mortality rate of sufficient proportion to affect population size significantly'. 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 or impacts to embryos were observed and impacts were limited to statocyst condition, behavioural reflexes and immune response functions in adult lobsters. Day et al (2016a) note that these could have some effect on longer-term survivability.

Based on the available evidence the following conclusions can be drawn about impacts to SRL exposed to underwater sound:

- Mortality of adult lobsters is not predicted;
- Increased mortality, delayed development or abnormal development to the egg mass carried by any 'berried' females, if present, or larvae produced from those eggs, is highly unlikely;
- Changes to haemolymph biochemistry, an indicator of acute or chronic metabolic stress, in adult lobsters near the acoustic source are unlikely;
- Damage to statocysts in adult lobsters near the acoustic source is likely, and it is not known whether a significantly damaged statocyst or impaired reflexes might disadvantage the growth or survival of lobsters in the wild;

- Statocyst damage is known to exist in wild SRL populations that have very high survival rates and are near carrying capacity;
- Changes to haemocyte count, an indicator of immune response function, in adult lobsters near the acoustic source is likely; and
- Increased probability of mortality, delayed development or abnormal development of crustacean larvae in the water column is only possible at very close range.

Subsequent to the Day et al (2016a) study, Day et al (2019) undertook additional work to determine whether SRL with pre-existing damage to their mechanosensory statocyst organs as a result of exposure to anthropogenic sound, incur further damage from exposure to MSS. This is relevant to the Sequoia survey area because of the existing anthropogenic sound in the survey area (e.g., vessel movements) and the potential for other MSS to take place near the Sequoia survey area around the same time.

For this study, SRL 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 (2016a) 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 MSS 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) undertook a study to determine whether early development and recruitment of SRL 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) study involved exposing puerulus and juvenile SRL within oyster baskets on the seabed to a full-scale array (three 2,820 cui seismic sources with 2,000psi at a depth of 8 m) during a commercial seismic survey in 51-58 m of water. The study site is shallower than the Sequoia operational area (predominantly 100-200m depth), the study seismic source was at a depth closer to the seabed (8 m vs 6 m for Sequoia MSS) and the source was activated at a shorter time period (mean of every 5 seconds vs 9 seconds for the Sequoia MSS) potentially resulting in greater exposures than for the Sequoia MSS.

Day et al. (2021) 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 SRLs.
- 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 SRLs. 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 juvenile below the sound source did not show the capacity for recovery whereas juvenile lobsters at 500 m form 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.

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 level, serum enzyme levels, and serum calcium level. 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 µPa².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, serum enzymes and serum 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 5 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 (AST) and Creatine kinase (CK), 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 hemodilution 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 in order 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. This study did not provide evidence for delayed mortality in lobsters several months after exposure, with some observations extending to 9 months.
- During the histological analysis conducted 4 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.

The available research on temporal moulting patterns in adult SRL in Tasmanian waters including King Island, which tracked over 4000 tagged individuals, shows that female SRL mainly moult between February and May while male SRL moult mainly in August and September with most males moulting in August (Gardiner and Mills 2013). As such, it is expected that the majority of the SRL female breeding population will have moulted by the commencement of the Sequoia MSS. The exact effects of seismic exposure on soft shelled SRL after moulting is not well understood. However, Gardiner and Musgrove (2004) present data that shows the shell only remains soft for approximately 20 days. Therefore, it is anticipated that the majority of the SRL population will not have soft shells during the period of seismic acquisition. Professor McCauley (inquiry into the impact of seismic testing on fisheries and the marine environment 2020) stated that lobsters hide under a rock and grow a new exoskeleton. There is also evidence that suggests, before moulting the lobster begins to grow a new layer of exoskeleton beneath the old shell, but this takes a few days to harden, and that during this period the lobster is known to take shelter to avoid predation.

McCauley et al (2000a) extensively reviewed seismic surveys and their effects on marine life, reporting that the amount of exposure to air gun signals for the larvae of a given invertebrate species will depend upon its abundance, spatial distribution, depth distribution, seasonal timing and the persistence of seismic surveys in the region where it occurs. McCauley et al (2000a) concluded that a single seismic survey has a negligible impact on larval supply by comparisons with the size of the larval populations involved. This has been supported by the conclusions of Day et al (2016a) and Przeslawski et al (2016b). Przeslawski et al (2016b) also note that various studies conducted in the 2000s detected no significant differences to marine invertebrates between sites exposed to seismic operations and those not exposed.

Sound Effect Criteria

For crustaceans (lobster, crab), a PK-PK sound level of 202 dB re 1 µPa (Payne et al. 2008), associated with no mortality or damage to mechano-sensory systems and recoverable injury, was applied at the seafloor. Modelling (Appendix E) predicted that the maximum distance at which this sound level is reached is 414 m. Consultation with relevant persons indicated that 750 m would be a more appropriate distance for effect to all life-stages of SRL. and the release of Day et al. (2021) indicates no long-term righting effect to juvenile lobsters at 500 m, and a moderate, non-significant effect to intermoult duration for juveniles at 500 m, with the results for puerulus confounded by small sample size.

Injury/mortality to fauna – increase predation due to physiological changes

Day et al (2016a) reported that lobsters used for their 2014 experiments, which were collected from the Crayfish Point Reserve in the Derwent Estuary near Taroona, were found to have pre-existing damage to statocysts, likely resulting from prolonged exposure to shipping traffic noise in shallow water at this location. The lobster population at Crayfish Point Reserve has been subject to long-term monitoring. The population is thought to be at carrying capacity (Kordjazi et al., 2015) and survival rates within this reserve have been estimated through capture and release studies at around 95% (Green & Gardner, 2009).

The abundance of SRL within the Crayfish Point Reserve can reasonably be ascribed to the exclusion of the lobster fishery since 1971. Lobster populations within marine protected areas have consistently been found to demonstrate higher biomass and higher abundance of larger size classes than lobster populations subject to fishing pressure (Barret et al., 2009;b; Young et al., 2016). Barret et al (2009) suggested that exploitation had reduced SRL biomass in the fishery adjacent to the Maria Island marine protected area, east coast Tasmania, to <10% of natural values, with consequent severe ecological effects on rocky reef ecosystems (Ling et al., 2009, Ling & Johnson, 2012).

Thus, whilst the ecological effects of damaged statocysts in the SRL has not been the subject of dedicated experimental studies, long-term monitoring of the lobster population with damaged statocysts at Cray Point Reserve indicates that any population-level survivability effects are not significant and, importantly, ecological effects are likely to be negligible relative to the effect of fishing mortality.

In early 2018, the CarbonNet Project undertook the Pelican 3DMSS 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 SRL surveys before and after the MSS to ascertain whether any differences in abundance could be attributed to the MSS. 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 acquisition area and four reference sites located more than 15 km to the northeast. At all sites, more SRL were retrieved during the post-MSS assessment (4 months after the MSS), with 81 individuals trapped during the pre-MSS assessment compared to 122 trapped post-MSS. This increase in numbers post-MSS was most likely due to seasonal effects rather than any impact of the MSS (CarbonNet, 2018). These results indicate no effect of the MSS on lobster abundance.

Injury/mortality to fauna – loss of recruitment into the fishery

In its submission to NOPSEMA during the EP public comment period, DPIPWE stated that the area west of King Island is an important source of SRL larvae to Tasmania, with larvae drifting eastward from South Australia and western Victoria. This is supported by Hartmann et al (2013), who state that modelling of larval dispersal suggests that Tasmanian recruits mainly originate from South Australia and Victoria (Hartmann et al., 2013) and Bruce et al., 2007 who found the most important sources of successfully settling pueruli across the entire southern Australia fishery were the areas to the west of western Victoria.

SRL spawning occurs between late winter and early spring and drift as plankton for up to 24 months before settlement (Hinojosa et al, 2016). The timing of the Sequoia 3DMSS may overlap with the spawning period and/or the plankton drifting phase for SRL. Impacts to plankton are considered earlier and indicate that crustaceans in the drifting planktonic phase are not likely to be impacted by the survey unless within 170 m of the active sound source.

FRDC (2018g) states that larval release occurs over wide spatial scales, and release across the continental shelf allows for good dispersal due to the high currents of southern Australian waters. Genetic analysis indicates that SRL present across southern Australia is a single biological stock (FDRC, 2018g) able to maintain population numbers (Linnane et al 2018). Recent stock assessments estimate that egg production in 2016-17 was 21% of the unfished level, indicating that stock biomass is unlikely to be depleted and that recruitment is unlikely to be impaired (FRDC, 2018g). Bruce et al., 2007 predicted that North-west Tasmania had the lowest input to settlement (along with eastern Victoria) across the range of the SRL fishery, with many larvae lost to Bass Strait where high levels of mortality are predicted. Of those that are transported offshore, the relatively few successful pueruli settlers recruit primarily to Tasmanian waters. This region may be a less productive area for stock rebuilding in terms of overall benefits to the fishery (Bruce et al., 2007), especially when compared to the significant levels of recruitment from South Australia and Victoria, and south-western Tasmania.

Hartmann et al (2013) states that phyllosoma larvae are not retained inshore on the continental shelf (i.e., most of the survey area) but rather, live in oceanic waters and are transported over large distances. Booth et al., 1991 found settlement of the returning pueruli onto reef habitat occurs primarily in depths from 50 m to the intertidal zone, below the planned water depths of 70-1,000 m for the Sequoia MSS. Hinojosa et al, 2016 identified that the duration of the pueruli phase is dependent on the energy reserves stored during the preceding phyllosoma phase so the duration of the pueruli phase is constrained by limited energy reserves.

Puerulus actively swim inshore over a 3-4 week non-feeding stage to settle onto reef habitat in depths from 50m to the intertidal zone (Booth et al., 1991; Phillips and McWilliam 2009). After inshore settlement, early juveniles are solitary and normally found in isolated holes and crevices. Linnane et al (2017) reported that, as they develop, juvenile lobsters become increasingly communal with larger juveniles and sub-adults residing in large aggregations inside rocky dens within structurally complex reef habitats.

McCauley et al (2000a) concluded that a single seismic survey has a negligible impact on larval supply by comparisons with the size of the larval populations involved. This has been supported by the conclusions of Hartmann et al., 2013, Bruce et al., 2007, and Booth et al., 1991, namely that phyllosoma larvae are not expected to be retained where the survey will take place, recruitment into the area is unlikely to be impaired based on modelling showing the most important sources are South Australia and Victoria, and that northwest Tasmania is predicted to have the lowest input to settlement across the range of the fishery with most of the pueruli originating from the survey area lost to Bass Strait. Additionally, Hinojosa et al, 2016 identified that pueruli are likely to use a range of orientation cues to locate suitable settlement areas.

Day et al., 2021 assessed impact of seismic sound on peuruli and juvenile SRLs exposed at the seabed and identified seismic surveys are unlikely to produce significantly increased mortality. An impact to righting reflex occurred directly below the source for puerulus and out to at least 500 m for juveniles. However, juveniles exposed at 500m recovered after the first moult. An increased intermoult period occurred to juveniles directly below the source and out to at least 500 m. The study found that there was no recovery in juveniles at the 500 m distance and suggested the same may be true for puerulus, noting that this could not be statistically analysed in puerulus due to low sample numbers. In addition, the intermoult period was significantly increased in juveniles exposed directly below the source and appeared to be increased in puerulus, though the latter could not be statistically analysed, and juveniles at 500 m showed a moderate, non-significant increase in moult duration.

Despite the presence of multiple seismic surveys over SRL habitat historical and contemporary stock assessment have shown that the SRL fisheries overlapping with the Sequoia MSS have all been and remain above their egg production limit reference points (VFA 2021; IMAS 2019). This is important in the consideration of cumulative impacts from previous and future seismic surveys in the region and supports the literature above in suggesting there is high confidence that there are low levels of impact from seismic surveys on the recruitment to the fishery.

Sound Effect Criteria - Larvae

The sound exposure guidelines from Popper et al. (2014) for fish eggs and larvae have been applied for this impact assessment, in the absence of accepted noise effect criteria for SRL larvae. The exposure guidelines from Popper et al. (2014) are comparable to other studies such as Day et al. (2016) for embryonic lobsters and Fields et al. (2019) for copepods. Day et al., 2021 indicated sub-lethal effects out to 500 m from 203 PK (dB re 1µPa). In this study the maximum range of the experiment was 500 m. Therefore, a precautionary distance of 750 m has been adopted following advice from UTAS.

The sound exposure guidelines and predicted maximum distances from the acoustic modelling (Koessler et al., 2020; Appendix E) are detailed in Table 4-15. The maximum predicted distance for mortality and potential mortal injury is 170 m.

Table 4-15: Sound exposure guidelines and maximum predicated distance for eggs and larvae

Criteria	Sound exposure guideline	Maximum Distance
Mortality and potential mortal injury	207 PK	170 m (maximum over depth) 154 m (maximum seafloor)
	210 SEL 24hr	80 m (maximum over depth) Not reached at seafloor
Sub-lethal effects - Delayed righting time - Increased intermoult period	203 PK	750 m (maximum over depth)

Impact Evaluation	Consequence
Extent The extent of impact to individual SRL is predicted to be within a maximum horizontal distance from the seismic source to the seafloor of 750 m for the duration of the Sequoia MSS acquisition. Based on this distance, the area where SRL may be affected by sound at any point in time is 1.76 km^2 at the seafloor around the source. This area of impact is entirely covered by the operational area which has been used as the basis of the subsequent analysis. At the population level, in the context of the operational area, this is: • <0.001% of reported SRL commercial catch across southern Australia. • 9.74% of the Otway bioregion (i.e. the Western Bass Strait IMCRA Transition zone). • 10.16% of the Otway bioregion <150 m water depth. • 1.6% overlap with the Tasmanian fishery management zone. • 2.6% overlap with Victoria Western Zone which is 6.38% of the Apollo Bay zone. Each of these calculated overlaps does not recognise that SRL habitat will not be evenly distributed throughout each area. Productive SRL fishing grounds could indicate increased abundance and productivity. For example, this is shown by the fact that 5.2% of the catch in the Victorian Western Zone came from the 2.6% overlap between this zone and Sequoia operational area. However, using	Minor (2)

catch data is also a poor indicator of ecological significance. This is because catch data are influenced by other factors such as distance to ports, fishing patterns within and across seasons, weather, quotas, and size limits.

The extent of impact to larvae is predicted to be within a maximum horizontal distance of 170 m from the sound source for a duration of the Sequoia MSS acquisition (see Plankton chapter for details).

Severity

The severity of impacts is assessed as follows:

- Available 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., 2007, Day et al., 2021). The Day et al (2016 and 2021) assessments are considered conservative given the water depths in the Sequoia MSS and the protection afforded by typical habitat features such as holes, crevices or rocky dens within structurally complex reef habitats. 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).The maximum distance to the no effect criteria (Payne et al., 2007) from the acoustic modelling was 414 m (adults) and from the Day et al., 2021 study >500 m for juveniles, however, consultation with relevant persons identified that 750 m would be a more appropriate distance to use.
- All of the adult female SRL population and the majority of the adult male SRL population will not have soft shells during the period of seismic acquisition, with female SRL moulting between February and May and male SRL moulting mainly in August (Gardiner and Mills 2013).
- New shell remains soft for approximately 20 days (Gardiner and Musgrove 2004) and there is some indication that moulted lobsters take shelter to avoid predation (Professor McCauley - Inquiry into the impact of seismic testing on fisheries and the marine environment 2020).
- A single seismic survey has a negligible impact on larval supply by comparisons with the size of the larval populations (McCauley et al., 2000a) 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.

Duration

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 predicted impacts to individuals. However, given fishery recruitment is largely unimpeded by the Sequoia MSS, the duration of population level impact is expected to be limited to juveniles in the current cohort.

Impact Summary

The predicted extent, severity, and duration of impacts from the Sequoia MSS is assessed as Minor (2) because:

- The impact assessment has evaluated impacts from underwater sound on SRL stocks, including at key life stages based on contemporary scientific literature.
- Conservative thresholds have been adopted and given the small spatial overlap with likely SRL habitat, the potential for impact at the population level is negligible, localised and recoverable.
- Modelling predicts that the operation of low-power mode over the SRL excise area in the Zeehan AMP, to protect southern right whales, will not emit enough energy for sound level effect thresholds to be reached at the seafloor.
- Mortality to any life stage of SRL (i.e. eggs, pueruli, juvenile and adults) is not predicted from seismic sound exposure based on the outcomes of the studies of Day et al. 2016a and Day et al. 2021.
- SRL population is sustainably fished meaning that the population is not vulnerable to mortal effects to large portions of the adult populations.
- The SRL population is highly recoverable shown by the overlaps with the Victorian Rock Lobster Fishing Area and the Tasmanian Rock Lobster Fishing Area (5) which have removed their full quota

since quotas were introduced, which was a combined Total Allowable Commercial Catch (TACC) of 1466.70 tonnes of the adult population in 2019/20. • The SRL cohort exposed to sound from the Sequoia MSS overlaps with a productive area of the fishery where this cohort had 22.35 tonnes of biomass removed in 2019/20, which is 1.523% of the combined TACC of the fisheries. • The last 7 years of data from the stock assessments reports from the Victorian fishery show increasing biomass and total allowable catch, and stable egg production well above the limit reference point. Over the last 8 year period ConocoPhillips has identified approximately 9 seismic surveys have been undertaken either partially or entirely overlapping productive fishing areas directly relevant to those stock assessments. This indicates that seismic acquisition and SRL fishing can coexist in this environment without affecting the sustainability of the fishery. The Victorian fishery upper limit reference point for catch per unit effort is 0.4 kg per pot lift and in the same fishery where seismic acquisition has been undertaken, the catch per unit effort is increasing and last year was 0.67 kg per pot lift, providing additional evidence that these activities can coexist. • Even if there were sublethal effects that led to mortal effects for the effected cohort of juveniles, given the small spatial overlap of impacts from seismic at a population level, this is still considered to be minor based on it representing <0.001% of reported SRL commercial catch across southern Australia; 9.74% of the Otway bioregion (i.e. the Western Bass Strait IMCRA Transition zone); 10.16% of the Otway bioregion <150 m water depth; 1.6% overlap with the Tasmanian fishery management zone, and 2.6% overlap with Victoria Western Zone which is 6.38% of the Apollo Bay zone. • . • The SRL 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 (50m to the intertidal zone) not present within the operational area, and relevant persons (DPIPWE 31/03/21) acknowledged that impact will be reduced in deeper waters; 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.	

4.2.3. Impact Assessment – Crustaceans – Giant Crab

4.2.3.1. Existing Environment

The Giant Crab (*Pseudocarcinus gigas*) is a commercially important species in the region and endemic to the waters of southern Australia (DoE, 2014) (Figure 4-8). The species resides on muddy or rocky bottoms in waters of the Southern Ocean at depths of 20–840 m, though is most abundant at 110–180 m (upper continental slope of the shelf) in the summer before moving deeper onto the upper slope at depths of 190–400 m in the winter, likely related to changing water temperatures (Levings & Gill, 2010). Williams et al (2009) notes that giant crabs observed during surveys along the continental slope were using ledges and sponges for shelter.

Values

The Giant Crab does not have EPBC status or associated recovery or management plan. 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

(Hartmann et al, 2018). Varying management arrangements between jurisdictions are being considered for the differing patterns of exploitation (Hartmann et al, 2018)

Harvesting of the species has been undertaken for decades, though total allowable catch has been decreasing in Victoria significantly since 2004 from 62 tonnes to just 10 tonnes by 2020 (VFA, 2020). 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 15 September to 15 November to protect males during moult, while Tasmania remains open all year round for males.

Source: Hartmann et al (2018)

Figure 4-8: Distribution of Giant Crab in Australia

Sensitivities

The general description for Zeehan Marine Park includes important rocky limestone habitat preferred by Giant Crabs (DNP, 2013).

The species feeds on carrion and slow-moving benthic species including gastropods, crustaceans and starfish. They breed in June and July, and the female carries up to two million eggs for about four months. -As hatching approaches (October to November), females are thought to migrate to the shelf-break (Currie et al., 2009). Upon hatching, the larval duration is around 50 days with larvae release occurring at the edge of the continental shelf (FRDC, 2017). There is a strong capacity for larval dispersal over large spatial scales prior to settlement (PIRSA, 2002) (see Figure 1-4 for distribution map). Recruitment is not distributed evenly, with some areas having higher juvenile abundance than others, which is not a function of habitat but larval drift and ocean current movements (FRDC, 2018f).

Female moulting peaks strongly in winter (June and July). Males moult in summer (November and December). Intermoult period estimates varied from 3 to 4 years for juvenile males and females, with rapid lengthening in time between moulting events to approximately seven years for females and four and a half years for males.

Gardner, C (1998) reports that females appear to mate while soft-shelled with stored sperm remaining viable for at least four years; broods are produced annually although females occasionally skip a reproductive season, which may be associated with moulting, and several broods may be produced between moults although fecundity declines with successive broods.

The species is long-lived (30+ years) and slow-growing (FRDC, 2018f). There are also key biological features of the Giant Crab which could leave the population vulnerable to decline. Oceanographic modelling has demonstrated the species is of a single biological stock with larval dispersal occurring along the edge of the continental shelf and drifting with plankton for a 50-day period.

Given its habitat preferences and mapped fishing activity (edge of the continental slope), Giant Crabs are known to be present in the shelf slope in the southwest of the survey area and are expected to be most abundant at 110-180 m depths. Discussion with UTAS indicates that abundance is likely to be higher in shallower waters between 150 – 180 m in the winter and that abundance is expected to decrease with an increase in depth (pers comms Caleb Gardner, 26/05/2021 – see section 3.

Existing Pressures

The Giant Crab is not listed under the EPBC threatened species list and does not have a management plan. However, there are a range of anthropogenic threats that affect Giant Crabs. Key threats identified include:

- Commercial and recreational fishing
- Ecosystem effects as a result of habitat modification and climate change
- Predation

The Status of Australian Fish Stocks classifies the Tasmanian giant crab stock as depleted. The FRDC 2018 report on the stock status of the fishery states that the egg production level is inadequate relative to benchmarks in most crustacean fisheries and has decreased to an estimated 14 per cent of unfished levels in 2013–14. DPIPWE have implemented reductions in total allowable catch (TAC) since 2006 in response to declining catch rates. Lack of appropriate biological data of the stock in the TGCF and the unknown extent to which trawling activities impact on giant crab stock and the species natural habitat, are the main factors limiting the understanding of the declining catch rate trend of giant crabs in the fishery for fishery managers and scientists (DoEE 2019). Since DPIPWE implemented a 46 per cent reduction in TAC, total landed catch has been fluctuating every fishing season but overall remains in a declining trajectory. Seasonal closures are in place in the fishery to allow for egg production during the giant crab breeding cycle. However, the continuing decline in catch rates is likely to be influenced by external factors including interaction issues with the trawl sector.

Giant Crab stock level are listed as ‘sustainable’ in Victoria (Hartmann et al 2018). The report by Hartmann et al (2018) attributes the inconsistency between these jurisdictions to variations in management arrangements.

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys in the area.

4.2.3.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to Giant Crab have been evaluated in Table 4-16; having had regard to the legislative and other controls (Section 4.2.1.5).

Table 4-16: Predicted impact levels – Emissions – Underwater Sound (Impulsive) for Giant Crab

Emissions – Underwater Sound (Impulsive)
Overview of Injury/mortality to fauna – physical or physiological impacts to Giant Crab There are no specific studies on changes to physical characteristics or the physiology of Giant Crab in the Otway from underwater sound generated by commercial seismic sound sources. Therefore, the prediction of impact has been made using what sparse data is available alongside data and literature from similar crab species in other areas. 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 millimetres carapace length (Gardner et al. 2002). Morris et al (2018) undertook field studies in 2015 and 2016 into the effects of a 2DMSS, and again in 2017 and 2018 into the effects of 2D seismic (Morris et al., 2020) on the snow crab (*Chionoecetes opilio*) fishery of the shelf and slope habitats of Atlantic Canada, using treatment and control sites in a multi-year BACI approach. As with the Victorian and Tasmanian giant crab fisheries, snow crab fishers in Canada were concerned about the potential impacts of MSS on their target species. The 2017 study found that no interface waves that would increase particle motion at the seafloor were detected and concluded that if MSS effects on snow crabs do occur, they are smaller than changes related to natural spatial and temporal variation. A pilot study on snow crabs (*C. opilio*) (Christian et al., 2003; 2004) exposed captive adult male snow crabs, egg-carrying female snow crabs, and fertilised snow crab 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 a 33-minute period 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 eighteen weeks following exposure. Subsequent work on larvae that had been exposed to seismic array signals as embryos but could hatch normally without being stripped from berried females did not suffer any negative effects (Payne et al., 2008). • Stress indicators in the haemolymph of adult male snow crabs 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. The 2020 study found 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 and concluded that, based on 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 observed differences owing to seismic surveying in the study design were likely a result of stochastic processes external to their manipulation. 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

Emissions – Underwater Sound (Impulsive)

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-acoustic source 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 sound pressure level as high as 231 dB re 1 µPa).

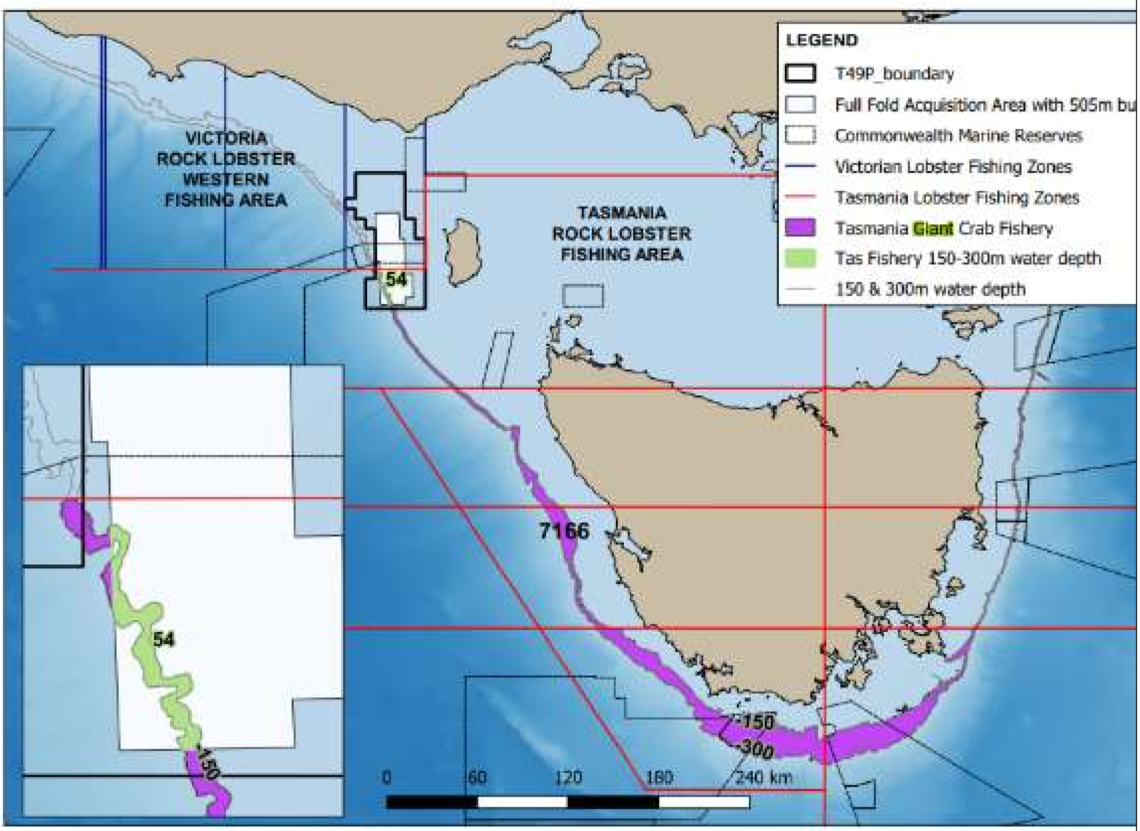
Sound Effect Criteria – Juvenile and adult Giant Crab

There are no seismic acoustic sound effect criteria for crabs and typically the PK-PK sound level of 202 dB re 1 µPa (Payne et al. 2008) associated with no impact to lobsters would be applied. Modelling (Appendix E) predicted that the maximum distance at which this sound level is reached is 414 m. However, consultation with relevant persons identified that based on unpublished literature 750 m would be a more appropriate distance noting that the publicly available information on the scope of the study is not explicitly linked to GC (https://www.frdc.com.au/project/2019-051).

Injury/mortality to fauna – larvae, early life-stage, and moulted GC

The inter-moult period is one of the longest of the crab species and can be up to fifteen years for mature females (Gardner et al. 2002). 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 (Kailola et al. 1993).

Figure 2 Depicts the overlap of the seismic survey with available habitat within both the Victorian and Tasmanian GC fisheries



The excise of the 140-300 m water depth region (and 'no-effect' buffer distance) effectively means that areas commercially fished for giant crabs have been removed from the survey area, along with the area in which effects to

Emissions – Underwater Sound (Impulsive)

giant crabs are predicted to extend, reducing impacts to giant crabs. Feedback from fishers during the consultation visit to King Island and from relevant experts at UTAS suggested that GC population abundance declines in deeper waters along with the presence of productive habitat.

A GC carries eggs for approximately 4 months with eggs hatching in the October/November period that are dispersed over about 50 days before settling. The timing of the Sequoia 3DMSS may overlap with the spawning period and/or the plankton drifting phase for giant crab. Courtney et al., 2009 found exposure to seismic energy did not kill snow crab embryos (87% survival in the seismic group including black eggs, pre-zoea and zoea compared to 89% in controls).

Christian et al., 2003 found that snow crab eggs exposed to 202 dB SPL of seismic sound showed an increase in mortality and delayed development, however the tests were conducted at distances 2 m from the source and the authors noted in normal situations eggs would never be this close to the array.

Males moult in summer (November and December) and female moulting peaks strongly in winter (June and July). Moulted giant crabs are expected to employ strategies to protect themselves from predation, however there may be little opportunity for this given their open habitat while the new exoskeleton hardens up over the course of a few days ((per comm Caleb Gardner, 26/05/2021).

Sound Effect Criteria - Larvae

The sound exposure guidelines from Popper et al. (2014) for fish eggs and larvae have been applied for this impact assessment, in the absence of accepted noise effect criteria for giant crab larvae. The exposure guidelines from Popper et al. (2014) are comparable to other studies such as Day et al. (2016) for embryonic lobsters and Fields et al. (2019) for copepods.

The guidelines and predicted maximum distances from the acoustic modelling (Koessler et al., 2020; Appendix E) are detailed in the table below. The maximum predicted distance for mortality and potential mortal injury is 170 m.

Table 4-17: Sound exposure guidelines and maximum predicated distance for plankton

Criteria	Sound exposure guideline	Maximum Distance
Mortality and potential mortal injury	207 PK	170 m (maximum over depth) 154 m (maximum seafloor)
	210 SEL 24hr	80 m (maximum over depth) Not reached at seafloor

Impact Evaluation

The extent of impact to Giant Crabs is predicted to be within a maximum horizontal distance from the seismic source to the modelled seafloor of 750 m for the duration of the Sequoia MSS. Based on this distance, the area where GC may be affected by sound at any point in time is 1.76 km^2 at the seafloor around the source, or less than 0.001% of the Otway bioregion. The extent of impact to larvae is predicted to be within a maximum horizontal distance of 170 m from the sound source for a duration of the Sequoia MSS (see Plankton chapter for details).

The severity is assessed as Minor (2) based on:

- The area of suitable habitat for giant crabs (upper parts of the shelf slope) is limited to the southwest corner of the survey area, or <2% of the survey area. Given the abundance of similar habitat available around the continental shelf (extending from the Otway region south around Tasmania and north to near the Victorian/NSW border), and that the species represents a single biological stock in this area, impacts at a population level are expected be negligible.
- The maximum distance to the no effect criteria (Payne et al., 2007) from the acoustic modelling was 414 m, however, based on consultation with relevant persons identified that based on unpublished literature 750 m would be a more appropriate distance has been used..
- Giant Crabs are not expected to be in moult during the survey.
- Available scientific literature has demonstrated no direct mortality of crabs from exposure to seismic sounds (Morris eta l., 2017; Christian et al., 2003, 2004; DFO, 2004).
- Larvae impacts are expected to be localised, temporary, and recoverable based on recruitment into the area of the same biological stock.
- Whilst the spawning period may overlap with the survey timing (October) the species is distributed from central NSW to south-west WA (Kailola et al, 1993). The Sequoia MSS timeframe may overlap with berried female phase of the reproductive cycle (FRDC, 2017).

Consequence

Moderate (3)

Note that after completion of this assessment the GC habitat has been excised resulting in a revised consequence ranking of:

Negligable (1)

Emissions – Underwater Sound (Impulsive)	
No change to development rate in exposed fertilised crab eggs/embryos is expected compared with unexposed eggs/embryos (Payne et al, 2008; Christian et al, 2003; DFO, 2004a; Pearson et al, 1994). • Identified giant crab habitat, based on fishery data, has been excised from the survey area, reducing impacts where the highest density of Giant Crab is expected in the survey area. Modelling predicts that the operation of low-power mode over the Giant Crab excise area, to protect southern right whales, will not emit enough energy for sound level effect thresholds to be reached at the seafloor. • Giant Crab adults may be present in the deeper waters of the south-west corner of the survey area. Giant Crab in these areas have less exposure to sound from the increased distance from the sound source. There is an absence of fishing effort in deeper waters. Anecdotal feedback from fishers and UTAS shared knowledge of the sparsity of adults and supporting habitat at increasing depths. Weighing these against the Sequoia survey objectives an increased or total excise of the southwest corner is not justified. • The lack of overlap with the moulting period (expected in May), the relative infrequency of moulting (~ every 4-5 years), along with the rapid growth of a new carapace (~1 day) mean there is no effect to GC's the assumed vulnerable life-cycle stage of moulting.	

4.2.4. Impact Assessment – Molluscs

4.2.4.1. Existing Environment

Molluscs recorded in the survey area include the Giant Squid, Gould's Squid and Pale Octopus. Commercial Scallops (*Pecten fumatus*) may also be present in the survey area but are not commercially fished in this area. Molluscs are distinguished by the presence of a mantle (a cavity used for breathing and excretion), a radula (a 'rasping' tongue, except for bivalves) and the structure of the nervous system. Molluscs include scallops, abalone, oysters, clams, mussels, limpets, squids, octopus and cuttlefish.

Values

Cephalopods are expected to occur in the area as they have a very broad distribution throughout southern Australian waters. Although there are no BIAs or critical habitats present in the Sequoia MSS area for cephalopods, they are known to inhabit coastal and shelf environments, canyon systems and deep waters off the continental shelf, depending on the species (Boyle & Rodhurst, 2005). Cephalopods are active mobile predators feeding mostly on fish and crustaceans living on or near the seabed (Boyle & Rodhurst, 2005).

Cephalopods have a high growth rate with a short life span and reproduce by sexual reproduction (Boyle & Rodhurst, 2005). The individual size and number of eggs (released in a jelly like egg mass) during a reproductive season is variable and ranges from a few large eggs (< 30 mm long) attached to the seabed to numerous (>1 million) small eggs drifting in the plankton. The incubation period is highly temperature dependent and is completed with the hatching of the larval stage which resembles a miniature adult. After breeding the adults die within a short time and in species with a highly synchronised breeding population this can result in conspicuous mass mortality (Boyle & Rodhurst, 2005).

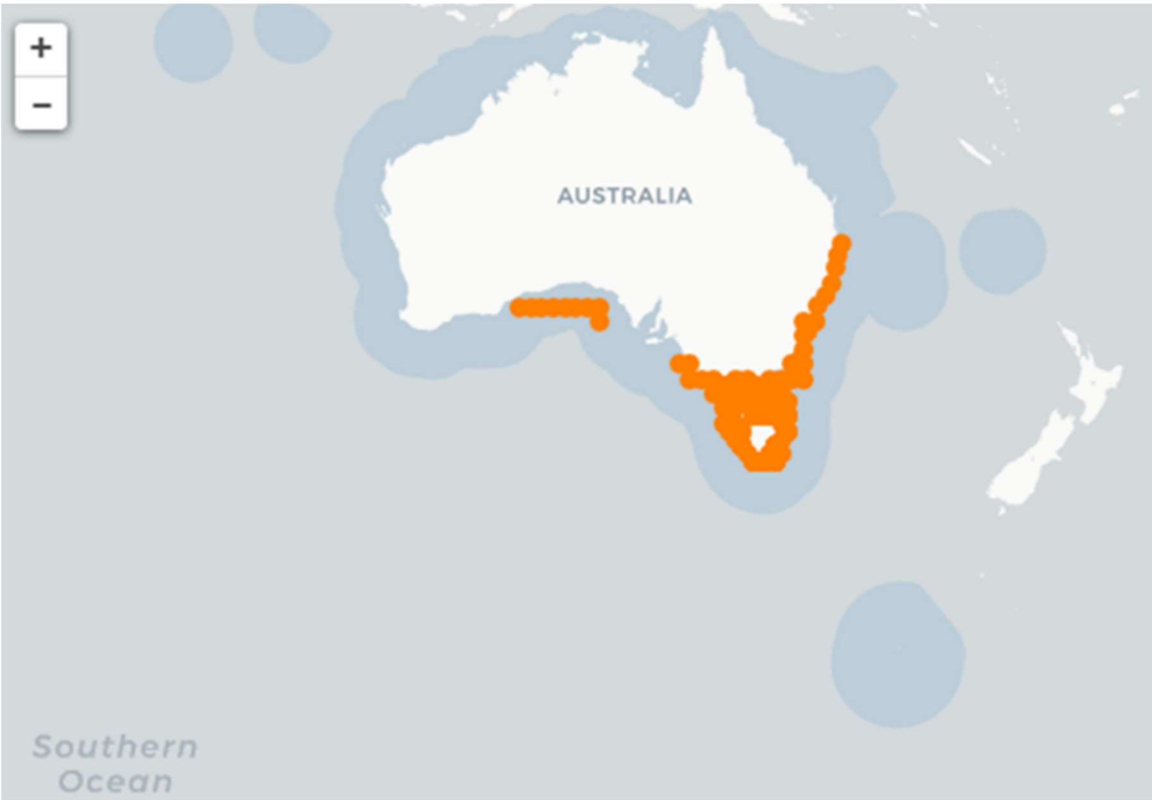
Although various cephalopod species are likely to be present in the sound EMBA, none have been identified as having a major conservation value within relevant Marine Parks or KEFs. However, Gould's Squid has been recorded by ABARES (2019) as supporting commercial fishing in the sound EMBA and therefore is considered commercially relevant.

Gould's Squid

There is no formal stock assessment available for the population, however stock status records show the species in south-eastern Australia to be of a sustainable level (Noriega et al, 2018).

Gould's squid (*Nototodarus gouldi*) is a commercially important species typically found at depths from 50 – 200 m off the subtropical and temperate coasts of Australia (Atlas of Living Australia, 2020). Gould's squid feeds on crustaceans, fish and cephalopods at night and is in turn prey for birds, large fish, sharks and marine mammals (O'Sullivan and Cullen, 1983). Gould's Squid is short lived (less than one year), spawns multiple times during its life, and displays highly variable growth rates, and size and age at maturity (Jackson & McGrath-Steer, 2003).

The species is commercially harvested using jigging by the Southern Squid Jig Fishery and the population size in Bass Strait varies from year to year. This is primarily due to its short life cycle, the 'boom and bust' nature of its population dynamics and life history characteristics. Figure 4-9 shows the distribution of reported commercial catch of Gould's Squid in south-eastern Australia (Noriega et al, 2018) which indicates it is likely that Gould's Squid will be present in the sound EMBA.



Source: Noriega et al (2018)

Figure 4-9: Distribution of reported commercial catch of Gould's Squid

Sensitivities

The potential impacts of seismic sound on molluscs has not been well studied until very recently. Cephalopods are capable of 'hearing' seismic surveys (Samson et al., 2016). Mooney et al (2012) notes that early anecdotal reports suggested that cephalopods might detect sounds because squid were attracted to 600 Hz tones and cuttlefish (Sepia officinalis) elicited startle responses to 180 Hz stimuli. It was thought that squid might be debilitated by the acoustic intensity of foraging odontocete (toothed whale and dolphin) echolocation clicks, though subsequent laboratory experiments demonstrated that squid do not exhibit anti- predator responses in the presence of odontocete echolocation clicks, indicating that they cannot detect the ultrasonic pressure component of a sound field.

Anatomically, squid have complex statocysts that are considered to serve primarily as vestibular and acceleration detectors (Mooney et al., 2012). Behavioural experiments confirmed that squid (Loligo vulgaris), octopus (Octopus vulgaris), and S. officinalis can detect acceleration stimuli from 1 to 100 Hz, presumably by using the statocyst organ as an accelerometer and that they can detect the low-frequency particle-motion component of a sound field (Mooney et al., 2012). Squid appear to only sense acoustic particle motion (the back-and-forth vibratory component of sound), with particle acceleration likely being the most relevant metric (Jones et al., 2020). Cephalopods detect particle acceleration via paired statocyst organs in the head, which contain a calcium-carbonate 'statolith' sensitive to linear acceleration. The ecological functions of squid and other cephalopods' hearing abilities are unknown. It is thought that cephalopods may utilise sound to assess the 'auditory scene' of their natural environment, orienting to and extracting information from their environment by segregating discrete components of natural soundscapes, which is thought to be a basal function of hearing. Squid may also utilise sound to detect the presence of nearby predators, especially when vision is impeded (Jones et al., 2020).

Gould's Squid

The report by Noriega et al (2018) highlights characteristics of the Gould's Squid's lifecycle which lend itself to rapid increases in biomass during favourable environmental conditions, making it less susceptible to becoming overfished than longer-lived species. Given spawning occurs throughout the year (Jackson & McGrath-Steer, 2003) there is minimal risk of overfishing in seasonal and localised fisheries such as those in South-Eastern Australia showcasing the resilience of the population despite its commercial status.

Existing Pressures

Gould's Squid, and cephalopods as a whole, are not listed under the EPBC threatened species list and do not have a management plan. However, there are a range of anthropogenic threats that affect the population including:

- Commercial and recreational fishing (assessed as sustainable in commercial fishing status reports)
- Ecosystem effects as a result of habitat modification and climate change
- Predation

4.2.4.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to cephalopods have been evaluated in Table 4-18; having had regard to the legislative and other controls (Section 4.2.1.5).

Table 4-18: Predicted Impact Levels – Emissions -Underwater Sound (Impulsive) for Cephalopods

Emissions – Underwater Sound (Impulsive)
Overview of change to behaviour for cephalopods Cephalopods are capable of 'hearing' seismic surveys (Samson et al., 2016). Mooney et al (2012) notes that early anecdotal reports suggested that cephalopods might detect sounds because squid were attracted to 600 Hz tones and cuttlefish (*Sepia officinalis*) elicited startle responses to 180 Hz stimuli. It was thought that squid might be debilitated by

the acoustic intensity of foraging odontocete (toothed whale and dolphin) echolocation clicks, though subsequent laboratory experiments demonstrated that squid do not exhibit anti- predator responses in the presence of odontocete echolocation clicks, indicating that they cannot detect the ultrasonic pressure component of a sound field. Squid are not known to utilise sound for communication, with their primary communication system considered to be visually based. In situ exposure of caged squid (*Sepioteuthis australis*) to impulsive noise from air guns induced behavioural alarm responses such as jetting (Fewtrell & McCauley, 2012). Though results from this small handful of studies suggest adverse effects, noise sources and cephalopod species are diverse, and little is known regarding how cephalopod species may behaviourally respond to anthropogenic noise. A range of cephalopod responses to seismic sound has been observed, including escape and startle type behaviour in relation to loud low frequency sounds (McMauley et al., 2000, Fewtrell & McCauley, 2012; Samson et al., 2016). The startle response (inking) may occur within 2.14 km to 3.56 km of the sound source, based on the acoustic modelling for Sequoia MSS (Koessler et al. 2020; Appendix E), if the source of the sound is sudden. Beyond the initial startle, octopus and squid are likely to disperse from the sound source and therefore not be subject to additional sound levels that result in physiological impacts. Anatomically, squid have complex statocysts that are considered to serve primarily as vestibular and acceleration detectors (Mooney et al., 2012). Behavioural experiments confirmed that squid (*Loligo vulgaris*), octopus (*Octopus vulgaris*), and *S. officinalis* can detect acceleration stimuli from 1 to 100 Hz, presumably by using the statocyst organ as an accelerometer and that they can detect the low-frequency particle-motion component of a sound field (Mooney et al., 2012). Squid appear to only sense acoustic particle motion (the back-and-forth vibratory component of sound), with particle acceleration likely being the most relevant metric (Jones et al., 2020). Cephalopods detect particle acceleration via paired statocyst organs in the head, which contain a calcium-carbonate 'statolith' sensitive to linear acceleration. The ecological functions of squid and other cephalopods' hearing abilities are unknown. It is thought that cephalopods may utilise sound to assess the 'auditory scene' of their natural environment, orienting to and extracting information from their environment by segregating discrete components of natural soundscapes, which is thought to be a basal function of hearing. Squid may also utilise sound to detect the presence of nearby predators, especially when vision is impeded (Jones et al., 2020). Any impacts of aquatic noise on cephalopods have yet to be established and are poorly understood. Ambient and anthropogenic ocean noise are substantial at lower frequencies where squid are sensitive, suggesting that they will be susceptible to masking or other physiological or behavioural impacts of anthropogenic noise, such as MSS. Statocyst or lateral line hair cells could be impacted by sound energy (either long duration or brief, high-intensity noise). Hair cell damage and related temporary hearing loss has been demonstrated in fish, so it follows that this could also be the case for squid given they have a lateral line analogue. However, cephalopods that are very mobile and can move away from areas where sound levels might have the capacity to cause physiological damage and may startle before sound exposure reaches impact levels. *Sound Effect Criteria* There are no seismic acoustic sound effect criteria for cephalopods and instead the inking and startle response (Fewtrell and McCauley, 2012) identified at 162 dB re 1 µPa².s SEL per-pulse for squid has been applied in this assessment. The predicted maximum distance from the acoustic modelling (Koessler et al., 2020; Appendix E) to this criterion is 3.56 km. Based on the maximum modelled horizontal distance, the area where cephalopods may be affected by sound at any point in time is less than 40 km² around the source, or 0.1% of the Otway bioregion.

Impact Evaluation	Consequence
The extent of the area of impact is predicted to be a maximum of 3.56 km from the sound source for the duration of the Sequoia MSS acquisition. The severity is assessed as **Minor (2)** based on: • Behavioural startle response and inking may occur within the area of potential impact. These predicted impacts are temporary, localised and recoverable. • Mortality or physiological damage to cephalopods is not predicted. • Cephalopods may be injured if a seismic source commences operation at full power immediately next to the species. With controls adopted, cephalopods which are very mobile can move away from areas where sound levels might have the capacity to cause physiological damage.	Minor (2)

4.2.5. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-19 compares the predicted impact levels for invertebrates against the acceptable levels.

Table 4-19: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Invertebrates

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th colspan="2" rowspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="4">Principles of ESD</td><td rowspan="4">Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.

Environmental impacts and risks have a worst-case consequence ranking less than Major (4).</td><td colspan="2">Of the invertebrates known to be present and predicted to be impacted by sound, SRL may suffer permanent injury, GC may suffer similarly but this is uncertain, and impacts to molluscs are behavioural only. Whilst the severity may be irreversible the extent and duration (at a population level) of impact is minor.</td><td rowspan="4">Yes</td></tr>
<tr><td>Severity</td><td>Injury</td></tr>
<tr><td>Extent</td><td>Crustaceans: 750 m from the sound source
Molluscs: 1.5 m to 3.56 km from the sound source</td></tr>
<tr><td>Duration</td><td>Maximum of 38 days of exposure. Injury to individuals is permanent but not significant at a population level.</td></tr>
<tr><td>Principles of ESD</td><td>Enough appropriate information to understand impact/risk of serious/irreversible environmental damage.

Application of the precautionary principle in the presence of scientific uncertainty.</td><td colspan="2">There is predictive uncertainty in relation to the impact assessments to SRL and GC. This needs to be assessed and managed further. See Table 4-20 and Table 4-21.</td><td>No</td></tr>
<tr><td>Principles of ESD</td><td>EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td><td colspan="2">No relevance to invertebrates (See Appendix A).</td><td>N/A</td></tr>
<tr><td>Biological</td><td>Physical, physiological, and behavioural effects with no impact on key life functions, vital rates, and population parameters</td><td colspan="2">Some crustaceans present within 750 m of each seismic impulse at the seafloor may experience permanent physical injury. There is some uncertainty about the subsequent effects – See Table 4-20 and Table 4-21.
Behavioural impacts to molluscs and cephalopods are limited to behavioural effects.</td><td>Uncertain</td></tr>
<tr><td>Ecological</td><td>Maintain the sustainable development of living resources.</td><td colspan="2">No population level effects are predicted inclusive of the predictive uncertainty in the biological effects on invertebrates.</td><td>Yes</td></tr>
<tr><td>Economic</td><td colspan="4">Assessed in Commercial Fisheries - Section 4.7</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>All reasonably practicable control measures have been adopted to</td><td colspan="2">CM 11 - the sail line plan ensures the activity is clearly scoped and bounded.</td><td>Yes</td></tr>
</table>

Defined Acceptable Levels		Predicted Impact Level		Is the predicted impact below the defined acceptable level?
Factor	**Level**			
	reduce environmental impacts and risks.			
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).	SRL	Minor (2)	Yes
		GC	Negligible (1)	
		Molluscs	Minor (2)	
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to invertebrates have been considered as detailed in Section 3.4. No public comments were made in relation to invertebrates.		Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	There were no specific standards identified that were relevant to the protection of invertebrates or applicable to the Sequoia MSS.		N/A

Acceptability Summary

Following completion of the impact assessment process, the environmental impacts to invertebrates arising from the identified aspects are acceptable because:

- The invertebrates present are not EPBC listed species, therefore ongoing consideration of the commercially relevant species is to ensure minimal impact to population levels for ongoing commercial fishing interests.
- A small fraction of the regional population of SRL and GC will be impacted at sub-lethal levels.
- Key habitat locations for commercially important species, i.e. GC, have been excised to ALARP or these species also exist in habitat outside of the Operational Area, i.e. SRL and GC.
- Outputs of the modelling show any impacts to crustaceans are not lethal to individuals and do not impact reproduction or larval development, i.e., no population level impacts predicted.
- Larvae impacts are expected to be localised, temporary and recoverable based on recruitment into the area of the same biological stock for GC and SRL.
- Impacts to molluscs are localised and temporary, with no mass mortality attributable to the MSS.

There is residual predictive uncertainty from the impact assessment which needs formal assessment.

4.2.5.1. Predictive Uncertainty

Where there is predictive uncertainty in the impact assessment it is important to identify the source of that uncertainty and appropriate controls to ensure impacts will be of an acceptable level. This includes acknowledging scientific data gaps and assessing their significance in the context of this activity. Then, decisions about whether the uncertainty can be tolerated (i.e. the impact is below an acceptable level even with the worst extent of any uncertainty) or if efforts need to be made to address the uncertainty can be made. Table 4-20 considers the predictive uncertainty for SRL. Table 4-21 considers the predictive uncertainty for GC.

Table 4-20: Assessment of Predictive Uncertainty in the Impact Assessment on SRL

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Physical effects	High		

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Physiological effects	High	There are impulsive sound criteria for no effect and physical effects that are relevant to SRL in this region, that have been published in peer reviewed journals. The no effect impulsive sound criteria for SRL was used in the impact evaluation.	High confidence in the impact prediction so no action is required.
Behavioural effects	High		
Key life function effects	High	ConocoPhillips Australia is aware that there is pending literature on the effects of seismic sound on the inter-moulting period of SRL which reduces the confidence in the impact prediction.	High confidence in the impact prediction given recent studies on key-life functions of SRL in the Otway region.
Population effects	High	With no mortal effects predicted to SRL adults and mortal effects on early life-cycle stages limited to 170 m from the sound source there are no population level effects predicted. This view is supported by peer reviewed literature. There is a high level of recoverability of the population, shown by the total allowable commercial catch and the status of the fishery as sustainable.	High confidence in the impact prediction so no action is required.
Distribution	High	There is high confidence in the distribution and abundance of SRL in the area given the fishing effort.	High confidence in the prediction of distribution and abundance so no action is required.
Abundance	High		
Habitat	Medium	Data on the characteristics of the SRL habitat in the operational area is sparse, however the distribution and abundance of SRL in the operational area suggest that suitable habitat for SRL is present throughout the area.	There are no impact pathways for seismic effects on benthic habitat so some uncertainty about the characteristics of SRL habitat can be tolerated.
Trophic interactions	High	The ecological processes in the Otway Region as they relate to SRL are well understood.	High confidence in the prediction so no action is required.

Table 4-21: Assessment of Predictive Uncertainty in the Impact Assessment on Giant Crab

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Physical effects	Medium	There is no specific literature on the effects of seismic sound on GC in this region, however peer reviewed no effect impulsive sound criteria for SRL are used as a proxy. Peer reviewed studies on snow crabs suggest the SRL effect criteria would be conservative.	The body of evidence for seismic effects on GC is sparse and there is a high reliance on analogues in the assessment. After speaking with DPIPWE and the local GC expert at UTAS it is unclear what the research priority
Physiological effects	Medium		
Behavioural effects	High		

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Key life function effects	Low	There is no literature on the effects of seismic on early life-cycle stages of GC. Given the difference in early life-stage development between SRL and GC the body of evidence for SRL cannot be relied on.	would be to close data gaps to improve the confidence in this impact assessment. Therefore, three actions are proposed in the presence of uncertainty: 1. Application of a low-power excise area over the known GC fishing habitat to ensure no additional pressure is exerted on a depleted stock. 2. ConocoPhillips Australia will fund UTAS to complete a literature review of seismic effects on GC, and suitable analogue crabs.
Population effects	Medium	Whilst population level effects are not predicted the uncertainty in biological effects means there must be some uncertainty in population level effects. A depleted stock and currently unsustainable fishery indicate this species is particularly vulnerable to any additional impact.	
Distribution	Medium	The areas commercially fished indicate a consistent distribution of GC within that zone but biomass distribution and abundance throughout the fishery, and in the adjacent marine park is poorly understood. UTAS confirmed the view that density of GC habitat decreases with depth throughout the ensonified area.	
Abundance	Medium		
Habitat	Low		
Trophic interactions	Medium	The ecological processes in the Otway as they relate to GC are well understood but less so than SRL.	

4.2.6. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Southern rock lobster populations remain a sustainable resource; and
Receptor	• Giant crab populations are not depleted further; and
Receptor	• Molluscs populations remain a sustainable resource; and
Impact	• Impacts are sub-lethal with no pathway for impacts on key life functions, vital rates, and population parameters.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-22 which assesses whether the control measures for invertebrates are effective to meet the EPO.

Table 4-22: Control Measure Effectiveness - Invertebrates

Measure	CM 11 - Sail line plan		
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.		
Is the EPO achieved?	Partially		
Residual impacts requiring additional management	A relevant study on SRL is yet to be released which may	GC stocks are listed as depleted and the Sequoia MSS will traverse the know	Uncertainty about the impacts of seismic sound on GC.

	necessitate a change to the survey.	GC habitat and fishing grounds.	
Additional Measures	CM 15 – Invertebrate adaptive management procedure	PS 11.2 – Excise area	PS 15.1 UTAS GC literature review
Assessment of Effectiveness	Knowing that a relevant study could be published before or during the Sequoia MSS requires a specific measure that would allow for adaption of the Sequoia MSS following re-assessment of the predicted impacts to SRL and other crustaceans.	An excise area over GC habitat will result in increased protection for a vulnerable and depleted stock. To ensure protection for marine mammals remains in place 'low-power' mode will be used over the excise area rather and having hard starts.	See Section 4.2.5.1 on predictive uncertainty.
Is the EPO achieved?	Yes	Partially	Yes
Residual impacts requiring additional management	None	There remains some uncertainty about the effects of seismic sound on GC, along with concerns from the fisheries management agency, resulting in a need to apply further precaution across the likely GC habitat.	None
Additional Measures	-	PS 11.2(a) – Additional GC habitat excise area	-
Assessment of Effectiveness		An excise area over the known habitat of GC is the most precautionary measure possible.	
Is the EPO achieved?		Yes	
Residual impacts requiring additional management		None	

4.3. Fish

4.3.1. Scoping the Assessment

4.3.1.1. Defining the aspects that lead to impacts

Table 4-23 identifies the aspects and impacts that have the potential to impact fish as a result of the Sequoia MSS. Aspects and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible, or where no cause/effect pathway has been identified.

Appendix B provides a summary and justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (refer to Section 5 for Unplanned Aspects).

Table 4-23: Aspects and Impacts – Fish

Aspects	Impacts	Marine Reptiles
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	*X*
	Change in fauna behaviour	✓
Emissions – Underwater Sound (Impulsive)	Change in hearing via permanent and temporary threshold shift	✓
	Change in fauna behaviour	✓
	Injury/mortality to fauna	✓
Emissions - Light	Change in fauna behaviour	*X*
Emissions – Atmospheric	Change in fauna behaviour	*X*
Planned Discharges – Vessels	Injury/mortality to fauna	*X*
	Change in fauna behaviour	*X*

4.3.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-24 describes the cause and effect pathways / the source of the aspect identified for fish (Table 4-23).

Table 4-24: Cause and Effect Pathway – Fish

Emissions – Underwater Sound (Continuous)
Underwater sound is generated from the survey and support vessels, mainly by propeller and thruster cavitation, with a smaller fraction produced through the hull from engines, gearing, and other mechanical systems. Underwater sound is also generated by helicopters during take-off and landing on the survey vessel. Continuous sound generated by the Sequoia MSS has 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 mammals, including: • a change in fauna behaviour.
Emissions – Underwater Sound (Impulsive)

Underwater sound is generated with each pulse from the seismic source that produces high intensity, low-frequency impulsive sounds. Impulsive sound generated by the Sequoia MSS has the potential to result in: • a change in ambient sound. As a result of a change in ambient sound, further impacts may occur to fish, including: • a change in fauna behaviour • mortality and potential mortal injury and recoverable injury • a change in hearing via temporary threshold shift.

4.3.1.3. Defining the EMBA

Table 4-25 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact fish (Table 4-23). A summary of relevant studies supporting the source of the criteria used are provided in the section : Sound EMBAS for Fish

Relevant Studies and the sound effect criteria and modelled distances are in the Sound Effect Criteria section.

The source of the aspect-receptor interactions has been described further in subsequent sections specific to receptor groupings. The EMBAs are shown in Figure 4-10.

Table 4-25: EMBA for Fish

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions – Underwater Sound (Continuous)	Helicopter sound	Helicopter activities produces strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson et al. 1995). Sound from helicopter activities is very localised and infrequent (once every 3-4 weeks)	Underwater sound only detectable within tens of metres of helicopter.	Operational Area
	Vessel sound	Fish may exhibit a response to vessel sound within the Operational Area based on the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014).	The Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. (2014) detail qualitative guidelines for shipping and continuous sounds for fishes. From the guidelines fish may exhibit: • High behavioural response at distances near (tens of metres) from a vessel. • Moderate behavioural response at distances intermediate (hundreds of metres) from a vessel.	Operational Area + 1 km
Emissions – Underwater Sound (Impulsive)	Seismic sound - Fish	The furthest distance to an acoustic threshold for fish from the acoustic modelling (Koessler et al., 2020; Appendix E – Sound Modelling E) is 2.55 km (Table 4-4)	The maximum distances to the acoustic thresholds (Popper et al., 2014) for fish from the acoustic modelling are: • Mortality and potential mortal injury and recoverable injury: 154 m • TTS 24hr: 2.55 km The Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. (2014) detail qualitative guidelines for masking and behaviour. From the guidelines fish may exhibit: • High behavioural response at distances near (tens of metres) and intermediate (hundreds of metres) from a vessel.	Operational Area + 2.55 km

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
			• Moderate masking response at distances intermediate (hundreds of metres) from a vessel.	

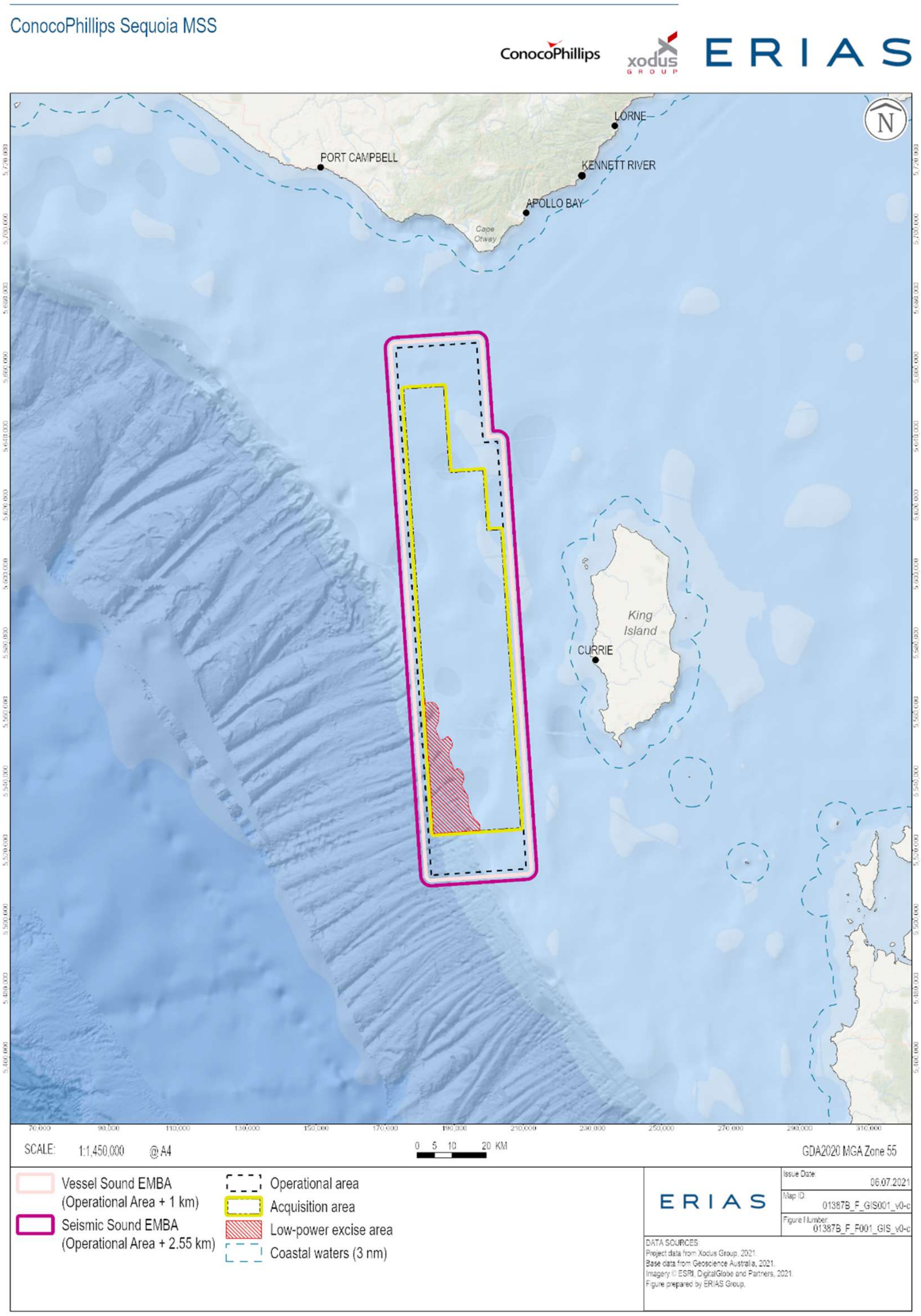


Figure 4-10: Sound EMBAS for Fish

Relevant Studies

Continuous – Vessel Sound

Up to three vessels will be within the Operational Area at one time, generating continuous sound. The operation of motorised vessels involves numerous mechanical processes that create underwater sound as a by-product. These processes range from the sound of the propeller, cavitation caused by propellers, flow noise from the vessel moving through the water, engines and auxiliary machinery in the vessel hull. This sound source will be at a much lower level than that emitted from the acoustic source array and expected to be masked during operation of the acoustic source array.

Seismic vessels in the absence of an operating acoustic source have been measured to have a broadband source level 156.9 – 180.3 dB re 1 µPa @ 1 m (Seiche, 2020). Studies of the radiating underwater sound generated from the thrusters and propellers of support vessels when holding position indicate highest measured levels of up to 182 dB re 1Pa with levels of 120 dB re 1 µPa measured at 3–4 km when the vessel was holding position and between 0.5 to 1 km when underway (McCauley 1998). As levels recorded in McCauley (1998) are similar to a seismic vessel it would be expected that received levels would be similar if not less than the distances of 0.5 to 1 km for 120 dB re 1 µPa as this seismic vessel and support vessels are always moving.

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The Working Group on the Effects of Sound on Fish and Turtles reviewed scientific literature available for sound on fish. From this review, sound exposure guidelines for fish and sea turtles were developed (Popper et al., 2014) and accredited with the American National Standards Institute (ANSI). For shipping and other continuous noise for fish with a swim bladder involved in hearing the guidelines provide sound exposure metrics for:

- Recoverable injury including injuries unlikely to result in mortality such as hair cell damage and minor haematoma.
- Temporary Threshold Shift (TTS) in hearing.

Within these guidelines, where insufficient data existed to make a quantitative guideline a subjective approach using 'relative risk' is used to assess risk at three distances from the source. This 'relative risk' is applied to mortality and potential mortal injury, masking and behavioural response.

The guidelines and predicted distances are:

- An exposure guideline for recoverable injury of 170 dB SPL for 48h. Based on McCauley (1998) this would require a fish to be within close proximity (<500 m) of a moving vessel for 48 hours.
- An exposure guideline for TTS of 158 dB SPL for 12h. Based on McCauley (1998) this would require a fish to be within close proximity (<500 m) of a moving vessel for 12 hours.

There is a high risk of behavioural response near the vessel (tens of metres) moderate risk at intermediate distance (hundreds of metres) and low risk at far distance (thousands of metres).

Based on this information avoidance behaviour may occur within the hundreds of metres from the vessel.

Continuous – Helicopter Sound

Helicopter operation produces strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson et al., 1995). The received sound level underwater depends on the helicopter source altitude and lateral distance, the receiver depth and water depth. Sound emitted from helicopter operations is typically below 500 Hz and sound pressure is greatest at surface in the water directly below a helicopter, but this diminishes quickly with depth. Sound pressure in the water directly below a helicopter is greatest at the surface and diminishes with increasing receiver depth. Richardson et al (1995) reports figures for a Bell 214 helicopter (stated to be one of the noisiest) being audible in the air for four minutes before it passed over underwater hydrophones, but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth. Noise from helicopter activities would therefore be localised and will also be infrequent (as personnel transfers will occur once every 3 – 4 weeks.

Impulsive – Seismic Sound

Table 4-26 provides a summary of studies undertaken on the potential impact of impulsive underwater sound on fish and sharks, where there is published relevant information.

Table 4-26: Studies of Underwater Sound (Impulsive) on Fish

Receptor	Sensitivity description
Sharks – behavioural	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 background ambient sound levels) when approaching within 10 m of the sound source. Free ranging sharks are attracted to sounds possessing specific characteristics – irregular pulse, broadband frequency and transmitted with a sudden increase in intensity (i.e. resembling struggling prey). At very loud levels an elasmobranch can discriminate between sounds based upon the phased difference between particle motion and acoustic pressure (Lobel, 2009). The US Navy observed that coastal and oceanic sharks (18 species) would often approach underwater speakers broadcasting low-frequency, erratically pulsed sounds as far away as several hundred meters. A sudden onset loud (20-30 dB above ambient) sounds played when a shark approached would result in startling the shark and it would turn away from the area. In most cases involving attraction and repelling, the sharks would habituate to the stimuli after a few trials (Casper et al, 2010). The available evidence indicates sharks will generally avoid seismic sources, so the likely impacts on sharks are expected to be limited to short-distance and short-term behavioural responses, such as avoidance of waters around the operating seismic source (Carroll et al, 2017). Shark species are known to respond via the lateral line to the relative motion between their body surface and surrounding water (Popper et al, 2014). This relative motion detection takes place very close to the sound source where there is a steep gradient of sound pressure and particle motion and the operational range of the lateral line is usually restricted to no more than one or two body lengths away from the source (Popper et al. 2014).
Fish – injury/mortality	In Popper et al. (2014), mortality and potential mortal injury, and recoverable injury guidelines are derived from impulsive sounds established during pile driving studies by Halvorsen at al., (2012). This proxy has been used as research to date has not identified a seismic threshold level where mortality has been observed. Available scientific literature has demonstrated no direct mortality of adult fish in response to seismic source emissions under field operating conditions (DFO, 2004b; Carroll et al., 2017; Popper et al., 2014; Popper et al., 2016). DFO (2004) notes that for some MSS, fish kill detection programs have been undertaken by 'follow-on vessels' instructed to watch for fish kills resulting from seismic and none have been observed. Fish deaths have been reported during cage experiments (Hassel et al., 2004) however these fatalities occurred as a result of the study methodology where a closing jaw of the grab sampler injured fish rather than an acoustic impact. Within this study no significant difference in mortality was observed between control and exposed sandeel groups (demersal fish) from a 3090 in^3 acoustic array of source pressure level of

256.9 dB re µPa (PK) and a received level of <221 dB re lµPa (PK) in approximately 54 m water depth (Hassel et al., 2004). This received level is above the sound exposure guideline for mortality and potential mortal injury, and recoverable injury in Popper et al. (2014).

For free-swimming pelagic fish which can move away from the seismic source as they approach, the potential for lethal physical damage from seismic source emissions is further reduced. Reef or demersal fish, particularly those which show greater site attachment, may be less inclined to move away from seismic sound and may exhibit greater effects. While studies indicate some physical damage and physiological effects are possible, no mortality was recorded.

The following studies support these observations:

- Popper et al. (2016) has added further information into the threshold levels of impulsive airgun sound to which adult fish can be exposed without immediate mortality. The study found that two fish species (pallid sturgeon and paddlefish) with body masses in the range 200-400 g, exposed to a single shot of maximum received level of 231 dB re 1µPa (PK) or 205 dB re 1µPa^2.s (SEL) remained alive for seven days after exposure and the probability of mortal injury did not differ between exposed and control fish. They also found no difference in injuries between fish exposed at closer distances to the source compared to those further away. Accordingly, this study using an actual seismic source, shows no mortality at higher sound thresholds than the "mortality, potential mortal injury and recoverable injury" thresholds for fish published by Popper et al. (2014).
- Song et al., (2008) exposed three fish species to 5 or 20 pulses from a 730 in^3 airgun array with the mean received sound per shot from 205 to 209 dB re 1Pa (PK). There was no damage to the sensory epithelia in any of the otolithic end organs in any of the fish species exposed, however the adult northern pike and lake chub exhibited TTS demonstrating that hearing loss in fish is not necessarily accompanied by morphological effects on the sensory hair cells.
- Woodside's Maxima 3D MSS at Scott Reef in 2007 evaluated the impacts of dual airguns each with a total capacity of 2055 in^3 with a source of 220-240 dB re 1 µPa^2.s @ 1 m (SEL) on reef fish. Target fish species utilised within experiments included the: blue-green damselfish (*Chromis viridis*) - non-fleeing, Type II fish; bluestripe seaperch (*Lutjanus kasmira*) - fleeing, Type II fish; sabre squirrelfish (*Sargocentron spiniferum*) - non-fleeing, Type II fish; pinecone soldierfish (*Myripristis murdjan*) - non-fleeing, Type III fish; and miscellaneous species from the Family Holocentridae, primarily from the genus Sargocentron. Results on fish pathology, physiology and hearing sensitivity identified the following (Woodside, 2012b):
    - Hair cell damage: There was a significantly greater level of damaged hair cells on fish that had been exposed to airgun sound. This damage was marginal (i.e. involved only small numbers of hair cells) and appeared to be confined to one treatment group. There was no apparent or statistically significant trend in epithelia damage with cumulative SEL or fish grouping. These results implied << 1% of hearing capability was likely to have been impaired in the species tested. While minor damage in exposed fish was evident after initial exposure to airgun sound emissions, the damage appeared to have been repaired 60 days after exposure.
    - Clinical and pathological damage: No structural abnormalities or tissue trauma/lesions commonly associated with high intensity noise emissions were found. Ulcerative and necrotising lesions and mortalities were observed in some experimental and control subjects, but these were attributed to myxobacterial infection in some of the test fish unrelated to the experimental sound exposures.
    - Auditory Brainstem Response (ABR) of fish hearing sensitivity: No significant differences in auditory thresholds were found among exposure groups, or between exposure groups and baseline or control thresholds, at any test frequency for the Bluestripe Sea-perch or the pinecone soldier-fish. The pinecone soldier-fish did not exhibit any TTS within the first six hours after receiving airgun noise emissions at the highest exposure level (cumulative SEL of 190 dB re: 1 µPa^2-s).
- Boeger et al. (2006) observed coral reef fish in enclosures before during and after seismic source exposure to a 635 in^3 airgun source (source pressure of 196 dB re 1µPa (PK)) at a distance varying from 0-7 m. Despite the severe conditions the experiments did not result in mortality or obvious external damage.
- Popper et al. (2005) exposed three caged fish (northern pike (demersal), broad whitefish (pelagic) and lake chub) to a 730 in^3 array varying in distance from 13 – 17 m from the cage with received levels from 205.2 dB re 1µPa (PK) to 209.9 dB re 1µPa (PK). Fish anatomy post exposure did not

	show any effect, swam normally post exposure and all fish held for 24 hours post exposure survived with no apparent adverse effects. • McCauley et al. (2003b) in field trials of seismic gun exposure to caged fish demonstrated some damage to the sensory hair cells of the pink snapper (*Pagrus auratus*) (a demersal fish) which increased for at least 54 days post exposure. There was no evidence of repair or replacement up to 58 days of exposure. The captive fish were located 5-15 m from the operating array (at the airgun's closest approach) with a source level of 222.6 dB re 1µPa (PK-PK) or 203.6 dB re 1µPa (SPL). No mortalities or physiological changes to blood cortisol/glucose levels were observed and functional hearing was not tested. Study limitations include the caged nature of the study (the monitoring video suggested that fish would have fled the source if possible). The impact of exposure on the survival of fish was also unclear. • Wardle et al. (2001) exposed marine fish (juvenile saithe, juvenile cod (demersal), adult pollock (demersal) and mackerel (pelagic)) received pressure levels of 229 dB re 1µPa PK (@ 1.5m) and 218 dB re 1µPa (PK) (@ 5.3 m) using a triple G. air gun and detected little effect on the "day–to–day" behaviour of resident reef fish. The fish were not restricted inside field enclosures. The fish did not show any signs of movement away from the reef nor was any mortality recorded. Received sound is above the Popper et al (2014) mortality thresholds. Santulli et al (1999) exposed caged European sea bass (*Dicentrarchus labrax*) (demersal) to a moving seismic airgun array of volume 2500 in^3 with a source of ~ 256 dB re 1µPa (PK) with a 180 m minimum distance between fish and seismic source. The received sound was not reported but were estimated to be approximately 195 dB re 1µPa^2.s (SEL). There was an absence of mortality or physiological damage during and 24 hours after the test, however biochemical stress responses as measured by serum adenylates, cortisol, glucose, and lactate levels were observed. The was a decrease in serum adenylates and elevated levels of cortisol, glucose, and lactate returned to pre-exposure levels within 72 hr of exposure.
Fish – TTS	Temporary Threshold Shift (TTS), as defined in Popper at al. (2014), is the temporary reduction in hearing sensitivity caused by exposure to intense sound. TTS has been demonstrated in some fish with variable magnitude and duration. TTS results in temporary changes to the sensory hair cells of the inner ear and/or damage to the auditory nerve. Sensory hair cells in fish are constantly added and replaced hence effects may be mitigated over time additional hair cells (Popper et al, 2014). After sound termination which causes TTS, normal hearing returns over time dependent on the sound exposure (intensity and duration). While in a TTS condition, fish may have decreased fitness in terms of communication, detecting predators or prey and assessing their environment. Guideline thresholds for TTS developed by Popper et al. (2014) are based upon exposure of several riverine species to a variable number of seismic array pulses over five minutes with a SEL24hr of 186 dB re 1 µPa^2.s (Popper et al., 2005). This exposure in caged outdoor tanks resulted in up to 20 dB of TTS loss in the lake chub (*Couesius plumbeus*) with a maximum TTS loss at 200 Hz and 400 Hz (species has a connection between the swim bladder and inner ear). Approximately 20 dB of TTS occurred at 400 Hz in adult northern pike (*Esox lucius*), a species that does not have such a connection. TTS did not occur at other frequencies. Another species without a connection between the ear and swim bladder, the broad whitefish (*Coregonus nasus*), showed no TTS to sounds after exposure at the same level. These effects were seen only in adults and not juvenile pike. In all cases fish with TTS recovered to normal hearing levels in 18-24 hours (Popper et al., 2005). As identified in Table 7-15, Popper et al., (2014) recommends a threshold of 186 dB re 1µPa^2.s SEL24hr for fish with a swim bladder which is not involved in hearing; and for fish with a swim bladder involved in hearing. Woodside (2012b) studies are consistent with the Popper et al. (2014) studies, while other studies indicate that TTS may occur at levels as high as 205-209 dB re 1µPa (PK) (Song et al, 2008; Popper et al., 2005).
Fish – Behavioural / masking	Behavioural sound thresholds for fish have not been established due to limited and varying scientific data and the specific nature of behavioural responses amongst fish species which is context specific (i.e. one threshold does not fit all). Behavioural responses are observed to vary by species, size, age class and motivation and may be linked to the circumstances of the animal, the activities in which it is engaged and the context in which it is exposed to sounds (Pena et al., 2013; Ellison et al, 2012). Behavioural effects are considered more likely than physical and physiological effects at lower sound levels and may provide a more useful indicator of sound impacts over a large spatial scale. Gausland (2000) postulates that while seismic acoustic source operation causes little direct physical damage to fish at distances greater than 1-2 m from the source, it is evident that fish respond to sounds emitted from acoustic sources, and that avoidance seems to be the primary response for all species. Behavioural responses to sound are variable but include:

	• Startle/alarm responses. • Leaving the area of the sound source (avoidance). • Spatial changes in schooling behaviour/swimming patterns. • Changes in depth (vertical distribution). Available evidence suggests that behavioural change for some fish species may occur, however this is thought to be localised and temporary, with displacement of pelagic or migratory fish populations having insignificant repercussions at a population level (McCauley, 1994). Behavioural changes such as startle or alarm responses are expected to be localised and temporary, with displacement of pelagic or migratory fish likely to have insignificant repercussions at a population level (McCauley, 1994; McCauley & Kent, 2012; Popper et al., 2015; Popper et al., 2007). The following studies support this: Bruce et al. (2018) found little evidence consistent with behavioural changes induced by a 2D MSS undertaken over part of the western Gippsland Basin in 2015. Behaviour consistent with a possible response to the survey operations was restricted to flathead, which showed an increase in swimming speed during the survey period and change in diel movement patterns after the survey. The increased swimming speed may indicate a startle response, but if so, the range of movement was not sufficient to generate a significant difference in displacement (travel) across the monitored array. Streever et al (2016) indicates that it is possible that fish move away from seismic sources, thereby not being exposed to high levels of sound. Slotte et al (2004) examined potential effects on fish abundance to exposure to a seismic acoustic source array (source SPL of 222.6 dB re 1 µPa PK-PK) during a period of one month. The sound levels received by the fish were not measured. Acoustic surveys of the local distributions of various kinds of pelagic fish, including herring, blue whiting, and mesopelagic species, were conducted during the seismic surveys. There was no strong evidence of short-term horizontal distributional effects. With respect to vertical distribution, blue whiting and mesopelagics were distributed deeper (20 to 50 m) during the seismic survey compared to pre-exposure. Wardle et al (2001) used video and telemetry to make behavioural observations of marine fishes (primarily juvenile saithe, adult pollock, juvenile cod, and adult mackerel) inhabiting an inshore reef off Scotland before, during, and after exposure to discharges of a stationary acoustic source. The received sound levels ranged from about 195 to 218 dB re 1 µPa0-p. Pollock did not move away from the reef in response to the seismic acoustic source sound, and their diurnal rhythm did not appear to be affected. However, there was an indication of a slight effect on the long-term day-to-night movements of the pollock. Video camera observations indicated that fish exhibited startle responses (‘C-starts’) to all received levels. There were also indications of behavioural responses to visual stimuli. If the seismic source was visible to the fish, they fled from it. However, if the source was not visible to the fish, they often continued to move toward it. Trials of effects of nearby seismic source operations on captive fish, undertaken by McCauley et al (2000) showed a generic fish ‘alarm’ response of swimming faster, swimming to the bottom, tightening school structure, or all three. From a review of trials and available published information, McCauley et al (2000) concluded the following effects on fish: Demersal fish could be expected to begin to change their behaviour by increasing speed and swimming deeper in the water column; • As the seismic source level increases, fish would be expected to form compact schools probably near the bottom in continental shelf water depths (<200 m); • Eventually levels may be reached at which involuntarily startle responses occur in the form of the classic C-turn (involuntary flexing of the body and subsequent darting swim away from the source); • In deeper water (>200 m), any effects would be expected to lessen with increasing depth, as the seismic source signal level dropped accordingly; • Startle responses may be generated by fish within 300 m and up to 2,000 m of an operating seismic source; and • Flight response could be expected up to several kilometres. The McCauley et al (2000) trials, as well as studies by Wardle et al (2001), Dalen et al (1996) and Gausland (2000), indicate the following: • Fish generally show little evidence of increased stress from exposure to seismic signals unless restricted from moving away from the source; and • Fish may become acclimatised to seismic signals over time.

	Prideaux (2017) notes that the behavioural response to an approaching seismic source by pelagic fin-fish is they tend to move downwards to eventually lie close to the seafloor or flee laterally, while site-attached fish may initially seek shelter in refuges or flee. Site-attached fish species that exhibit a high degree of site fidelity are more likely to be affected by MSS than larger more mobile roaming demersal species that have a greater ability to leave the affected area. Jones and McCormick (2002) report that coral reef fish frequently take refuge in the branches of corals or in holes in the reef matrix when showing a flight response. The impacts of seismic sound to such site-attached species can be broadly assessed using studies of reef fish, or studies where fish have been caged to prevent movement away from the sound source. Impacts to site-attached fish can be assessed through comparison with studies undertaken by Woodside at Scott Reef on tropical reef fish during the Maxima 3DMSS activities (Woodside, 2012a; b; c). The Scott Reef study identified the following impacts to site-attached reef fish: • No lethal or sub-lethal effects on fish were experienced. Behavioural responses were observed at close range with general movement from the water column to the seafloor, however normal feeding behaviour returned within 20 minutes of the survey vessel passing and when the vessel was beyond a distance of 1.5 km (Woodside, 2012a). • Fish exposed to acoustic pulses showed no structural abnormalities, tissue trauma or lesions, or auditory threshold changes (highest exposure level 190 dB re 1µPa^2.s). However, a small number of damaged hair cells (less than 1% of fish hearing capacity) were observed in fish exposed to acoustic noise (Woodside, 2012b). • 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 (Woodside, 2012c). • The 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) indicates that pelagic fish able to swim away from disturbing noise are likely to be even less at risk of impacts from seismic sound. Masking impairs an animal's hearing with respect to the relevant biological sounds normally detected within the environment. In effect, masking raises the threshold for detection by an animal. While the consequences of fish masking have not been fully examined, long lasting effects on survival, reproduction and population dynamics may result (Popper et al. 2014). Data on hearing for all vertebrates tested to date, including fish, show that the degree of masking relates both to the level of the masking noise and the frequencies it contains. In fish, pure tone sounds are masked most readily by noise at the same and immediate adjacent frequencies, falling within a critical band (Popper et al. 2014). Masking may occur where a noise exceeds the absolute hearing thresholds of an animal and is likely to occur for most fish at some locations due to the varying level of background noise in all aquatic environments. Data on masking by seismic sources are not available for any species. Masking is possible for the time that fish are exposed to seismic sound and may occur when animals are sufficiently far from the source where sounds merge and become more or less continuous (Nieukirk et al. 2004). Popper et al. (2014) surmised that "It is likely that increments in background sound within the hearing bandwidth of fish 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". However, masking only occurs while the interfering sound is present, and therefore masking resulting from a single pulse of sound (such as from a seismic source) or widely separate pulses would be distinguishable and unlikely to significantly affect an individual's overall fitness and survival.

Sound Effect Criteria

The Working Group on the Effects of Sound on Fish and Turtles reviewed scientific literature available for sound on fish. From this review, sound exposure guidelines for fish and sea turtles were developed (Popper et al., 2014) and accredited with the American National Standards Institute (ANSI). The guidelines provide sound exposure metrics for:

- Mortality and potential mortal injury.
- Recoverable injury including injuries unlikely to result in mortality such as hair cell damage and minor haematoma.
- Temporary Threshold Shift (TTS) in hearing.

Within these guidelines, where insufficient data existed to make a quantitative guideline for behavioural and masking effects, a subjective approach of 'relative risk' is used to assess risk at three distances from the source. This 'relative risk' is applied to masking and behavioural effects.

The guidelines and predicted maximum distances from the acoustic modelling (Koessler et al., 2020; Appendix E) are detailed in Table 4-27 for mortality and potential mortal injury, recoverable injury and TTS. For masking and behavioural effects, a relative risk (low, moderate and high) is given for receptors at three distances from the seismic source defined in relative terms as near (N) tens of metres, intermediate (I) hundreds of metres, and far (F) thousands of metres.

The criteria for behavioural response and disturbance, PTS and TTS and the distances at which acoustic modelling estimates they could be reached are provided in Table 4-27. The modelled distances for all single impulse sites are detailed in the acoustic modelling report (Appendix E).

Continuous vessel sound was not modelled; the distance used (+1 km) was based on published studies (refer to Section for Sound Effect Criteria). The guidelines for fish with a swim bladder involved in hearing is used as this is the most sensitive fish group and is representative of the majority of fish species identified in the sound EMBA.

Table 4-27: Sound exposure guidelines and maximum predicted distance for Sharks and Fish

Criteria	Sharks		Fish with a swim bladder	
	Sound exposure guideline	Maximum Distance	Sound exposure guideline	Maximum Distance
Mortality and potential mortal injury	>213 PK	81 m	>207 PK	154 m
	>219 SEL 24hr	80 m	>207 SEL 24hr	80 m
Recoverable injury	>213 PK	81 m	>207 PK	154 m
	>216 SEL 24hr	80 m	>203 SEL 24hr	90 m
Temporary threshold shift (TSS)	>186 SEL 24hr	2.55 km	186 SEL 24hr	2.55 km
Masking	(N) Low (I) Low (F) Low	NA	(N) Low (I) Low (F) Moderate	NA
Behaviour	(N) High (I) Moderate (F) Low	NA	(N) High (I) High (F) Moderate	NA

4.3.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups of fish depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

Greater detail is included for threatened species and commercially valuable species.

Because there are different sound effect criteria for sharks compared with fish with a swim bladder, an impact assessment has undertaken on these groups separately – Section 4.3.2 and 4.3.3 respectively.

Multiple species (or species habitat) of fish may occur within the relevant EMBAs. Table 4-28 identifies the presence, biologically important behaviour and protection status for each relevant EMBA. PMST records identified 37 fish species protected under the EPBC Act potentially occurring in the Seismic sound – Fish EMBA. This includes seven species listed as threatened, three species listed as migratory and a further 27 listed marine species, 25 of which are Sygnathiformes (seahorses, pipefishes and their relatives).

There are four active commercial fisheries that operate within the relevant EMBA targeting ten commercial fish species (refer to Table 4-29).

The National Conservation Values Atlas identifies that the relevant EMBA overlaps a known distribution BIA for the White Shark (Figure 4-10).

Values and Sensitivities

Table 4-28 identifies the presence, biologically important behaviour and protection status of fish to inform the assessment of values and sensitivities within the relevant EMBAs.

Zeehan AMP and Fish

All relevant EMBAs intersect the Zeehan Marine Park; with the largest (Seismic Sound – Fish) overlapping 2.92% of the park area (Figure 4-11) Fish are not identified as a major conservation value of this AMP (DNP, 2013). The general description identified the following in relation to fish:

- Concentrations of larval Blue Warehou (EPBC Act: Conservation Dependant) and Ocean Perch indicate the area is a nursery ground.
- It is also a foraging area for White Shark.

Apollo AMP and Fish

All relevant EMBAs intersect the Apollo Marine Park; with the largest (Seismic Sound – Fish) overlapping 5.8% of the park area (Figure 4-11). Fish are not identified as a major conservation value of this AMP (DNP, 2013). The general description identified the following in relation to fish:

- Concentrations of larval Blue Warehou (EPBC Act: Conservation Dependant) and Ocean Perch indicate the area is a nursery ground.
- It is also a foraging area for White Shark.

West Tasmania Canyons KEF and Fish

All relevant EMBAs intersect the West Tasmania Canyons KEF; with the largest (Seismic Sound – Fish) overlapping 2.29% of the KEFs area (Figure 4-11)

A value of the West Tasmania Canyons KEF are sponges that are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m depth. Sponges within the KEF are associated with abundance of fishes (DAWE, 2020b).

Table 4-28: Fish species that may occur within relevant EMBAs, biologically important behaviour and protection status

Scientific name	Common name	Type of Presence			BIA / habitat critical to the survival of the species	EPBC Status / Protection Level			
		Operational Area	Vessel Sound	Seismic Sound – Fish	BIA	Threatened Species*	Migratory Species*	Listed Marine Species	EPBC Management Plan
Sharks									
Carcharodon carcharias	White Shark	KO	KO	KO	D	V	✓	-	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPC, 2013)
Galeorhinus galeus	School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark	MO	MO	MO	-	CD	-	-	-
Isurus oxyrinchus	Shortfin Mako, Mako Shark	LO	LO	LO	-	-	✓	✓	-
Lamna nasus	Porbeagle, Mackerel Shark	LO	LO	LO	-	-	✓	✓	-
Fish									
Prototroctes maraena	Australian Grayling	MO	MO	MO	-	V	-	-	National Recovery Plan for the Australian Grayling (*Prototroctes maraena*)
Seriolella brama	Blue Warehou	KO	KO	KO	-	CD	-	-	Blue Warehou Stock Rebuilding Strategy 2014
Thunnus maccoyii	Southern Bluefin Tuna	LO	LO	LO	-	CD	-	-	-

Scientific name	Common name	Type of Presence			BIA / habitat critical to the survival of the species	EPBC Status / Protection Level			
		Operational Area	Vessel Sound	Seismic Sound – Fish	BIA	Threatened Species*	Migratory Species*	Listed Marine Species	EPBC Management Plan
Centrophorus zeehaani	Southern Dogfish, Endeavour Dogfish, Little Gulper Shark	LO	LO	LO	-	CD	-	-	-
Hoplostethus atlanticus	Orange Roughy, Deep-sea Perch, Red Roughy	LO	LO	LO	-	CD	-	-	Orange Roughy Rebuilding Strategy 2014
Sygnathids									
Heraldia nocturna	Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish	MO	MO	MO	-	-	-	-	-
Hippocampus abdominalis	Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse	MO	MO	MO	-	-	-	✓	-
Hippocampus breviceps	Short-head Seahorse, Short-snouted Seahorse	MO	MO	MO	-	-	-	✓	-
Hippocampus minotaur	Bullneck Seahorse	MO	MO	MO	-	-	-	✓	-
Histiogamphelus briggsii	Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish	MO	MO	MO	-	-	-	✓	-
Histiogamphelus cristatus	Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish	MO	MO	MO	-	-	-	✓	-

Scientific name	Common name	Type of Presence			BIA / habitat critical to the survival of the species	EPBC Status / Protection Level			
		Operational Area	Vessel Sound	Seismic Sound – Fish	BIA	Threatened Species*	Migratory Species*	Listed Marine Species	EPBC Management Plan
Hypselognathus rostratus	Knifesnout Pipefish, Knife-snouted Pipefish	MO	MO	MO	-	-	-	✓	-
Lissocampus caudalis	Australian Smooth Pipefish, Smooth Pipefish	MO	MO	MO	-	-	-	✓	-
Kaupus costatus	Deepbody Pipefish, Deep-bodied Pipefish	MO	MO	MO	-	-	-	✓	-
Kimblaeus bassensis	Trawl Pipefish, Bass Strait Pipefish	MO	MO	MO	-	-	-	✓	-
Leptoichthys fistularius	Brushtail Pipefish	MO	MO	MO	-	-	-	✓	-
Lissocampus runa	Javelin Pipefish	MO	MO	MO	-	-	-	✓	-
Maroubra perserrata	Sawtooth Pipefish	MO	MO	MO	-	-	-	✓	-
Mitotichthys semistriatus	Halfbanded Pipefish	MO	MO	MO	-	-	-	✓	-
Mitotichthys tuckeri	Tucker's Pipefish	MO	MO	MO	-	-	-	✓	-
Notiocampus ruber	Red Pipefish	MO	MO	MO	-	-	-	✓	-
Phycodurus eques	Leafy Seadragon	MO	MO	MO	-	-	-	✓	-
Phyllopteryx taeniolatus	Common Seadragon, Weedy -Seadragon	MO	MO	MO	-	-	-	✓	-
Pugnaso curtirostris	Pugnose Pipefish, Pug-nosed Pipefish	MO	MO	MO	-	-	-	✓	-
Solegnathus robustus	Robust Pipehorse, Robust Spiny Pipehorse	MO	MO	MO	-	-	-	✓	-
Solegnathus spinosissimus	Spiny Pipehorse, Australian Spiny Pipehorse	MO	MO	MO	-	-	-	✓	-

Scientific name	Common name	Type of Presence			BIA / habitat critical to the survival of the species	EPBC Status / Protection Level			
		Operational Area	Vessel Sound	Seismic Sound – Fish	BIA	Threatened Species*	Migratory Species*	Listed Marine Species	EPBC Management Plan
Stigmatopora argus	Spotted Pipefish, Gulf Pipefish, Peacock Pipefish	MO	MO	MO	-	-	-	✓	-
Stigmatopora nigra	Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish	MO	MO	MO	-	-	-	✓	-
Stipecampus cristatus	Ringback Pipefish, Ring-backed Pipefish	MO	MO	MO	-	-	-	✓	-
Urocampus carinirostris	Hairy Pipefish	MO	MO	MO	-	-	-	✓	-
Vanacampus margaritifer	Mother-of-pearl Pipefish	MO	MO	MO	-	-	-	-	-
Vanacampus phillipi	Port Phillip Pipefish	MO	MO	MO	-	-	-	-	-
Vanacampus poecilolaemus	Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish	MO	MO	MO	-	-	-	✓	-
Type of Presence: *MO Species of species habitat may occur within area* *LO Species or species habitat likely to occur within area* *KO Species or species habitat known to occur within area*				Threatened Species: D Distribution CD Conservation Dependant V Vulnerable E Endangered CE Critically Endangered					

*✓= Listed Migratory/Marine species; *= Matter of National Environmental Significance*

Source: PMST; Appendix J.

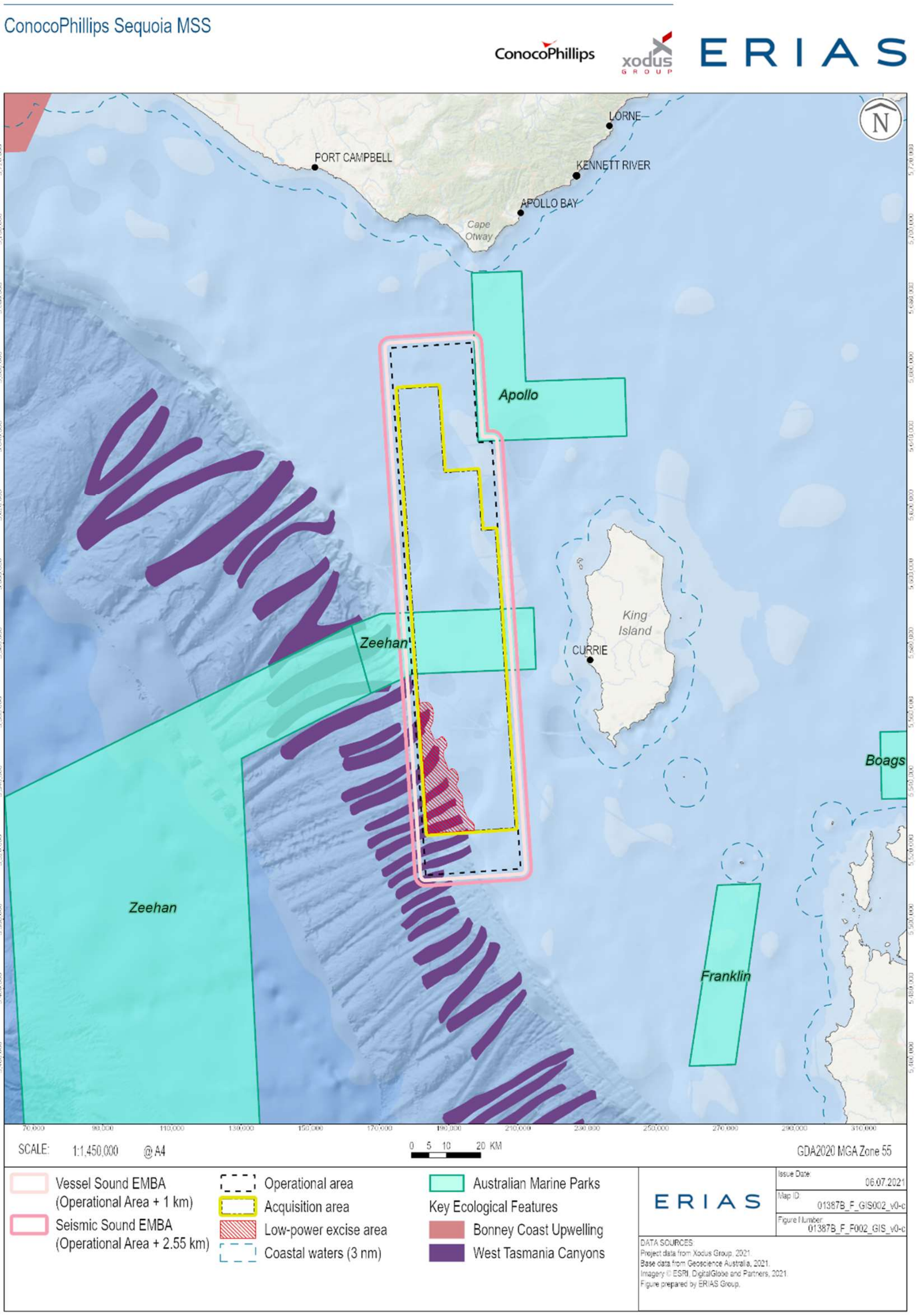


Figure 4-11: Sound EMBAs overlap with BIAs and AMPs relevant to Fish

Table 4-29 identifies those fish species that have an active fishery within the continuous and impulsive underwater sound EMBAs. The stock status for relevant species, that may indicate greater sensitivity to stressors, has been listed below with more information presented in the impact assessment sections for each.

Refer to Temporal Presence and Absence section in Appendix A for the likely temporal presence and absence of fish within the relevant EMBAs, including spawning periods.

Table 4-29: Commercial fish species that may occur within the relevant EMBAs

Commercial Fish Species		Stock status	Fishery
Scientific Name	Common Name		
Callorhinchus milii	Elephant Fish	Sustainable	Southern and Eastern Scalefish and Shark Fishery – Scalefish Hook Sector (SESSF – SHS) Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector Fishery (bycatch from *Mustelus antarcticus*)
Galeorhinus galeus	School Shark	Depleted	Southern and Eastern Scalefish and Shark Fishery – Scalefish Hook Sector (SESSF – SHS) Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector Fishery
Genypterus blacodes	Pink Ling	Sustainable	Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector
Hoplostethus atlanticus	Orange Roughy	Three stocks within relevant EMBA 1 sustainable 2 depleted	Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)
Macruronus novaezelandia	Blue Grenadier	Sustainable	Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)
Mustelus antarcticus	Gummy Shark	Sustainable	Southern and Eastern Scalefish and Shark Fishery- Commonwealth Trawl Sector Southern and Eastern Scalefish and Shark Fishery – Scalefish Hook Sector (SESSF – SHS) Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector Fishery
Neoplatycephalus richardsoni	Tiger Flathead	Sustainable	Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)
Pristiophorus cirratus, P. nudipinnis	Sawshark	Sustainable	Southern and Eastern Scalefish and Shark Fishery – Scalefish Hook Sector (SESSF – SHS) Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector Fishery
Sillago flindersi	Eastern School Whiting	Sustainable	Southern and Eastern Scalefish and Shark Fishery- Commonwealth Trawl Sector

4.3.1.5. Legislative Requirements

Table 4-30 identifies the minimum legislative and other requirements that are relevant to fish. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-30: Other Requirements for Fish

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Guideline	EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic	All seismic survey vessels operating in Australian waters must undertake a soft start	Environmental impact assessment for underwater sound on fish has been

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
	Exploration and Whales: Industry Guideline	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 fish (DoEE, 2017).	completed in this EP (Section 4.3.2 and Section 4.3.3). Adoption of control measures (refer to Environmental Performance section in Appendix A)
EPBC Management Plan	Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPC, 2013)	The recovery plan does not identify sound as a threat.	
EPBC Management Plan	National Recovery Plan for the Australian Grayling *(Prototroctes maraena*)	The recovery plan does not identify sound as a threat.	
EPBC Management Plans	Recovery Plans / Conservation Advices for other listed threatened and/or migratory MNES species	Recovery Plans / Conservation Advices for other fish species that may occur in the relevant EMBAs do not identify underwater sound as a key threat; or have any explicit relevant objectives or management actions.	
Fisheries stock rebuilding plans	Orange Roughy *(Hoplostethus atlanticus)* Stock Rebuilding Strategy 2014	Aims to return all Orange Roughy stocks to levels where they can be harvested in an ecologically sustainable manner consistent with the Commonwealth Fisheries Harvest Strategy Policy 2007 (AFMA, 2014a).	
Fisheries stock rebuilding plans	Blue Warehou *(Seriolella brama)* Stock Rebuilding Strategy 2014.	The strategy aims to rebuild the stocks to their biomass limit reference point (AFMA, 2014).	

4.3.2. Impact Assessment – Sharks

4.3.2.1. Existing Environment

Values

Threatened Species

The **White Shark** is an EPBC protected species, listed as vulnerable and migratory with a known occurrence in the relevant sound EMBA (Table 4-28).

The White Shark is widely distributed throughout temperate and sub-tropical regions in the northern and southern hemispheres. It is a highly mobile species, primarily found in coastal and offshore areas of the continental shelf and islands however has been caught in varying depths up to 1,280 m (EA, 2002). White Sharks are generally observed between the coast and the 100 m depth contour (Bruce et al., 2006) with areas of frequent encounter around seal colonies particularly when juveniles are present (EA, 2002). Australian fur-seal colonies are known to occur at Lady Julia Percy Island (Vic) (130 km northwest); Reid Rocks (Tas) (50 km east); and Seal Rocks (Vic) (162 km north east) (Shaughnessy, 1999). New Zealand fur-seal colonies occur at Cape Bridgewater (Vic) (180 km northwest); Lady Julia Percy Island (130 km northwest); Kanowna Island (Vic) (238 km east) and Maatsuyker Island (Tas) (421 km southeast) (Kirkwood et al., 2009).

White Sharks feed on a variety of prey aside from pinnipeds, including fish, other sharks and rays, marine mammals, squid and crustaceans (CoA, 2015). Juvenile White Sharks feed on finfish, rays and other sharks and shift to include marine mammals when they reach approximately 3.4 m (CoA, 2015). A recent study has found that the energy requirements of adult White Sharks may be several times higher than previously estimated, and that seasonal feeding on seal colonies is important in meeting these energy needs (CoA, 2015).

Studies of White Sharks sighted at pinniped colonies indicate the sharks appear to be largely transient with only a few longer-term residents (EA, 2002). The location of shark pupping areas in Australia is not known, however juveniles aggregate seasonally in certain areas such as Goolwa (SA), Corner Inlet-Lakes Entrance (Vic), Newcastle-Foster (NSW), Fraser Island (Qld) and Portland (Vic) (161 km northwest) (DOE, 2014d). White Sharks appear to return on a seasonal basis and appear to have a degree of fidelity to certain areas (Bruce and Bradford, 2008) They are known to make excursions into the open ocean and cross ocean basins with exchange between Australia and both South Africa and New Zealand recorded (CoA, 2020).

The South-West Commonwealth Marine Reserves Network Management Plan 2013 – 2023 (DNP, 2013) recognises that White Sharks forage in the Apollo and Zeehan Commonwealth Marine Reserve. The known distribution BIA identified by National Conservation Atlas reflects areas used by White Sharks as they move between nursery areas particularly for juvenile White Sharks during autumn/winter/spring (DAWE, 2020d). The White Shark may transit the Seismic sound - Fish EMBA to nursery and foraging locations during the survey (refer to Figure 4-11 for BIA Map) (CoA, 2020). The temporal presence of White Sharks is shown in the Temporal Presence and Absence section in Appendix A which indicates that there is insufficient data to determine their annual presence during the survey period, however they are a transitory species with a known occurrence in the relevant sound EMBA.

Commercially Valuable Species

School Shark (EPBC listing: Conservation Dependant) is fished commercially as bycatch by SESSF- SHS and SESSF- GSHSF (Table 4-28 and Table 4-29). It is a widespread mainly coastal and bottom associated shark found in temperate areas over the continental shelf to about 800 m on the continental slope (DAWE, 2020f).

The School Shark has low reproductive rate and slow growth in comparison to most bony species (DAWE, 2020f; TSSC 2009). Maturity is estimated to occur at 10 years with reproduction occurring every 2–3 years (DAWE, 2020f; Fenton 2001; Stevens 2005; TSSC 2009). Life expectancy is estimated to be more than 55 years (DAWE, 2020f; Fenton 2001; Stevens 2005; TSSC 2009). In the absence of fishing, mortality is expected to be low, with a natural mortality rate of about 0.10–0.26 (DAWE, 2020f; Stevens 2005). Female School Sharks give birth to 15–43 pups (average 26, maximum 54) at 30–35 cm in length (DAWE, 2020f; Stevens 2005; TSSC 2009). The young develop within eggs that remain within the mother's body until they hatch, when they emerge as live young (ovoviviparous). Pups are born in spring or summer (in December and January off southern Australia), after a gestation period of 12 months (DAWE, 2020f; McLoughlin 2007; Pogonoski et al. 2002; Stevens 2005).

Juveniles are often found in shallow, inshore bays of Victoria and Tasmania. School Sharks also occur well offshore in the Tasman Sea. Although usually found near the bottom, the species ranges through the water column even into the pelagic zone (DAWE, 2020f). The species feeds on bony fishes (bottom-dwelling and pelagic species), squid and octopus. Small juveniles feed on crustaceans, polychaete worms, gastropods and echinoderms.

School Shark has been fished throughout its range and heavily exploited due to the excellent quality of its flesh for eating. The species stock status is depleted, considered overfished in the SESSF (DAWE, 2020f). It cannot be targeted but is taken as by-catch by fishers targeting Gummy Shark in Southern Australia (Braccini et al., 2018). The temporal presence of the School Shark is shown in the Temporal Presence and Absence section in Appendix A which shows that their presence is assumed to overlap with the survey period and breeding may overlap for the end of the survey period.

Sawshark do not have a threatened listing under the EPBC Act. It is commercially fished by SESSF-SHS and SESSF- GSHSF, classified as a sustainable stock according the FRDC (Table 4-29) (Braccini et al., 2018a).

There are three species of Sawshark, however only the Common Sawshark (Pristiophorus cirratus) and the Southern Sawshark (P. nudipinnis) overlap with the relevant EMBA. Common Sawshark range from Jurien Bay in Western Australia to southern New South Wales and Tasmania to depths of 310 m; Southern Sawshark ranges from the western Great Australian Bight to Bass Strait to depths of 70 m (Braccini et al., 2018a). Young are born during winter in shallow coastal areas after a 12-month gestation period (AFMA, 2021g). Common and Southern Sawsharks produce about 5 20 pups per litter and probably breed only every second year (AFMA, 2021g).

Sawshark species that overlap with the relevant sound EMBA occur around the southern and south-eastern coasts of Australia but are mainly caught in the Bass Strait (Braccini et al. 2018a). The majority of the historical catch has been taken in Bass Strait (Walker and Hudson, 2005) and these species are primarily assessed and managed in the SESSF (Braccini et al., 2018a). The temporal presence of the Saw Shark is shown in the Temporal Presence and Absence section in Appendix A shows that their presence is assumed to overlap with the survey period and breeding may overlap for the beginning of the survey period, during August.

Gummy Shark is classified as a sustainable stock according the FRDC, fished by SESSF- SHS, SESSF-CTS and SESSF- GSHSF (Table 4-29) (Braccini et al.Al, 2018c).

They are a demersal species that inhabits the continental shelf from the near shore region to depths of 80-350 metres (AFMA, 2021), and remain either on or near the seabed. New-born and juvenile Gummy Sharks aggregate in many areas across southern Australia, while young and adult Gummy Sharks are more widely distributed (AFMA, 2021). Conventional tagging showed adult Gummy Sharks exhibit broad-scale displacements from tagging locations of up to 2,362 km in 6.8 years, yet only 15 per cent of adults were recaptured > 250 km from the tagging location (Braccini et. Al, 2018c). The mean displacement was approximately 150 km [Walker 2000]. Juvenile male and female Gummy Sharks have similar rates of movement, but females travel longer distances as their age increases. Gummy Sharks prey on cephalopods, crustaceans, and occasionally fish (AFMA, 2021). Juveniles are known to be preyed on by Broadnose Sevengill Sharks (AFMA, 2021). Gummy Sharks tend to aggregate by sex and size (AFMA, 2021), and reach reproductive maturity at 4-5 years of age, with males maturing at a smaller size than females (AFMA, 2021). Females are ovoviviparous (AFMA, 2021), and have an average longevity of 16 years (Braccini et. Al, 2018c). Litters usually comprise of about 14 pups, but large females have been recorded producing up to 57 pups. Gummy Shark are born during the summer months after an 11 12-month gestation period (AFMA, 2021). The temporal presence of the Gummy Shark is shown in the Temporal Presence and Absence section in Appendix A which shows that their presence is assumed to overlap with the survey period, however breeding does not overlap.

Elephantfish are a commercially fished species classified as a sustainable stock according the FRDC and fished by the SESSF- SHS and SESSF- GSHSF (Table 4-29) (Conron et. Al, 2018b). Elephantfish are a demersal species, growing to about 1.2 metres in length and 7 kg (AFMA, 2021c). They have a single gill opening immediately in front of the pectoral fin on each side of the fish. The snout is covered in pores that sense movement and weak electrical fields, which are used in detecting prey (AFMA, 2021c). They are often found in shallow bays and large estuaries, but also to depths of 200 metres on the continental shelf. Juveniles inhabit shallow coastal waters for about three years and gradually move into deeper water as they mature (AFMA, 2021c). Elephantfish appear to school by gender (AFMA, 2021c). They prey on fish, shellfish and molluscs and are predated by larger fish and sharks (AFMA, 2021c).

Elephant fish mature relatively early, with males reaching reproductive maturity at 3 years of age and females reaching reproductive maturity at 4-5 years of age (AFMA, 2021c). They can have a lifespan of up to 15 years but average at 6 years (AFMA, 2021c; Conron et. Al, 2018b). They are oviparous (lay eggs). Adults aggregate in February to spawn, with eggs being deposited in pairs over several weeks in sand or mud near river mouths and estuaries (AFMA, 2021c). The eggs are encapsulated in elongated, flat leathery cases and hatch after about 8 months (AFMA, 2021c). The temporal presence of the Elephantfish is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning does not overlap.

Sensitivities

Threatened Species

White Sharks are long-lived, living for 30 years or more with low levels of reproduction (DSWEPC, 2013). The species has a relatively slow development and low reproductive rate with a long gestation period, estimated at up to 18 months DSEWPC (2013a). These characteristics imply a low reproductive potential which has implications for the vulnerability of the white shark to non-natural mortality and the recoverability of the population. These factors have considerable implications for the conservation of the White Shark DSEWPC (2013a). The White Shark is an ecologically important apex predator that is recorded in low numbers in comparison with other large sharks, even in its known centres of abundance (DSWEPC, 2013). Ferrretti et al., 2010 reported that the removal of apex predators can cause changes in prey behaviour and survival rates that result in trophic cascades or collapses of trophic levels below the apex predator, disrupting ecosystem functioning and biodiversity.

Commercially Valuable Species

School Sharks depend on inshore nursery areas (shallow sheltered bays, estuaries and inlets) as habitat for females giving birth and for juveniles. The most important pupping areas identified were around Tasmania, particularly in the south-east, and in Victoria, including Port Phillip Bay, Western Port Bay and Corner Inlet (DAWE, 2020f). This preferred birthing habitat, as well as their low reproductive rate, makes this species vulnerable to predation, fishing, habitat destruction and pollution (DAWE, 2020f; Olsen 1954; Walker et al. 2005).

The **Saw Shark** does not have any management plans or conservation advice outlining sensitivities. Total catch of saw shark across all SESSF sectors in the 2017–18 fishing season was 205 tonnes (t). This is slightly below, but consistent with the average annual catch of the previous 10 years of around 210 t (Braccini et. Al, 2018a).

The FRDC predicts that the biomass of this stock is unlikely to be depleted, recruitment is unlikely to be impaired, and the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired based on historical catch, effort and standardised Catch per Unit Effort (CPUE) (Braccini et. Al, 2018a). This evidence informed the sustainable stock status.

The sustainable stock level of the **Gummy Shark** is based on biomass catch (Braccini et. Al, 2018c). There is a close relationship between the number of pups and both the number, and length, of females [Walker 1992] and so the Commonwealth assessment uses pup production as an indicator of biomass for Gummy Shark (Braccini et. Al, 2018c). The stock assessment model incorporates available catch data from all jurisdictions impacting the stock (Braccini et. Al, 2018c). The FRDC deemed fishing unlikely to cause the biological stock to become recruitment impaired, based on the catch mortality of previous years (Braccini et. Al, 2018c). The gummy shark is not a threatened species under the EPBC Act, and the stock is not at risk of depletion.

The FRDC classified the **Elephantfish** stock as sustainable based on the previous CPUE and catch effort (Conron et. Al, 2018b). The CPUE standardisations performed for the stock (including and excluding discards) show relative stability in recent CPUE (Conron et. Al, 2018b. This evidence indicates that the biomass of this stock is unlikely to be depleted, that recent fishing pressure is unlikely to have been too high and that recruitment is unlikely to be impaired (Conron et. Al, 2018b).

Existing Pressures

There are a range of anthropogenic threats and pressures on shark species in the relevant EMBA. These include:

- Commercial and recreational fishing
- Invasive marine species
- Cumulative impacts from previous and simultaneous activities in the area (i.e. seismic, drilling, vessels)
- Illegal trade in White Shark products
- Ecosystem effects as a result of habitat modification and climate change
- Shark control programs
- Habitat degradation.

The most recent seismic survey undertaken in the vicinity of the Operational Area was completed in April 2020 by Schlumberger (Appendix A Cumulative Impact Assessment). No concurrent surveys in the Otway or Gippsland locations have been identified and the only post Sequoia MSS seismic survey identified is the Prion MSS ~112 km east of the Operational Area in the Gippsland location (Appendix A Cumulative Impact Assessment).

Threatened Species

The Recovery Plan for the White Shark (DSEWPC, 2013) identifies the primary threats to White Sharks as mortality from being caught accidentally (bycatch) or illegally (targeted) by commercial and recreational fishing and mortality related to shark control activities such as meshing or drum lining (DSEWPC, 2013, DSEWPC, 2013a). Secondary threats include trade in White Shark products, ecosystem effects due to habitat modification or degradation (development, pollution and overfishing) and climate change (including change in sea temperature, ocean currents and acidification and ocean currents) and ecotourism (including cage diving) (DSEWPC, 2013, DSEWPC, 2013a). The recovery plan recognises that management should be focused on minimising impacts on survivorship and protecting critical habitat due to their life history characteristics and habitat use (DSEWPC, 2013).

Due to White Sharks being long lived, these threats may cause a cumulative impact over time and a cumulative impact across the ecosystem as they are an apex predator (DSEWPC, 2013). The Recovery Plan for the White Shark (DSEWPC, 2013) has been reviewed for threats posed by MSS activities. Underwater sound is not identified as a threat to species recovery.

Commercially Valuable Species

The School Shark is threatened internationally by uncontrolled targeted fisheries, incidental and purposeful catch of pregnant females and juveniles around nursery grounds, habitat loss (especially of inshore pupping areas), coastal development and pollution (sediment and chemical run-off) caused by increasing human populations in coastal areas and installation of high voltage direct current sub-sea cables across their migration lanes which disrupt the electric sensors sharks use to feed and navigate (Backhouse et al., 2008; Walker et al. 2005).

4.3.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to sharks have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.3.1.5).

Table 4-31: Predicted Impact Levels – Emissions – Underwater Sound (Continuous) for Sharks

Emissions – Underwater Sound (Continuous)	Consequence
Change in fauna behaviour Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to fish from vessel noise. There are currently no quantitative exposure guideline or criteria for sharks for continuous sound such as those generated by vessels. Popper et al. (2014) details that there is a low risk to fish without a swim bladder (sharks) from shipping and continuous sound except for: • TTS near (10s of metres) to the sound source. • Masking at near, intermediate (hundreds of metres) and far (thousands of metres) distances. • Behaviour at near and intermediate distances from the sound source. Based on this information avoidance behaviour may occur within hundreds of metres from the vessel and thus, would be restricted to the Operational Area. The White Shark has a distribution BIA within the Operational Area and commercial shark species such as Sawsharks, School Shark and Gummy Shark may be present in the Operational Area based on fishing activity of the Southern and Eastern Scalefish and Shark Fishery. The extent of the area of impact is predicted to be within hundreds of metres of the vessels while the Sequoia MSS is undertaken. Based on the maximum predicted horizontal distance of 1 km for a 'behavioural response' (Popper et al. (2014) to vessel sound, the area where sharks may exhibit a moderate to high behavioural response at any point in time is ~3 km^2 around the source, or less than 0.001% of the Otway bioregion. The severity is assessed as **Minor** based on: • There is no direct evidence of mortality or potential mortality to sharks from continuous vessel sound. • Avoidance behaviour may occur but would be limited to a small area (~3 km^2 at any point in time) as the seismic and support vessel move through the Operational Area.	Minor (2)

Emissions – Underwater Sound (Continuous)	Consequence
• As detailed in Section 4.7 – Commercial Fisheries, a maximum of 1% of the Southern and Eastern Scalefish and Shark Fishery comes from the Operational Area thus it is not identified as an important area for the commercial shark species and a likely to be transitory. • The Recovery Plan for the White Shark *(Carcharodon carcharias)* (DSEWPC, 2013) does not identify sound emission as a threat to the White Shark, thus, it is unlikely they would be disturbed from transiting or foraging in the area including the Apollo or Zeehan AMPs.	

Table 4-32: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for Sharks

Emissions – Underwater Sound (Impulsive)	Consequence
Sharks and rays (elasmobranchs) differ from bony fish in that they have no accessory organs of hearing (i.e. a swim bladder) and therefore are unlikely to respond to the pressure component of the sound field (Myrberg, 2001). Elasmobranchs sense sound via the inner ear and organs and as they lack a swim bladder it is thought that only the particle motion component of acoustic stimuli is detected (Myrberg, 2001). Elasmobranchs have the highest sensitivity to low frequency sound (~20Hz to 1500 Hz) particularly in the range 100-150 Hz and can respond to a low frequency source from a distance of up to 250 m (Myrberg, 2001) with evidence suggesting that pelagic species have more sensitive hearing (thresholds at lower frequencies) than demersal species (Carroll et al., 2017). However, studies have only been conducted on a small number of species to date and the hearing sensitivities are generally very poorly understood (Carroll et al, 2017).	
Predicted maximum distances to sound exposure guidelines relevant to sharks are: • Mortality and potential mortal injury, and recoverable injury: 81 m (PK) and 80 m (SEL 24 hr) • TSS: 2.55 km (SEL 24 hr) Based on the maximum predicted horizontal distance of 81 m to the per-pulse (PK) criteria, the area within which sharks could experience morality and potential mortal injury and recoverable injury at any point in time, is ~0.02 km^2 around the source. The acoustic modelling (Koessler et al., 2020; Appendix E) predicts the exposure area for the mortality and potential mortal injury and recoverable injury effects SEL criterion, the area within which residing sharks could accumulate these effects over a 24-hour period, is 3.26 km^2 (based on a maximum distance of 80 m), representing less than 0.01 % of the Otway bioregion. The acoustic modelling (Koessler et al., 2020; Appendix X) predicts the exposure area for the TTS effects criteria, the area within which residing sharks could experience TTS over a 24-hour period, is 827 km^2 (based on a maximum distance of 2.55 km), representing ~2% of the Otway bioregion. The severity is assessed as **Minor (2)** based on: • Available scientific literature has demonstrated no direct mortality of more sound sensitive fish species (i.e. with a swim bladder), in response to seismic source emissions under field operating conditions (DFO, 2004b; Carroll et al., 2017; Popper et al., 2014; Popper et al., 2016). • Injury in shark species is considered remote given their biology (i.e. no swim bladder), their observed response to sound through near-field particle motion (Myrberg, 2001; Klimley and Myrberg, 1979; Casper et al, 2010) and their unlikely potential to remain close enough to the sound source to be physically injured. • The likelihood of sharks experiencing TTS is low, as the accepted threshold assumes an individual shark remains within the range of the acoustic sources for a continuous 24-hour period. Shark species identified in the area of impact are transitory with wide ranging distribution area and will generally exhibit avoidance behaviour before TTS impacts could occur. • A distribution BIA for the White Shark is present within the area of impact and they may potentially forage in the Apollo and Zeehan AMPs that are also overlapped by the area of impact. The Recovery Plan for the White Shark *(Carcharodon carcharias)* (DSEWPC, 2013)	Minor (2)

Emissions – Underwater Sound (Impulsive)	Consequence
does not identify sound emissions as a threat, thus, it is unlikely they would be disturbed from transiting or foraging within the distribution BIA including the Apollo or Zeehan AMPs. • The area of impact does not overlap the White Shark foraging BIA or breeding BIA. • White shark exposure to sound levels causing behavioural disturbance is expected to be low given the species is generally observed in coastal areas to the 100 m depth contour (Bruce et al, 2006) and near seal colonies when juveniles are present (EA, 2002). The shallowest depth of acquisition in the Sequoia MSS is 90 m and temporal overlap of the survey is predominantly prior to the pupping season (mid-October to January). • Behavioural responses are likely to occur close to the seismic source and the level of response diminish further from the source based on the relative risk proposed by Popper et al. (2014). • Bruce et al (2018) in their Gippsland Basin study during a MSS, monitored the displacement of the Gummy Shark and Swell Shark from the survey area during survey activities. Tagged sharks were observed to move out of the monitoring area but this was largely prior to the commencement of the survey. Individuals of both shark species were observed to move in and out of the monitoring area through the study period, and two Gummy Sharks returned to the monitoring zone during the MSS. • As detailed in Section 4.7 – Commercial Fisheries, a maximum of 1% of the Southern and Eastern Scalefish and Shark Fishery comes from the Operational Area thus it is not identified as an important area for commercial shark species and these species are likely to be transitory in the area of impact.	

4.3.3. Impact Assessment – Fish (swim bladder)

4.3.3.1. Existing Environment

Values

Threatened Species

The **Australian Grayling** (EPBC listed: Vulnerable) is a dark brown to olive-green fish attaining 19 cm in length. The species typically inhabits the coastal streams of New South Wales, Victoria and Tasmania, migrating between streams and the ocean (Backhouse et al., 2008). The National Recovery Plan for the Australian Grayling states that the Australian Grayling spend most of their lives in freshwater, inhabiting rivers and streams, usually in cool, clear waters with a gravel substrate and alternating pool and riffle zones (Bishop & Bell 1978b; Berra 1982) but can also occur in turbid water. Spawning occurs in freshwater, usually from late Summer to Winter, with timing dependant on many variables including latitude and varying temperature regimes (Backhouse et al., 2008, DAWE, 2021c). Larvae and juveniles inhabit estuaries and coastal seas, and there appears to be an obligatory marine stage, although their precise habitat requirements are not known (Backhouse et al., 2008). The species may be present in and around King Island, although these waters do not represent habitat critical for the species (Backhouse et al., 2008). The temporal presence of the Australian Grayling is shown in the Temporal Presence and Absence section in Appendix A which shows that their presence is assumed to be possible year-round and their spawning period overlaps with the survey period, however spawning occurs in freshwater (DAWE, 2021c).

Blue Warehou (EPBC listing: Conservation Dependant) are a bentho-pelagic species that inhabits continental shelf and slope waters (AFMA, 2021i). They been managed under AFMA's Blue Warehou Stock Rebuilding Strategy (AFMA, 2014) since 2008 to prevent targeted fishing as all stocks are depleted (Chick et. Al, 2018). Adults can be found at depths from 50-300 metres. They prey on salps and pyrosomes (planktonic tunicates), krill, crabs and small squid (AFMA, 2021i). Key predators are unknown, although there are records of Blue Warehou in the stomach contents of school sharks (AFMA, 2021i).

Blue Warehou are a schooling fish and usually aggregate close to the seabed. Juveniles can sometimes be found schooling close to the surface in estuaries, often in association with jellyfish (AFMA, 2021i). Blue Warehou reach reproductive maturity at about 3 years of age. The main spawning season is during winter/spring, although some low-level spawning may occur throughout the year (Knuckey and Sivakumaran 1999). The primary spawning ground is off western Victoria and Tasmania (AFMA, 2021i). Earlier studies have shown concentrations of young Blue Warehou larvae found from Kangaroo Island in South Australia to southern Tasmania, with a major concentration off the north-western coast of Tasmania and another off the eastern Victoria / New South Wales border (Knuckey and Sivakumaran 1999). On average females spawn around three times per season. Females produce 430 000 1 350 000 eggs per spawning event depending on their body size (AFMA, 2021i). They have a lifespan of up to 15 years (AFMA, 2021i). The temporal presence of the Blue Warehou is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with part of the survey period.

Ocean Perch are a benthopelagic species that inhabits flat, hard seabeds on the continental shelf and upper slope. Inshore ocean perch is often found at depths of 80-350 metres. Offshore ocean perch is often found at depths of 250-350 metres (AFMA, 2021h). They have a lifespan of up to 60 years. Ocean Perch feed on large benthic invertebrates such as squid, small fish (e.g. cardinal fish) and benthic crustaceans (e.g. royal red prawns) (AFMA, 2021h). They are predated by sharks and marine mammals such as seals (AFMA, 2021h).

Females reach reproductive maturity at about 5 years of age, with male ocean perch reach maturity at 5-7 years of age (AFMA, 2021h). Spawning occurs over an extended period from winter to early summer, in June for reef ocean perch and slightly later for bigeye ocean perch. Spawning is distinctive in that fertilisation and larvae development is internal (i.e. ocean perch are lecithotrophic viviparous) (AFMA, 2021h). Females produce 150 000 200 000 eggs per spawning season. Larvae are extruded in floating jelly-like masses when they reach about 1 mm in length (AFMA, 2021h). Once extruded, the jelly-like mass dissolves to release the larvae. Inshore ocean perch are thought to retain larvae for longer than offshore ocean perch (AFMA, 2021h). The survey period intersects with the temporal presence and spawning period of Ocean Perch. The temporal presence of the Ocean perch is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with the entire survey period.

Concentrations of larval Blue Warehou and Ocean Perch have been identified in the Zeehan Marine park, which overlaps the Seismic sound - Fish EMBA(Figure 4-11), indicating a potential nursery ground (DAWE, 2020d). Both species are commercially fished elsewhere, however are not identified as being fished in the relevant EMBAs.

Commercially Valuable Species

The **Eastern School Whiting** is a commercially fished species classified as a sustainable stock according the FRDC and fished by the SESSF- CTS (Table 1-4) (Conron et. Al., 2018c). They are caught throughout the year, though larger catches are commonly seen between March and July (AFMA, 2018a).

They are a benthic species found on shallow tidal flats down to depths of 180 metres on the continental shelf (AFMA, 2021a), and are usually associated with sandy substrates. Juveniles tend to be found in shallower waters than adults (AFMA, 2021a). The Eastern School Whiting prey on crustaceans, molluscs and polychaetes (AFMA, 2021a). They are predated by birds, larger fish, sharks, rays and marine mammals such as dolphins (AFMA, 2021a).

Eastern School Whiting reach reproductive maturity at about 2 years of age (AFMA, 2021a). 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 (AFMA, 2021a). Females spawn twice each year in deeper waters. Females produce 30 000 110 000 eggs per spawning season depending on their body size (AFMA, 2021a). The temporal presence of the Eastern School Whiting is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period however spawning does not overlap.

The **Tiger Flathead** is a commercially fished species classified as a sustainable stock according the FRDC and fished by the SESSF- CTS (Table 1-4) (Conron et. Al, 2018a). Tiger flathead are a demersal species that is found at depths of 10 400 metres. Juveniles inhabit shallow waters of the continental shelf and move into the deeper outer shelf zone as they reach maturity (AFMA, 2021b). 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 (AFMA, 2021b). There is evidence that mature fish migrate to shallower waters prior to the spawning period (AFMA, 2021b). They have a lifespan of up to about 15 years however females live longer than males (AFMA, 2021b). Flathead feed on small fish and crustaceans and are predated by other small fish (AFMA, 2021b).

Tiger flathead reach reproductive maturity at 3-5 years of age (AFMA, 2021b). Spawning occurs over an extended period from spring to autumn, with some variation on the timing of spawning depending on location (AFMA, 2021b). Females produce 1.5 2.5 million eggs per spawning season (AFMA, 2021b). The temporal presence of the Tiger Flathead is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with the end of the survey period.

Pink Ling are a commercially fished species classified as a sustainable stock according the FRDC and fished by the SESSF- CTS (Table 1-4) (Georgeson and Rowan C 2018). Pink Ling are a demersal species that inhabits the continental shelf and slope (AFMA, 2021d). They can be found at depths of 20 1000 metres (AFMA, 2021d). 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 (AFMA, 2021d). Aside with some movement associated with spawning, Pink Ling are thought to be relatively sedentary. They prey on crustaceans such as Royal Red Prawns, and a variety of fish including Gemfish and Blue Grenadier. They are predated on by Tiger Flathead (AFMA, 2021d).

Pink Ling grow up to 1 metre in length and 20 kg, though are commonly found at 50 90 cm in length and 0.6 4.5 kg and have a lifespan of up to 30 years (AFMA, 2021d). Pink Ling reach reproductive maturity at 7-12 years of age (AFMA, 2021d). 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 (AFMA, 2021d). Females produce about 333 000 eggs per spawning event depending on body size (AFMA, 2021d). The temporal presence of the Pink

Ling is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with the survey period.

Blue Grenadier are a commercially fished species classified as a sustainable stock according the FRDC and fished by the SESSF- CTS (Table 1-4) (Georgeson, 2018). They are fished in the Great Australian Bight and in the waters off VIC and TAS (Georgeson, 2018). Blue Grenadier are commercially valuable, representing 55% of the species caught in the Commonwealth Trawl Sector (CTS) from 2008- 2017 (SETFIA, 2018; AFMA, 2021e).

Blue Grenadier are a deep-water species that occurs on the continental slope (AFMA, 2021e). They can be found at depths of 200 – 700 metres. Juveniles often occur in shallower bays and inlets (AFMA, 2021e). Blue Grenadier aggregate near the seabed during the day and move up into the water column at night (AFMA, 2021e). They have a large mouth and tiny scales and grow up to 1.2 metres in length and 6 kg in weight but are commonly found at 0.6 1 metre in length and 1 3.5 kg (AFMA, 2021e). Females grow slower but become larger than males (AFMA, 2021e). They can live up to 25 years. Females live longer than males (AFMA, 2021e).

Blue Grenadier feed on other fish (particularly lanternfish), squids and crustaceans and they are predated by pink ling (AFMA, 2021e). Most Blue Grenadier reach reproductive maturity at 4-7 years of age (AFMA, 2021e). Spawning occurs in winter and early spring (AFMA, 2021e). The main spawning ground for blue grenadier is on the west coast of Tasmania (AFMA, 2021e). Females release about 1 million eggs in a single spawning event (AFMA, 2021e). The temporal presence of the Blue Grenadier is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with the beginning of the survey period (winter and early spring).

The **Orange Roughy** (EPBC listed: Conservation Dependant) is a commercially valuable species and is managed under AFMAs Orange Roughy Rebuilding Strategy 2014 (AFMA, 2014a). The species is assessed as six biological stocks. Two stocks are sustainable, one is undefined and three are depleted (Georgeson L and Helidoniotis F, 2018). Four of these stocks are under the SESSF (CTS) fishery, with two classified as sustainable stocks (Cascade Plateau and Eastern Zone) and two classified as depleted by the FRDC (Southern Zone and Western Zone) (Georgeson and Helidoniotis, 2018). The Southern, Eastern and Western Zone are the stocks likely to be present in the relevant EMBA (SETFIA, 2018).

It is a demersal fish species that is found in ridge and slope waters 180 – 1,800 m deep (DAWE, 2020c). Orange Roughy. They are very long-lived, very slow to mature and have low fecundity relative to other bony fishes. Ageing studies show that they do not mature until their mid-20s to mid-30s and have a mean generation time of 56 years (AFNMA, 2014a). Although widespread, Orange Roughy migrate hundreds of kilometres to form spawning aggregations over seamounts between June and August in the Southern Hemisphere (DAWE, 2020c). They are synchronous spawners and form dense spawning and feeding aggregations. 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. Adult males appear to spawn over a 1-2-week period, with females spawning for up to 1 week (AFMA, 2021f). Females produce 10 000-90 000 eggs in a single spawning event each season (AFMA, 2021f). Hatching is thought to occur 10-20 days after fertilisation. It is likely that females do not spawn every year (AFMA, 2021f).

Excluding substantial migrations to spawning grounds, Orange Roughy are a relatively sedentary species (AFMA, 2021f).

The Orange Roughy feed on bentho-pelagic and meso-pelagic fish and invertebrates such as squid, viperfish, lanternfish, whiptails, crustaceans, amphipods and mysids (AFMA, 2021f). Their predators include oilfish and large basketwork eels (AFMA, 2021f). The Orange Roughy forms dense feeding aggregations which are targeted by the fishing industry during the non-spawning season. In 2006, Orange Roughy were listed as conservation-dependent in Australian waters, with most stocks reported to be well below 20% of estimated pre-fishing equilibrium biomass and closed to targeted fishing (DAWE, 2020c). While there are records for the Orange Roughy in the Seismic sound – Fish EMBA, it is highly unlikely that the EMBA is a spawning aggregation site due to the lack of seamounts in the area. The temporal presence of the Orange Roughy is shown in the Temporal Presence and Absence section in Appendix A which shows their presence is assumed to overlap with the survey period and spawning overlaps with the beginning of the survey period (however not occurring every year).

Impacts to fish eggs and larvae from seismic surveys has the potential to affect fisheries yield and spawning stock in subsequent years. The Sequoia MSS overlaps up to 1% of the following fisheries annual revenue (SETFIA, 2020; Appendix F).

- SESSF Shark Gillnet Sector and Shark Hook Sector
- SESSF Scalefish Hook Sector
- SESSF Commonwealth Trawl Sector

Table 4-33 details a review of the fish species targeted by these fisheries.

Distribution of Blue Warehou larvae suggests that the species spawns over a large area from Kangaroo Island to southern Tasmania with a major spawning grounds located on the central west and northwest coast of Tasmania (Bruce et al., 2001). DNP (2013) reports that the Zeehan AMP, intersected by the Seismic sound – Fish EMBA, is a likely nursery ground for Blue Warehou, with concentrations of larvae recorded in the park.

DNP (2013) also report Ocean Perch larvae recorded in the Zeehan AMP. There is limited information on Ocean Perch spawning.

Table 4-33: Review of spawning by commercially valuable fish species

Species	Spawning	Biomass Status	Spawning	Depths
Blue Grenadier	Winter and early spring	Not overfished	Females release about 1 million eggs in a single spawning event. The main spawning ground for blue grenadier is on the west coast of Tasmania.	200 – 700 m
Blue Warehou	Winter and spring	Overfished	Females spawn around three times per season producing 430 000-1 350 000 eggs per spawning event.	50-300 m
Eastern School Whiting	Late summer in Tasmania	Not overfished	Females spawn twice each year in deeper waters. Females produce 30 000-110 000 eggs per spawning season.	Up to 180 m
Ocean Perch	Winter to early summer	Not overfished	Females produce 150 000-200 000 eggs per spawning season.	80-350 m
Orange Roughy	June to August	Not overfished	Migrate hundreds of kms to form spawning aggregations over seamounts.	700 - 1400 m
Pink Ling	Late winter and spring	Not overfished	Serial spawners, females produce about 333 000 eggs per spawning event.	20 – 1000 m
Tiger Flathead	Spring to autumn	Not overfished	Females produce 1.5-2.5 million eggs per spawning season.	10 – 400 m

Sensitivities

Threatened Species

The Australian Grayling has a relatively short life span, most individuals spawn only once before they die, so populations are especially vulnerable to any disruption of spawning or recruitment (Backhouse et al., 2008). The National Recovery Plan for the Australian Grayling predicts that habitats such as spawning, refuge and juvenile habitats are likely to be limited in distribution, yet crucial to the grayling's life cycle (Backhouse et al., 2008).

Spatial and temporal patchiness of the Blue Warehou make it difficult to estimate the biomass and biomass depletion levels. The Blue Warehou Stock rebuilding Strategy 2014 highlights that further data is needed on the species to gain a better understanding of stocks and recoverability (AFMA, 2014). The Stock Rebuilding Strategy focuses on overcoming the impacts of overfishing on the Blue Warehou. As a depleted stock they remain vulnerable to fishing, including as bycatch/incidental catch.

The Ocean Perch does not have a management plan or conservation advice identifying particular vulnerability or sensitivity information.

Commercially Valuable Species

The sustainable stock assessment by FRDC is based on fishing mortality. Results of the most recent tier 1 assessment base case, incorporating data from all jurisdictions and sectors, suggest that the current spawning potential ratio (1-SPR, relative to the target), integrated across all fleet in the fishery was near the target reference point corresponding to when the stock is at least 48 per cent of unfished biomass [Day 2017] (Conron et.al., 2018). This level of fishing mortality is unlikely to cause the stock to become recruitment impaired (Conron et.al., 2018).

The sustainable stock status of fish is based on their spawning stock biomass, current and historical fishing pressure. The sustainable stock status of the following fish species are not considered to be recruitment impaired; and the level of fishing mortality is unlikely to cause the stock to become recruitment impaired:

- Tiger Flathead (Conron et. Al, 2018a)
- Pink Ling (Georgeson and Rowan, 2018)
- Blue Grenadier (Georgeson, 2018).

The Orange Roughy is long lived, slow to mature and exhibits a low recruitment rate which makes it extremely vulnerable to overfishing (DAWE, 2020c). The biological characteristics of the Orange Roughy result in the species having very low resilience to fishing as the likelihood of being caught prior to reproduction is much higher in comparison to other fish species (DAWE, 2020c; DEWR, 2007). The importance of seamounts to the spawning of Orange Roughy makes them vulnerable to habitat damage, particularly from commercial trawling (DAWE, 2020c). Oil and gas exploration is identified as a potential threat to the Orange Roughy, however sound is not specified (DAWE, 2020c).

Any reductions in Orange Roughy biomass will have impacts on the species on which they feed and which feed on them (DAWE, 2020c; Bruce et al. 2002). Surveys in New Zealand have shown declines in several species associated with the Orange Roughy, either directly through by-catch or indirectly through trophic or habitat interactions (DAWE, 2020c; DEWHA 2008a).

Existing Pressures

There are a range of anthropogenic threats and pressures on fish species in the relevant EMBAs. These include:

- Commercial and recreational fishing
- Invasive marine species
- Cumulative impacts from previous and simultaneous activities in the area (i.e. seismic, drilling, vessels)
- Ecosystem effects as a result of habitat modification and climate change
- Habitat degradation

Other pressures have been identified for particular species:

Threatened Species

The National Recovery Plan for the Australian Grayling (Backhouse et al., 2008) lists threatening processes for this species as barriers to movement (instream dams, weirs, culverts, levee banks, areas of unsuitable habitat including dewatered areas, and high flow or turbulence), river regulation, poor water quality, siltation, introduced fish, climate change, diseases and fishing. These impacts will not result from the seismic activity. Underwater sound is not identified as a threat to species recovery.

Commercially Valuable Species

The Orange Roughy Stock Rebuilding Strategy 2014 (AFMA, 2014a) identifies that the key threat to the Orange Roughy in Australian waters is commercial trawl fishing in the SESSF (AFMA, 2014a). Commercial trawling directly reduces stock numbers and potentially reduces stock through degradation to habitat (DAWE, 2020c). Other threats include species interaction, habitat damage and other threats such as impacts from oil and gas exploration, laying down of cables and telecommunications links and waste disposal (DAWE, 2020c).

The Blue Warehou Stock Rebuilding Strategy 2014 (AFMA, 2014) identifies fishing mortality as having a significant impact on Blue Warehou stocks, however also acknowledges that current catch levels are not a key threat to recovery, however fishing mortality could become a key threat (AFMA, 2014). The Strategy also recognises environmental variability such as climate change as having the possibility to affect population dynamics and recovery of the Blue Warehou (AFMA, 2014).

The most recent seismic survey undertaken in the vicinity of the Operational Area was completed in April 2020 by Schlumberger (Appendix A Cumulative Impact Assessment). No concurrent surveys in the Otway or Gippsland locations have been identified and the only post Sequoia MSS seismic survey identified is the Prion MSS ~112 km east of the Operational Area in the Gippsland location (Appendix A Cumulative Impact Assessment).

4.3.3.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to fish have been evaluated in the tables below; having had regard to the legislative and other controls (Section 4.3.1.5).

Table 4-34: Predicted Impact Levels – Emissions – Underwater Sound (Continuous) for Fish

Emissions – Underwater Sound (Continuous)	Consequence
The extent of the area of impact is predicted to be within hundreds of metres of the vessels while the Sequoia MSS is undertaken. Based on the maximum predicted horizontal distance of 1km for a 'behavioural response' (Popper et al. (2014) to vessel sound, the area where fish may exhibit a moderate to high behavioural response at any point in time is ~3 km^2 around the source, or less than 0.001% of the Otway bioregion. The severity is assessed as **Negligible** based on: • National Recovery Plan for the Australian Grayling *(Prototroctes maraena)* (Backhouse et al., 2008) does not identify noise as a threat. • Avoidance behaviour may occur but would be limited to a small area as the seismic and support vessel move through the Operational Area. • Recoverable injury and TTS are unlikely to occur based on the fish having to be within close proximity (<500 m) of a moving vessel for 48 hrs and 12hs, respectively, which is considered unlikely given the distances for moderate behavioural response. • As detailed in the Section 4.7 – Commercial Fisheries, a maximum of 1% of the Southern and Eastern Scalefish and Shark Fishery comes from the Operational Area thus it is not identified as an important area for the commercial fish species and commercial fish species are transitory.	Negligible (1)

Table 4-35: Predicted Impact Levels – Emissions Underwater Sound (Impulsive) for Fish

<table>
<tr><th colspan="2">Emissions – Underwater Sound (Impulsive)</th></tr>
<tr><td colspan="2"><u>Overview of Underwater Sound (Impulsive) and Fish</u>
All fish studied to date can detect sound, with the main auditory organs in teleost (bony) fish being the otolithic organs of the inner ear (Carroll et al., 2017). Hearing in fish primarily involves the ability to sense acoustic particle motion via direct inertial stimulation of the otolithic organs or their equivalent. Many species also sense sound pressure using an indirect path of sound stimulation involving gas-filled chambers such as the swim bladder (Carroll et al., 2017).
The predominant frequency range of MSS sound is within the detectable hearing range of most fish.
There are substantial differences in auditory capabilities from one fish species to another, hence the use of anatomy to distinguish fish groups, as done by Popper et al (2014). Within these categories, two groups have an increased ability to hear.
Fish with swim bladders close, but not intimately connected to the ear, can hear up to about 500 Hz, and are sensitive to both particle motion and sound pressure. In Australian waters, such fish species include:
• Snappers, emperors, groupers and rock cods.
• Some tuna species (Thunnus sp.).
Fish with swim bladders mechanically linked to the ear are primarily sensitive to pressure, although they can still detect particle motion. These fishes have the widest hearing range, extending to several kilohertz, and are generally more sensitive to sound pressure than any of the other groups of fish (Hawkins and Popper, 2016). In Australian waters, such fish typically include some species from the following families:
• Clupeidae (herrings, sardines, pilchards).
• Gadidae (cods such as whiting).
• Pomacentridae (damsel and clown fish).
• Haemulidae (grunters and sweetlips).
Underwater noise levels significantly higher than ambient levels can have a negative impact on fish, ranging from physical injury or mortality, to temporary effects on hearing and behavioural disturbance effects.
The effects of underwater sound on fish 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.</td></tr>
<tr><th>Mortality and potential mortal injury and recoverable injury predicted impact</th><th>Consequence</th></tr>
<tr><td><u>Injury/mortality to fauna</u>
Predicted maximum distances to sound exposure guidelines relevant to fish with a swim bladder are:
• Mortality and potential mortal injury, and recoverable injury: 154 m (PK) and 90 m (SEL 24 hr)
Based on the maximum predicted horizontal distance of 154 m to the per-pulse (PK) criteria, the area within which fish could experience morality and potential mortal injury and recoverable injury at any point in time is less than 0.07 km^2 around the source, representing less than 0.0002% of the Otway bioregion. The acoustic modelling (Koessler et al., 2020; Appendix X) predicts the exposure area for the mortality and potential mortal injury and recoverable injury effects SEL criterion, the area within which residing fish could accumulate these effects over a 24-hour period, is 5.11 km^2 (based on a maximum distance of 90 m), representing ~0.01 % of the Otway bioregion.
The extent of the area of impact is predicted to be a maximum of 154 m from the sound source while the Sequoia MSS acquisition is undertaken. The severity is assessed as Minor (2) based on:
• Available scientific literature has demonstrated no direct mortality of adult fish in response to airgun emissions under field operating conditions (DFO, 2004b; Carroll et al., 2017; Popper et al., 2014; Popper et al., 2016).
• The adopted sound thresholds to determine impact are derived from impulsive pile driving studies as mortality from seismic source have not been observed (Popper et al, 2014). Popper et al (2016) has since shown that seismic sound higher than the adopted thresholds does not result in “mortality, potential mortal injury and recoverable injury” in fish species.</td><td>Minor (2)</td></tr>
</table>

- Pelagic fish present in the area of impact are wide-ranging and likely to move from areas of high sound (Slotte et al, 2004; Carroll et al, 2017 - refer behavioural effects). - Injury impacts might occur if an acoustic array commences at full power adjacent to the fish. In reality, soft-start procedures allow for the detection of increasing sound and for displacement of species. - It is noted that the lack of significant impacts observed in site attached species in reef habitats (Woodside, 2012b; Boeger et al, 2006; Wardle et al, 2001) supports that demersal/site-attached are unlikely to be at risk of mortality or recoverable injury from seismic sound. - National Recovery Plan for the Australian Grayling (Prototroctes maraena) (Backhouse et al., 2008) does not identify noise as a threat.	
Temporary Threshold Shift predicted impact	**Consequence**
<u>*Change in hearing via permanent and temporary threshold shift*</u> Predicted maximum distances to sound exposure guidelines relevant to fish are: - Temporary Threshold Shift: 2.55 km The extent of the impact is predicted to be within a maximum horizontal distance of 2.55 km from the sound source while the Sequoia MSS acquisition is undertaken. The acoustic modelling (Koessler et al., 2020; Appendix E) predicts the exposure area for the TTS effects criteria, the area within which residing fish could experience TTS over a 24-hour period, is 827 km^2 (based on a maximum distance of 2.55 km), representing ~2% of the Otway bioregion. The severity is assessed as **Minor (2)** based on: - 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 therefore is not representative of a MSS with a moving source. On this basis, the Popper et al (2005) study represents the worst-case scenario as the source is fixed and not moving (i.e. fish received five pulses of identical intensity over five minutes which is not representative of a moving source). Since a seismic survey vessel is constantly moving, a stationary receptor is exposed to the maximum sound level once in a sequence of exposures. - Since the Popper et al. (2014) TTS sound exposure guidelines were developed Professor Popper 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 Sequoia 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. Based on very limited data, recovery within 24 hours (or less) is very likely; and	Minor (2)

• There is no information regarding the behavioural implications of TTS in fishes in the wild. However, since the TTS is likely very transitory, the likelihood of it having a significant impact on fish fitness is very low. • Demersal/site-attached fish: The area of impact overlaps the West Tasmania Canyons KEF (2.29%) where sponge habitats may support demersal/site-attached fish. These species may be less inclined to move away from the seismic source. However, based on the information from Popper (2018), impacts are likely to be within the normal variations in hearing sensitivity and recovery will start as soon as the most intense sounds end, the likelihood of it having a significant impact on fish fitness is very low. • National Recovery Plan for the Australian Grayling *(Prototroctes maraena)* (Backhouse et al., 2008) does not identify noise as a threat. This species inhabits inland and coastal waters (Backhouse et al., 2008) which are outside of the area of impact based on the Operational Area being 26 km from the Victorian coast and 22 km from the King Island coast. It is therefore unlikely that this species would be present within 2.55 km of the seismic source for a 24-hour period.	
Behavioural and Masking Predicted Impact	**Consequence**
<u>Change in fauna behaviour</u> There are currently no quantitative exposure guideline 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' is used 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. The extent of the area of impact is predicted to be within thousands of metres of the seismic source while the Sequoia MSS is undertaken. The severity is assessed as minor based on: • Behavioural impacts in pelagic species have been shown to be short-term (Slotte et al, 2004; Woodside, 2012b) and localised (Pena et al, 2013; Woodside, 2008). • Behavioural impacts have been shown to be localised and temporary within demersal fish species (Chapman and Hawkins, 1969; Bruce et al. 2018; Wardle et al, 2001) and in site-attached species during MSS activity (Millar and Cripps, 2013; Woodside, 2012b). Fish species were observed to either return to pre-exposure behaviour within a short-period of the MSS activity ceasing (Pearson et al, 1992; Woodside, 2012b) or experienced habituation to the sound after a short period of exposure (Chapman and Hawkins, 1969; Fewtrell and McCauley, 2012). • National Recovery Plan for the Australian Grayling (Prototroctes maraena) (Backhouse et al., 2008) does not identify noise as a threat. This species inhabits inland and coastal waters (Backhouse et al., 2008) which are outside of the area of impact based on the Operational Area is 26 km from the Victorian coast and 22 km from the King Island coast.	Minor (2)

Reproductive success	Consequence
Injury/mortality to fauna – change in recruitment Impacts to fish eggs and larvae from seismic surveys has the potential to affect fisheries yield and spawning stock in subsequent years. The Sequoia MSS overlaps up to 1% of the following fisheries annual revenue (SETFIA, 2020, Appendix F): • SESSF Shark Gillnet Sector and Shark Hook Sector • SESSF Scalefish Hook Sector • SESSF Commonwealth Trawl Sector A review of spawning of the commercially valuable species targeted by these fisheries (Table 4-33) identified: • The Sequoia MSS does not overlap the spawning timing of the Eastern School Whiting. • The Sequoia MSS does not overlap the spawning area of the Blue Grenadier and Orange Roughy. • Sequoia MSS period of acquisition (when the seismic source is active) (between August and October) • The remaining species are serial spawners spawning over a number of months, producing large amounts of eggs per spawning event. • Only one species, the Blue Warehou, has a biomass status of overfished. Section 4.1 provides an overview of studies in relation to impacts of seismic sound on plankton including fish eggs and larvae. The majority of these studies reported low mortalities typically within natural mortality rates. Based on the assessment of plankton in Section 4.1, the extent of the area of impact is predicted to be a maximum of 170 m from the sound source while the Sequoia MSS acquisition is undertaken. Utilising the Popper et al. (2014) criteria for plankton mortality it is estimated ~2% of the plankton present within Sequoia MSS acquisition area (for the entire survey) and ~0.1% of plankton present in the Otway bioregion would be impacted per day which is less than identified daily natural mortality rates for fish eggs and larvae[2] (detailed in Section 4.1 – Plankton). The severity is assessed as **Minor (2)** based on: • Distribution of eggs and larvae are predicted to be over a large area as species identified are not restricted in their habitat and spawning areas. • Spawning occurs over months and is not limited to a single event. • Females release large numbers of eggs and as previously described mortality and potential mortal injury effects will be inconsequential when compared to natural mortality rates of fish eggs and larvae, which are generally very high. In a review of mortality estimates (Houde and Zastrow, 1993) detailed that the mean mortality rate for marine fish larvae was M = 0.24, a rate equivalent to a loss of 21.3% per day. The Sequoia MSS run north to south, perpendicular to prevailing currents, minimising the duration of exposure of eggs and larvae to seismic sound as they will be moving away from the seismic source not with it.	Minor (2)

4.3.4. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-36 compares the predicted impact levels for fish against the acceptable levels.

Table 4-36: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Fish

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th colspan="2" rowspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="4">Principles of ESD</td><td rowspan="4">Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.

Environmental impacts and risks have a worst-case consequence ranking less than Major (4).</td><td colspan="2">The scientific literature indicates mortality of fish has not been demonstrated, no significant impacts observed to pelagic/demersal/site-attached fish and impacts such as TTS recoverable within less than 24 hrs.</td><td rowspan="4">Yes</td></tr>
<tr><td>Severity</td><td>Recoverable injury</td></tr>
<tr><td>Extent</td><td>Operational area + 2.55km</td></tr>
<tr><td>Duration</td><td>Maximum 38 days (impulsive sound) and 78 days (continuous sound)</td></tr>
<tr><td>Principles of ESD</td><td>Enough appropriate information to understand impact/risk of serious/irreversible environmental damage.

Application of the precautionary principle in the presence of scientific uncertainty.</td><td colspan="2">There is high confidence in the prediction of impact which is based on peer reviewed and published literature.</td><td>Yes</td></tr>
<tr><td>Principles of ESD</td><td>The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td><td colspan="2">No relevance to fish (See Appendix A). The acquisition area overlaps 1% the Distribution BIA for the White Shark (or 1.3% including 2.55km for TTS). The Recovery Plan for the White Shark does not identify sound as a threat, and it is unlikely they would be disturbed from transiting or foraging in the area including the Apollo or Zeehan AMPs.
National Recovery Plan for the Australian Grayling The recovery plan does not identify sound as a threat.</td><td>Yes</td></tr>
<tr><td>Biological</td><td>Physical, physiological, and behavioural effects with no impact on key life functions, vital rates, and population parameters</td><td colspan="2">Sub-lethal effects to individuals with no knock-on effects to population levels.</td><td>Yes</td></tr>
<tr><td>Ecological</td><td>Maintain the sustainable development of living resources.</td><td colspan="2">No long-term reduction of fish diversity and abundance in the survey area.</td><td>Yes</td></tr>
<tr><td>Economic</td><td colspan="4">Assessed in Commercial Fisheries (Section 4.7)</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.</td><td colspan="2">CM 11, the sail line plan ensures the activity is clearly scoped and bounded.</td><td>Yes</td></tr>
<tr><td rowspan="2">ConocoPhillips Australia Policies</td><td rowspan="2">Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).</td><td>Fish</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Sharks</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Relevant Persons</td><td>Measures have been adopted because of the consultations to</td><td colspan="2">Claims and objections relevant to fish have been considered in Section 3.</td><td>Yes</td></tr>
</table>

	address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	No public comments were made in relation to fish.	
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 4-30	Yes
Acceptability Summary			
Following completion of the impact assessment process, the environmental impacts to fish (and sharks) arising from the identified aspects are acceptable because: • Mortality or injury to fish are not predicted. • Predicted impacts such as TTS are recoverable in less than 24 hours. • The likelihood of it having a significant impact on fish fitness is very low. • The survey will not result in damage or modification to fish habitat.			

4.3.5. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Fish populations remain a sustainable resource; and
Receptor	• Shark populations remain a sustainable resource; and
Impact	• Impacts are sub-lethal with no pathway for impacts on key life functions, vital rates, and population parameters.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-37 which assesses whether the control measures for fish are effective to meet the EPO.

Table 4-37: Control Measure Effectiveness - Fish

Measure	CM 11 - Sail line plan
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

4.4. Birds

4.4.1. Scoping the Assessment

4.4.1.1. Defining the Aspects that Lead to Impact

Table 4-38 identifies the aspects and impacts that have the potential to impact birds as a result of the petroleum activity. Aspects and impacts marked 'X' are predicted to have no significant cause/effect pathway or negligible consequence considered (that is less than Minor) and have not been discussed further in this chapter.

Appendix B – Justification for screening out receptorsprovides a summary and justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 – Unplanned Aspects).

Table 4-38: Aspects and Impacts – Birds

Aspects	*Impacts*	*Birds*
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	*X*
	Change in fauna behaviour	*X*
Emissions – Underwater Sound (Impulsive)	Injury/mortality to fauna	*X*
	Change in hearing via permanent and temporary hearing shift	*X*
	Change in fauna behaviour	*X*
Emissions – Light	Change in fauna behaviour	✓
Emissions – Atmospheric	Change in ecosystem dynamics	*X*
Planned Discharges – Vessels	Change in fauna behaviour	*X*
	Injury/mortality to fauna	*X*

4.4.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-39 describes the cause-and-effect pathways and source of the aspect identified for birds (Table 4-38).

Table 4-39: Cause and Effect Pathway – Birds

Emissions - Light
Throughout the petroleum activity, external lighting will be required on the survey vessel, support vessels and floating towed equipment for safe navigation and to facilitate safe working conditions. Vessel and facility lighting are considered standard practice and a navigational requirement. Lighting used during offshore operations is generally bright white light such as light emitting diodes, halogens, fluorescent and metal halide lights; and would be similar to lighting used by other offshore mariners (e.g. shipping and fishing). Light emissions generated by the petroleum activity has the potential to result in: • a change in ambient light. As a result of a change in ambient light, further impacts may occur to birds, including: • a change in fauna behaviour.

4.4.1.3. Defining the EMBA

Table 4-39 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact birds (Table 4-38).

The source of the aspect-receptor interactions has been described further in subsequent sections specific to receptor groupings. The relevant EMBAs for bird receptors is shown in Figure 4-12.

Table 4-40: EMBA for Birds

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions - Light	Light	The National Light Pollution Guidelines (DoEE, 2020) state an environmental impact assessment should be done if there is sensitive habitat within 20 km of the petroleum activity. Light emissions are generated by artificial light on the vessels, while undertaking the petroleum activity. 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 DoEE (2020) has been used.	The adoption of 20 km buffer for considering important seabird habitat is based on the observed grounding of seabirds in response to a light source at least 15 km away DoEE's (2020). Further, DoEE (2020) notes that seabird fledglings may be affected by lights up to 15 km away.	Operational Area + 20 km radius

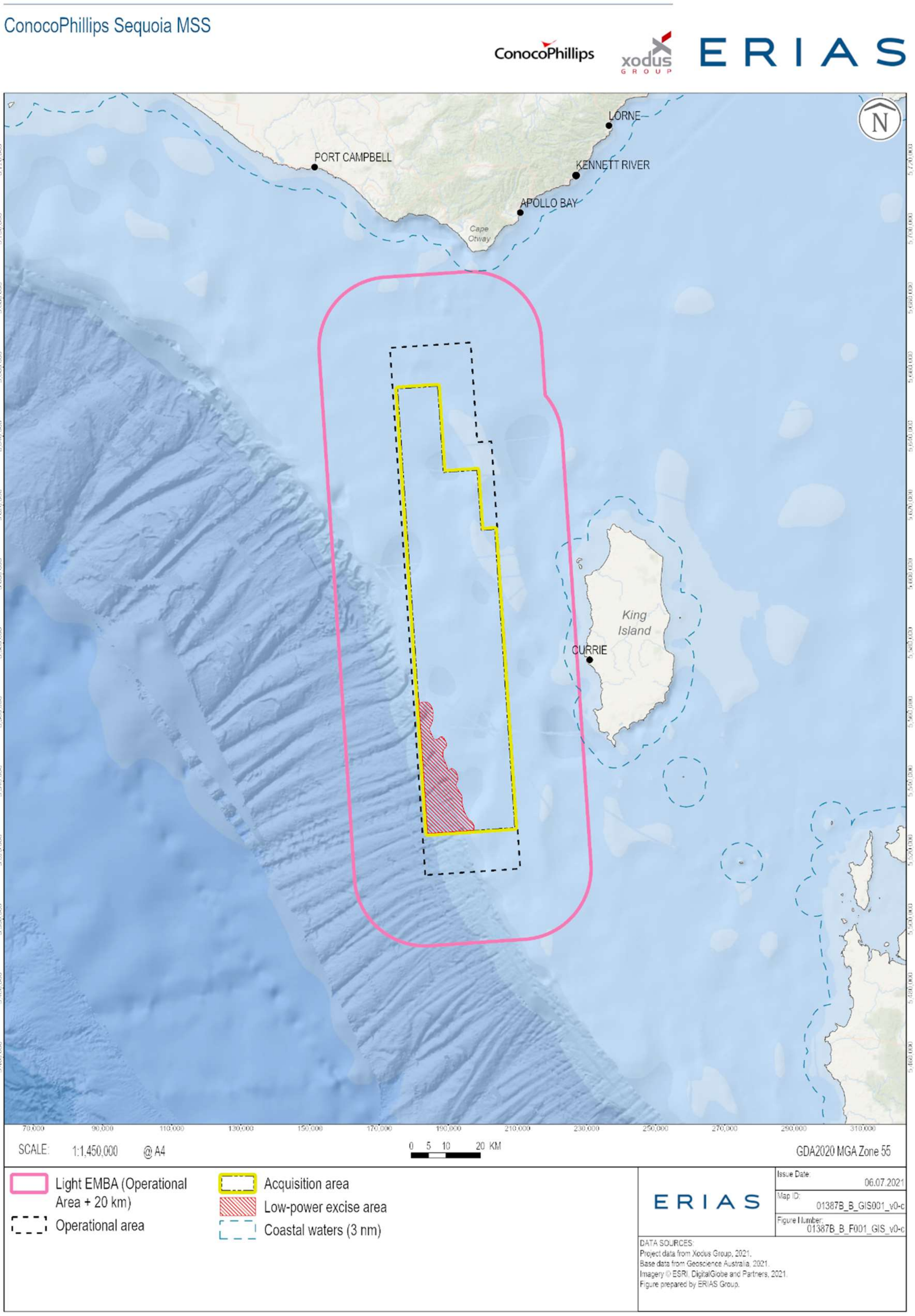


Figure 4-12: Light EMBA

4.4.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

Greater detail is included for threatened species.

Multiple species (or species habitat) of birds may occur within the Light EMBA. Table 4-40 identifies the presence, biologically important behaviour and protection status relevant to the Light EMBA.

PMST records identified 33 bird species potentially occurring in the Light EMBA (Table 4-40, Appendix J). The presence of most species identified within this EMBA is expected to be of a transitory nature only.

The EPBC Act Conservation Values Atlas database identified 12 species with BIAs overlapping the Light EMBA (Table 4-40).

The focus of this assessment is on seabirds and migratory shorebirds. Seabirds are categorised as those whose normal habitat and food source is derived from the sea (i.e. coastal or offshore), while shorebirds spend more of their time (nesting, feeding and breeding) on the shoreline and do not swim. Migratory and resident shorebirds would not be expected to be routinely found within the marine waters of the Light EMBA but are expected to fly over the area. Shorebirds (and shorebird important habitats) are more likely to be encountered along shorelines and coastal wetlands (e.g. intertidal mudflats / sandflats, shallower areas of seagrass, sheltered coasts, estuaries, mangrove swamps, bays, harbours and lagoons). These habitats do not occur within the Light EMBA. As such international conventions that aim to protect shorebird species and/or their habitat do not intersect Light EMBA and are therefore not addressed in this section.

Refer to respective bird receptor grouping sections for detail specific to likely temporal presence and absence of birds identified in the Light EMBA.

Values and Sensitivities

Table 4-41 describes the values and sensitivities for birds within the Light EMBA.

Bird species identified via PMST or Conservation Values Atlas tools have been identified as a major conservation value in the South-East Regional Plan. These values are discussed further in Appendix H. In general, birds have been identified as a major conservation value of Zeehan AMP, Apollo AMP and West Tasmania Canyons KEF.

Zeehan AMP and Birds

The Light EMBA overlaps the Multiple Use Zone (IUCN VI) of the Zeehan AMP and adjoins the Special Purpose Zone (IUCN VI) (Figure 4-13). The major conservation values for the Zeehan AMP relevant to this assessment are (DNP, 2013):

- An important foraging area for Black-Browed, Wandering and Shy Albatrosses, and Great-winged and Cape Petrels.

Of these five bird species, the PMST search identified that foraging, feeding or related behaviour is likely to occur within the Light EMBA for the Black-Browed, Wandering and Shy Albatrosses. The two petrel species were not identified within the Light EMBA.

Additional description of Zeehan AMP can be found in Appendix H.

Apollo AMP and Birds

The Light EMBA overlaps the Apollo AMP (66% area overlap; Figure 4-13). Seabirds are known to forage in this reserve (DNP, 2013). The major conservation values for the AMP relevant to this assessment are (DNP, 2013):

- An important foraging area for Black-browed and Shy albatross, Australasian Gannet, Short-tailed Shearwater and Crested Tern.

Of these five bird species, the PMST search identified that foraging, feeding or related behaviour are likely to occur within the Light EMBA for the Black-Browed and Shy Albatrosses; and foraging, feeding or related behaviour is known to occur within the Light EMBA for the Short-tailed Shearwater. The other two species were not identified within the Light EMBA, based on PMST results or Conservation Values Atlas database. Additional description of Apollo AMP can be found in Appendix H.

West Tasmania Canyons and Birds

The West Tasmania Canyons KEF intersects the Light EMBA (8.44% area overlap; Figure 4-13].

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 (DAWE, 2020b). Based upon this enhanced productivity, the West Tasmanian canyon system includes known foraging seabirds (albatross and petrels). Additional description of West Tasmania Canyons KEF can be found in Appendix H.

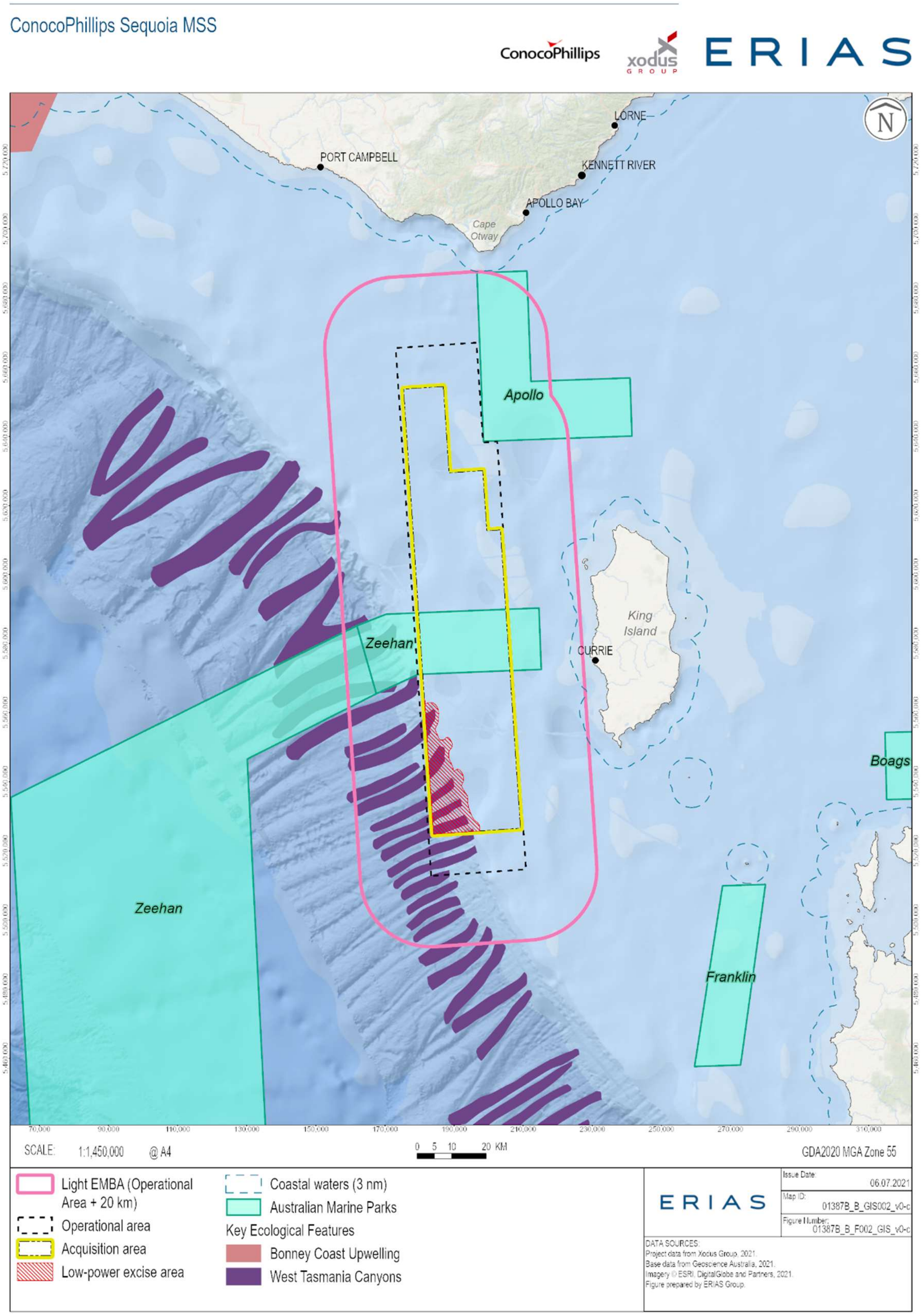


Figure 4-13: Light EMBA overlap with AMPs and KEFs relevant to birds

Table 4-41: EPBC listed bird species that may occur within the light EMBA and protection status

Scientific Name	Common Name	Type of presence and behaviour		Biologically important area/habitat critical to the survival of the species	EPBC Status/ Protection Level			
		Operational Area	Light EMBA	BIA	Threatened Species*	Migratory Species*	Listed Marine species	EPBC Management Plan
Migratory Seabirds								
Ardenna carneipes	Flesh-footed Shearwater, Fleshy-footed Shearwater	FLO	FLO	-	-	✓	✓ (Listed as *Puffinus carneipes*)	-
Ardenna grisea	Sooty Shearwater	MO	MO	-	-	✓	✓ (Listed as *Puffinus griseus*)	-
Diomedea antipodensis	Antipodean Albatross	FLO	FLO	FKO	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Diomedea epomophora	Southern Royal Albatross	FLO	FLO	-	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Diomedea exulans	Wandering Albatross[1]	FLO	FLO	FKO	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Diomedea sanfordi	Northern Royal Albatross	FO	FLO	-	E	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Macronectes giganteus	Southern Giant-Petrel, Southern Giant Petrel	FLO	FLO	-	E	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Macronectes halli	Northern Giant Petrel	MO	HMO	-	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels

Scientific Name	Common Name	Type of presence and behaviour		Biologically important area/habitat critical to the survival of the species	EPBC Status/ Protection Level			
		Operational Area	Light EMBA	BIA	Threatened Species*	Migratory Species*	Listed Marine species	EPBC Management Plan
Phoebetria fusca	Sooty Albatross	LO	LO	-	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche bulleri	Buller's Albatross Pacific Albatross	FLO	FLO	FKO	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche cauta	Shy Albatross[1,2]	FLO	FLO	FLO	E	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche chrysostoma	Grey-headed Albatross	MO	MO	-	E	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche impavida	Campbell Albatross, Campbell Black-browed Albatross	FLO	FLO	FKO	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche melanophris	Black-browed Albatross[1,2]	FLO	FLO	FKO	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche salvini	Salvin's Albatross	FLO	FLO	-	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Thalassarche steadi	White-capped Albatross	FLO	FLO	-	V	✓	✓	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Resident Seabirds								
Fregetta grallaria grallaria	White-bellied Storm-Petrel (Tasman Sea), White-bellied	LO	LO	-	V	-	-	-

Scientific Name	Common Name	Type of presence and behaviour		Biologically important area/habitat critical to the survival of the species	EPBC Status/ Protection Level			
		Operational Area	Light EMBA	BIA	Threatened Species*	Migratory Species*	Listed Marine species	EPBC Management Plan
	Storm-Petrel (Australasian)							
Halobaena caerulea	Blue Petrel	MO	MO	-	V	-	✓	-
Ardenna pacifica	Wedge-tailed Shearwater	-	-	FLO (August – May)	-	-	-	-
Ardenna tenuirostris	Short-tailed Shearwater[2]	-	-	FKO (September – May)	-	-	-	-
Pachyptila turtur	Fairy Prion	MO	MO	-	-	-	✓	-
Pachyptila turtur subantarctica	Fairy Prion (southern)	MO	MO	-	V	-	-	Conservation Advice *Pachyptila turtur subantarctica* Fairy Prion (southern)
Pelagodroma marina	White-faced Storm-petrel	-	-	FKO	-	-	-	-
Pelecanoides urinatrix	Common Diving-petrel	-	-	FKO (year-round)	-	-	-	-
Pterodroma leucoptera leucoptera	Gould's Petrel, Australian Gould's Petrel	MO	MO	-	E	-	-	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan
Pterodroma mollis	Soft-plumaged Petrel	MO	MO	-	V	-	✓	Conservation Advice *Pterodroma Mollis* Soft-plumaged Petrel
Stercorarius skua	Great Skua	MO	MO	-	-	-	✓ (Listed as Catharacta skua)	-

Scientific Name	Common Name	Type of presence and behaviour		Biologically important area/habitat critical to the survival of the species	EPBC Status/ Protection Level			
		Operational Area	Light EMBA	BIA	Threatened Species*	Migratory Species*	Listed Marine species	EPBC Management Plan
Sternula nereis nereis	Australian Fairy Tern	FLO	FLO	-	V	-	-	Conservation Advice for *Sternula nereis nereis* (Fairy Tern)
Thalassarche bulleri platei	Northern Buller's Albatross, Pacific Albatross	FLO	FLO	-	V	-	✓ (Listed as Thalassarche sp. nov.)	-
Thalassarche chlororhynchos bassi	Indian Yellow-nosed Albatross	-	-	FKO	-	-	-	National Recovery Plan for Threatened Albatrosses and Giant Petrels
Migratory Shorebirds								
Actitis hypoleucos	Common Sandpiper	MO	MO	-	-	✓	✓	-
Calidris acuminata	Sharp-tailed Sandpiper	MO	MO	-	-	✓	✓	-
Calidris canutus	Red Knot	MO	MO	-	E	✓	✓ Overfly marine area	Conservation Advice *Calidris canutus* Red Knot
Calidris ferruginea	Curlew Sandpiper	MO	MO	-	CE	✓	✓ Overfly marine area	Conservation Advice *Calidris ferruginea* Curlew Sandpiper
Calidris melanotos	Pectoral Sandpiper	MO	MO	-	-	✓	✓ Overfly marine area	-
Numenius madagascariensis	Eastern Curlew, Far Eastern Curlew	MO	MO	-	CE	✓	✓	Conservation Advice *Numenius madagascariensis* Eastern Curlew

Scientific Name	Common Name	Type of presence and behaviour		Biologically important area/habitat critical to the survival of the species	EPBC Status/ Protection Level			
		Operational Area	Light EMBA	BIA	Threatened Species*	Migratory Species*	Listed Marine species	EPBC Management Plan
Thinornis cucullatus cucullatus	Hooded Plover (eastern), Eastern Hooded Plover	MO	MO	-	V	-	✓ Overfly marine area (Listed as *Thinornis rubricollis rubricollis*)	Conservation Advice *Thinornis rubricollis rubricollis* Hooded Plover (Eastern)
Other Marine Listed Birds								
Neophema chrysogaster	Orange-bellied Parrot	LO	LO	-	CE	-	✓	National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster*
Eudyptula minor	Little Penguin#	-	-	FKO	-	-	✓	-

Type of Presence:

- *MO* *Species of species habitat may occur within area*
- *LO* *Species or species habitat likely to occur within area*
- *KO* *Species or species habitat known to occur within area*
- *FMO* *Foraging, feeding or related behaviour may occur within area*
- *FLO* *Foraging, feeding or related behaviour likely to occur within area*
- *FKO* *Foraging, feeding or related behaviour known to occur within area*
- *BLO* *Breeding likely to occur within area*
- *BKO* *Breeding known to occur within area*
- *RMO* *Roosting may occur within area*
- *RLO* *Roosting likely to occur within area*
- *RKO* *Roosting known to occur within area*

Threatened Species:

- *V* *Vulnerable*
- *E* *Endangered*
- *CE* *Critically Endangered*

*✓= Listed Migratory/Marine species; *= Matter of National Environmental Significance; # Little Penguin was not identified in PMST as present, but has a foraging BIA*

Source: PMST (Appendix J) and Conservation Values Atlas Tool as of April 2021

4.4.1.5. Legislative Requirements

Table 4-42 identifies legislative and other requirements that are relevant to the petroleum activity and birds. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-42: Other Requirements for Birds

<table>
<tr><th>Type</th><th>Requirement</th><th>Relevant Item/Objective/Action</th><th>Addressed/Managed by Sequoia MSS</th></tr>
<tr><td>Legislation</td><td>Commonwealth Navigation Act 2012 and the various Marine Orders (as appropriate to vessel class) enacted under this Act</td><td>Regulates navigation and shipping including Safety of Life at Sea (SOLAS), including specific requirements for navigational lighting. Although the Act does not apply to the operation of petroleum facilities, it may apply to some support vessels.</td><td rowspan="5">Environmental impact assessment for light emissions on birds has been completed in Section 1.2.
Adoption of control measures (refer to Environmental Performance section in Appendix A).</td></tr>
<tr><td>Legislation</td><td>Facility Safety Cases, required by OPGGS Act 2006</td><td>A safety case is a document produced by the operator of a facility, and assessed by NOPSEMA, which:
Identifies the hazards and risks
Describes how the risks are controlled
Describes the safety management system in place to ensure the controls are effectively and consistently applied.</td></tr>
<tr><td>Guidelines</td><td>National Light Pollution Guidelines (CoA 2020)</td><td>The aim of the Guidelines is that artificial light will be managed so wildlife is:
Not disrupted within, nor displaced from, important habitat
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.</td></tr>
<tr><td>Guidelines</td><td>EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance</td><td>This Significant impact guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law.</td></tr>
<tr><td>Guidelines</td><td>EPBC Act Policy Statement 3.21 - Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed</td><td>This policy statement is intended to provide a guide for stakeholders in assessing the likelihood of a proposed action having a significant impact on one or more migratory shorebird species in Australia.</td></tr>
</table>

	migratory shorebird species (DoEE, 2017)		
EPBC Management Plans	National Recovery Plan for the Orange-bellied Parrot, *Neophema chrysogaster* (DELWP, 2016)	This recovery plan outlines the long-term strategy, and short-term objectives and actions, for the recovery of the Orange-bellied Parrot.	
EPBC Management Plans	National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC, 2011)	Covered in this recovery plan are 21 species, including 19 albatross species and two giant petrel species, categorised as Breeding species and Foraging species. It sets out relevant information on the biology and ecology of Australia's albatrosses and giant petrels, identifies issues and threats to these species, and also appropriate management strategies. With overall objective being to ensure the long-term survival and recovery of albatross and giant petrel populations breeding and foraging in Australian jurisdiction by reducing or eliminating human related threats at sea and on land.	
EPBC Management Plans	South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013)	The Plan outlines the management strategies for research and monitoring, assessment and permitting, compliance, community participation, Indigenous involvement and environmental management. The Plan identifies light pollution associated with offshore mining operations and other offshore activities as a threat to the AMP network.	
EPBC Management Plans	Wildlife Conservation Plan for Migratory Shorebirds (DoE, 2015g)	This plan outlines national activities to support migratory shorebird conservation initiatives and provides a strategic framework to ensure these activities plus future research and management actions are integrated and remain focused on the long-term survival of migratory shorebird populations and their habitats. The Plan outlines the statutory elements as legislated by the EPBC Act by addressing topics relevant to the conservation of migratory shorebirds, including a summary of Australia's commitments under international conventions and agreements, and identification of important habitat.	
EPBC Management Plans	Other Recovery Plans for listed threatened species: • Gould's Petrel	Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community.	
EPBC Management Plans	Other Conservation Advices for listed threatened species: • Fairy Prion southern • Australian Fairy Tern • Soft-plumaged Petrel	Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a newly listed species or ecological community.	

EPBC Management Plans	Recovery Plans / Conservation Advices for other listed threatened and/or migratory MNES species	Recovery Plans / Conservation Advices for other bird species that may occur in the relevant EMBAs do not identify underwater sound as a key threat; or have any explicit relevant objectives or management actions.	

4.4.2. Impact Assessment

4.4.2.1. Existing Environment

Values

Migratory and Resident Seabirds

The Light EMBA spatially overlaps the following BIAs for albatross and petrel species (Figure 4-15, Figure 4-16, Figure 4-17):

- Albatross (foraging BIAs) - Wandering Albatross (1.03% area overlap) ; Antipodean Albatross (0.34% area overlap); Shy Albatross (1.05% area overlap); Buller's Albatross (1.81% area overlap); Campbell Albatross (0.74% area overlap); Black-Browed Albatross (0.74% area overlap) and Indian Yellow-nosed Albatross (0.72% area overlap).
- Petrels (foraging BIAs) - Common Diving Petrel (2.86% area overlap) and White-faced Storm Petrel (0.37% area overlap).

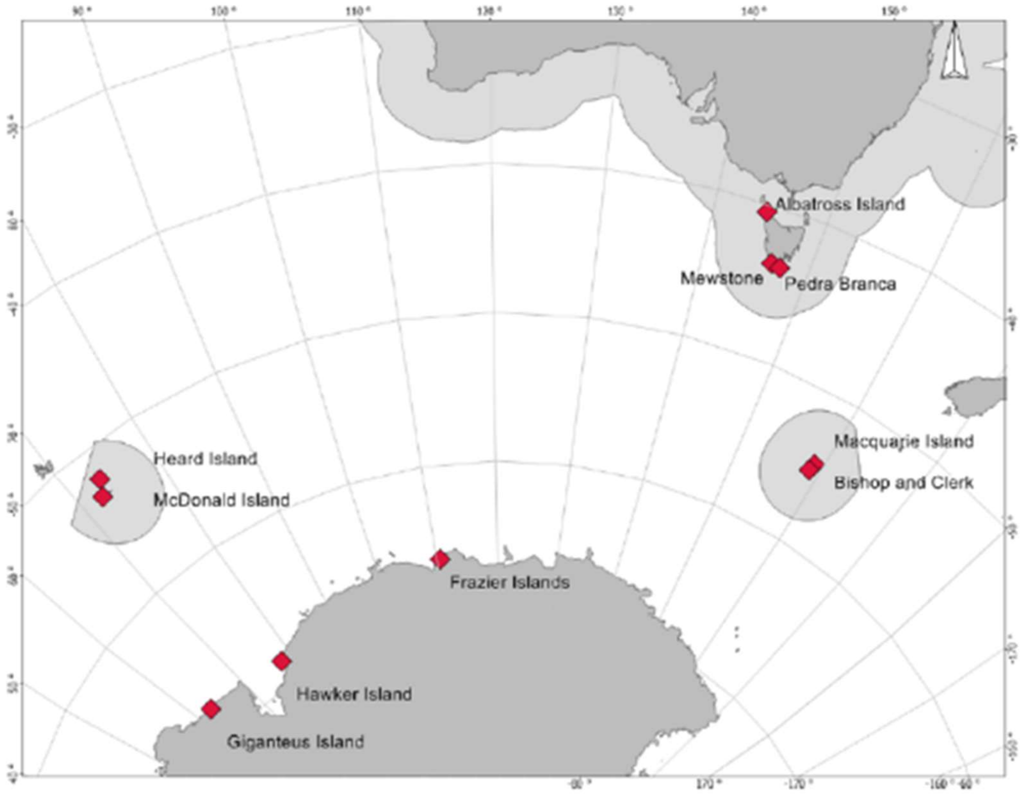
Albatrosses and Giant-petrels are among the most oceanic of all seabirds, and seldom come to land unless breeding (DSEWPAC, 2011b). Many species, such as Antipodean Albatross, are extremely dispersive, spending most of their time over the pelagic waters of the oceans, while others like adult Shy Albatrosses, tend to remain sedentary, regularly foraging over coastal waters throughout their adult lives (DSEWPAC, 2011b). Albatross and Giant 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 (DSEWPAC, 2011b). Albatross and petrels are likely to overfly and forage within the Light EMBA during the petroleum activity.

The albatross species 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, 2012). 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 (DSEWPAC 2011b). Of the species listed, the Wandering Albatross, Black-browed Albatross, Grey-headed Albatross and Shy Albatross breed in Australian jurisdictions (DSEWPAC, 2011b). The remaining species forage in Australian waters.

No breeding colonies or nesting areas for listed albatross species are located within, or adjacent to, the Light EMBA. The closest breeding island to the Light EMBA is Albatross Island (Tas) [Shy Albatross] (70 km east of the Light EMBA); and Macquarie Island [Black-browed Albatross, Grey-headed Albatross and Wandering Albatross] (1,920 km southeast of the Light EMBA) (outside the EMBA) (ACAP, 2012; DSEWPAC, 2011b) (Figure 4-14).

The petrel species listed in Table 4-41 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 (DSEWPAC, 2011b). No breeding colonies or nesting areas for listed petrel species are located within or adjacent to the Light EMBA. The closest breeding islands to the Light EMBA, are Maatsukyer Island (Tas) [Soft Plumaged Petrel] (400 km southeast of the Light EMBA) and Macquarie Island [Blue Petrel, Northern and Southern giant Petrels] (1,920 km southeast of the Light EMBA) (ACAP, 2012; DSEWPAC, 2011b) (Figure 4-14).

Refer to the Temporal Presence and Absence section in Appendix A for the illustration of the likely temporal presence and absence of albatross and petrels identified within the Light EMBA.



Source: DSEWPAC (2011b)

Figure 4-14: Location of Albatross and Giant Petrel breeding colonies within Australian jurisdiction

The **Antipodean Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). It is a sub-species of the Wandering Albatross. It breeds on islands in the New Zealand subantarctic with egg-laying during the austral summer and fledging from December to March (ACAP, 2011). The species forages in all areas of the South-east Marine Region, excluding Bass Strait, and feeds primarily on cephalopods, fish and crustaceans (BirdLife International 2009; Gales, 1998). The South-east Marine Region, excluding Bass Strait, is recognised as a BIA for foraging for the species (overlaps Light EMBA) (Figure 4-15).

The **Black-browed Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). It has a circumpolar distribution and is found over Antarctic, subantarctic and sub-tropical waters (DoE, 2015b). Breeding populations occurs on Macquarie Island, adjacent Bishop and Clerk Islets, as well as locations outside the South East region occur at Heard Island and McDonald Islands (Australian external territory) (Figure 4-17). Black-browed Albatross breed annually, with the breeding season beginning in September and fledging in

April to May. In southern Australia, Black-browed Albatrosses mainly forage along the southern coasts from Perth to Sydney (Marchant and Higgins, 1990; Reid et al., 2002). The majority of Black-browed Albatrosses seen in south-eastern Australian waters between October and January are immature birds (Reid et al. 2002), probably coming from Indian Ocean and Southern Georgian breeding colonies. Sub-adults are observed in Australian waters all year round. The entire South-east Marine Region is recognised as a BIA for foraging for the species (overlaps Light EMBA) (Figure 4-17).

Buller's Albatross (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). This species is a breeding endemic to New Zealand but forages across the South Pacific, in general, adults forage between 40–50°S from Tasmania eastwards to the Chatham Rise (NZ), while juveniles and non-breeding adults disperse across the South Pacific Ocean to the coast of South America (BirdLife International, 2004; DSEWPaC, 2011a). This species is mainly present around Tasmania from January to July (Stahl et al., 1998). Satellite tracking studies of this species from the Snares and Solander Islands (NZ) (Sagar and Weimerskirch, 1996; Stahl and Sagar, 2006) have shown that during much of the breeding season birds forage in New Zealand waters. However, both breeding adults and juveniles and non-breeding adults also forage around Tasmania. An important foraging area is recognised for the species in the South-east Marine Region, from south of latitude 38° S and north of latitude 45° S and bounded to the west at longitude 140° E. This area is recognised as a BIA for the species (overlaps Light EMBA) (Figure 4-16).

The **Campbell Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is a sub-species of Black-browed Albatross and is recognised as a conservation value in the temperate east (DoE, 2015b). The Campbell Albatross is endemic to Campbell Island (New Zealand subantarctic) and breeds annually from early August to May (ACAP, 2011). Juveniles appear to migrate north and disperse through the subtropics in winter, including along the eastern coast of Australia (ACAP, 2011). During winter, adults are found widely dispersed around the Tasman Sea and the south-western Pacific Ocean east of New Zealand, whereas in summer the distribution of both breeding and non-breeding birds is more restricted and southerly (32° S to 44° S) (Waugh et al. 1999). The Campbell Albatross feeds on krill and fish, with some cephalopods, salps and jellyfish. The entire South-east Marine Region is recognised as a BIA for foraging for the species (overlaps Light EMBA) (Figure 4-17).

The **Indian Yellow-nosed Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). It breeds on the French subantarctic islands and on South Africa's Prince Edward Islands (ACAP,2011). Eggs are laid in September to October with fledging in March to April (ACAP 2009). At-sea records indicate that, for the non-breeding range, birds disperse from their breeding islands and commonly occur off southern Africa and Australia (ACAP 2009). Recent satellite tracking data shows that, during the winter months this species occurs throughout the South-east Marine Region as far south as latitude 45º S (Delord and Weimerskirch, 2011) during winter months. This is recognised as a BIA for foraging for the species (overlaps Light EMBA) (Figure 4-17).

The **Shy Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). It is the only endemic Australian albatross species, and breeds on Albatross Island, Bass Strait, and the Mewstone and Pedra Branca (Figure 4-14), off southern Tasmania in the Tasmanian Wilderness World Heritage Area (Gales, 1998; Alderman et al. 2010). They breed annually, laying eggs in September and fledging chicks in April (Gales, 1998). The Shy Albatross ranges across Australian coastal waters below 25° S and is most commonly observed over the shelf waters around Tasmania and south eastern Australia (DAWE, 2021). Bird band recoveries, satellite tracking and genetic show that although most frequently found around Tasmania and southern Australia, its range extends to southern Africa (Brothers et al., 1998; Hedd et al., 1997; Abbott et al., 2006; Alderman et al., 2010). Breeding locations (Albatross Island, Bass Strait, Mewstone and Pedra Branca) are recognised as BIA, as is a substantial foraging area around Albatross Island (70 km east of the Light EMBA) (Figure 4-15). Noting that Albatross Island, The MewStone, Pedra Branca are listed as Habitat Critical for Shy Albatross, whereby Albatross Island is closest to the Light EMBA at closest point (Figure 4-16).

The **Wandering Albatross** (EPBC Act: Vulnerable, Migratory, Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). It breeds on six sub Antarctic island groups (DELWP, 2011; Marchant and Higgins, 1990; ACAP, 2011). The Wandering Albatross breeds biennially, laying eggs in December and fledging chicks between mid-November and late February. In Australian waters, a very small population breeds on Macquarie Island (1,920 km southeast of the Light EMBA) (Terauds et al, 2006; DAWE, 2021; ACAP, 2011). Limited satellite tracking of Wandering Albatross from Macquarie Island shows that breeding females forage north of the Island in waters off southern Tasmania, while males forage in open waters of the Southern Ocean, south of 50° S, reflecting a spatial segregation seen in other populations of this species. Juveniles are concentrated in lower latitudes north and east of Macquarie Island in Pacific waters, off the south east coast of Australia and in New Zealand waters. Wandering Albatross feed in the Southern Ocean (Nicholls et al., 1997) mainly on squid and fish but also crustaceans and carrion (Marchant and Higgins 1990). Foraging trips by breeding Wandering Albatross have exceeded 15,200 km between incubation bouts (Jouventin and Weimerskirch, 1990). Southern Australia is an important wintering ground for non-breeding and juvenile birds from the Atlantic and Indian Ocean breeding colonies. Non-breeding and juvenile birds remain north of 50° S. During the non-breeding season, birds disperse more widely with females generally foraging in more northerly latitudes of the southern hemisphere and males generally foraging further south (Baker and Hamilton, 2013). The entire South-east Marine Region north of 50° S is recognised as a BIA for foraging for the species (overlaps Light EMBA) (Figure 4-15). Noting that Macquarie Island is listed as Habitat Critical for Wandering Albatross (Figure 4-15).

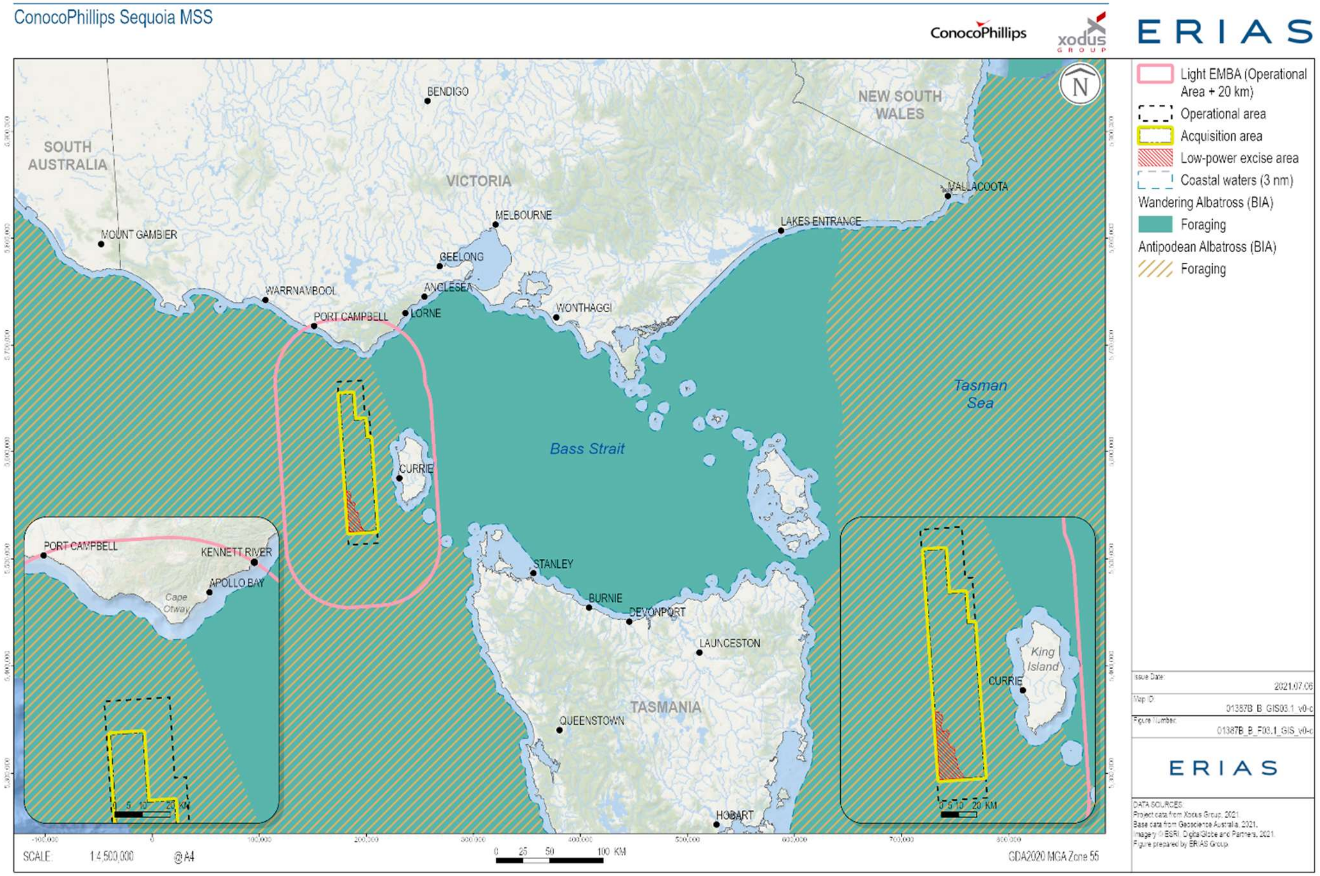


Figure 4-15: Wandering and Antipodean Albatross foraging BIAs

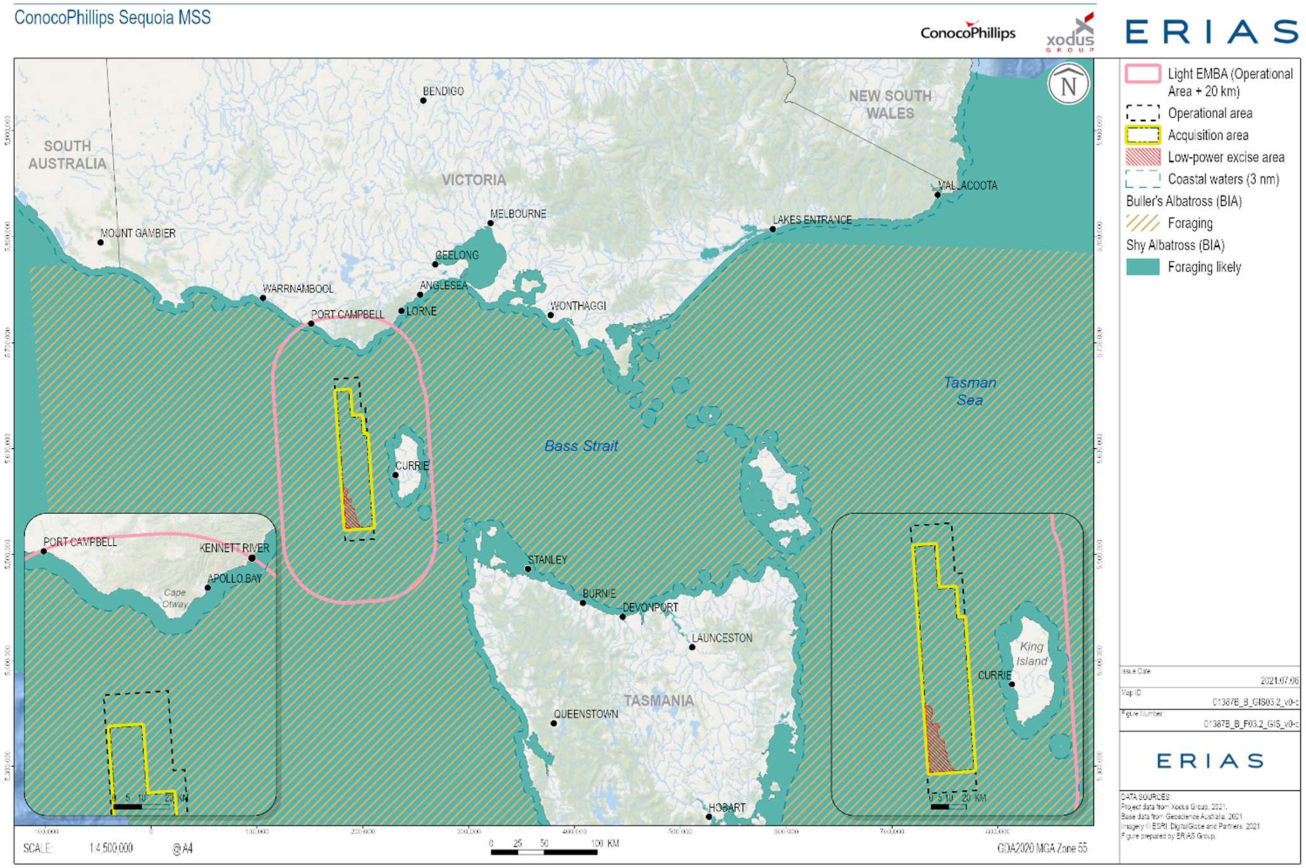


Figure 4-16: Buller's and Shy Albatross foraging BIAs

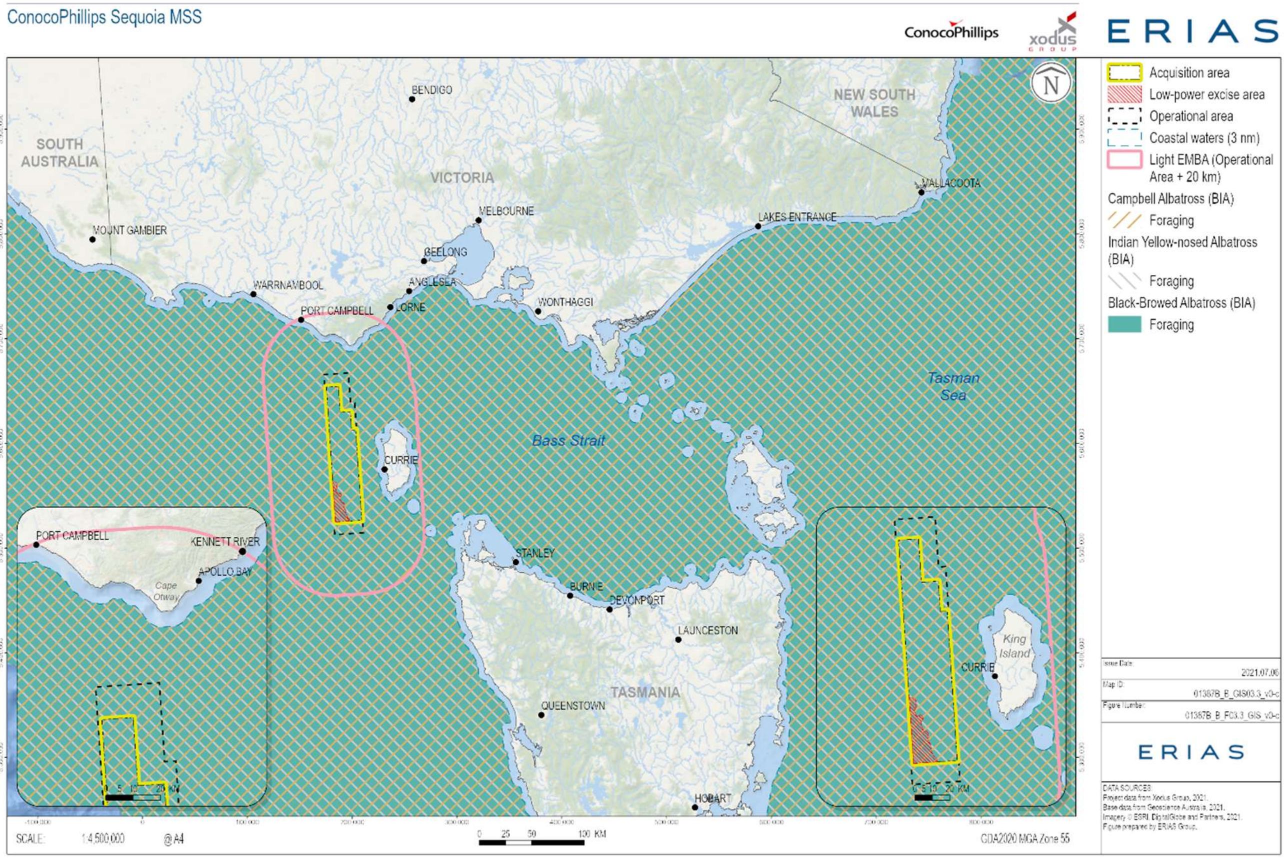


Figure 4-17: Campbell, Indian Yellow-nosed and Black-browed Albatross foraging BIAs

Common Diving Petrels (EPBC Act: Marine) are recognised as a conservation value in the temperate east (DoE, 2015b). They have been recorded from waters ranging from the subtropics to the subantarctic, usually between 35 to 55° S (DoE, 2015b). They are widely distributed over southern Australian and New Zealand waters. The estimated size of the Australian population is thought to exist mainly located in Victoria and Tasmania and make up approximately 5 per cent of the global population (Baker et al., 2002). The species breeds only on islands of south-east Australia, Tasmania, New Zealand and Cook Strait. The subspecies P. u. exsul breeds on Macquarie Island and Heard Island (Garnett et al., 2011) and over 5,000 km from Light EMBA. There are 30 sites with significant breeding colonies (more than 1,000 breeding pairs) known from Tasmania (DoE, 2015b). There are 12 known breeding sites in Victoria, including Seal Island, Notch Island, Cliffy Island, Rag Island, Citadel Island, Dannevig Island, McHugh Island, Wilson's Promontory, Wattle Island, Kanowna Island, Lady Julia Percy Island and Lawrence Rocks (Marchant and Higgins, 1990), though the current status of some of these colonies is uncertain (DoE, 2015b). These breeding sites are recognised as BIA for the species – which are outside of the Light EMBA, however a foraging BIA overlaps Light EMBA (Figure 4-18).

The **White-faced Storm Petrel** (EPBC Act: Marine) is recognised as a conservation value in the temperate east (DoE, 2015b). The Australian population estimate for this species is estimated to be about 25 per cent of the global population (DSEWPAC, 2011b). This species is migratory, moving from temperate breeding sites to tropical and subtropical waters in the non-breeding season. In Australia, the species returns to colonies in late September to early October, with egg laying beginning in early summer and fledging occurring mid-February to mid-March. This species is known to feed on pelagic crustaceans, small fish and other surface plankton (Marchant and Higgins, 1990). There are 15 sites with significant breeding colonies (more than 1,000 breeding pairs) in Tasmania and three sites with significant breeding colonies in Port Phillip Bay in Victoria: Tullaberga Island, Mud Island and South Channel Island (Marchant and Higgins 1990; Menkhorst et al. 1984; Menkhorst 2010). These breeding and foraging areas are recognised as BIA (breeding BIA outside of Light EMBA however overlaps with Foraging BIA) (Figure 4-18).

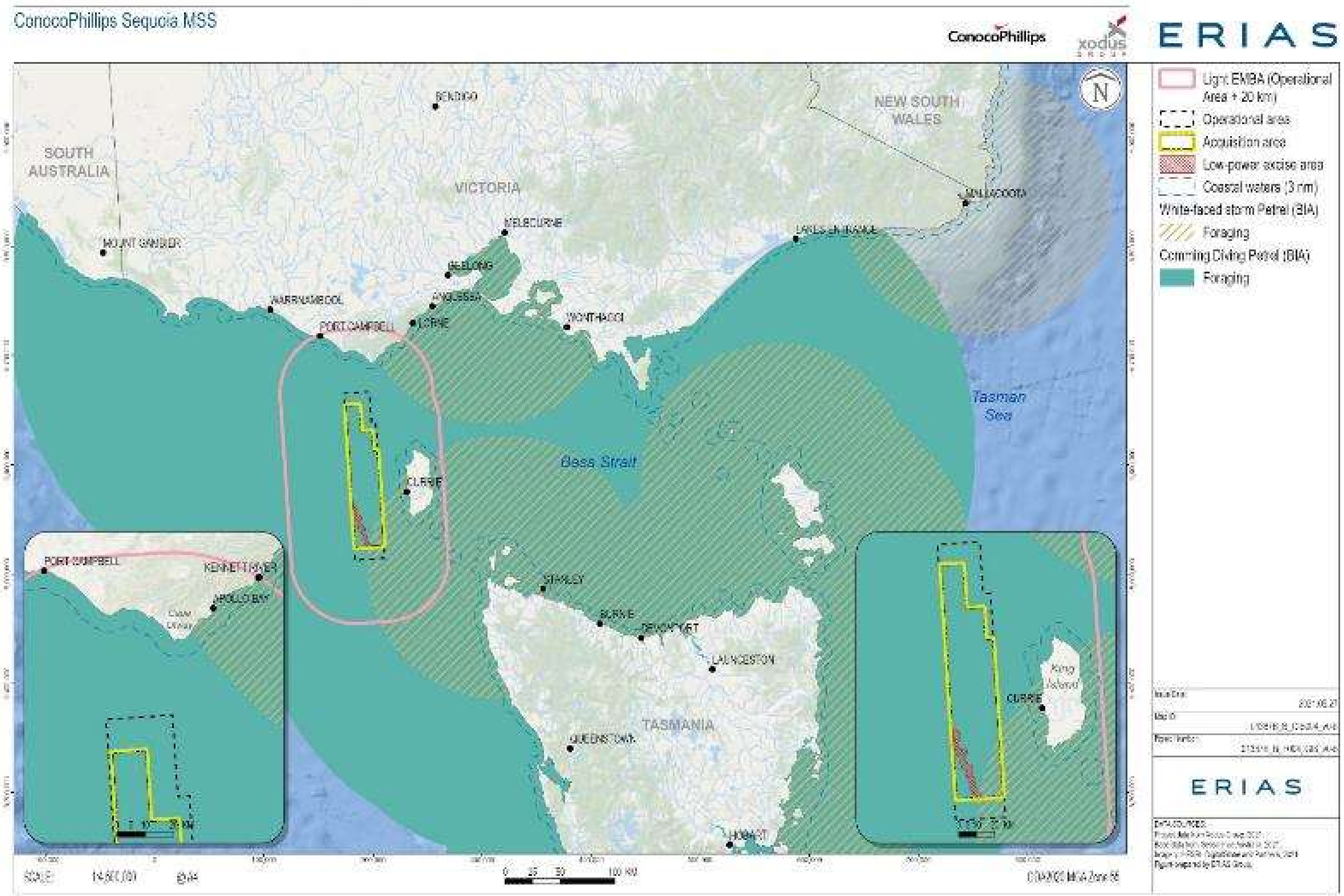


Figure 4-18: Petrel foraging BIAs

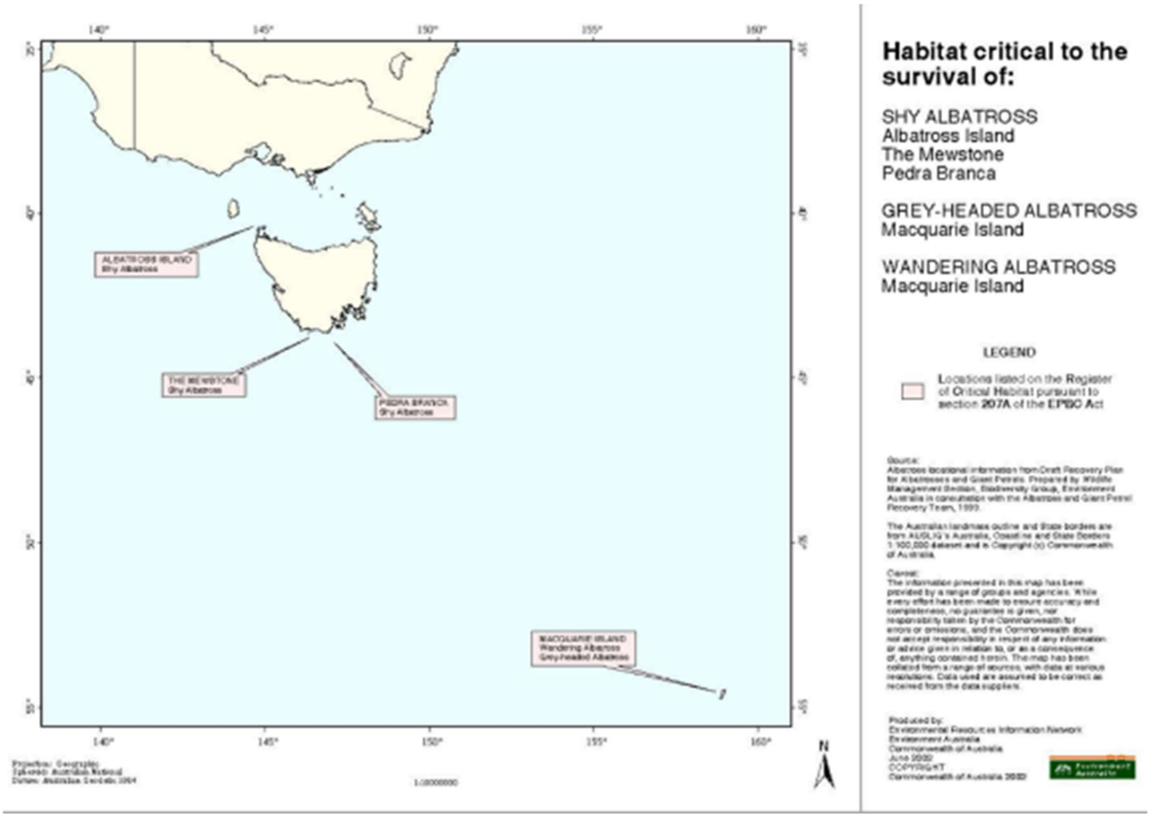


Figure 4-19: Habitat critical to the survival of Shy Albatross, Wandering Albatross and Grey-headed Albatross

Shearwaters

Four species of Shearwater (Flesh-footed Shearwater, Short-tailed Shearwater, Sooty Shearwater, Wedge-tailed Shearwater) may occur within the Light EMBA. None of these species is identified as an EPBC threatened species. However, the Light EMBA spatially overlaps the following BIAs for shearwaters (Figure 4-20):

- Wedge-tailed Shearwater (Foraging BIA) (1.21% overlap with Light EMBA)
- Short-tailed Shearwater (Foraging BIA) (4.27% overlap with Light EMBA)

The **Flesh-footed Shearwater** (*Ardenna carneipes*) [EPBC Act: Marine, Migratory] is a trans-equatorial migrant widely distributed across the south-western Pacific during breeding season (early September to early May) and is a common visitor to the waters of the continental shelf/slope and occasionally inshore waters. The species breeds in burrows on sloping ground in coastal forest, scrubland, shrubland or grassland, the majority of which lie off the coast of southern Western Australia, with the remaining being Smith Island (SA) and Lord Howe Island. The flesh-footed Shearwater feeds on small fish, cephalopod molluscs (squid, cuttlefish, nautilus and argonauts), crustaceans (barnacles and shrimp), other soft-bodied invertebrates (such as Velella) and offal. The species forages almost entirely at sea and very rarely on land. It obtains most of its food by surface plunging or pursuit plunging. It also regularly forages by settling on the surface of the ocean and snatching prey from the surface ('surface seizing'), momentarily submerging onto prey beneath the surface ('surface diving') or diving and pursuing prey beneath the surface by swimming ('pursuit diving'). Birds have also been observed flying low over the ocean and pattering the water with their feet while picking food items from the surface (termed 'pattering') (DotEE, 2014).

The **Short-tailed Shearwater** (*Ardenna tenuirostris*) although not identified via PMST, has foraging BIAs (September to May) within the Light EMBA and is recognised as a conservation value in the temperate east (DoE, 2015b). 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). Feeding occurs in flocks of up to 20,000 birds, and it has been seen associated with cetaceans.

Sooty Shearwaters (*Ardenna grisea*) [EPBC Act: Marine, Migratory] is recognised as a conservation value in the temperate east (DoE, 2015b). It nests on islands and headlands in large colonies. Burrows are dug for breeding under tussock grass and low scrub. Birds typically do not return to their natal colonies until age four. They feed on fish, crustacea and cephalopods, caught while diving. Short (1–3 days) and long (5–15 days) provisioning trips are made by parents; longer trips allow foraging along the Antarctic Polar Front, reducing competition close to breeding grounds and allowing vast colonies to persist (Birdlife, 2013). The Australian total population is now estimated to be less than 1000 pairs (Garnett et al. 2011). Breeding populations are known on Tasman Island, Hippolyte Rock, Maatsuyker Island and Courts Island. These and associated substantial foraging areas are recognised as biologically important areas for the species. Sooty Shearwaters are listed as migratory and marine under the EPBC Act.

The **Wedge-tailed Shearwater** (*Ardenna pacifica*) although not identified via PMST, has a foraging BIA (August to May) within the Light EMBA. This BIA is associated with mainland breeding locations and represents a 160 km buffer around each breeding area. 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 non-breeding season in the tropics (DotE, 2021). 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 (DotE, 2021). Food is taken by contact-dipping, dipping, surface-seizing and, rarely, deep-plunging up to 2 m deep (DotE, 2021).

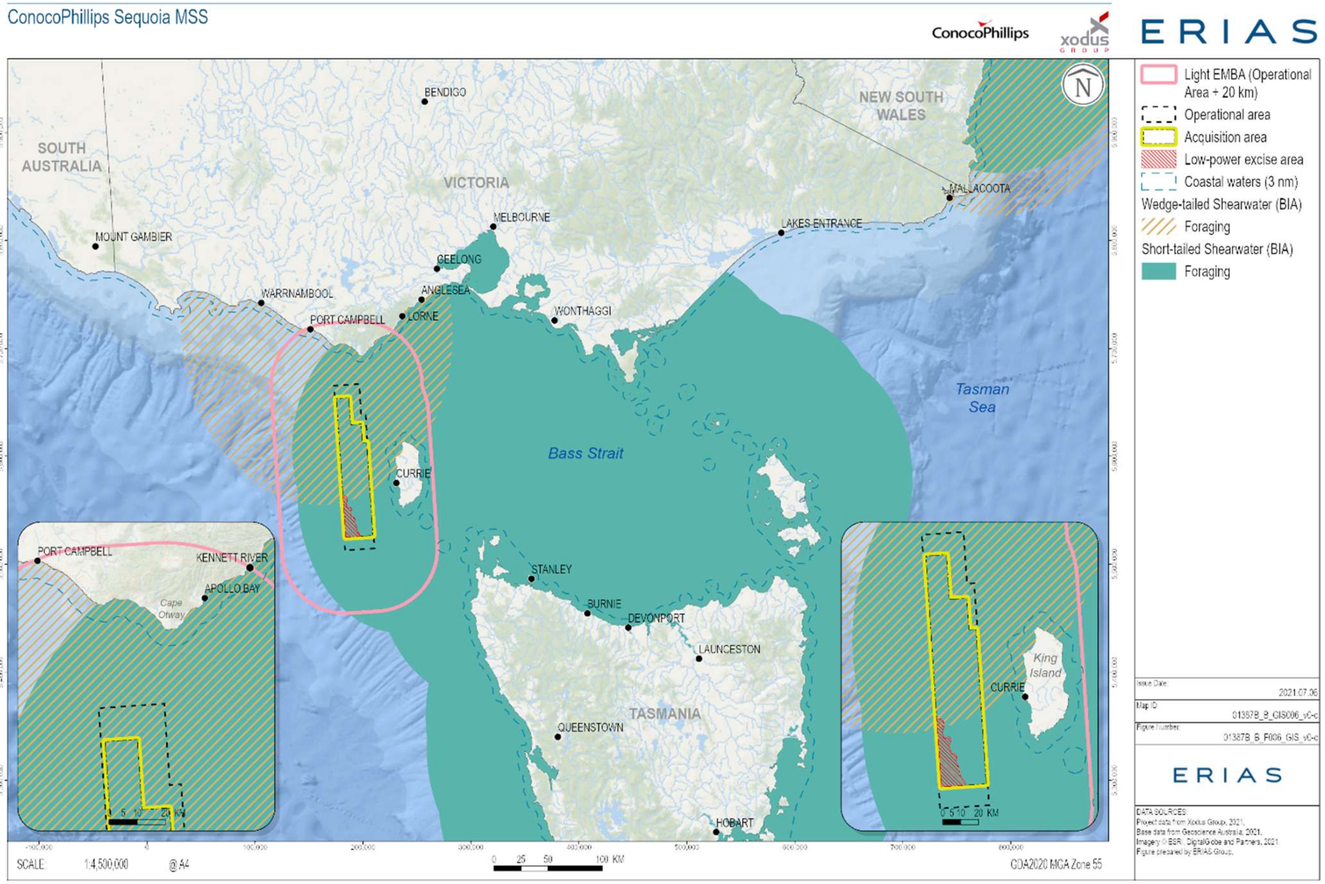


Figure 4-20: Wedge-tailed Shearwater and Short-tailed Shearwater BIAs

Other Marine Listed Birds

The **Orange-bellied Parrot** (EPBC Act: Critically Endangered, Marine) is a ground feeding parrot which breeds in south-west Tasmania in summer and overwinters on the coast of south-east mainland Australia (DELWP, 2016). Birds arrive in Tasmania's south west in early October and depart after the breeding season usually in March and April (TSS,2021). After breeding, migrating birds move northwards up the west coast of Tasmania via King Island to the mainland during autumn (Holdsworth, 2006) (Figure 4-21). The southward migration tends to be rapid (Stephenson, 1991), while northward migration in autumn across western Bass Strait is more prolonged (Higgins, 1999).

In Victoria, the Orange-bellied Parrot mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries, or, rarely, saltworks. Given its habitat preferences, this species is not expected to occur within the Light EMBA, other than overflying it during migrations (Figure 4-21). The parrot's breeding habitat is restricted to southwest Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast (Brown and Wilson, 1980). During winter, on mainland Australia, Orange-bellied Parrots are found mostly within 3 km of the coast (DELWP, 2016). There is no identified BIA for this species that intersects with the Light EMBA.

Refer to the Temporal Presence and Absence section in Appendix A for the illustration of the likely temporal presence and absence of albatross and petrels identified within the Light EMBA.

The **Little Penguin** has a coastal waters habitat and can spend weeks away at sea, dozing and eating fish, squid, krill and small crustaceans among the waves (Carter, 2020). The species did not appear in the PMST report; however, a foraging BIA (representing a 10 km foraging around known aggregation site) overlapping the Light EMBA was identified around New Year and Christmas Islands, as well as parts of King Island and Tasmania (NCVA, 2021). Little Penguins occur along the southern edge of mainland Australia, as well as Tasmania, New Zealand and the Chatham Islands (BLA, 2021). Although the population is considered stable in Australia, one colony in Manly, NSW is protected as an endangered population (DPIE, 2019). Breeding season varies in different parts of the country but occurs sometime between September and February, with male penguins building nests to attract a mate (Carter, 2020). A breeding BIA also exists outside the light EMBA at Christmas Island, close to King Island, from September – February with some birds residing at the colony all year round (NCVA, 2021).

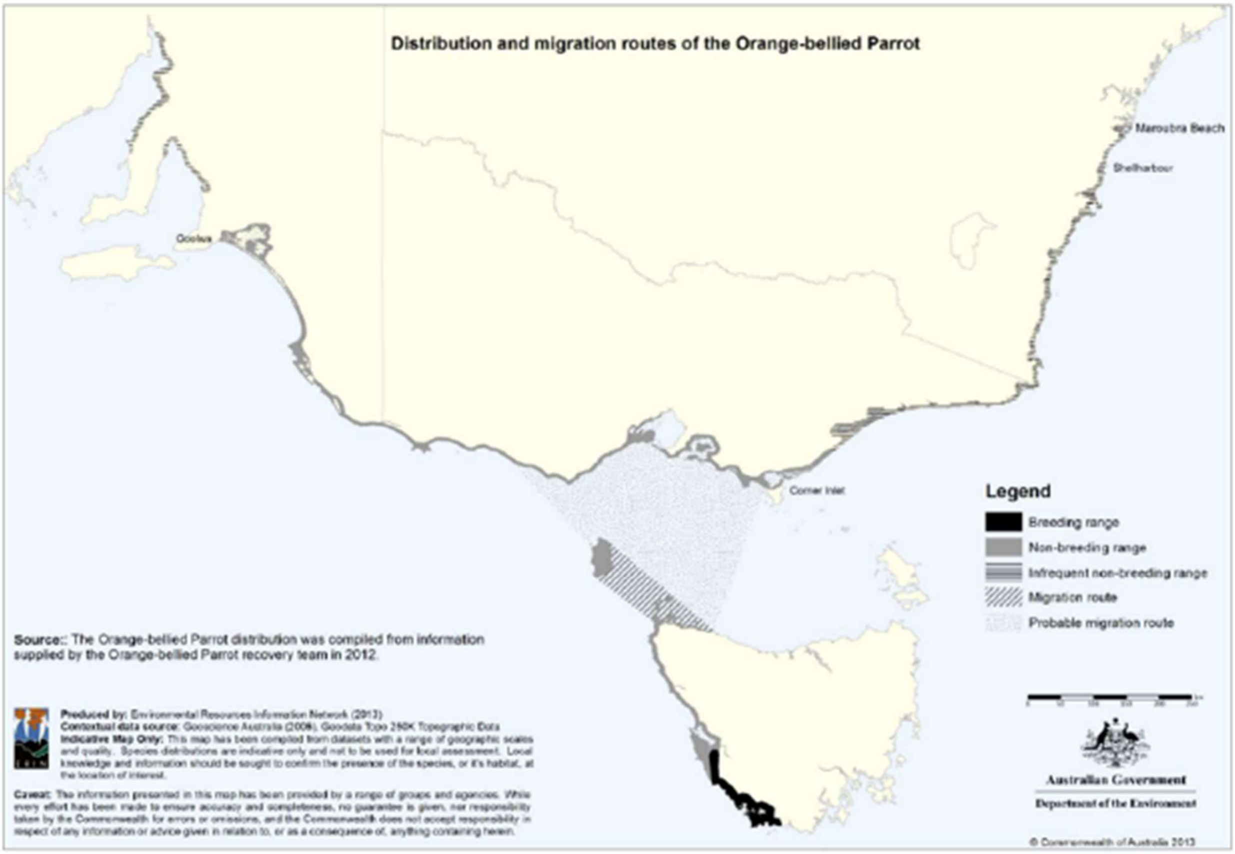


Figure 4-21: Distribution and migration routes of the Orange-bellied Parrot. Labels refer to localities included in the distribution description (DELWP, 2016)

Migratory Shorebirds

The **Curlew Sandpiper** (EPBC Act: Critically Endangered, Marine, Migratory) is a common visitor during the Australian summer, congregating in large flocks, sometimes comprising thousands of birds, at sheltered intertidal mudflats and also at the muddy margins of terrestrial wetlands. In Tasmania, they are recorded on King Island and the Furneaux Group (outside the Light EMBA).

The **Eastern Curlew** (EPBC Act: Critically Endangered, Marine, Migratory) is one of Australia's largest shorebirds and a long-haul flyer. Eastern curlews are found on islands in Bass Strait and along the north-west, north-east, east and south- east coasts of Tasmania (DotE, 2015).

The range of the **Eastern Hooded Plover** (EPBC Act: Vulnerable, Marine) extends from Jervis Bay in New South Wales to Fowlers Bay in South Australia and includes Tasmania and various offshore islands such as Kangaroo Island, King Island and Flinders Island (Marchant and Higgins, 1993; Garnett et al., 2011). The King Island coastline supports populations at Yellow Rock Beach and Christmas Island (PWS, 2018b; TSS. 2012) and at sandy beach locations along the west King Island Coastline. Refer to the Temporal Presence and Absence section in Appendix A for the illustration of the likely temporal presence and absence of albatross and petrels identified within the Light EMBA.

The **Red Knot** (EPBC Act: Endangered, Marine, Migratory) breeds in the northern hemisphere (eastern Siberia) and undertakes migration along the EAAF to spend summer in Australasia; where it may be present within the Light EMBA (Temporal Presence and Absence section in Appendix A). The

Red Knot widespread along the coasts of NSW and Victoria and is a regular visitor to the coasts of Tasmania, and King and Flinders Islands, in small numbers, with the closest Australian site of international importance being Corner Inlet, Victoria (outside the Light EMBA). The Red Knot is diurnal and nocturnal, and prefers sandy beach, tidal mudflats and estuary habitats, where it feeds on bivalve molluscs, snails, worms and crustaceans (Birdlife Australia, 2020).

There are four EPBC Act-listed sandpiper species (Common Sandpiper, Sharp-tailed Sandpiper, Curlew Sandpiper, Pectoral Sandpiper) that may occur within the Light EMBA. Sandpipers are small wader species found in coastal and inland wetlands, particularly in muddy estuaries, feeding on small marine invertebrates (Birdlife Australia, 2020).

Sensitivities

There are five seabird species listed as Endangered, and 16 as Vulnerable within the Light EMBA (Table 1 3). The Orange-bellied Parrot is a migratory bird which may overfly the marine area of the Light EMBA and is listed as Critically Endangered (Table 4-41). Table 4-43 identifies key biological sensitivities which may influence population resilience of those species.

Table 4-43: Biological Sensitivities for Birds

Receptor	Sensitivity description
Seabirds (Resident and Migratory)	The most recent State of the Environment Report (2016), suggests a small proportion of seabird (migratory and resident) species are suffering substantial adverse effects from existing pressures, with population status and trends for species being mixed, with some increasing, some decreasing, some stable and some unknown. Note however these conclusions are based on limited data. In general, seabirds live much longer (up to 60 years), delay breeding for longer (for up to 10 years), and invest more effort into fewer young, than other birds (Robertson 1993; Schreiber and Burger 2002). Most seabird species will only have one clutch a year (unless they lose the first), and many species lay only one egg a year (Schreiber and Burger 2002; Brooke 2004). Due to the extended period of care, breeding tends to occur every two years rather than annually for some species. As a result, seabirds tend to be slow to recover from population declines. Some seabirds make trans-equatorial trips, between breeding and non-breeding locations annually. Other species migrate shorter distances away from the breeding sites, their distribution at sea determined by the availability of food. For long-distance migratory species, habitats that allow birds to breed, rest and feed are critically important as they provide resources so birds can build enough energy reserves to travel the long distance to complete their annual migration (CoA, 2019). As such seabird populations are sensitive to subtle changes to their resting and foraging habitats (CoA, 2019). Even more so, given many seabirds show remarkable site fidelity, returning to the same burrow, nest or site for many years (CoA, 2019).
Other Marine Listed Birds	The **Orange-bellied Parrot** is endemic to South-eastern Australia, with fewer than an estimated 50 birds remain in the wild; with a captive breeding population of 320 individuals (DELWP, 2016). The species is at risk of extinction in the wild in the near-term. However recent survey suggests conservation efforts by DPIPWE have been positive (DPIPWE, 2021a). Breeding birds are currently restricted to an area around Melaleuca, south-west Tasmania (Holdsworth, 2006). This makes the parrot highly susceptible to changes in land use and habitat destruction. Pairs are not known to produce more than one brood in a breeding season and low breeding participation by females (i.e. not breeding in all years) has been implicated in notable population declines (2000-2010). The reason for low female participation is not known but may relate to the body condition of females at the start of the breeding season post migration (DELWP, 2016). Genetic analysis of neutral markers suggests that the wild population suffered a significant genetic decline in the early 1990s. Further genetic losses are predicted to have occurred due to a documented recent decline (2000-2010) and current very low population size (DELWP, 2016). The **Little Penguin** is the smallest of all penguin species at 30-35cm tall and is distributed along the southern edge of mainland Australia, as well as Tasmania, New Zealand and The Chatham Islands (BLA, 2021). In the wild the species will live up to an average of 7 years and start reproducing at approximately 3 years old (DPIE, 2019). Little Penguins form a long-term monogamous pair bond with a separation rate of about 18% and will

	return to their colonies to reconstruct old burrows. Breeding typically occurs from September to February, but some birds reside at colony all year round. Whereby the Bass Strait supports approximately 60% of the known breeding population Although a colony of Little Penguins at Manly on Sydney Harbour is protected as an endangered population, the Australian population as a whole is considered stable at approximately one million birds (Birdlife, 2021).
Migratory Shorebirds (General)	Australia is geographically and ecologically an important location for migratory shorebirds within the EAAF, with the vast majority of Australian migratory shorebird species breed in the northern hemisphere and migrate annually to southern nonbreeding areas, including Australia (DoEE, 2017). Migratory shorebird species are mostly present in Australia during the non-breeding period, from as early as August to as late as April/May each year. These important habitats in Australia allow adult birds to build up the energy reserves necessary to support northward migration and subsequent breeding. While in Australia, migratory shorebirds need to maintain an energy intake greater than in the Northern Hemisphere given the additional energy expenditure required to recover from the southward migration, to allow moulting and replacement of worn feathers, and to build fat reserves in preparation for the northward migration (CoA, 2017). As such relative amounts of time spent feeding and resting, and distances between feeding and roosting areas, are therefore important factors in the energy budgets of individual shorebirds (CoA, 2017). This high energy demands on migratory shorebirds resulting from their migratory lifecycle means that resting is critical when not breeding. The Curlew Sandpiper population in Australia are thought to be 115,000 individuals during the non-breeding period (Bamford et al., 2008), but numbers have subsequently declined (Garnett et al., 2011). It is necessary to maintain undisturbed feeding and roosting habitat along the south-east coast and at sites on the north-west coasts used during migration for the species to survive at current population levels (Lane 1987; Gosbell et al. 2002). Eastern Curlew (EPBC Act: Critically Endangered, Marine, Migratory) are experiencing steady population decline globally. In 2016 the global population was estimated at 35,000 individuals (Hansen et al. 2016) but numbers have been declining rapidly, thought to be due to the loss of habitat around the Yellow Sea (DoE, 2018).

Existing Pressures

The threatened bird species identified in Table 4-41 are managed under various Commonwealth Government EPBC Management Plan documents. The risk posed by threats vary depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, abundance and trends in nesting and foraging numbers. Table 4-44 provides key threats specific to higher order bird receptor groupings identified.

Table 4-44: Existing Pressures relevant to Birds

Receptor Group	Existing Pressures
Seabirds (Resident and Migratory)	In Australia, threats to seabird populations can generally be attributed to one of four broad categories: biological, climate, resource use or chemical. CoA (2019) identified the most pervasive threats to seabird's survival being invasive species, fisheries interactions and by-catch and climate variability. Invasive species are one of the primary threats to seabirds around the globe (CoA, 2020). Mammals such as cats (*Felis catus*), rodents (*Rattus spp*.), European Red Fox, dogs (*Canis familiaris*) and pigs (Sus scrofa) predate adults, chicks and eggs on breeding islands and have caused localised extinctions. Goats (*Capra hircus*), cattle (*Bos spp*.) and rabbits (*Oryctolagus cuniculus*) alter breeding areas making them unsuitable for breeding or reducing breeding success. Incidental mortality (bycatch) in fisheries remains one of the greatest threats to seabirds globally (Clay et al. 2019). Whereby seabirds are attracted to fishing vessels as a source of food, particularly when by-catch and fisheries waste and offal is being thrown back into the ocean. Climate change is emerging as an important factor in understanding the threats and recovery of seabird populations (CoA, 2019). Through modifications to marine and terrestrial environments, climate change is likely to cause fundamental changes to aspects of the breeding biology and foraging ecology of albatross and giant petrel species. Changes in abundance and distribution of fish species leads to continual changes in fishing methods and spatial and temporal distribution of fishing effort – which has direct implications for

	albatross and giant petrel conservation. Climate change may also influence the scale and severity of other threats, in turn directly influencing survival and breeding parameters (CoA, 2019).
Other Marine Listed Birds	A combination of threats caused steep decline in Orang-bellied Parrots population over the past 100 years and fewer than 50 birds remain in the wild (DELWP, 2016). Current knowledge suggests that habitat loss and degradation, particularly in the non-breeding range, has driven the decline in Orang-bellied Parrots (DELWP, 2016). With low breeding participation by females (2000-2010) exacerbated declining population and may be a consequence of low food availability due to loss or inappropriate management of habitat, or the impacts of drought on habitat condition (DELWP, 2016). The species is also at risk from climate change, and the small population size places the species at increased risk from factors such as loss of genetic diversity and inbreeding, stochastic environmental events, predators and competitors, disease, and barriers to migration and movement (DELWP, 2016). The Marine bioregional plan for the Temperate East Marine Region describes existing pressures on Little Penguins in the Temperate East Marine Region (DoE, 2015). Although Light EMBA does not fall within this bioregion, existing pressures are expected to be similar. DoE (2015) identifies invasive species to be key pressure of concern, as well as changes in sea temperature, changes in oceanography and ocean acidification, chemical pollution/ contaminants and marine debris as potential concerns. While nutrient pollution and noise pollution are considered lesser concern.
Migratory Shorebirds (General)	Sutherland et al. (2012) identify 45 threats facing global shorebird populations that can be divided into three categories: natural, current anthropogenic and future issues. The natural issues include volcanoes and cyclones, while current anthropogenic threats encompass climate change, abandonment of rice fields and human disturbance (Sutherland et al. 2012). Likely future issues that could affect shorebird population include microplastics, global hydro-security and changes in sedimentation rates (Sutherland et al. 2012). In Australia and the EAAF, many of the current threats are linked to the changing availability of wintering, stop-over and breeding habitat (MacKinnon et al. 2012). The loss of key locations at any point on the migratory pathway will have significant consequences to a number of species. Key threat to the migration and survival of Australian migratory includes human disturbance, habitat degradation and climate variability and change (DoE, 2015g). Human disturbance significant threat to migratory shorebirds, primarily associated with the loss and degradation of foraging and roosting habitat and through interference during important lifecycle stages of migratory shorebirds (DoE, 2015g). The key threats the Curlew Sandpiper and Eastern Curlew face in Australia, especially eastern and southern Australia, include ongoing human disturbance, habitat loss and degradation from pollution, changes to the water regime and invasive plants (Rogers et al., 2006; DEH, 2009; Garnett et al., 2011).

4.4.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to birds have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.4.1.5).

Table 4-45: Predicted Impact Levels – Emissions – Light

Receptor-Impact Description	Consequence
Change in fauna behaviour	
Seabirds (Migratory and Resident) Seabirds may be attracted to light glow from the survey and support vessels at night. Whereby all species are vulnerable to the effects of lighting. Seabirds active at night while migrating, foraging or returning to colonies are most at risk (DoEE, 2020). Fledglings are more affected by artificial lighting than adults for several reasons including, naivety of their first flight, the immature development of ganglions in the eye at fledging and the potential connection between light and food and the synchronised mass exodus of fledglings from their nesting sites (Montevecchi 2006 and Mitkus et al 2018 in CoA, 2019; DoEE, 2020). The physical aspects of light that have the greatest impact on seabirds include intensity and colour (wavelength) (DoEE, 2020). Bright lighting can disorientate birds, thereby increasing the likelihood of seabird injury or mortality through collision with the vessel, or mortality from starvation due to disrupted migration or foraging at	Negligible (1)

sea (Wiese et al., 2001 in DSEWPC, 2011). This disorientation may also result in entrapment, stranding, grounding and interference with navigation (DoEE, 2020). Once grounded, DoEE (2020) reports that petrel species in the Southern Ocean may be unable to take off from a deck. The DoEE (2020) notes that seabird fledglings may be affected by lights up to 15 km away. These impacts are most prevalent where lighting occurs near nesting and roosting locations, where birds are frequently returning to and leaving. Studies conducted between 1992 and 2002 in the North Sea confirmed that artificial light was the reason that birds were attracted to and accumulated around illuminated offshore infrastructure (Marquenie et al., 2008) and that lighting can attract birds from large catchment areas (Wiese et al., 2001). Noting these studies were based on non-moving light sources. DoEE (2020) noted that artificial light may provide enhanced capability for seabirds to forage at night. Due to the absence of seabird breeding colonies and breeding sites within the Light EMBA, (i.e. Short-tailed Shearwaters BIA on King Island; Shy Albatross breeding at Albatross Island (TAS), Mewstone and Pedra Branca; and Black-browed Albatross, Grey-headed Albatross, Wandering Albatross, Northern and Southern Great Petrel breeding at Macquarie Island), light glow from small moving and temporary light sources is not expected to result in impacts at the species population level or indirectly at the ecosystem level. Each of these key locations are located more than 20 km away from the Light EMBA, which is the precautionary threshold applied by the National Light Pollution Guidelines for Wildlife (DoEE, 2020). As such overlap with seabird Foraging BIA (Antipodean Albatross, Wandering Albatross, Buller's Albatross, Shy Albatross, Campbell Albatross, Black-browed Albatross, Wedge-tailed Shearwater, Short-tailed Shearwater, White-faced Storm-petrel, Common Diving-petrel, Indian Yellow-nosed Albatross) is not expected to have a detrimental effect on foraging behaviour, besides noted Albatross grounding concerns. There are no actions within the National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011- 16 (DSEWPC, 2011a), the National Light Pollution Guidelines for Wildlife (DoEE, 2020), Conservation Advices (Fairy Prion [southern], Australian Fairy Tern, Soft-plumaged Petrel) or Recovery Plans (Gould's Petrel) that are compromised by light emissions from the vessels. The extent of the area of impact is predicted to be a maximum of 20 km from the light source (between August and October) that there may be vessels present for the Sequoia MSS. The severity is assessed as **Negligible (1)** based on: • Environmental impact assessments have been conducted on potential sensitive habitat within conservative 20 km distance from vessel activities as recommended by National Light Pollution Guidelines for Wildlife (DoEE, 2020). • Light glow occurring away from roosting and breeding sites has not been identified as a threat within National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011- 16 (DSEWPC, 2011b) or the relevant Conservation Advice (Fairy Prion southern, Australian Fairy Tern, Soft-plumaged Petrel) or Recovery Plan (Gould's Petrel). • The area of impact does not represent key breeding, migration or aggregation areas for seabirds; and seabird presence in the Light EMBA is expected to be representative of their wide distribution in southern Australian waters and within the survey acquisition period. • Identified foraging BIAs which overlap the Light EMBA have a wide distribution in southern Australian waters during the survey acquisition period. Further no detrimental impact on foraging behaviour has been identified associated with a small moving and temporary light source. • Changes to biologically important behaviours (such as nesting, hatchling orientation, sea-finding and dispersal behaviour) for seabirds are not expected to occur, given localised and temporary nature of the petroleum activity.	
Migratory Shorebirds Most migratory shorebirds make an annual return journey of many thousands of kilometres between breeding grounds in the northern hemisphere and their non-breeding grounds in the southern hemisphere. As such presence of migratory shorebirds identified via PMST are expected to be transitory only as they overfly the EMBA on route to and from breeding grounds. There is evidence that 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. However, DoEE (2020) notes that the overall the effect of artificial	Negligible (1)

light on migratory shorebirds remains understudied and consequently any assessment should adopt the precautionary principle and manage potential effects from light unless demonstrated otherwise. Due to the absence of shorebird nocturnal roosts or foraging BIA sites within the Light EMBA, light glow from small moving and temporary light sources is not expected to result in impacts at the species population level or indirectly at the ecosystem level. Further there are no actions within the National Light Pollution Guidelines for Wildlife (DoEE, 2020) or Conservation Advices (Curlew Sandpiper, Eastern Curlew, Eastern Hooded Plover, Red Knot) that are compromised by light emissions from vessels operating outside of identified feeding or roosting habitats. The extent of the area of impact is predicted to be a maximum of 20 km from the light source (between August and October) that there may be vessels present for the Sequoia MSS. The severity is assessed as **Negligible (1)** based on: • No actions specific to shorebirds are identified within National Light Pollution Guidelines for Wildlife (DoEE, 2020) or Wildlife Conservation Plan for Migratory Shorebirds (DoE, 2015g) that are compromised by light emissions from the vessels. • Light pollution from an offshore moving vessel has not been identified as a threat within relevant or Conservation Advices (Curlew Sandpiper, Eastern Curlew, Eastern Hooded Plover, Red Knot). • The area of impact does not represent key breeding, foraging or roosting areas (i.e. located offshore in deepwaters) or Nationally or Internationally Important Habitat for shorebirds "Important habitat". • Changes to biologically important behaviours (such as nesting, hatchling orientation, sea-finding and dispersal behaviour) for shorebirds are not expected to occur.	
Other Birds The Orange-bellied Parrot (EPBC Act: Critically Endangered, Marine) is at risk of extinction in the wild in the near-term; and is facing substantial existing pressures (Section 4.4.2.1). There are about 50 Orange-bellied Parrots remaining in the wild, and a captive breeding population of around 320 individuals. The National Recovery Plan for the Orange-bellied Parrot (DELWP, 2016a) identifies barriers to migration and movement, including wind energy turbines, powerlines, aircraft, illuminated structures and illuminated boats, as known or potential threat, though states the evidence of impact is weak and little more than anecdotal (Holdsworth 2006). Individuals may be killed by flying into barriers, or behaviour may be modified by the presence of barriers, leading to avoidance of some habitat (DELWP, 2016a). The Recovery Plan states that illuminated structures and illuminated boats may pose a barrier, and that impacts of these barriers may be greatest where they occur on migration routes, where a larger portion of the population may be exposed to the barrier during a key biological behaviour. The Orange-bellied parrot may overfly the light EMBA from MSS vessels in the northern extent of the Operational Area at night, during the southern (more rapid) migration (between September and October). The spatial extent of impact is conservatively assumed to be within a 20 km radius of the vessels, or 1200 km^{2}. This area represents 3% of the probable migration route, assuming the entire Light EMBA falls within the route at any given time. The Little Penguin (EPBC Act: Listed Marine) has a foraging BIA with a 10 km buffer around Christmas Island, which intercepts the Light EMBA, although it was not identified as present in the PMST report. Studies suggest that penguins were habituated to artificial lights and were unaffected by a 15 lux increase in artificial illumination (DoEE, 2020). However direct light disturbance around nesting areas, such as light shining on nesting areas, may disorient or prevent birds returning to shore, presenting a potential to populations affected (DPIE, 2021). Therefore, the guideline does not consider the species to be sensitive to light and are unlikely to be impacted by light. The worst-case potential severity for other birds is assessed as **Moderate (3)** based on: • There are no BIAs or habitat critical to the survival of the Orange-Bellied Parrot that overlap the Light EMBA, and it does not intersect nor overlap the known migration route, non-breeding, infrequent non-breeding or breeding range. • Although Light EMBA overlap Little Penguin Foraging area it does not overlap with associated shoreline of associated aggregation site, whereby disturbance from light on Little Penguins described is associated with direct light on nesting areas. As such Sequoia MSS offshore light source is not expected to disturb nesting areas.	Moderate (3)

• Orange-Bellied Parrot overlap between the Light EMBA and probable migration route are predicted to occur for a few hours only when the MSS vessels are in the northern extent of the Operational Area at night, between September and October. • The National Recovery Plan for the Orange-bellied Parrot (DELWP, 2016a) identified illuminated structures and illuminated boats as a potential barrier to migration and movement; especially where they occur on migration routes; and identifies relevant actions that may result in a significant impact on the Orange-bellied Parrot including 'New industrial, urban or infrastructure developments that permanently affect Orange-bellied Parrot flight paths between sites, create disturbance that interrupts foraging, and/or introduces predators into habitats.' • The Sequoia MSS is not a permanent development will not permanently affect flight paths of Orange-bellied Parrot or Little Penguin nesting areas. • There is no published information available on the sensitivity of the Orange-bellied Parrot to light, and only anecdotal evidence regarding the impact of barriers to migration (DWELP, 2016a). • MSS vessel are unlikely to remain in the relevant area for extended periods of time, as they are continuously moving (~4 knots). However, the species is at risk of extinction in the wild in the near-term, with only 50 individuals remaining in the wild. Therefore, a conservative consequence of Moderate has been assigned.	

4.4.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-46 compares the predicted impact levels for plankton against the acceptable levels.

Table 4-46: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Birds

Defined Acceptable Levels		Predicted Impact Level		Is the predicted impact below the defined acceptable level?
Factor	**Level**			
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Predicted impacts are temporary, reversible, small-scale, and light intensity will be reduced to minimum levels of safe operations and navigation.		Yes
		Severity	Behavioural disturbance	
		Extent	Operational Area + 20 km radius	
		Duration	Maximum of 78 days	
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction of impacts to birds.		Yes
Principles of ESD	The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013) identifies light pollution associated with offshore mining operations and other offshore activities as a threat to the AMP		Yes

		network. This has been addressed throughout the impact assessment. The National Recovery Plan for the Orange-bellied Parrot identifies illuminated structures and illuminated boats as a potential barrier to migration and movement; especially where they occur on migration routes. This has been addressed in the impact assessment. The following do not identify light as a threat: • National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016. • Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan. • Conservation Advice *Pachyptila turtur subantarctica* Fairy Prion (southern). • Conservation Advice for *Sternula nereis nereis* (Fairy Tern). • Conservation Advice *Pterodroma Mollis* Soft-plumaged Petrel. • Conservation Advice *Calidris canutus* Red Knot. • Conservation Advice *Calidris ferruginea* Curlew Sandpiper. • Conservation Advice *Numenius madagascariensis* Eastern Curlew • Conservation Advice *Thinornis rubricollis rubricollis* Hooded Plover (Eastern)		
Biological	No effect to biologically important behaviours of individuals.	Changes to biologically important behaviours are not predicted to occur.		Yes
Ecological	No impact on key life functions, vital rates, and population parameters.	Behavioural disturbance is not predicted to result in changes to predator-prey dynamics, spatial distribution, migration, reproduction or changes in population dynamics.		Yes
Economic	Not relevant.			
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM 11 - the sail line plan ensures the activity is clearly scoped and bounded. CM 5 – vessels fitted with shrouded lights to prevent light spill or directional lighting.		Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).	Seabirds	Negligible (1)	Yes

		Migratory shorebirds	Negligible (1)	
		Other Birds	Moderate (3)	
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to birds have been considered as detailed in Section 3.4. No public comments were made in relation to birds.		Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	The management actions listed for seabirds in The National Light Pollution Guidelines for Wildlife (DoEE, 2020) have been considered.		Yes

Acceptability Summary
Following completion of the impact assessment process, the environmental impacts to birds arising from the identified aspects are acceptable because: • Activity does not overlap nesting or breeding BIAs or significantly overlap temporally or spatially with identified albatross, petrel or Little Penguin foraging BIAs. • While the Orange-bellied Parrot may overfly the Operational Area during their southern migration, the Sequoia MSS is not predicted to permanently affect their flight path. • Overlap with small area of total foraging habitat available and limited overlap with peak usage or spatially limiting food sources. Noting relevant bird species are highly mobile (including Little Penguin which routinely forages 15 – 50 km). • Impacts to the prey species that support the seabirds and penguins were evaluated, thus indirect impacts known and insignificant. • The nature of the Sequoia MSS is short-term and constantly moving which limits bird exposure.

4.4.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP and ensure that lighting is kept to the minimum needs for safe operations and navigation so that:
Receptor	• Birds continue biologically important behaviours; and
Impact	• Impacts are behavioural only with no pathway for impacts on key life functions, vital rates, and population parameters.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-47 which assesses whether the control measures for birds are effective to meet the EPO.

Table 4-47: Control Measure Effectiveness – Birds

Measure	CM 11 - Sail line plan
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.

Is the EPO achieved?	Partially	
Residual impacts requiring additional management	This CM only covers the impacts from impulsive sound and the spatial extent of light impacts. It lacks methods of reducing the severity of light impacts.	
Next Measure	CM 5 – Project vessels, PS 5.10	CM 7 – Marine assurance system
Assessment of Effectiveness	Vessels fitted with shrouded lights to prevent light spill or directional lighting.	Ensures that maritime law is being complied with.
Is the EPO achieved?	Yes	Yes
Residual impacts requiring additional management	None	

4.5. Marine Mammals

4.5.1. Scoping the Assessment

4.5.1.1. Defining the aspects that lead to impact

Table 4-48 identifies the aspects and impacts that have the potential to impact marine mammals as a result of the Sequoia MSS. Aspects and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible (1); or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 Unplanned Aspects).

Table 4-48: Aspects and Impacts – Marine Mammals

Aspects	Impacts	Marine Mammals
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	*X*
	Change in fauna behaviour	✓
Emissions – Underwater Sound (Impulsive)	Injury/mortality to fauna	*X*
	Change in hearing via permanent and temporary threshold shift	✓
	Change in fauna behaviour	✓
Emissions – Light	Change in fauna behaviour	*X*
Emissions – Atmospheric	Change in fauna behaviour	*X*
Planned Discharges – Vessels	Injury/mortality to fauna	*X*
	Change in fauna behaviour	*X*

4.5.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-49 describes the cause and effect pathways / the source of the aspects identified for marine mammals (Table 4-48).

Table 4-49: Cause and Effect Pathway – Marine Mammals

Emissions – Underwater Sound (Continuous)
Underwater sound is generated from the survey and support vessels, mainly by propeller and thruster cavitation, with a smaller fraction produced through the hull from engines, gearing, and other mechanical systems. Underwater sound is also generated by helicopters during take-off and landing on the survey vessel. Continuous sound generated by the Sequoia MSS has 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 mammals, including: • a change in fauna behaviour.
Emissions – Underwater Sound (Impulsive)
Underwater sound is generated with each pulse from the seismic source that produces high intensity, low-frequency impulsive sounds. Impulsive sound generated by the Sequoia MSS has 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 mammals, including: • a change in fauna behaviour • a change in hearing via permanent and temporary threshold shift.

4.5.1.3. Defining the EMBA

Table 4-50 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact marine mammals (Table 4-48).

The source of the aspect is described further in Section 4.5.1.2. The EMBAs are shown in Figure 4-22.

Table 4-50: EMBA for Marine Mammals

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions – Underwater Sound (Continuous)	Helicopter sound	Helicopter activities produces strong underwater sounds for brief periods when the helicopter takes off/lands on the survey vessel. Sound from helicopter activities is very localised and infrequent (operations once every 3-4 weeks)	Underwater sound only detectable within tens of metres of the helicopter (Richardson et al. 1995).	Operational Area
Emissions – Underwater Sound (Continuous)	Vessel sound	Hearing damage in marine mammals from shipping noise has not been widely reported (OSPAR, 2009). Marine mammals may exhibit a response to vessel and NFMS (2014) propose 120 dB SPL for non-impulsive sound sources such as vessels as the marine mammal behavioural criteria.	Patterson et al. (2007) details that sound levels from a seismic survey vessel when undertaking a seismic survey was 125 – 132 dB SPL at 500 m. This aligns with McCauley (1998) who recorded noise levels of 120 dB SPL at 0.5 – 1 km for rig support vessels when underway at 12 knots.	Operational Area +1 km

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions – Underwater Sound (Impulsive)	Seismic sound – Low-frequency Marine Mammals (baleen whales)	The furthest distance to an acoustic criterion for marine mammals from the acoustic modelling (Koessler et al., 2020; Appendix E).	The acoustic criteria s for low-frequency marine mammals and modelled distance are: • Behavioural response[1] 160 dB SPL: 11.1 km • Behavioural response[2] (Cow/Calf): 140 dB SPL: 28 km in offshore direction and into Bass Strait 25 km towards King Island[3] 15 km towards Victorian Coast • PTS 24hr[2] 183 dB SEL24hr: 1.18 km • TTS 24hr[2] 168 dB SEL24hr: 56.6 km in offshore direction 25.9 km towards King Island West Coast 11.7 km towards Victorian Coast	Operational Area + 56.9 km
	Seismic sound – Mid-frequency Marine Mammals (toothed whales)		The acoustic criteria for mid-frequency marine mammals and modelled distance are: • Behavioural response[1]: 160 dB SPL: 11.1 km • PTS 24hr[2] 185 dB SEL24hr: not reached • TTS 24hr[2] 170 dB SEL24hr: 80 m	Operational Area + 11.1 km
	Seismic sound – High-frequency Marine Mammals (toothed whales)		The acoustic criteria s for high-frequency marine mammals and modelled distance are: • Behavioural response[1]160 dB SPL: 11.1 km • PTS 24hr[2] 155 dB SEL24hr: 340 m • TTS 24hr[2] 140 dB SEL24hr: 620 m	
	Seismic Sound –Phocid Pinnipeds		The acoustic criteria s for Phocid pinnipeds and modelled distance are:	

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
			• Behavioural response[1]160 dB SPL: 11.1 km • PTS 24hr[2] 185 dB SEL24hr: 80 m • TTS 24hr[2] 170 dB SEL24hr: 720 m	
	Seismic Sound –Otariid Pinnipeds		The acoustic criteria s for Otariid pinnipeds and modelled distance are: Behavioural response[1]160 dB SPL: 11.1 km PTS 24hr[2] 203 dB SEL24hr: not reached TTS 24hr[2] 188 dB SEL24hr: 80 m	

[1] NOAA (2019), [2] NMFS (2018)

[2] Wood et al, 2012, 140 dB SPL-weighted

[3] Based on comparison to conservative 140 dB SPL-unweighted contours

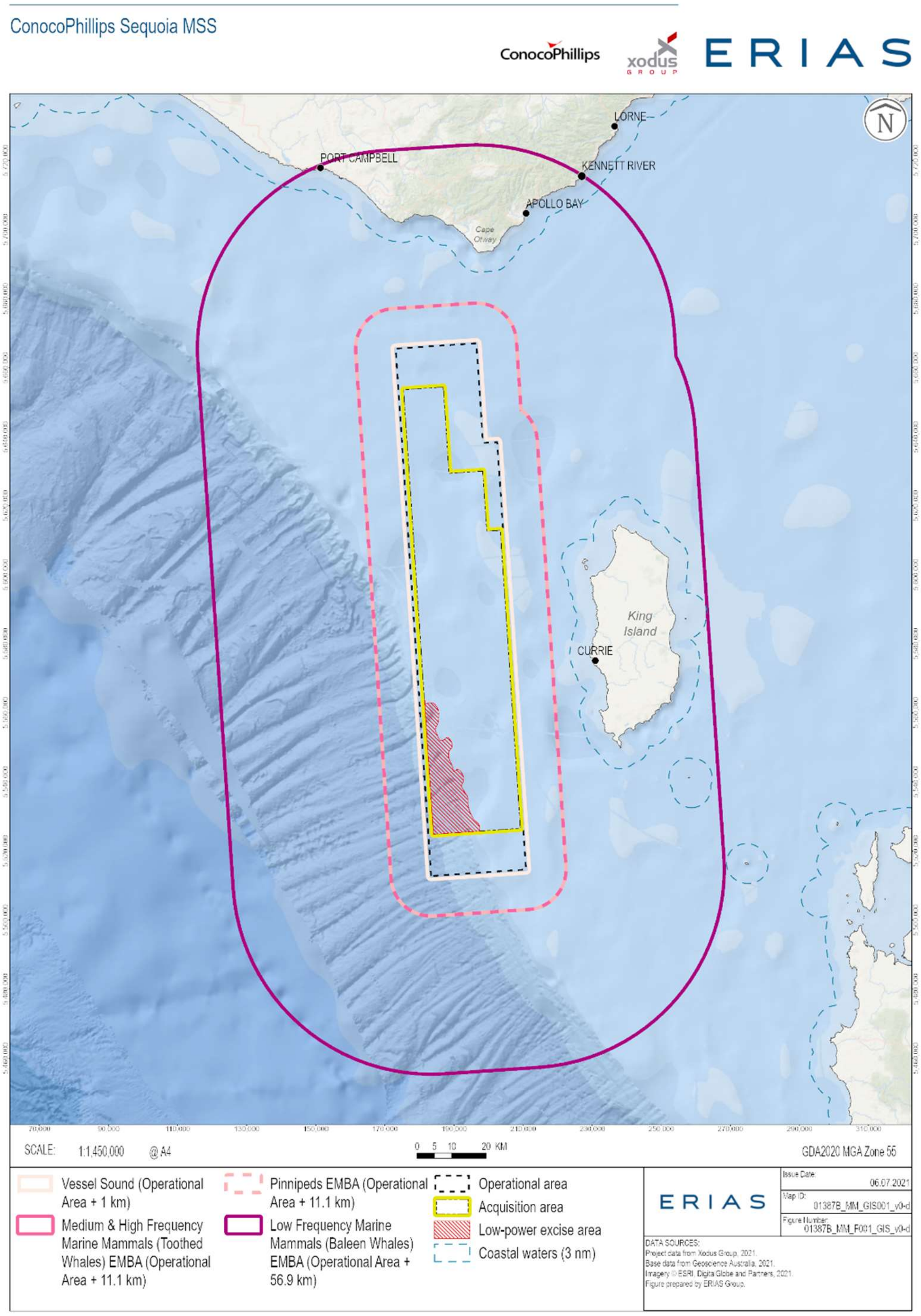


Figure 4-22: Marine Mammals Sound EMBAs

Relevant Studies

Table 4-51 provides a summary of studies on the potential impact of impulsive underwater sound on marine mammals identified as relevant species within the EMBAs.

Table 4-51: Studies of Underwater Sound (Impulsive) on Marine Mammals

Receptor	Sensitivity description
Whales - Physiological impacts	Physiological impacts such as physical damage to the auditory apparatus (e.g., loss of hair cells or permanently fatigued hair cell receptors), can occur in marine mammals, including cetaceans, when they are exposed to intense or moderately intense sound levels and could cause permanent or temporary loss of hearing sensitivity. While the loss of hearing sensitivity is usually strongest in the frequency range of the emitted noise, it is not limited to the frequency bands where the noise occurs but can affect a broader hearing range. This is because animals perceive sound structured by a set of auditory bandwidth filters that proportionately increase in width with frequency. TTS is hearing loss from which an animal recovers, usually within a day at most, whereas PTS is hearing loss from which an animal does not recover (permanent hair cell or receptor damage). The severity of TTS is expressed as the duration of hearing impairment and the magnitude of the shift in hearing sensitivity relative to pre-exposure sensitivity, in decibels (dB). TTS occurs at lower exposure levels than PTS. The cumulative effects of repeated TTS, especially if the animal receives another sound exposure near or above the TTS criteria before recovering from the previous sensitivity shift, could cause PTS. If the sound is intense enough, an animal could succumb to PTS without first experiencing TTS (Weilgart, 2007). Though the relationship between the onset of TTS and the onset of PTS is not fully understood, a specific amount of TTS can be used to predict sound levels that are likely to result in PTS. For example, in establishing PTS criteria, Southall et al (2007) assume that PTS occurs within 40 dB of TTS. While there are results from TTS and PTS studies on odontocetes exposed to impulsive sounds (Finneran, 2016), there is no data for mysticetes. Gotz et al (2009) notes that there is no conclusive evidence linking MSS with cetacean mortality. For MSS in Australian waters, the EPBC Act Policy Statement 2.1 determines suitable exclusion zones with an unweighted per-pulse SEL threshold of 160 dB re 1 µPa^2.s (DEWHA, 2008). This threshold value is used in the policy to determine whale exclusion zones where MSS must lower their acoustic power output, or shut down completely, in order to prevent significant exposure to sound levels that could induce TTS. So: • If it is demonstrated that SELs from air gun pulses fall below 160 dB re 1 µPa^2.s at <1 km, a reduced 1 km 'low-power' exclusion zone can be adopted. • If it is demonstrated that SELs from air gun pulses are greater than 160 dB re 1 µPa^2.s at <1 km, the survey must operate with a 2 km exclusion zone (applicable to this survey, as the distance to per-pulse SEL ranges from 2.8 km to 4.4 km, depending on water depth). The 160 dB re 1 µPa^2.s threshold minimises the likelihood of TTS in mysticetes and large odontocetes according to the policy background paper. Policy Statement 2.1 does not apply to smaller dolphins and porpoises, as DEWHA assessed these cetaceans as having peak hearing sensitivities occurring at higher frequency ranges than those that seismic arrays typically produce.
Whales - behavioural	Behavioural responses to underwater sound are difficult to determine because animals vary widely in their response type and strength, and the same species exposed to the same sound may react differently (Nowacek et al., 2004; Gomez et al., 2016; Southall et al., 2016). Dunlop et al (2017) notes that establishing a simple dose–response relationship between a behavioural response and noise exposure levels in marine mammals has proved elusive, with this relationship considered to be an over-simplification because of the complexity of the behavioural responses. An individual's response to a stimulus is influenced by the context in which the animal receives the stimulus and how relevant the individual perceives the stimulus to be. A number of biological and environmental factors can affect an animal's response—behavioural state (e.g., foraging, travelling or socialising), reproductive state (e.g., female with or without calf, or single male), age (juvenile, sub-adult, adult), and motivational state (e.g., hunger, fear of predation, courtship) at the time of exposure as well as perceived proximity, motion, and biological meaning of the sound and nature of the sound source. Animals might temporarily avoid anthropogenic sounds but could display other behaviours such as approaching novel sound sources, increasing vigilance, hiding and/or retreating, that might decrease their foraging time (Purser & Radford, 2011). Some cetaceans might also respond acoustically to seismic survey noise in a range of ways, including by increasing the amplitude of their calls (Lombard effect), changing their spectral (frequency content) or temporal vocalisation properties, and in some cases, cease vocalising

Receptor	Sensitivity description
	(McDonald et al., 1995; Parks et al., 2007; Di lorio & Clark, 2010; Castellote et al., 2012; Hotchkin & Park, 2013; Blackwell et al., 2015). Masking can also occur (Erbe et al., 2015). The BRAHSS (Behavioural Response of Australian Humpback whales to Seismic Surveys) project conducted studies at Peregian Beach, Qld, and Dongara, WA, to better understand the behavioural responses of humpback whales to noise from the operation of seismic air gun arrays (20 cui and 140 cui arrays) (Cato et al., 2013). Results from the experiments are published in Dunlop et al (2015;2016;2017) and Godwin et al (2016), together with concurrent studies of the effects of vessel noise on humpback whale communications (Dunlop, 2016). The BRAHSS Project found: • In most exposure scenarios, a distance increase from the sound source was observed and interpreted as potential avoidance. • No difference in the 'avoidance' response to either 'ramp-up' or the constant source producing sounds at a higher level than early ramp-up stages. In fact, a small number of groups showed inspection behaviour of the source during both treatment scenarios. • 'Control' groups also responded, which suggested that the presence of the survey vessel alone had some effect on the behaviour of the whales. Despite this, the majority of groups appeared to avoid the survey vessel at distances greater than the radius of most injury-based mitigation zones. • Significant responses to the air guns occurred when the source was within about 3 km and the received level was greater than about 140 re. 1 μPa^2s. Humpback whale groups responded more to the smaller source (which was closer) than to the larger source, indicating that proximity to the source (rather than simply source level) is also important. • The results of this 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., 2003). Small odontocetes responded to acoustic source sounds by moving laterally away from the sound, showing the strongest lateral spatial avoidance, compared to mysticetes and killer whales that showed more localised spatial avoidance. Other larger odontocetes studied included long-finned pilot whales (*Globicephala melas*) which only changed their orientation in response to sound exposure, while sperm whales did not significantly avoid the sound (Stone & Tasker, 2006). Southall et al (2007) extensively reviewed marine mammal behavioural responses to sounds as documented in the literature. Their review found that most marine mammals exhibit varying responses between an SPL of 140 and 180 dB re 1 µPa, but a lack of convergence in the data from multiple studies prevented them from suggesting explicit criteria. The causes for variation between studies included lack of control groups, imprecise measurements, inconsistent metrics, and context dependency of responses including the animal's activity state.
Blue Whale	There are very few peer-reviewed papers that examine the responses of blue or PBW to MSS. The only study that specifically examines responses was that from Di lorio and Clark (2010), who found that Blue Whales increased their discrete, audible calls during a seismic survey. The Blue Whale Study has undertaken a number of studies associated with MSS' along the Bonney coast (southeast South Australia/southwest Victoria) between 1998 and 2012. The Blue Whale Study has used aerial surveys to assess distribution and migration movements of marine mammals, with particular attention to great whales, in Bass Strait and the Otway Basin. Aerial surveys of PBW distributions during MSS have observed the following: • In February 2011, during the Blue Whale peak migration period, aerial surveys (conducted by Origin) observed only a single PBW within the Astrolabe 3DMSS (Otway Basin), and eight PBW within a 10 km buffer area around the survey area. The total number of PBW sightings during the February 2011 aerial surveys was 51, of which 42 were located outside the 10 km buffer around the Astrolabe study area. Blue Whales continued feeding behaviour at a distance of approximately 30 km from the seismic vessel, irrespective of the seismic operations. • Morrice et al (2004) stress that the proximity of whales to seismic vessels must be interpreted in the context of their pressing need to consume tonnes of food per day. PBW may need to feed into their zone of acoustic discomfort if the only krill available is in proximity to a seismic vessel. Blue Whales have been sighted within approximately 2.4 km of an active seismic source array and cow

Receptor	Sensitivity description
	and calf pairs, which are considered the most sensitive of whale aggregations, were recorded within 7.1 km (Morrice et al., 2004). • In December 2003, Santos carried out a 2DMSS (3,150 cui sound source) in EPP32 west of Kangaroo Island (SA) where Blue Whales were observed. Some of the whales approached as close as 2.4 km to the operating seismic vessel, feeding on dense krill swarms. • During an MSS in VIC/P51 in November 2003, Blue Whales were sighted near krill swarms approximately 18 km from the seismic vessel and left the area as the vessel approached closer. It is unknown if the approach of the vessel triggered the whales to move from the area. • During November-December 2002, Santos conducted 2D and 3DMSS in VIC/P51 and VIC/P52 (3,150 cui sound source) with no PBW sightings within 60 km of the operating seismic vessel. • During the 1999-2000 season, Woodside conducted a 3DMSS in VIC/P43 (2,250 cui sound source). During aerial surveys, no Blue Whales were sighted within 90 km of the operating seismic vessel, despite abundant krill surface swarms in the area. McDonald et al. (1995) report on the movements of a single blue whale based on analysing data from an array of seismometers mounted on the seafloor during an MSS (using a source array with a total capacity of 1,600 cui and a source level of 215 dB PK-PK over a 10- 60 Hz band). This study detailed the whale started its call sequence well within the tracking range of the array when the survey vessel was 15 km distant. The whale closed on the ship following a pursuit track until it stopped calling at a range of 10 km. At this point, the ship was moving about 10 km/h and was beginning to increase its distance from the whale; the sound level of the seismic source was 143 dB PK-PK at the whale. After a gap in the call sequence, a new call series, presumably by the same whale, was again located 10 km from the ship, suggesting it had taken a track generally paralleling the ship. The series of positions show the whale moving diagonally away from the ship. McDonald et al., (1995) detailed that it appeared the whale may have been approaching the ship intentionally, or perhaps was unaffected by the Survey vessel and that more data of this type was needed to draw conclusions about the effect of such noise on blue whale behaviour.
SRW	In common with other large whales that feed within Antarctic waters during the Austral summer, the SRW has evolved within, and annually enters, an environment with a ubiquitous natural source of low frequency sound. Behavioural studies into MSS sound impacts to migrating mysticetes have observed some deviation as a result of an operational array (Dunlop et al, 2017; McCauley et al, 2000; Richardson et al, 1999; Manley et al, 2007), however proximity to the operating source array, also appears to be a factor in the level of disruption to migration (Dunlop et al, 2017).
Humpback Whales	Humpback whales have not been observed to be significantly displaced from their migratory pathways as a result of seismic sound, with the most consistent observed response to seismic activity being an alteration of course and swimming speed (McCauley et al., 2000a). Cows with young calves may have greater susceptibility to acoustic disturbance (McCauley et al., 2000a). The BRAHSS experiment found that in most exposure scenarios, a distance increase from the sound source was observed and interpreted as potential avoidance from the seismic source. McCauley et al., (1998) reports on observations of humpbacks to a MSS off Exmouth. The MSS used one of two 2678 cui seismic arrays of source level 258 dB re 1µPa^2−m p−p operating every eight seconds for 33.4 days of continual operation. Survey lines ran east-west across the path of southerly migrating humpback whales. Before the seismic survey began aerial surveys determined that humpbacks moving through the seismic area were distributed uniformly seaward of the 20 m depth contour. Based on observations there did not appear to be any gross changes in the migratory path of humpback whales through the seismic area. Whales approaching the survey vessel began avoidance manoeuvres at 5−8 km and mostly kept a standoff range of 3−4 km. Some whales approached the vessel closer. McCauley et al., (1998) also conducted experiments in Exmouth Gulf where the movements and behaviour of humpback pods were monitored before, during and after an approach with a 20 cui seismic source of source level 227 dB re 1µPa^2−m p−p. The levels at which avoidance manoeuvres began during these trials was approximately 159 dB re 1µPa^2 p−p, which is roughly equivalent to the received level of the 2678 cui array at 5 km, at 162 dB re 1µPa^2 p−p. General avoidance of the 20 cui seismic source was observed at 1 km, or a level of 168 dB re 1µPa^2 p−p, which was roughly equivalent to the level of the 2678 cui array at 3 km at 170 dB re 1µPa^2 p−p, which was the general minimum humpback standoff range observed from this array. Whales were observed to move closer to the operating 20 cui source and 2678 array. McCauley et al., (1998)

Receptor	Sensitivity description
	speculated that these whales were mostly males intent on investigating or passing quickly by the appropriate source of array.
Sperms whales	Sperm whales show little response to MSS', but noise may disrupt/delay foraging and swim effort (Mate et al. 1994; Madsen et al. 2002; Stone 2003; Stone and Tasker 2006; Jochens et al. 2008; Miller et al. 2009). Miller et al. (2009) tagged 8 sperm whales, recording sounds and movement while exposing them to operating airgun arrays. For seven of the eight animals observed, they found that gross diving behaviour did not change. They did not change their buzz rates however oscillations in pitch were affected.
Dolphins	The oceanic dolphins that may be encountered during the survey (such as the Bottlenose Dolphin and Common Dolphin) have very broad distributions and habitat requirements. Both of these species are known to ride the bow waves of vessels (Bannister et al., 1996, Perrin, 1998; Ross, 2006; Hawkins and Gartside, 2009; Barkaszi et al., 2012; Barry et al., 2012). Bow riding of seismic vessels is also a common occurrence, though likely to occur less frequently when the source is operating.
Pinnipeds	Pinnipeds may tolerate seismic pulses of high intensity and may be able to approach operating seismic vessels to a close range because their hearing is poor in low frequencies (McCauley, 1994). However, it is also suggested that MSS may affect pinniped prey abundance or behaviour, particularly if the seismic survey runs for long periods. Fur-seals are less sensitive to low frequency sounds (<1 kHz) than to higher frequencies (>1 kHz). McCauley (1994) suggests that the sound frequency of seismic air gun pulses is below the greatest hearing sensitivity of otariid pinnipeds, but data is lacking for Australian species. Prideaux (2017) reports that the effective underwater auditory bandwidth in water for otariid pinnipeds is 60 Hz to 39 kHz. Aerial sounds produced by the Australian fur-seal have strong tonal components at frequencies that are less than 1 kHz, although they all range up to 6 kHz with most energy between 2-4 kHz. If the low frequency components of calls are used, then seals may also hear at low frequency and may be affected by seismic source pulses. However, Shaughnessy (1999) states that seismic activity will only be a threat to pinnipeds if it takes place close to critical habitats. Gotz et al (2009) reports that controlled exposure experiments with small acoustic sources (215 – 224 dB re 1 µPa) were carried out over 1 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 1 µPa. Prideaux (2017) reports that spatial displacement of pinnipeds by noise has been observed, however observations are too sparse. Such displacement could have serious consequences if affecting species in their critical habitats. Displacement can cause the temporary loss of important habitat, such as feeding grounds, forcing individuals to either move to sub-optimal feeding location, or to abandon feeding altogether. Noise can also reduce the abundance of prey (such as fin-fish and cephalopods). Displacement can also reduce breeding opportunities, especially during mating seasons. Foraging habitat and breeding seasons are therefore important lifecycle components of pinniped vulnerabilities. In particular, the periods of suckling and weaning are vulnerable times for both mothers and pups. Monitoring studies (Harris et al. 2001) undertaken on the behaviour of phocid seals, more sensitive to sound than otariid pinnipeds, during a near-shore seismic program in Alaska observed that: • During daylight hours seals were seen at nearly identical rates during periods where there were no airguns firing, one airgun 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 airgun 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.

Receptor	Sensitivity description
	• 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 (Harris et al. 2001).

Continuous Sound

Hearing damage in marine mammals from shipping noise has not been widely reported (OSPAR, 2009). Observed marine mammal behaviour to vessel sound includes the following:

- Sea lions (an otariid pinniped similar to fur seals) in water tolerate close and frequent approaches by vessels and sometimes congregate around fishing vessels. However, the amount of evidence is slender, and it is not known whether these animals are affected or are stressed by these encounters (Peterson and Bartholomew, 1967; cited in Richardson et al, 1995).
- Dolphins tolerate or even approach vessels but sometimes show avoidance. Reactions appear to be dependent on the dolphin's activity at the time - resting dolphins tend to avoid boats, foraging dolphins ignore, and socialising dolphins may approach vessels (B. Wursig, pers.obs; cited in Richardson et al, 1995). Dolphins also reduce the energy costs of travel by riding the bow and stern waves of vessels (Williams et al, 1982; cited in Richardson et al, 1995).
- Baleen whales seem to ignore weak vessel sounds and move away in response to strong or rapidly changing vessel noise. Avoidance is particularly strong when vessels approached directly (Watkins, 1986; cited in Richardson et al, 1995). Vessels operating in gray whale breeding lagoons caused short term escape reactions in the species particularly when the vessels are moving fast and erratically, however there is little response to slow-moving or anchored vessels (Reeves 1977; Swartz and Cummings, 1978; Swartz and Jones, 1978, 1981; cited in Richardson et al. 1995). Some whales are attracted to noise from idling outboard motors and are not seriously disturbed by small vessels however calling behaviour may change to reduce masking by boat noise. During migration, gray whales were observed to change course at 200-300 m in order to move around a vessel in their path (Wyrick, 1954; cited in Richardson et al, 1995).

Sound Effect Criteria

The potential for sound to affect animals depends on how well the animals can hear it. Sounds are less likely to affect an animal if they are at frequencies that the animal cannot hear well. In 2015, a U.S. Navy technical report by Finneran (2015) recommended auditory weighting functions with five functional hearing groups for marine mammals in water: low, mid and high-frequency cetaceans, phocid pinnipeds, and otariid pinnipeds. These auditory weighting functions have been used to inform the acoustic modelling as recommended by NMFS (2018).

Impulsive – Seismic Sound

The dominant source of underwater sound during the Sequoia MSS will be from the operation of the seismic source (acoustic source array). There will be limited periods of time when the seismic source is not operational (e.g., during line turns, maintenance and marine fauna shut-downs). Given that underwater sound from the acoustic source array is the dominant source of noise during the Sequoia MSS, the EIA for underwater sound is focussed on the seismic source array rather than vessel operations.

A description of the marine mammal sound effect criteria applicable to the assessment of seismic source sound are presented in Table 4-52 with the maximum distances to the criteria based on the acoustic modelling (Koessler et al., 2020; Appendix E).

Continuous – Vessel Sound

Up to three vessels will be within the Operational Area at one time, generating continuous sound. The operation of motorised vessels involves numerous mechanical processes that create underwater sound as a by-product. These processes range from the sound of the propeller, cavitation caused by propellers, flow noise from the vessel moving through the water, engines and auxiliary machinery in the vessel hull. This sound source will be at a much lower level than that emitted from the acoustic source array and expected to be masked during operation of the acoustic source array.

Seismic vessels in the absence of an operating acoustic source have been measured to have a broadband source level 156.9 – 180.3 dB re 1 µPa @ 1 m (Seiche, 2020). Studies of the radiating underwater sound generated from the thrusters and propellers of support vessels when holding position indicate highest measured levels of up to 182 dB re 1Pa with levels of 120 dB re 1 µPa measured at 3–4 km when the vessel was holding position and between 0.5 to 1 km when underway (McCauley 1998). As levels recorded in McCauley (1998) are similar to a seismic vessel it would be expected that received levels would be similar if not less than the distances of 0.5 to 1 km for 120 dB re 1 µPa as this seismic vessel and support vessels are always moving.

The current interim NFMS (2014) criterion of 120 dB re 1 µPa for non-impulsive sound sources such as vessels is used as the marine mammal behavioural criteria for this assessment as it represents a conservative criterion as Southall et al. (2007) review of literature and studies in relation to marine mammal behavioural response to impulsive (seismic, pile driving) and non-impulsive (drilling, vessels) found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa.

Continuous – Helicopter Sound

Helicopter operation produces strong underwater sounds for brief periods when the helicopter is directly overhead (Richardson et al., 1995). The received sound level underwater depends on the helicopter source altitude and lateral distance, the receiver depth and water depth. Sound emitted from helicopter operations is typically below 500 Hz and sound pressure is greatest at surface in the water directly below a helicopter, but this diminishes quickly with depth. Sound pressure in the water directly below a helicopter is greatest at the surface and diminishes with increasing receiver depth. Richardson et al (1995) reports figures for a Bell 214 helicopter (stated to be one of the noisiest) being audible in the air for four minutes before it passed over underwater hydrophones, but detectable underwater for only 38 seconds at 3 m depth and 11 seconds at 18 m depth. Noise from helicopter activities would therefore be localised and will also be infrequent (as personnel transfers will occur every few weeks, based on the assumption that the crew will undertake their first rotation after mobilising to the vessel from an Australian port).

Table 4-52: Marine Mammal Sound Effect Criteria and Modelled Distances

	Permanent Threshold Shift (PTS)	**Temporary Threshold Shift (PTS)**	**Behaviour**
Source of criteria	PTS is considered injurious in marine mammals but there are no published data on the sound levels that cause PTS. The EIA evaluates dual metric criterion requiring consideration of both PK and accumulated SEL. PTS onset criteria for marine mammals have not been directly measured, but the NFMS (2018) criteria incorporate the best available science to estimate PTS onset in marine mammals from sound energy (SEL24h) or very loud, instantaneous peak sound pressure levels (PK) through extrapolation from available TTS onset measurements.	TTS onset is often defined as a threshold shift of 6 dB above the normal hearing threshold (Southall et al., 2007; 2019). In marine mammals, the onset level and growth of TTS is frequency specific and depends on the temporal pattern, duty cycle and the hearing test frequency of the fatiguing stimuli. There is considerable individual difference in all TTS-related parameters between subjects and species tested to date.	NMFS (NOAA 2019) currently used a step function with a 50% probability of inducing behavioural responses at an SPL of 160 dB re 1 µPa to assess behavioural impacts. This value was derived from the responses of migrating baleen whales to an acoustic source sound (Malme et al., 1983;1984). 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. In recognition of the likely greater sensitivity of southern right whale connecting BIA along the west of King Island and the temporal overlap with the MSS (i.e. August-October); a more precautionary behavioural disturbance criteria has been applied for cow/calf pairs that may be in the BIA during the Sequoia MSS. The Wood et al., 2012 SPL weighted criteria of 140 dB re 1 µPa has been applied for the evaluation of potential impacts to southern right whales cow/calf pairs associated with the BIAs. There is no SEL24h metric for behavioural responses in high-frequency cetaceans, so per pulse SPL of 160 dB re 1 µPa is used to assess these impacts (as it is for all cetaceans).
Justification for criteria	The TTS and PTS criteria are from NFMS (2018), which is the most current, globally recognised technical guidance for assessing the effect of anthropogenic sound on marine mammal hearing. The criteria and weighting functions are identical to those in Southall et al (2019). Given that it is difficult to determine criteria for behavioural response in individual cetaceans due to their varied responses (Nowacek et al., 2004; Wood et al., 2012, Gomez et al., 2016; Southall et al., 2016), which are also influenced by biological and environmental factors such as age, sex, health and activity at the time of exposure, the behavioural disturbance criteria applied is the current NMFS criterion for marine mammals (NOAA 2019) for adult SRWs. This summarises the most recent scientific literature on the impacts of sound on marine mammal hearing and is therefore considered the most relevant to use for this impact assessment. The more conservative Wood et al., 2012		

	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	criteria at which only 50% of individuals exposed are assumed to produce a behavioural response is used for cow-calf pairs.					
Low-Frequency Cetaceans (e.g. Pygmy Blue Whale, Southern Right Whale, Sei, Fin and Humpback Whales)						
Criteria	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (TTS)		Behaviour	
	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs
	219 dB PK	183 dB SEL_{24h}	213 dB PK	168 dB SEL_{24h}	160 dB SPL	NA
Modelled distance R_{max}	30 m	1.18 km	70 m	56.6 km (offshore) 25.9 km (towards King Island) 11.7 km (towards Victorian Coast)	11.1 km	NA
Criteria					140 dB SPL weighted	NA
Modelled distance R_{max}					28 km (offshore) 25 km (towards King Island) 15 km (towards Victorian Coast)	NA
Mid-Frequency Cetaceans (e.g. Sperm Whales, Killer Whales, beaked whales and dolphins)						
Criteria	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs
	230 dB PK	185 dB SEL_{24h}	224 dB PK	170 dB SEL_{24h}	160 dB SPL	NA
Modelled distance R_{max}	Not reached	Not reached	Not reached	80 m	11.1 km	NA
High-Frequency Cetaceans (e.g. Dwarf and Pygmy Sperm Whales)						
Criteria	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs
	202 dB PK	155 dB SEL_{24h}	196 dB PK	140 dB SEL_{24h}	160 dB SPL	NA
Modelled distance R_{max}	340 m	80 m	600 m	320 m	11.1 km	NA
Otariid Pinniped (e.g. Fur Seals and Sea Lions)						
Criteria	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs
	232 dB PK	203 dB SEL_{24h}	226 dB PK	188 dB SEL_{24h}	160 dB SPL	NA
Modelled distance R_{max}	Not reached	Not reached	Not reached	80 m	11.1 km	NA
Phocid Pinniped e.g. True seals						
Criteria	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs	Per pulse	Over 24 hrs

	Permanent Threshold Shift (PTS)		Temporary Threshold Shift (PTS)		Behaviour	
	218 dB PK	185 dB SEL_{24h}	212 dB PK	170 dB SEL_{24h}	160 dB SPL	NA
Modelled distance R_{max}	40 m	80 m	80 m	720 m	11.1 km	NA

4.5.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups of birds depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

As impulsive sound has different sound effect criteria for different marine mammals – and therefore different sensitivities, potential impacts and spatial extents – Underwater Sound (impulsive) has been evaluated separately for the following groups of marine mammals:

- Low-frequency cetaceans (Sections 4.5.2, 4.5.3 and 0)
- Mid and High-frequency cetaceans (Section 4.5.5)
- Pinnipeds (Section 4.5.6).

The Blue Whale and Southern Right Whale have been evaluated in greater detailed because they are listed as Endangered under the EPBC Act, they have biologically important behaviour or known core range within the relevant EMBA; and they are vulnerable to anthropogenic threats (Sections 4.5.2 and 4.5.3).

As continuous sound has the same sound effect criteria for all marine mammal groups, and the severity of the potential impact is lower (i.e. change in fauna behaviour) – all marine mammal species present in the Vessel Sound EMBA have been assessed together in Section 4.5.7.

Multiple species (or species habitat) of marine mammals may occur within the relevant EMBAs. Table 4-53 identifies the presence, biologically important behaviour and protection status for marine mammals for each relevant EMBA.

PMST records identified eight low-frequency (LF) cetaceans within the Seismic sound – Low-frequency EMBA, 18 mid-frequency (MF) cetaceans within the Seismic sound – mid-frequency EMBA, two high-frequency (HF) cetaceans within the Seismic sound – high-frequency EMBA and two Otariid pinnipeds within the within the Seismic sound – Pinniped EMBA. No Phocid pinnipeds were identified in the Seismic sound – Pinniped EMBA.

The National Conservation Values Atlas identified the following BIAs (Table 4-53):

- Blue Whale Foraging Area (annual high use area) BIA within the Operational Area/Helicopter and Vessel Sound EMBA and Seismic sound – Low-frequency EMBA.
- Southern Right Whale Migration and resting on migration BIA and a and Connecting habitat BIA within the Seismic sound – Low-frequency EMBA.

Cetaceans can be categorised as follows:

- Mysticetes (baleen whales, including species such as humpback and Blue Whales) - hear better at lower frequencies (Wartzok & Keeten, 1999; c et al., 2012) and communicate at low frequencies (20 Hz to approximately 5 kHz) using predominantly tonal type calls. In the sound modelling, these are referred to as low-frequency cetaceans (LF).

- Odontocetes (beaked whales, including species such as killer whales, sperm whales and dolphins) - hear best at higher frequencies and communicate using both tonal signals (up to approximately 30 kHz) and echolocation clicks (peak frequencies range from approximately 40 – 130 kHz), which they also use for hunting and navigation (Au et al., 2000). In the sound modelling, these are referred to as mid-frequency cetaceans (MF).
- Other odontocetes (porpoises, dwarf and pygmy sperm whales, river dolphins) - generally produce narrow band, high-frequency echolocation signals. In the sound modelling, these are referred to as high-frequency cetaceans (HF).

Pinnipeds (seals and sea lions) produce sounds over a generally lower and more restricted bandwidth (generally from 100 Hz to several tens of kHz) than cetaceans. Their sounds are used primarily in critical social and reproductive interactions (Southall et al., 2007). Most pinniped species have peak sensitivities between 1 and 20 kHz (NRC, 2003).

The type and scale of the effect of underwater sounds on marine mammals will depend on a number of factors including 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; Southall et al., 2016).

High levels of anthropogenic underwater noise can have potential effects on marine mammals ranging from changes in their acoustic communication, behavioural disturbances and in more severe cases physical injury or mortality (Richard et al., 1995).

Values and Sensitivities

Table 4-53 describes the values and sensitivities of marine mammals within the relevant EMBAs.

Marine mammal species identified via PMST or National Conservation Values Atlas tools have been identified as a major conservation value in the South-East Regional Plan (CoA, 2015). All marine mammals are protected under the EPBC Act in the Australian Whale Sanctuary and, to some extent, beyond its outer limits (CoA, 2015).

Receptors have been grouped according to low, medium and high frequency sound sensitivity.

Zeehan AMP and Marine Mammals

The Operational Area and sound EMBAs overlap the Multiple Use Zone (IUCN VI) of the Zeehan AMP and adjoins the Special Purpose Zone (IUCN VI (Figure 4-23). The major conservation values for the Zeehan AMP relevant to this assessment are (DNP,2013):

- Important migration area for Blue (LF) and Humpback Whales (LF).

Of these two whale species, the PMST search identified that foraging, feeding or related behaviour is known to occur within the sound EMBAs for the Blue Whale.

Additional description of Zeehan AMP can be found in Appendix H.

Apollo AMP and Marine Mammals

The sound EMBAs overlaps the Multiple Use Zone (IUCN VI) of the Apollo AMP (Figure 4-23). The major conservation values for the Apollo AMP relevant to this assessment are (DNP,2013):

- Important migration area for Blue (LF), Fin (LF), Sei (LF) and Humpback Whales (LF).

The PMST identified that foraging, feeding or related behaviour is likely to occur within the sound EMBA for Sei and Fin Whales, may occur for Pygmy Right Whale and is known to occur for Pygmy Blue Whales.

Although not a value of the marine park, other marine mammals, such as dolphins and seals, are included in the general description of the Apollo AMP for their known foraging behaviour (DNP 2013).

Additional description of Apollo AMP can be found in Appendix H.

West Tasmania Canyons KEF and Marine Mammals

The West Tasmania Canyons KEF intersects the sound EMBA (Figure 4-23).

There are no marine mammal species listed as a specific value of this KEF. However, the high productivity associated with West Tasmania Canyons is commonly thought to influence marine mammal foraging behaviours and seasonality.

Additional description of West Tasmania Canyons KEF can be found in Appendix H

Bonney Coast Upwelling KEF and Marine Mammals

Although the Bonney Coast Upwelling is not within the extent of the sound EMBAs, it is a known foraging ground, seasonally attracting whale species to the area due to the abundant swarms of krill which are nourished by the Bonney Upwelling (CoA, 2015). The Bonney Coast Upwelling KEF is ~120km from the Sequoia MSS Operational Area.

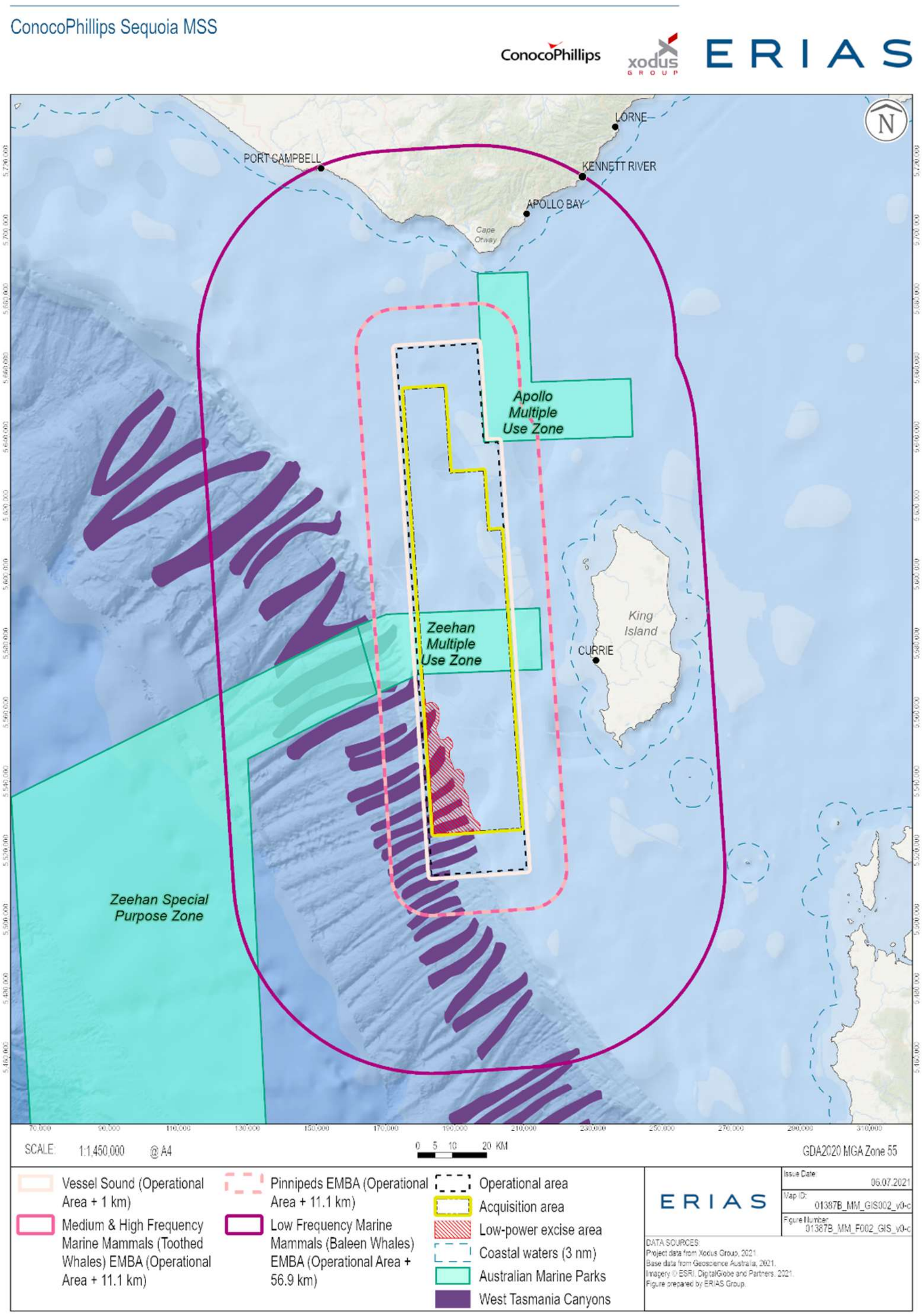


Figure 4-23: Sound EMBAs overlap with AMPs and KEFs relevant to Marine Mammals

Table 4-53: Marine Mammal species that may occur within the EMBAs and Protection Status

Scientific name	Common name	Type of Presence – EMBA				Biologically important area / habitat critical to the survival of the species			EPBC Status / Protection Level			
		Operational Area	Vessel Sound EMBA	Seismic sound (LF) EMBA	Seismic sound (MF, HF, Pinnipeds) EMBA	Operational Area, Helicopter & Vessel Sound EMBA	Seismic sound (LF) EMBA	Seismic sound (MF, HF, Pinnipeds) EMBA	Threatened Species*	Migratory Species*	Listed Marine Species	EPBC Management Plan
Low-frequency (LF) cetaceans												
Balaenoptera acutorostrata	Minke Whale	MO	MO	MO	NA	-	-	NA	-	-	-	-
Balaenoptera bonaerensis	Antarctic Minke Whale	LO	LO	LO	NA	-	-	NA	-	✓	-	-
Balaenoptera borealis	Sei Whale	FLO	FLO	FLO	NA	-	-	NA	V	✓	-	Conservation Advice *Balaenoptera borealis* Sei Whale (DoE 2015b)
Balaenoptera musculus	Blue Whale (and Pygmy Blue Whale)	FKO	FKO	FKO	NA	F+, FKO, (Jan – Apr)	F+, FKO, (Jan – Apr)	NA	E	✓	-	Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (DoE, 2015e)
Balaenoptera physalus	Fin Whale	FLO	FLO	FLO	NA	-	-	NA	V	✓	-	Conservation Advice *Balaenoptera physalus* Fin Whale (DoE, 2015c)
Eubalaena australis	Southern Right Whale	KO	KO	KO	NA	-	MR, CH (May-Nov)	NA	E	✓	-	Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021 (DSEWPC, 2012)
Megaptera novaeangliae	Humpback Whale	KO	KO	KO	NA	-	-	NA	V	✓	-	Conservation Advice *Megaptera novaeangliae* Humpback Whale (DoE, 2015d)
Caperea marginata	Pygmy Right Whale	FMO	FMO	FMO	NA	-	-	NA	-	✓	-	-

Mid-frequency (MF) cetacean												
Berardius arnuxii	Arnoux's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Delphinus delphis	Common Dolphin	MO	MO	NA	MO	-	NA	-	-	-	-	-
Globicephala macrorhynchus	Short-finned Pilot Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Globicephala melas	Long-finned Pilot Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Grampus griseus	Risso's Dolphin	MO	MO	NA	MO	-	NA	-	-	-	-	-
Lagenorhynchus obscurus	Dusky Dolphin	LO	LO	NA	LO	-	NA	-	-	✓	-	-
Lissodelphis peronii	Southern Right Whale Dolphin	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon bowdoini	Andrew's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon densirostris	Blainville's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon grayi	Gray's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon hectori	Hector's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon layardii	Strap-toothed Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Mesoplodon mirus	True's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Orcinus orca	Killer Whale	LO	LO	NA	LO	-	NA	-	-	✓	-	-
Pseudorca crassidens	False Killer Whale	LO	LO	NA	LO	-	NA	-	-	-	-	-
Physete macrocephalus	Sperm Whale	MO	MO	NA	MO	-	NA	-	-	✓	-	-
Torsiops truncates s. str.	Bottlenose Dolphin	MO	MO	NA	MO	-	NA	-	-	-	-	-
Tursiops aduncus	Indian Ocean Bottlenose Dolphin	-	-	NA	-	-	NA	-	-	-	-	-
Ziphius cavirostris	Cuvier's Beaked Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
High-frequency (HF) cetacean												
Kogia breviceps	Pygmy Sperm Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Kogia simus	Dwarf Sperm Whale	MO	MO	NA	MO	-	NA	-	-	-	-	-
Pinnipeds												
Arctocephalus forsteri	New Zealand Fur-seal	MO	MO	NA	MO	-	NA	-	-	-	✓	-

Arctocephalus pusillus	Australian Fur-seal	MO	MO	NA	MO	-	NA	-	-	-	✓	-

Type of Presence: *MO Species of species habitat may occur within area* *LO Species or species habitat likely to occur within area* *KO Species or species habitat known to occur within area* *FMO Foraging, feeding or related behaviour may occur within area* *FMO Foraging, feeding or related behaviour likely to occur within area* *FKO Foraging, feeding or related behaviour known to occur within area*	*Threatened Species:* *V Vulnerable* *E Endangered* *CE Critically Endangered* *Migratory Species:* *M Marine* *W Wetland* *T Terrestrial*	*BIA* *KFO Known foraging area* *F+ Foraging Area (annual high use area)* *MR Migration and resting on migration* *CH Connecting habitat*

*✓= Listed Migratory/Marine species *= Matter of National Environmental Significance*

Source: Appendix J

4.5.1.5. Legislative Requirements

Table 4-54 identifies the minimum legislative and other requirements that are relevant to marine mammals. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-54: Other Requirements for Marine Mammals

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Guidelines	EPBC Policy Statement 2.1 Interaction between offshore seismic exploration and whales	Provides practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations and provides 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.	Environmental impact assessment for underwater sound on marine mammals has been completed in this Section. Adoption of control measures refer to Environmental Performance section in Appendix A)
EPBC Management Plans	Conservation Management Plan for the Blue Whale - A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 (DOE 2015e)	Identifies noise interference as a threat. No explicit relevant objectives. Management Action Area A.2 (assessing and addressing anthropogenic noise): Improved management and understanding of what impact anthropogenic noise may have on Blue Whales by: • Assessing the effect of anthropogenic noise on Blue Whale behaviour. • 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. • EPBC Act Policy Statement 2.1—Interaction between offshore seismic exploration and whales is applied to all seismic surveys.	
EPBC Management Plans	Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021 (DSEWPC 2012)	Identifies noise interference as a threat. No explicit relevant objectives. Management Action Area A.2 (assessing and addressing anthropogenic noise): • 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. • If necessary, developing further mitigation measures for noise impacts.	
EPBC Management Plans	Conservation advice *Balaenoptera borealis* Sei Whale (TSSC 2015a)	Identifies anthropogenic noise and acoustic disturbance as a threat. No explicit relevant objectives. Relevant management action: • Once the spatial and temporal distribution (including biologically important areas) of Sei Whales is further defined an assessment of the impacts of increasing anthropogenic noise (including from seismic surveys, port	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
		expansion, and coastal development) should be undertaken on this species.	
EPBC Management Plans	Conservation advice *Balaenoptera physalus* Fin Whale (TSSC 2015b)	Identifies anthropogenic noise and acoustic disturbance as a threat. No explicit relevant objectives. Relevant management action: • Once the spatial and temporal distribution (including biologically important areas) of Fin Whales is further defined an assessment of the impacts of increasing anthropogenic noise (including from seismic surveys, port expansion, and coastal development) should be undertaken on this species.	
EPBC Management Plans	Approved Conservation Advice for *Megaptera novaeangliae* (Humpback Whale) (TSSC 2015c)	Identifies noise interference as a threat. No explicit relevant objectives. Relevant management action: • All seismic surveys must be undertaken consistently with the EPBC Act Policy Statement 2.1 – Interaction between offshore seismic exploration and whales. Should a survey be undertaken in or near a calving, resting, foraging area, or a confined migratory pathway then Part B. Additional Management Procedures must also be applied. • For actions involving acoustic impacts (example pile driving, explosives) on Humpback Whale calving, resting, feeding areas, or confined migratory pathways site specific acoustic modelling should be undertaken (including cumulative noise impacts). • Should acoustic impacts on Humpback calving, resting, foraging areas, or confined migratory pathways be identified a noise management plan should be developed.	
Marine Reserves Management Plans	South-east Commonwealth Marine Reserves Network management plan 2013-23	Apollo AMP, identifies the following as major conservation values: • Blue Whale migration • Sei Whale migration • Fin Whale migration • Humpback Whale migration Zeehan AMP, identifies the following as major conservation values: • Blue Whale migration • Humpback Whale migration	

4.5.2. Impact Assessment – Blue Whales

4.5.2.1. Existing Environment

Values

The Blue Whale (EPBC Act: Endangered; listed Migratory) is present in waters off Australia's Antarctic Territory and is widespread in all Australian waters at various times of the year (DAWE, 2020d). There are two subspecies of Blue Whales that use Australian waters (including Australian Antarctic waters), the Pygmy Blue Whale (PBW) (*B. m. brevicauda*) and the Antarctic Blue Whale (*B. m. intermedia*) (DoE, 2015b).

The species is oceanic and appears to undertake extensive migrations between warm water (low latitude) breeding areas and cold- water feeding grounds during summer between approximately 20oS and 60-70oS (Bannister et al., 1996; DoE, 2015b). Migration pathways are not known however it is thought the species migrates to Antarctic waters in early summer and leaves in autumn migrating to tropical breeding areas (Indonesian and possibly southwest Pacific waters) during winter (DAWE, 2020d). Blue Whales have extensive, global migration patterns that are not known to follow particular coastlines or oceanographic features (Bannister et al., 1996). Exact breeding ground locations are also not known (Bannister et al., 1996) however it is thought a region in deep oceanic waters around the Indonesian archipelago may be significant (DAWE, 2020d).

Migration

PBW do not migrate as far south (to approximately 55^{o}S) as the Antarctic Blue Whale (Bannister et al., 1996). While Antarctic Blue Whales appear to feed mainly, if not exclusively, in the Antarctic, PBW feed in more temperate latitudes. It is therefore likely that records of Blue Whales feeding in Australian waters between are PBW (DEH, 2005b). The PBW feeds on pelagic crustaceans (zooplankton including krill, salps and copepods) (DAWE, 2020d). The PBW distribution around Australia is provided in Figure 4-24; and migration pathways are provided in Figure 4-25.

Photo-identification has confirmed within and between season PBW move between the Bonney upwelling and Perth Canyon feeding areas (Garcia-Rojas et al., 2018). Satellite tagged individuals have been tracked migrating north from the Perth Canyon to Indonesian waters almost to the equator, the likely breeding area for this population (Branch et al., 2007; Gales et al., 2010; Double et al., 2014: cited in Garcia- Rojas et al., 2018).

The Subtropical Front (confluence of sub-tropical and subantarctic waters between 40-45^{o}S) is likely to be a large-scale feeding area (Mikhalev, 2000; cited in DAWE, 2020d). Satellite tagging has shown rapid movement from western and eastern Australia to the Subtropical Front – an area targeted by Soviet whalers during the 1960s (Mikhalev, 2000; cited in DAWE, 2020d) (Figure 4-26).

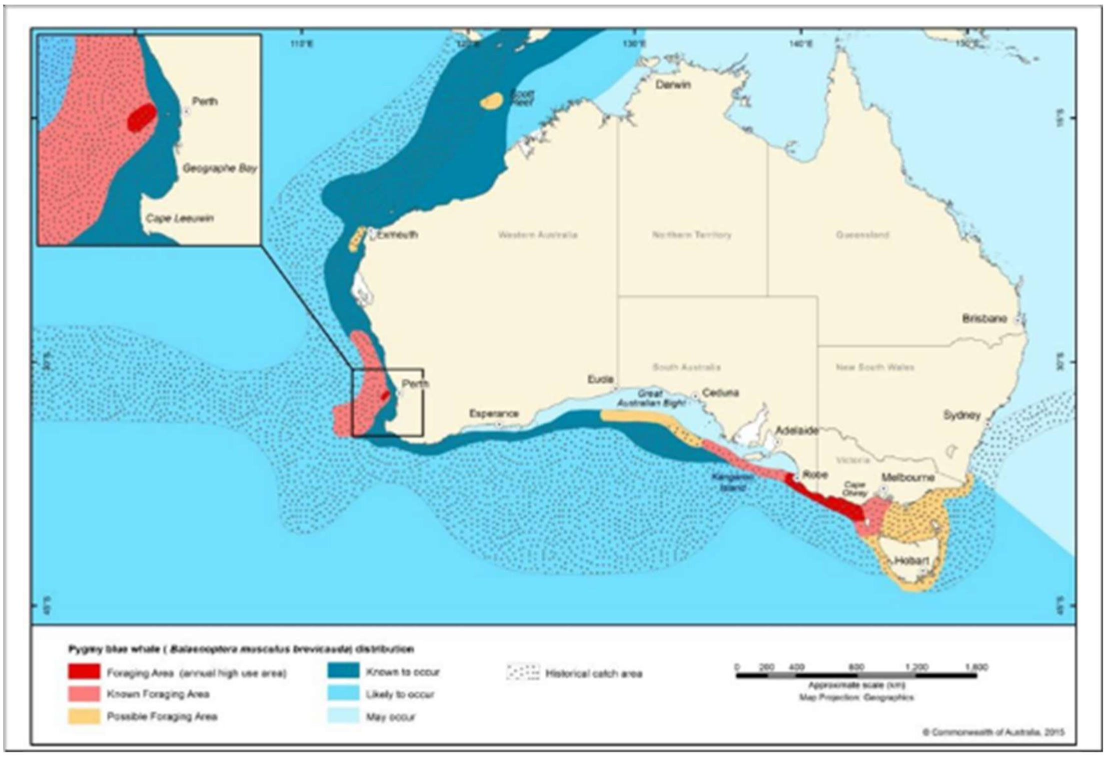


Figure 4-24: PBW distribution around Australia

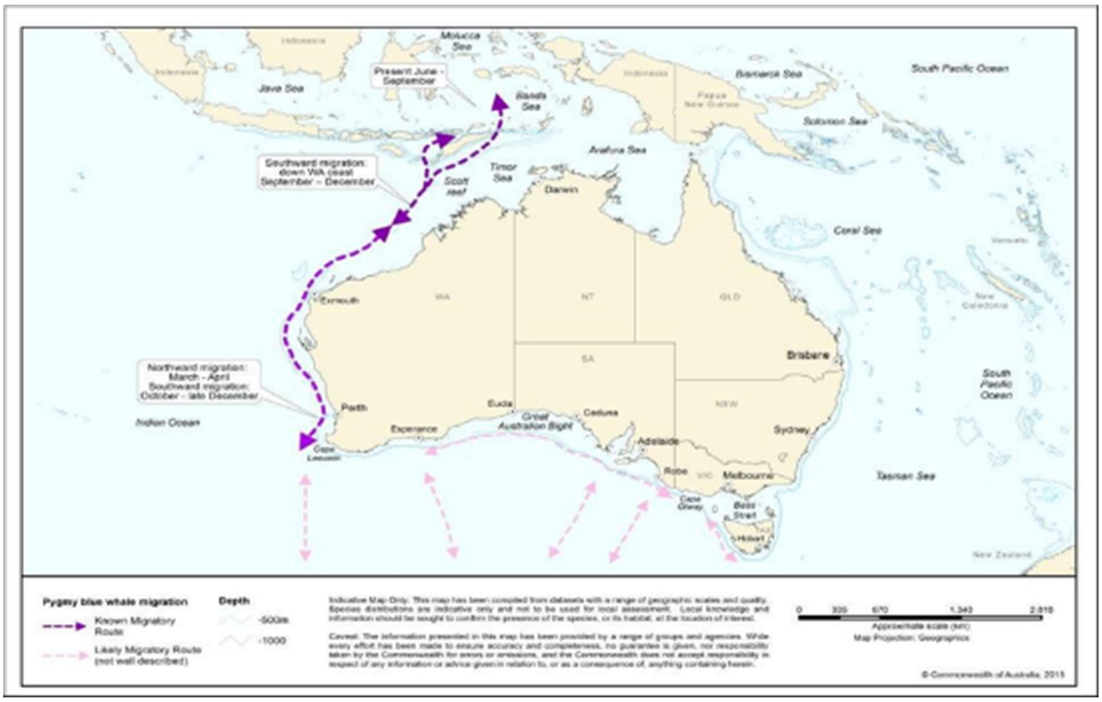
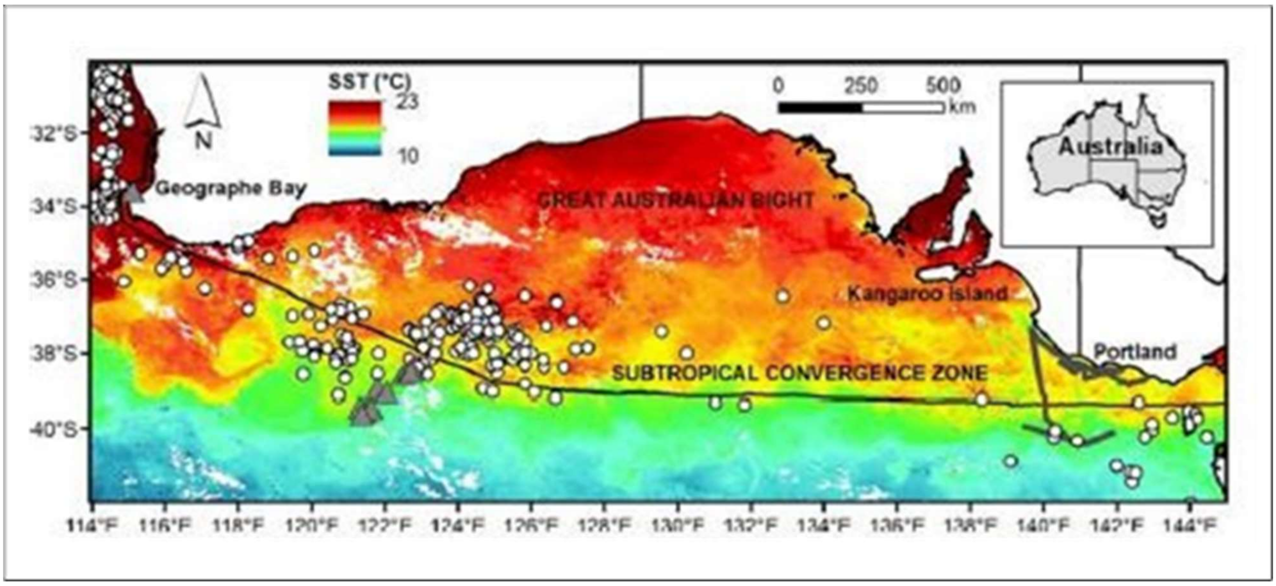


Figure 4-25: PBW Migration Routes



Source: Garcia, Rojas et al. (2018)

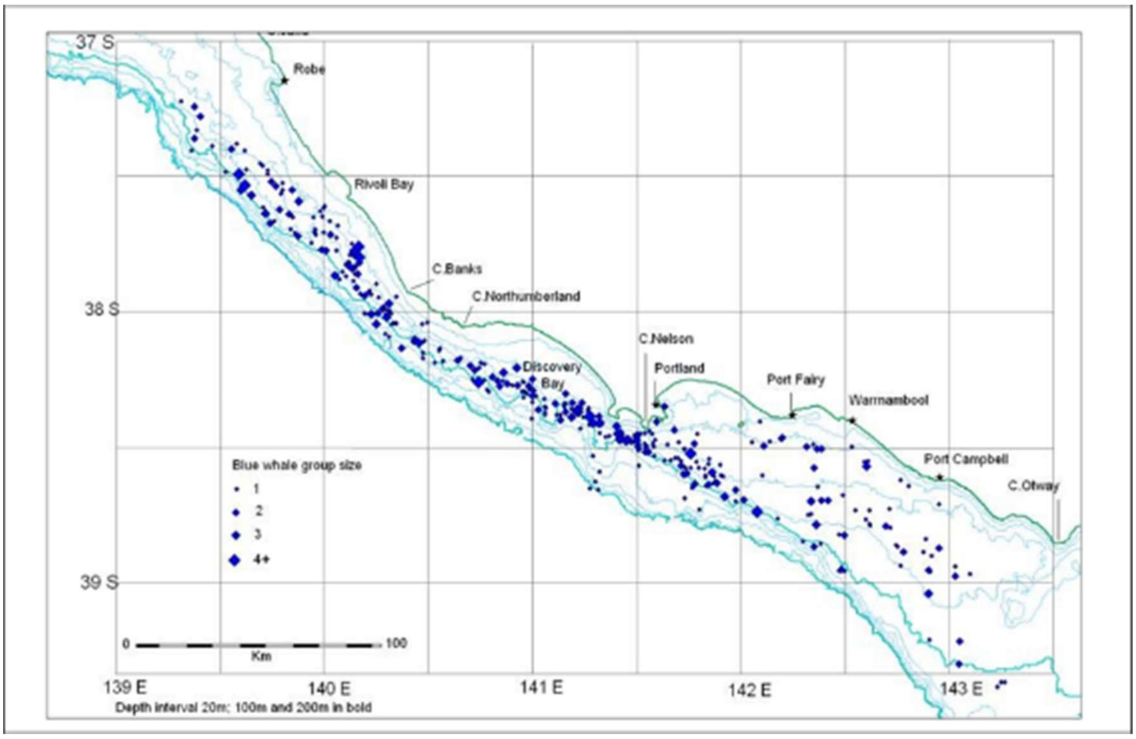
Figure 4-26: Satellite tracking of PBW individuals in the STC zone between 4th of December 2002–31st of January 2003 (grey triangles) and historical Soviet whaling catches of PBW (white circles)

PBW Temporal Presence in the Otway Basin

Key feeding areas within Australian waters for the PBW are the Bonney Upwelling system and adjacent waters off South Australia and Victoria and the Perth Canyon off Western Australia (Figure 4-24). The continental shelf area between Robe and Cape Otway is a foraging area with high annual use where the PBW feed on abundant swarms of coastal krill (*Nyctiphanes australis*) nourished by the Bonney Upwelling, a seasonal event where nutrient rich cold waters are pushed to the surface from the deeper ocean (DoE, 2015b) (refer to Appendix H). PBW 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, then move south-east to the Bonney Upwelling system off eastern South Australia and Victoria (between Robe, SA and Cape Otway, Vic) from January to April and then decrease between May and June (Commonwealth of Australia, 2015c).

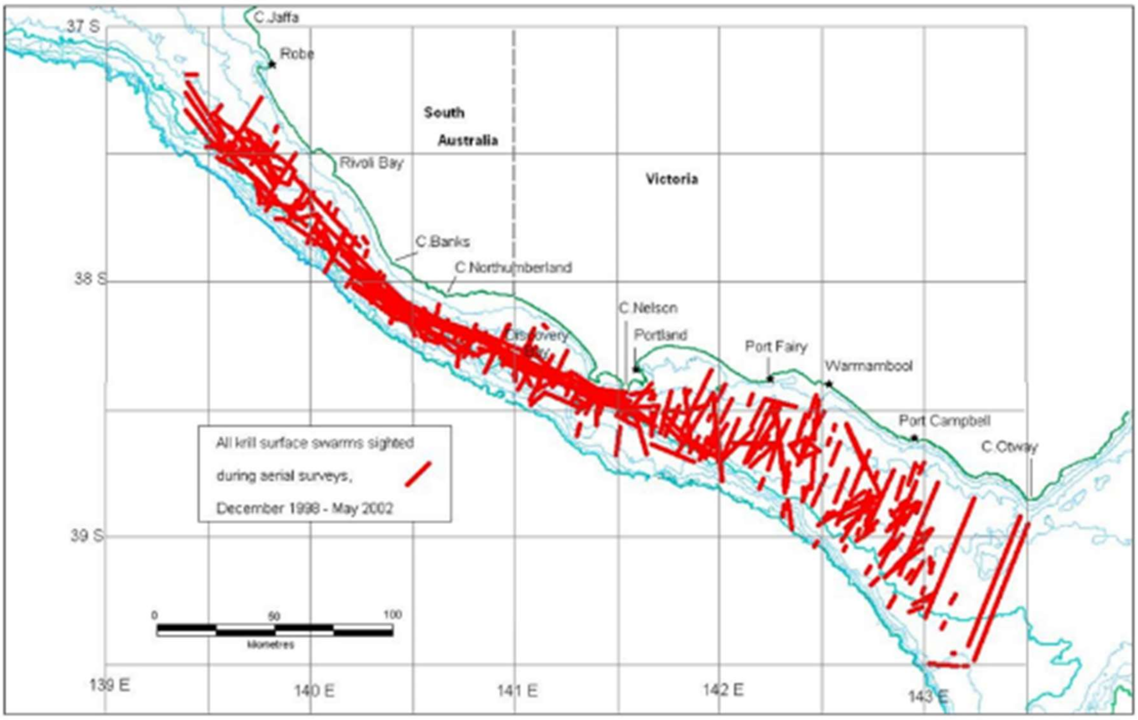
Branch et al (2007), based upon PBW records for historic catch, sightings, strandings, mark-recapture movement studies and acoustic detections (period 1950-2007), established a low seasonal presence between June and October with increased sightings from November and December. Aerial surveys (1998- 2001) did not sight PBW during June-October (Gill, 2002; cited in Gill et al., 2011). Non-systematic surveys conducted between June and October have found no whales, nor have any been reported from other sources (Thiele 2005; cited in DAWE, 2020d).

The Blue Whale Study (BWS), the longest-running Blue Whale research program in the Southern Hemisphere, undertook a review of relevant research projects pertaining to PBW presence in the Otway Basin (Gill, 2020). The primary research method utilised by BWS was aerial surveys, complemented to a lesser degree by yacht- and small vessel-based studies. Between 1998 and 2003, aerial surveys established the distribution of PBW as presented in Figure 4-27 (Gill, 2020), which correlated to surface swarms of krill during the same period (Figure 4-28). At that time, surveys did not extend beyond Robe or Cape Otway. During the surveys, PBW were sighted between November to May and were absent during surveys conducted between June - October (Gill, 2020). The presence of PBW coincided with the period of active upwelling and the period immediately after active upwelling (April – May) when the region is still enriched by the upwelling (Gill, 2020).



Source: Gill (2020)

Figure 4-27: Sightings of PBW from aerial survey during 1998-2003. Bathymetry shown to 200m isobath

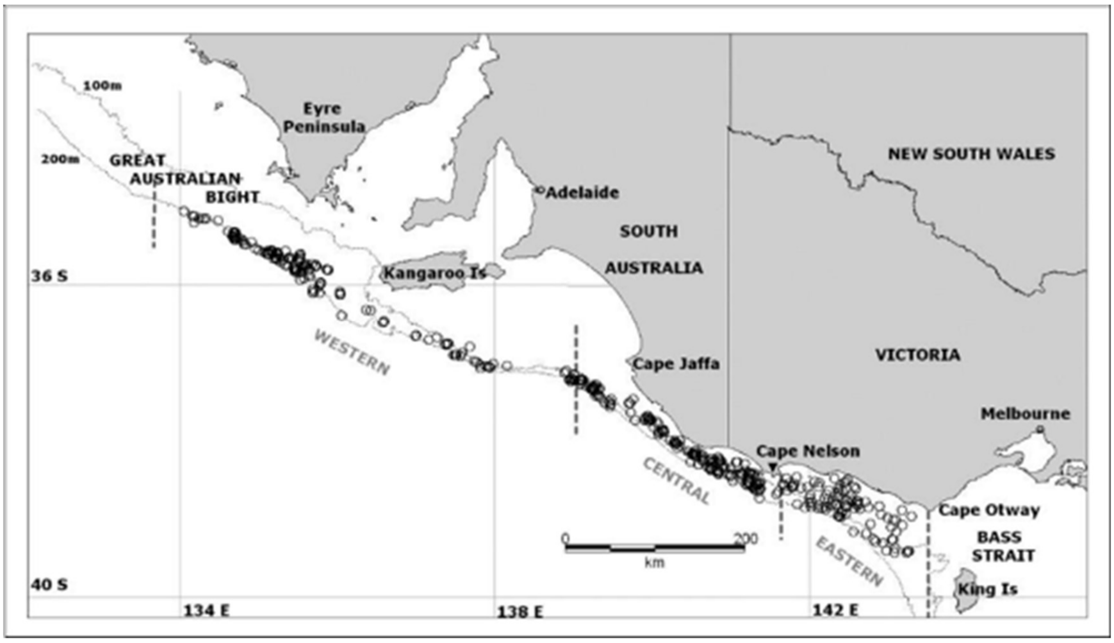


Source: Gill (2020)

Figure 4-28: Distribution of Krill surface swarms sighted from aerial surveys during 1998-2003

Gill et al (2011) undertook 69 aerial surveys between January 2002 and May 2007 to establish the spatial and temporal variation of abundance and distribution of PBW in the area extending from west of Kangaroo Island (~136°E) to Cape Otway (Vic) during the upwelling season (November-May). The total survey area was partitioned into western, central and eastern zones and differentiated physio-graphically by variations in shelf width, shelf orientation and sea surface temperature (SST). The central zone lies along the narrow shelf where the Bonney Upwelling surface plume is expressed (Gill, 2020). The Eastern zone occupies the broader shelf between Cape Nelson and Cape Otway, which is also subject to a largely subsurface upwelling except for nearshore surface plumes during strong upwelling events (Gill, 2020). The survey area partially overlaps the eastern zone. The following observations were made during the 2002-2007 surveys with respect to PBW:

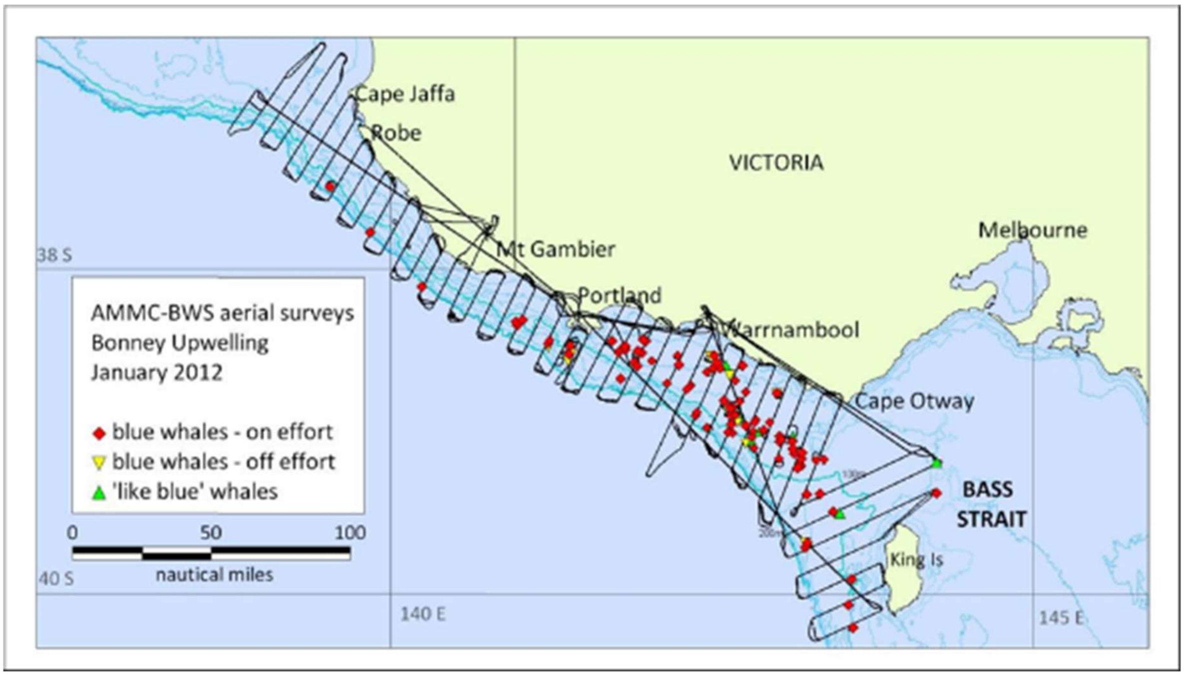
- PBW are usually restricted to the western and central zones in November entering the eastern zone in December (Figure 4-29)
- PBW are widely spread through the central and eastern zones during January-April
- In the eastern zone, encounter rates peak in February (9.8 whales/1,000 km); dropping slightly to 8.8 whales/1,000 km in March; then declining to approximately 4 whales/1,000 km in April and to a single sighting in May (0.4 whales/1,000 km). Encounter rates in November are zero and in December is 1 whale/1,000 km (Figure 4-27)
- The central zone received less survey coverage than the Eastern Zone (20,339 km vs 24,380 km), yet more PBW were sighted in the central zone, with the encounter rate in the central zone more than twice that in the eastern zone (11 whales/1,000 km vs 4.8 whales/1,000 km)
- The central zone is most consistently used by PBW (located 165 km northwest to the survey area at its closest point)
- Eighty percent (80%) of PBW are encountered at depths between 50–150 m and 93% of sightings occurred in water depths <200 m in the eastern and central zones with 10% of sightings within 5 km of the 200 m isobath
- A mean PBW group size of 1.3±0.6 was observed per sighting record with cow-calf pairs observed in 2.5% of the sightings. This group size minimises the potential for prey competition (DAWE, 2020d)
- The overall pattern of seasonal distribution implied that PBW start foraging from the west early in the upwelling season (about November), spread eastward through the central and eastern zones until April, then possibly contract toward the central zone prior to departure for wintering grounds in April or May
- No PBW were sighted in the eastern zone in November of any year and peak months in this zone were February and March.



Source: Gill et al. (2011)

Figure 4-29: Distribution of Blue Whale sightings 2002-2007

In January 2012, the BWS conducted six aerial surveys across the Bonney Upwelling/Otway Shelf feeding area to coincide with a vessel-based Blue Whale acoustic research program (Gill, 2020). All sightings from the surveys are shown in Figure 4-30. Unlike previously reported results, the surveys conducted in January 2012 recorded a near-absence of PBW in the central zone and a comparatively high abundance of whales in the eastern zone (Gill, 2020).



Source: Gill (2020)

Figure 4-30: Blue Whale sightings and tracks from January 2012

In an effort to avoid peak PBW presence in the Otway region, Origin Energy conducted MSS activities during November and December in 2012 (Gill, 2020). BWS flew monthly aerial surveys of the Astrolabe and Bellerive prospects from June 2012 to investigate temporal changes in marine mammal presence. No PBW were sighted between June-October 2012, though whales and dolphins were observed during November (Gill, 2020). During late November 2013, the BWS conducted aerial surveys during an MSS located on the outer shelf between Warrnambool and Port Campbell. A total of 19 and 31 PBW were sighted on two survey days, all near the 200 m shelf break (Gill, 2020).

Summary

The noise EMBAs overlap an area of high productivity and seasonal upwelling. Evidence suggests the region acts as an important, and consistently used PBW foraging area (Figure 4-31). Seasonally PBW are expected to be observed during the November-May period, which defines the upwelling season and post-welling enrichment of the region. Sightings of PBW in the region between June-October are rare. Therefore, it is not expected PBW will be present in high numbers during the Sequoia MSS (August to October).

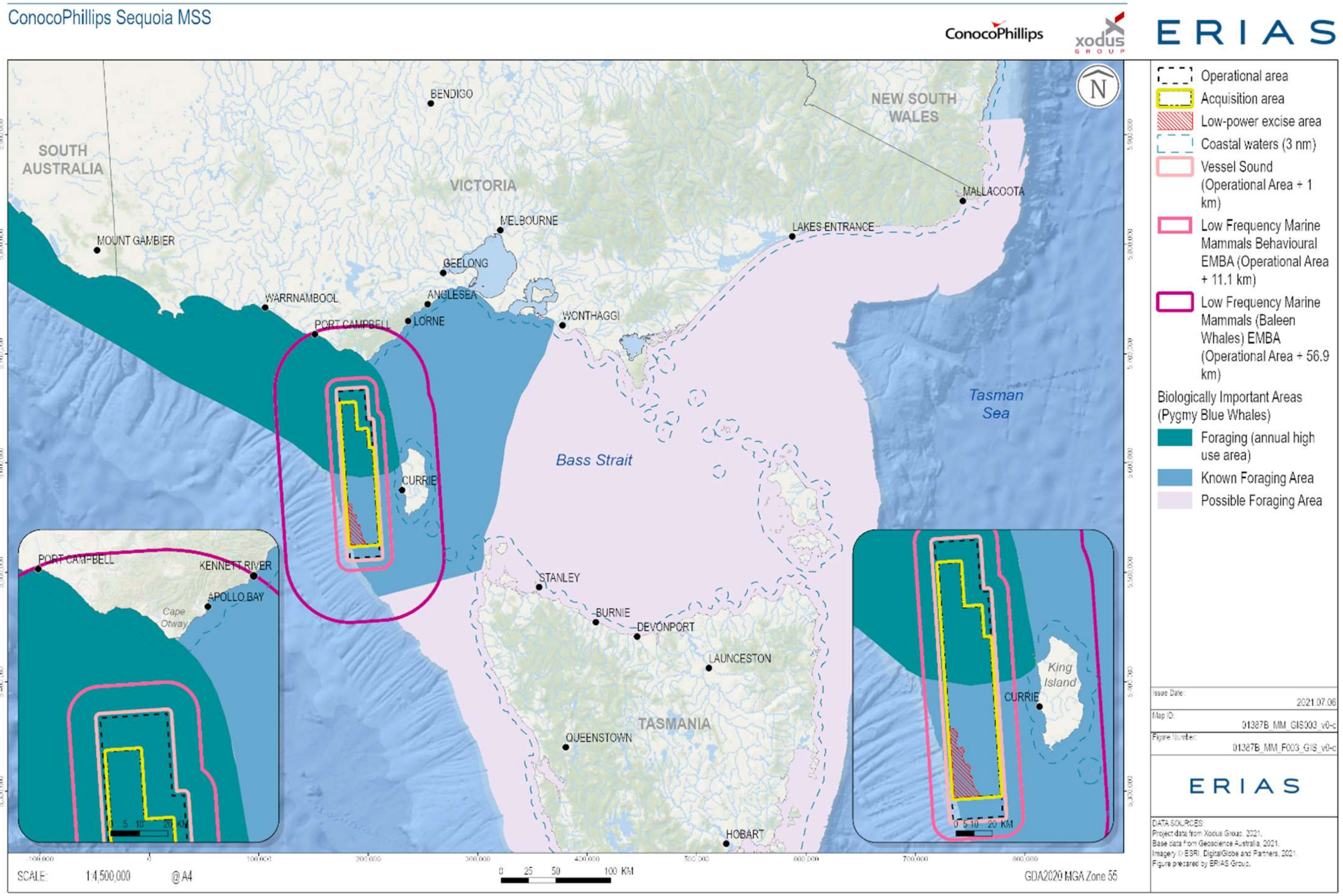


Figure 4-31: PBW foraging areas intersected by the Operational Area and the EMBA

Sensitivities

The Blue Whale is currently listed as an endangered species under the Commonwealth EPBC Act. The Antarctic Blue Whale subspecies remains severely depleted from historic whaling and its numbers are recovering slowly. For the Pygmy Blue Whale there is uncertainty in the number's pre-exploitation, and their current numbers are not known (DoE 2015e).

According to the Recovery Plan (DoE 2015e), along with a heavily depleted population status from whaling activities, there are also several life cycle traits of Blue Whales which make them vulnerable to a wide range of anthropogenic threats; these include:

- High age at sexual maturity (10 years old)
- Slow reproductive rates (calve every 2 to 3 years with gestation taking 10 months)
- Foraging grounds requiring high primary productivity (whales have the highest known prey requirements of any predator, requiring two tonnes of krill per day)
- Migration over long distances for foraging and breeding activities

All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.

4.Existing Pressures

In Australia, Blue Whales are managed under the Blue Whale Conservation Management Plan (CMP) (DoE 2015a). There are a range of anthropogenic threats that affect Blue Whales. The risk posed by these threats vary depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015e).

Key threats identified in the CMP (DoE 2015e) include whaling, climate variability and change, noise interference (including cumulative impacts from previous and simultaneous activities in the area, i.e. seismic, drilling, vessels), and vessel disturbance.

Due to the long-lived nature of Blue Whales, as well as their highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire life cycle causing a cumulative impact on a stock. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017b).

Local pressures within the relevant EMBA are likely to include climate change and variability, marine debris – entanglement, vessel interference, and anthropogenic noise pollution, including other petroleum activities.

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys and drilling activities in the area.

Beach Energy are undertaking a drilling program throughout 2021. The drilling will occur concurrently with the Sequoia MSS. The Seismic Sound – LF cetacean EMBA for TTS (56.6 km) extends into the drilling area. However, as the timing of the Sequoia MSS avoids PBW migration and foraging in the region, cumulative impacts to the Blue Whale from overlap with drilling activities occurring concurrently are not predicted.

4.5.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to Blue Whales have been evaluated in Table 4-55; having had regard to the legislative and other controls (Section 4.5.1.5).

Table 4-55: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for Blue Whales

<table>
<tr><th>Emissions – Underwater Sound (Impulsive)</th><th>Consequence</th></tr>
<tr><td><u>Change in fauna behaviour</u>
Predicted maximum distances to sound exposure guidelines for relevant to Blue Whales (Table 4-52) are:
• Behavioural response: 11.1 km
The extent of the impact is predicted to be within a maximum distance of 11.1 km from the seismic source at any point in time during the Sequoia MSS acquisition between August and October. Based on the maximum modelled horizontal distance for behavioural response (11.1 km), the area where marine mammal behaviour may be affected by sound at any point in time (i.e. increased vigilance or potential avoidance) (Purser & Radford, 2011) is ~390 km^2 around the source, or 1% of the PBW annual high use foraging BIA (35,627 km^2). The severity is assessed as Negligible (1) based on:
• The area of impact for behavioural response intersects 1% of the PBW annual high use foraging BIA.
• The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with Blue Whales, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The absence of temporal overlap avoids impacts to foraging Blue Whales.</td><td>Negligible (1)</td></tr>
<tr><td><u>Change in hearing via permanent and temporary threshold shift</u>
Predicted maximum distances to sound exposure guidelines relevant to Blue Whales (Table 4-52) are:
• Temporary Threshold Shift (TTS)
  o PK Criteria: 70 m
  o SEL 24hr Criteria 56.6 km in the offshore direction
  o SEL 24hr Criteria 25.9 km towards King Island
  o SEL 24hr Criteria 11.7 km towards the Victorian Coast
  o Total SEL 24hr area 6,524 km^2
• Permanent Threshold Shift (PTS)
  o PK Criteria: 30 m.
  o SEL 24hr Criteria: 1.18 km (319 km2)
The extent of TTS impact is predicted to be within a maximum distance of 56.6 km from the seismic source for the duration of the Sequoia MSS acquisition between August and October. Modelling predicts the exposure area for TTS, the area within which residing low frequency cetaceans could experience TTS over a 24-hour period, is 6,524 km^2. This area represents 18% of the PBW annual high use foraging BIA (35,627 km^2).
The extent of PTS impact is predicted to be within a maximum distance of 1.18 km from the sound source for the duration of the Sequoia MSS acquisition between August and October. Modelling predicts the exposure area for PTS, the area within which residing low frequency cetaceans could experience PTS over a 24-hour period, is 319 km^2. This area represents 0.89% of the PBW annual high use foraging BIA (35,627 km^2).
The severity is assessed as Negligible (1) based on:
• The distances to the per pulse criteria is 30 m for PTS and 70 m for TTS. Thus, as it would be unlikely for a whale to be within 30 m or 70 m of the seismic source, per pulse PTS and TTS impacts are not predicted to PBW.</td><td>Negligible (1)</td></tr>
</table>

• The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with Blue Whales, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The absence of temporal overlap avoids impacts to migration and foraging Blue Whales.	

4.5.3. Impact Assessment – Southern Right Whale

4.5.3.1. Existing Environment

Values

The Southern Right Whale (SRW) (EPBC Act: Endangered; listed Migratory) is distributed in the southern hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They are seasonally present on Australia's southern coastline, distributed in the southern hemisphere between 20oS and 60oS and generally occupy shallow sheltered bays that offer protection from south westerly weather, within 2 km of the shore and in water depth of less than 10 m (Charlton, 2017). The species is regularly present on the Australian coast between early-April to early November with isolated individuals seen outside these periods (DSEWPC, 2012c).

The SRW is pelagic in summer foraging in the open Southern Ocean (Bannister et al., 1996) between 32° and 65°S, with their main feeding areas thought to occur between 40oS and 55oS (DSEWPC, 2012c), and migrates from the subantarctic to southern Australian coastal waters to calve and mate (Mustoe & Ross, 2004).

Gill et al. (2015) assessed the presence of cetacean species over the continental shelf/slope waters between western Bass Strait to the eastern GAB (Cape Otway to Cape Jaffa) from systematic aerial surveys between 2002 and 2013. These surveys were undertaken across all months with the highest seasonal effort from April to November. There were twelve sightings of SRW, most often between June and September, with 52 individuals identified in a mean group size 4.2 ± 4.2. Recorded encounter data per 1,000 km of survey distance for the period the SRW was observed is listed below:

- May - 0 whales sighted.
- June – 0.8 whales sighted.
- July – 3.1 whales sighted.
- August – 6.8 whales sighted.
- September – 8.8 whales sighted.
- October – 0 whales sighted.

The peak period for SRW mating is from mid-July through to August (DSEWPC, 2012c). 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 (DSEWPC, 2012c).

In recent decades, sightings of SRW have been recorded around the coastline of Tasmania with most sightings occurring on the east coast, particularly in the south east region. The areas of most frequent use are consistent with the locations of the whaling stations and reflect the areas of sheltered bays and shallow water where the whales used to congregate and breed in large numbers (AMMC, 2012). Within Tasmanian waters, the seasonal occurrence of SRW is most observed between June and August, although they have been reported in all months (AMMC, 2009). Reports of these whales in Tasmania show an overall increase in recent years, notwithstanding significant inter-annual variation and increasing observations of whale aggregations remaining in the area for increasing periods, increasing observations of feeding and highly active and social behaviours. Cow-calf pairs are recorded in low numbers in Tasmania in most years (AMMC, 2012).

Tasmanian sighting data recorded between 1899 to 2018 identifies the east coast of Tasmania as having a higher sighting occurrence than the west coast (928 of 1,068 sighting records) and King Island (13 of 1,068 sighting records) (AMMC, 2018). Tasmanian sightings comprised of up to 7 individuals per sighting predominantly in south-eastern Tasmania, with 1 to 2 individuals per sighting usual (AMMC, 2018). Of the sightings around King Island, 12 were observed in the more sheltered coastal areas along the east coast (AMMC, 2018). A total of 19 SRW were observed within these 13 sightings (AMMC, 2018).

Until recently, SRW have been thought to be one population, however it is possible two populations exist, these are:

- South-east SRW population (Ceduna to Sydney including Tasmania); and
- South-western SRW population (located between Cape Leeuwin, WA and Ceduna) (DSEWPC, 2012c).

In terms of spatial recovery, the southwest population is recovering moderately well with three well established calving areas and evidence of a number of smaller and emerging calving areas being regularly but variably occupied. The southeast population is not showing the same spatial recovery with very low regular habitat occupancy, particularly when considered in relation to historic ecology (DSEWPC, 2012c). Photo-identification studies for the southeast population (approximately 300 individuals) shows there is little population movement within the region or between the southeast and other regions (AMMC, 2009).

Calving Areas

Key breeding areas within Australia are southern WA (Doubtful Island Bay, Israelite Bay, Twilight Cove, Flinders Bay and Albany), South Australia (Head of Bight, HOB) and Victoria (Warrnambool) (~110 km northwest of the Operational Area) (DSEWPC, 2012c). Areas along the Victoria coastline such as Port Fairy and Portland also provide seasonal calving habitat (SEWPC, 2012). During calving, SRW generally remain within 2 km of the shoreline with calving occurring in waters less than 10 m deep (DAWE, 2020d) (refer to Figure 4-32). At Logan's Beach (Warrnambool), up to 6 cow/calf pairs (average 2.4) are resident per season (AMMC, 2009) and tend to be resident for most of the season, whereas at other southeast Victorian sites, they appear to be transiting through and are only seen for a short time (AMMC, 2009). The majority of first sightings in western Victoria occur in May (54%) and June (42%), while the majority of last sightings in western Victoria occur in September (50%) and October (38%) but there may be an increasing trend towards October with the last sightings occurring in 7 out of the last 10 years (SWIFFT, 2018).

Calving/nursery areas appear to be exclusively coastal, either off continental land masses or oceanic islands and are occupied during late autumn, winter and early spring, and other near-shore waters connecting calving/nursery areas are also occupied at that time (DSEWPaC, 2012). In Australia, calving/nursery grounds are occupied from May to October (occasionally as early as April and as late as November), but not at other times. Female-calf pairs generally stay within the calving ground for 2–3 months. Other population classes stay for shorter and variable periods, moving about more from place to place on the coast and generally departing the coast earlier than female-calf pairs (most have left by September) (DSEWPaC, 2012).

Coastal visitation varies between years probably due to cohort structured breeding and environmental variability. Substantial changes in the number of whales recorded on the coast from year to year and the absence of reproductively mature females in virtually all years between calving events, indicates that not all whales migrate to the coast each year (DSEWPaC, 2012). The winter distribution of whales not appearing on the Australian coast is unknown, and the absence of reproductively mature females indicates that this winter distribution may include offshore breeding (conception) habitat (DSEWPaC, 2012).

Foraging

Foraging ecology for the species is poorly understood and observations of feeding are rare (DSEWPC, 2012). Species have been observed feeding in the region of the Sub-Tropical Front (41-44ºS) in January and December. In that region copepods are mainly consumed, whereas at higher latitudes krill is the main prey item. Coastal Australian waters are not generally used for feeding (DSEWPC, 2012c).

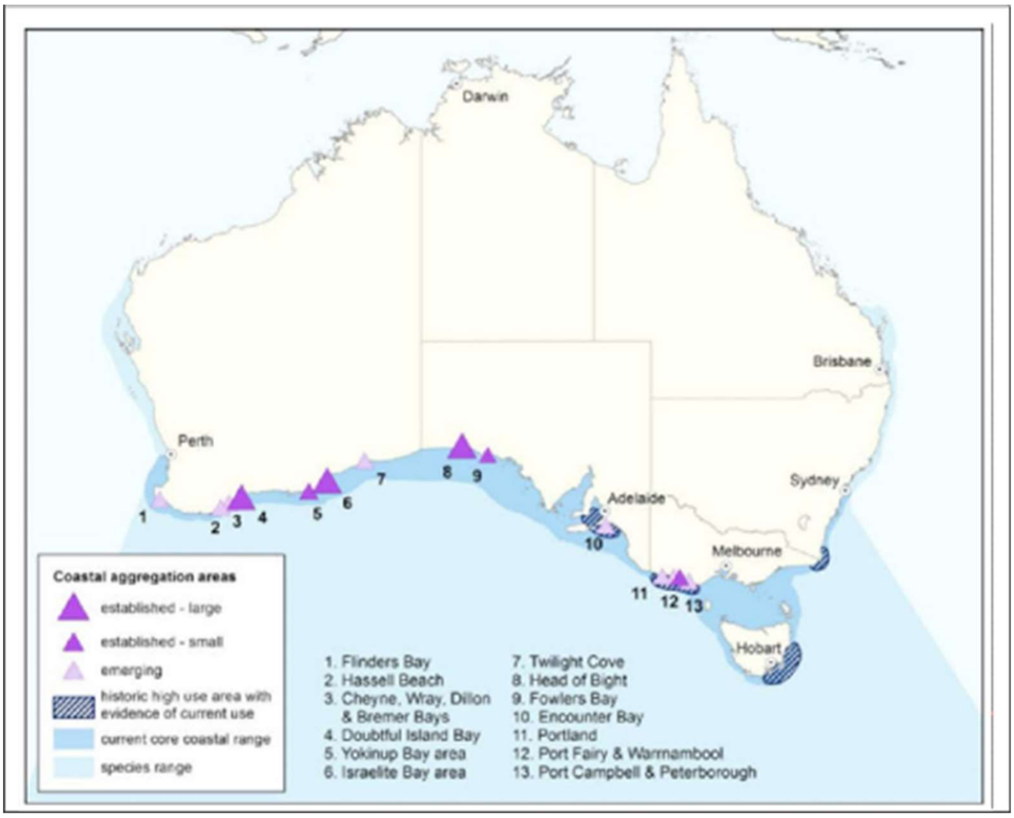
Migration

Individuals of the species are known to use widely separated coastal waters (200-1500 km apart) within a season, indicating substantial coast-wide movements (Kemper et al. 1997; Burnell, 2001: cited in Charlton et al. 2014). The longest movements are undertaken by non-calving whales, though calving whales have also been recorded to move up to 700 km in a single season. Such movements indicate the connectivity of coastal habitat is important for the species (DSEWPC, 2012; Charlton et al., 2014).

Migration pathways between coastal Australian waters and offshore feeding grounds are not well defined (Gill et al. 2015; DSEWPC, 2012). Exactly where whales approach and leave the coast from and to offshore areas is not well understood (DSEWPC, 2012). A predominance of westward movements amongst long-rang photo-identification may indicate a seasonal westward movement in coastal habitat (DSEWPC, 2012). More or less direct approaches and departures from the coast are also likely (DSEWPC, 2012). SRW are thought to be solitary during migration or accompanied by a dependent calf (DSEWPC, 2012).

A resident SRW CC-pair is defined as a pair that has selected a breeding aggregation habitat to reside for the season (>1 week) to nurse and rear their young. Mean residency periods for CC-pairs are 65 days (Charlton 2017). Resident CC-pairs occupy typically shallow water <10m deep within 1km of the coast (Charlton 2017).

The Victorian and Tasmania coastal waters are known to include migrating habitat and SRW are known to arrive at the south eastern Australian coastline and travel west to established aggregation areas in South Australia such as the Head of the Great Australian Bight (Watson et al. 2021). There is one established calving ground for female and calf pairs in south eastern Australian at Logans Beach, Warrnambool, Victoria (Watson et al. 2021). SRW are known to have an east to west migration pattern and mothers often travel with their calves west along the coast to prepare for migration.



Source: DSEWPC (2012b)

Figure 4-32: SRW Aggregation Areas

Based on head callosity 'matches,' individual SRW movements have been recorded between the Antarctic and the West Australian/South Australian coast (15 animals), between 41-44°S and the WA/SA coast (2 animals), along the coast between HOB (SA) and WA (mainly westward movement - 18/30 animals) and between the Auckland Islands (New Zealand subantarctic) and HOB (3 animals). Two discovery mark returns show summer movement eastwards south of the GAB and Tasmania (Tormosov et al., 1998; cited in AMMC, 2012). American whaling logbook data ('Townsend's Charts' - see Bannister, 2001; cited in AMMC, 2012) show a general movement south from the coast from September, with south-easterly movement offshore in summer. In the 1840s, whalers were reported as believing that right whales moved northwards from the south early in the season, approaching Tasmania from about April and continuing on past Victoria and into the Bight. SRW were also thought to approach the whole coast from the south, striking southward as a body from Cape Leeuwin and working southeast, 200-300 miles from land in October/November. Such a generalised, almost circular, anti-clockwise pattern for right whales south of Australia was suggested by Burnell (2001; cited in AMMC, 2012) from intra-year (95% westerly) and inter- year (75% easterly) movements recorded mainly from HOB (AMMC, 2012).

BIAs for the species are present at large and small established and emerging aggregation areas used for calving and nursing, as well as coastal connecting habitat (coastal waters) (refer to Figure 4-33). As identified in that figure, there is a seasonal aggregation area between Bridgewater Bay, Portland and Logan's Beach, Warrnambool for seasonal calving in shallow waters between May and November. It is also noted that less than 10% of the Australian SRW population is distributed east of Adelaide (DoEE, 2018). BIAs are present to 3 km from the shoreline in the coastal waters surrounding King Island (low use coastal connecting habitat BIA) and the Victorian coastline (migration and resting on migration habitat BIA) which is likely used by the SRW between May to November (DAWE, 2020d).

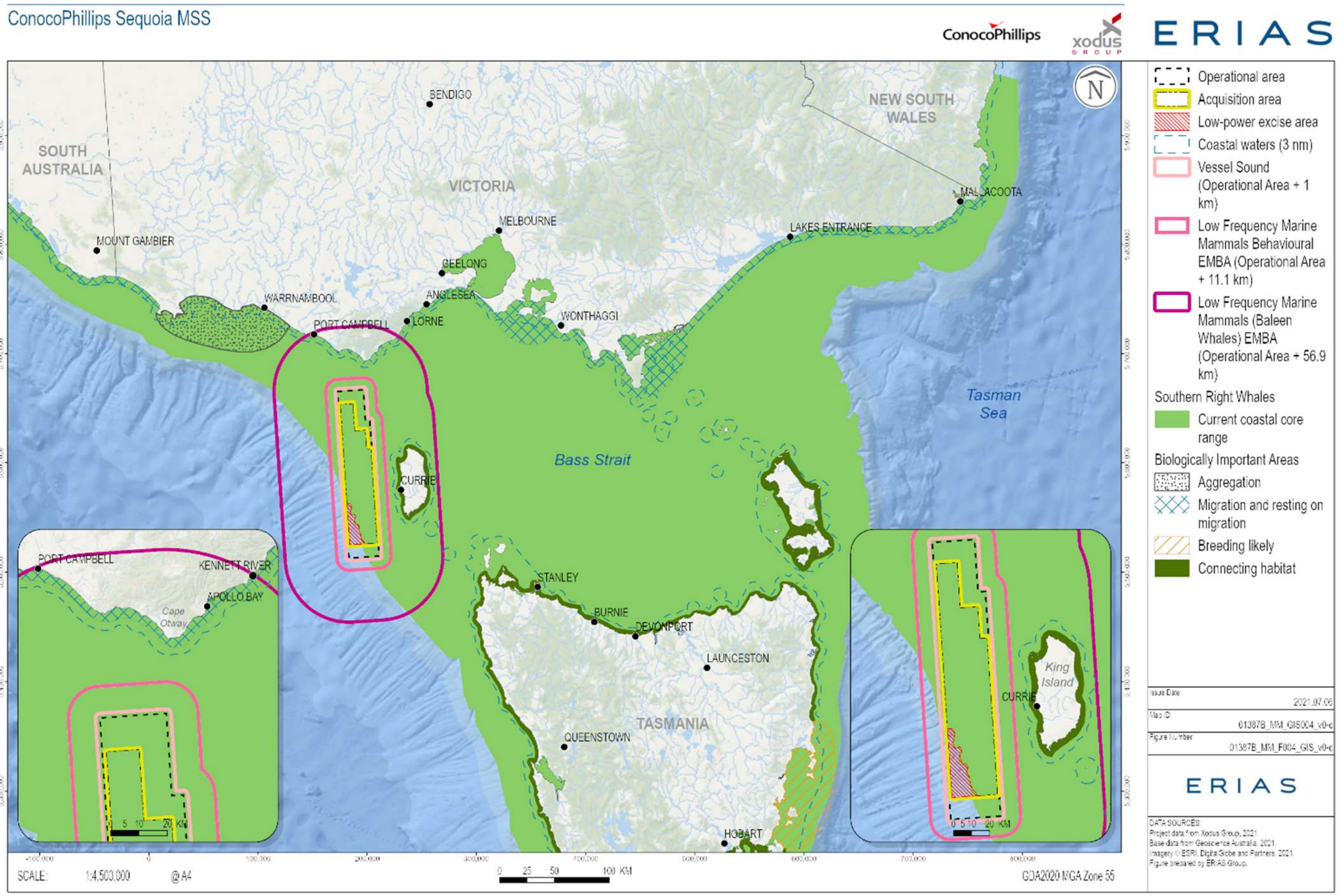


Figure 4-33: SRW BIA intersected by the Operational Area and the EMBA

Sensitivities

The SRW (*Eubalaena australis*) is currently listed as an endangered species under the Commonwealth EPBC Act 1999. The depleted population is a result of historic whaling in the 1700's and then again in the 1960's which brought about further protection measures (DSEWPC 2012). According to the DSEWPC Recovery Plan (2012) the population of Australian SRWs have been monitored annually since 1976 and are experiencing a consistent rate of population increase of approximately 6.8 per cent each year.

With respect to the SRW life stages, females appear to be more sensitive to disturbance at the start of the season. Once they are on calving grounds and give birth, they tend to be more settled (AMMC, 2009). Coastal bays along the southern coast of Australia, including Warnambool Victoria, provide critical habitats for SRW mothers and calves, which aggregate in such areas to find protection from predators and shelter (Charlton et al. 2019). Studies on marine mammals, including right whales, show that human activities, in particular underwater noise can negatively affect the behaviour of the animals (Nowacek, D.P. et al. 2007), which use sounds for communication, navigation, foraging etc. (Tyack, P. 1998). In North Atlantic right whales, a close relative to the southern right whales, underwater noise has been shown to result in elevated levels of stress which is contributing to the current decline of the population (Pace et al. 2017).

According to the Recovery Plan (DSEWPC 2012), along with a heavily depleted population status from whaling activities, there are also several life cycle traits of SRWs which make them vulnerable to a wide range of anthropogenic threats; these include:

- High age at sexual maturity (6-9 years old)
- Slow reproductive rates (single calf every 3-4 years with gestation taking 12 months)
- Female SRWs generally return to the same location to give birth and nurse offspring
- Foraging grounds requiring high primary productivity
- Migration for foraging and breeding activities

All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.

Existing Pressures

In Australia, SRWs are managed under the Conservation Management Plan for the SRW (DSEWPC 2012). There are a range of anthropogenic threats that affect SRWs. The risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015).

Key threats identified in the Recovery Plan include whaling, climate variability and change, noise interference (including cumulative impacts from previous and simultaneous activities in the area, i.e. seismic, drilling, vessels), vessel disturbance, entanglement, habitat modification, and overharvesting of prey (DSEWPC 2012).

Noise interference within or close to SRW aggregation areas was identified as a particular concern by the SRW Recovery Plan due to the presence of young calves and whales residing for long periods of time (DSEWPC 2012). Noise can disrupt critical behaviours such as establishing aggregations in otherwise suitable but currently unused habitat and disrupt migratory movements, thereby preventing individuals from using preferred habitats (DSEWPC 2012).

Due to the long-lived nature of SRWs, as well as their highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire life cycle causing a cumulative impact on the population. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DEWHA, 2008b).

Local pressures within the relevant EMBA are likely to include climate change and variability, marine debris – entanglement, vessel interference, and anthropogenic noise pollution. Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys.

Beach Energy are undertaking a drilling program throughout 2021. The drilling will occur concurrently with the Sequoia MSS. The Seismic Sound – LF cetacean EMBA for TTS (56.6 km) extends into the drilling area. This is taken into consideration as part of the cumulative impact assessment in Appendix A Cumulative Impact Assessment

4.5.3.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to SRW have been evaluated in Table 4-49; having had regard to the legislative and other controls (4.5.1.5).

Table 4-56: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for SRW

Emissions – Underwater Sound (Impulsive)	Consequence

Change in fauna behaviour
Predicted maximum distances to sound exposure guidelines relevant to SRWs (Table 4-52) are:
• Behavioural response: 11.1 km
• Behavioural response cow/calf pairs: based on the Criteria from Wood et al., 2012 –
  o 15 km towards the Victorian Coast
  o 25 km towards King Island (in the north); and
  o 28 km in the offshore direction
The extent of the area of behavioural impact for adult SRWs is predicted to be a maximum distance of 11.1 km from the seismic source at any point in time duration the Sequoia MSS acquisition between August and October. Based on the maximum modelled horizontal distance for behavioural response (11.1 km), the area where marine mammal behaviour may be affected by sound at any point in time (i.e. increased vigilance or potential avoidance) (Purser & Radford, 2011) is ~390 km^2 around the source, or 0.18% of the current core coastal range (217,825 km^2) The severity is assessed as **Moderate (3)** based on:
• The area of impact for adult behavioural response, as demonstrated at the northern most modelled site (site 11) (Figure 4-34), does not intersect the:
  o Migration and resting on migration BIA along the Victorian coast (34 km to the north).
  o Connecting habitat BIA on the King Island coast (17 km east).
  o Aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground.
  o Emerging aggregation area at Port Campbell (~ 34 km to the north).
• The area of impact for behavioural response cow/calf pairs, as demonstrated at the northern most modelled site (site 11) (Figure 4-35), does not intersect the:
  o Migration and resting on migration BIA along the Victorian coast (34 km to the north).
  o Aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground.
  o Emerging aggregation area at Port Campbell (~34 km to the north).
• The area of impact for behavioural response cow/calf pairs intersects the:
	Moderate (3)

- Connecting habitat BIA on the King Island coast (17 km east). • The area of impact for behavioural response and behavioural response cow/calf pairs overlaps the current core coastal range. • The timing of the Sequoia MSS acquisition does not overlap with the period when the majority of pregnant females arrive in Australian waters during May - July (Charlton et al. 2019). The timing of the Sequoia MSS acquisition does overlap with the period when mothers with calves leave Australian waters during September and October (Charlton et al. 2019). • SRWs leave the Victorian coastal aggregation BIA (based on last sighting data) in September (50%) and October (42%) (SWIFFT, 2018). Available offshore migratory information indicates SRWs leave aggregation areas and migrate south or south-west to foraging grounds located at the sub-tropical convergence (DSEWPaC, 2012; Mackay et al, 2015; Mate et al, 2011; Childerhouse et al, 2010). DSEWPaC (201a) details that where whales approach and leave the Australian coast from, and to, offshore areas is not well understood. A defined near-shore coastal migration corridor is unlikely given the absence of any predictable directional movement of southern right whales such as that observed for humpback whales. A predominance of westward movements amongst long-range photo-identification re-sightings may indicate a seasonal westward movement in coastal habitat. More or less direct approaches and departures to the coast are also likely. Thus, there is a potential for mothers with calves to move through the area of impact as they leave coastal aggregation area. SRW are thought to have a counter-clockwise migration pattern where animals arrive in the east of Australia in May-July, peak in coastal aggregation areas during July/August and then migrate west along the coast before migrating back to southern feeding grounds in Sept/Oct (Burnell 2001). Peak abundance of SRW in coastal aggregation areas occurs mid-July to end-August (Charlton et al. 2019). The majority of female and calf pairs are expected to have reached the coastline before acquisition starts in August. The mean residency period is 65 days (Charlton 2017) so it can be assumed that pairs will be residing in coastal aggregation areas until end-August, start-September. • Masking of communications and avoidance behaviour may be exhibited if SRW are within the area of impact. This avoidance behaviour or impaired ability to communicate may add tens of kilometres to their migration from the Australian coast. Any disturbance on the behaviour of the mothers that could increase their energy expenditure (Christiansen et al. 2014a), will result in a reduction of energy available for their calf and for their return migration (Christiansen et al. 2014b). Southern right whale calves need to gain considerable energy from their mothers in order to grow to a sufficient size to migrate back to their feeding grounds (Christiansen et al. 2018). Southern right whale mothers are fasting during their time in Australian waters, which means that they have a finite amount of energy that they can supply to their calves (through milk production) (Christiansen et al. 2018).	

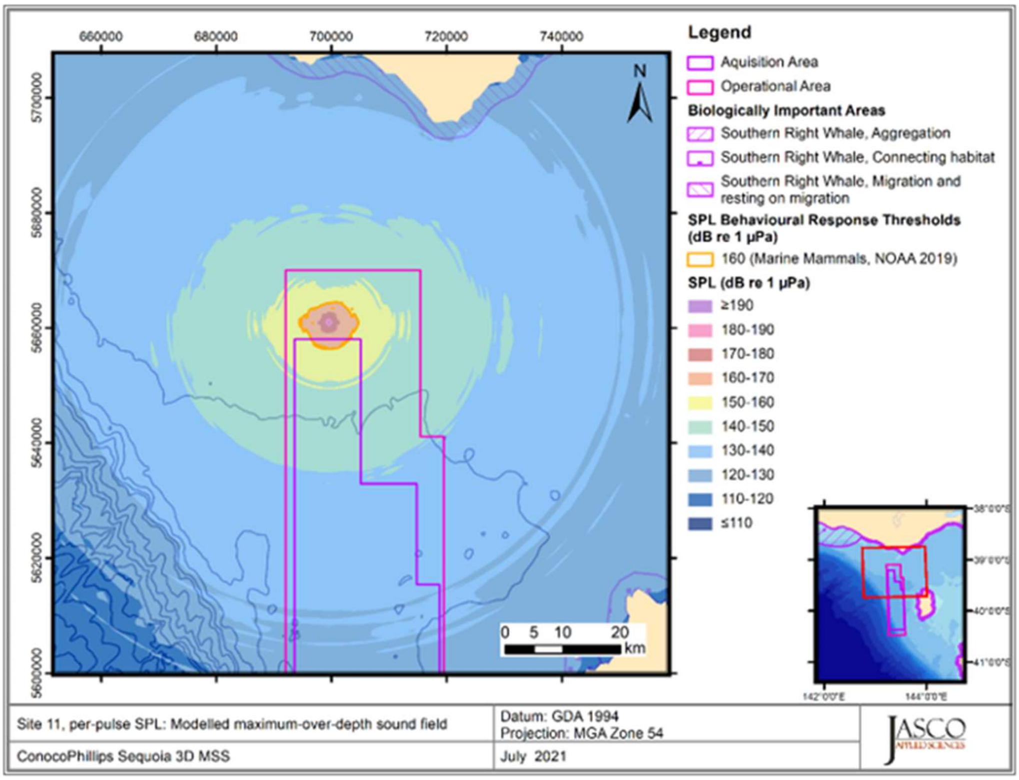
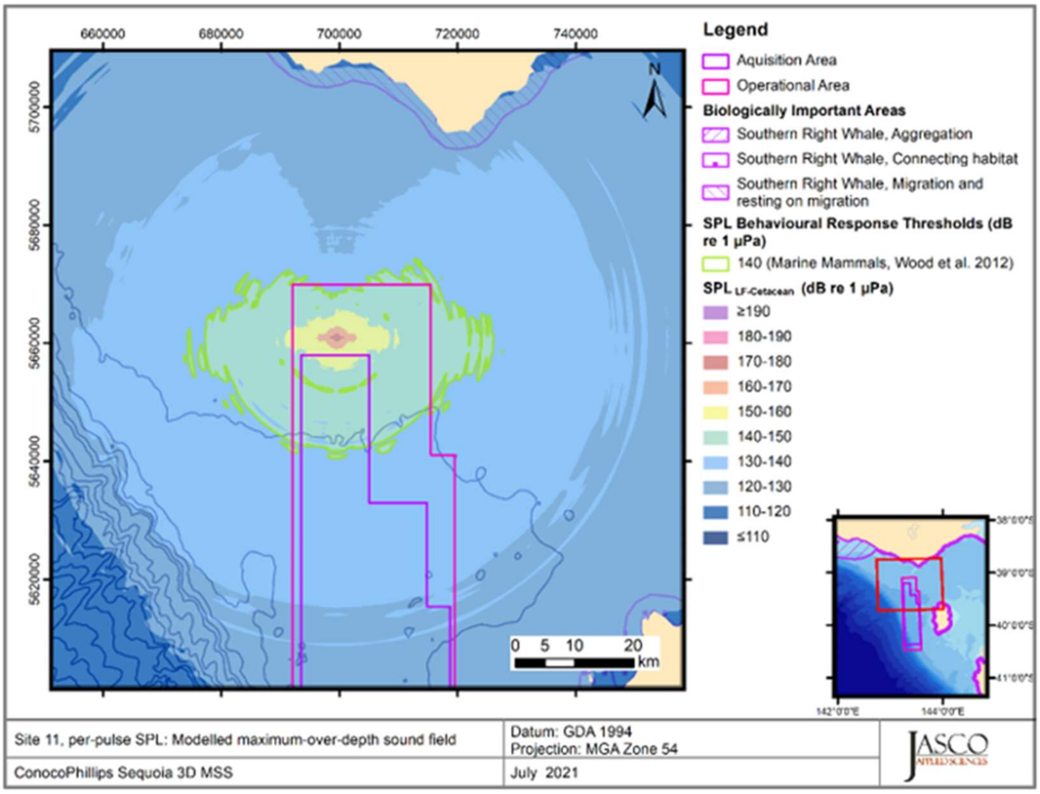


Figure 4-34: Site 11 sound level contour map showing unweighted maximum-over-depth sound fields and the isopleths of behavioural response thresholds for marine mammals



<table>
<tr><td>Figure 4-35: Site 11 sound level contour map showing weighted maximum-over-depth sound fields and the isopleths of behavioural response thresholds for marine mammals</td><td></td></tr>
<tr><td>
Change in hearing via permanent and temporary threshold shift
Predicted maximum distances to sound exposure guidelines relevant to SRWs (Table 4-52) are:

Permanent Threshold Shift (PTS)

PK Criteria: 30 m.
SEL 24hr Criteria: 1.18 km (319 km²)

Temporary Threshold Shift (TTS)

PK Criteria: 70 m
SEL 24hr Criteria: 56.6 km in the offshore direction
SEL 24hr Criteria 25.9 km towards King Island
SEL 24hr Criteria 11.7 km towards the Victorian Coast
Total SEL 24hr area 6,524 km²

The extent of TTS impact is predicted to be within a maximum distance of 56.6 km from the seismic source for the duration of the Sequoia MSS acquisition between August and October. Modelling predicts the exposure area for TTS, the area within which residing low frequency cetaceans could experience TTS over a 24-hour period, is 6,524 km². This area represents ~3% of the current core coastal range (217,825 km²).
The extent of PTS impact is predicted to be within a maximum distance of 1.18 km from the sound source for the duration of the Sequoia MSS acquisition between August and October. Modelling predicts the exposure area for PTS, the area within which residing low frequency cetaceans could experience PTS over a 24-hour period, is 319 km². This area represents ~0.15% of the current core coastal range (217,825 km²).
The severity is assessed as Moderate (3) based on:

The timing of the Sequoia MSS acquisition does not overlap with the period when pregnant females generally arrive in Australian waters during late May/early June. However, the timing of the Sequoia MSS acquisition does overlap with the period when mothers with calves leave Australian waters during September and October.
The area of impact for PTS per pulse (30 m) and SEL 24hr (1.15 km) does not intersect the:

Migration and resting on migration BIA along the Victorian coast (34 km to the north).
Connecting habitat BIA on the King Island coast (17 km east).
Aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground.
Emerging aggregation area at Port Campbell (~ 34 km to the north).

The area of impact for PTS does overlap the current core coastal range.
The distances to the per pulse criteria is 30 m for PTS. It would be unlikely for a whale to be within 30 m of the seismic source, thus per pulse PTS impacts are not predicted to SRW.
The maximum distance to the PTS 24hr criteria is 1.18 km and does not intersect areas where SRW are expected to be present for 24 hrs. The area of impact for the PTS 24hr criteria does overlap the current core coastal range where mothers with calves may transit through as they leave Australian waters from nearshore aggregation areas. A whale would need to be within 1.18 km of the survey vessel for 24 hrs to receive PTS. This would be unlikely based on the behavioural response distance of 11.1 km.
The area of impact for TTS per pulse criteria (70 m) does not intersect the:

Migration and resting on migration BIA along the Victorian coast (34 km to the north).
Aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground.
Emerging aggregation area at Port Campbell (~ 34 km to the north).

</td><td>Moderate (3)</td></tr>
</table>

- The distance to the per pulse TTS criteria is 70 m. It would be unlikely for a whale to be within 70 m of the seismic source, thus per pulse TTS impacts are not predicted to SRW.
- The maximum distance to the TTS 24hr criteria is 56.6 km in the offshore direction, 25.9 km towards King Island and 11.7 km towards the Victorian Coast. Received levels at the following locations are not predicted above the TTS 24hr criteria (Figure 4-36 and Figure 4-37):
  - Migration and resting on migration BIA along the Victorian coast (34 km to the north).
  - Most of the connecting habitat BIA on the King Island coast (17 km east).
  - Aggregation BIA in south-west Victoria (90 km north-west) a known calving and nursery ground.
  - Emerging aggregation area at Port Campbell (~ 34 km to the north).
- The area of impact for TTS 24hr does overlap the current core coastal range and the Connecting habitat BIA on the King Island coast near Whistler Point (17 km east) where there is the potential for mothers with calves to transit through as they leave Australian waters from nearshore aggregation areas. They may be in these areas for up to 24 hrs.

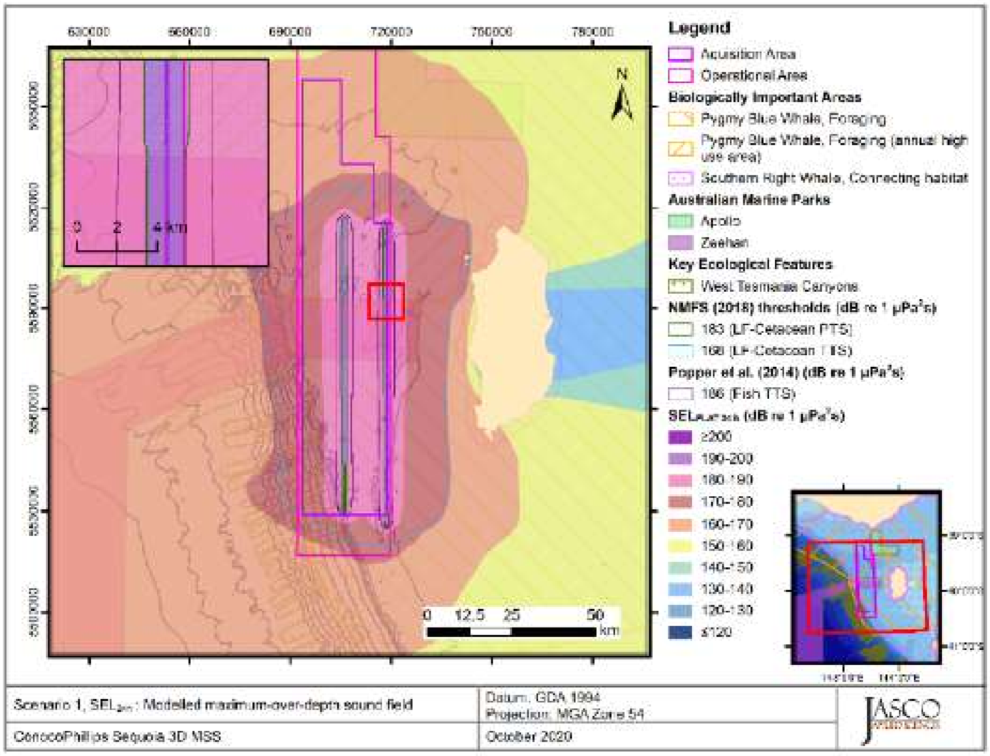


Figure 4-36: Acoustic modelling Scenario 1 sound level contour map showing unweighted maximum-over-depth SEL24h results

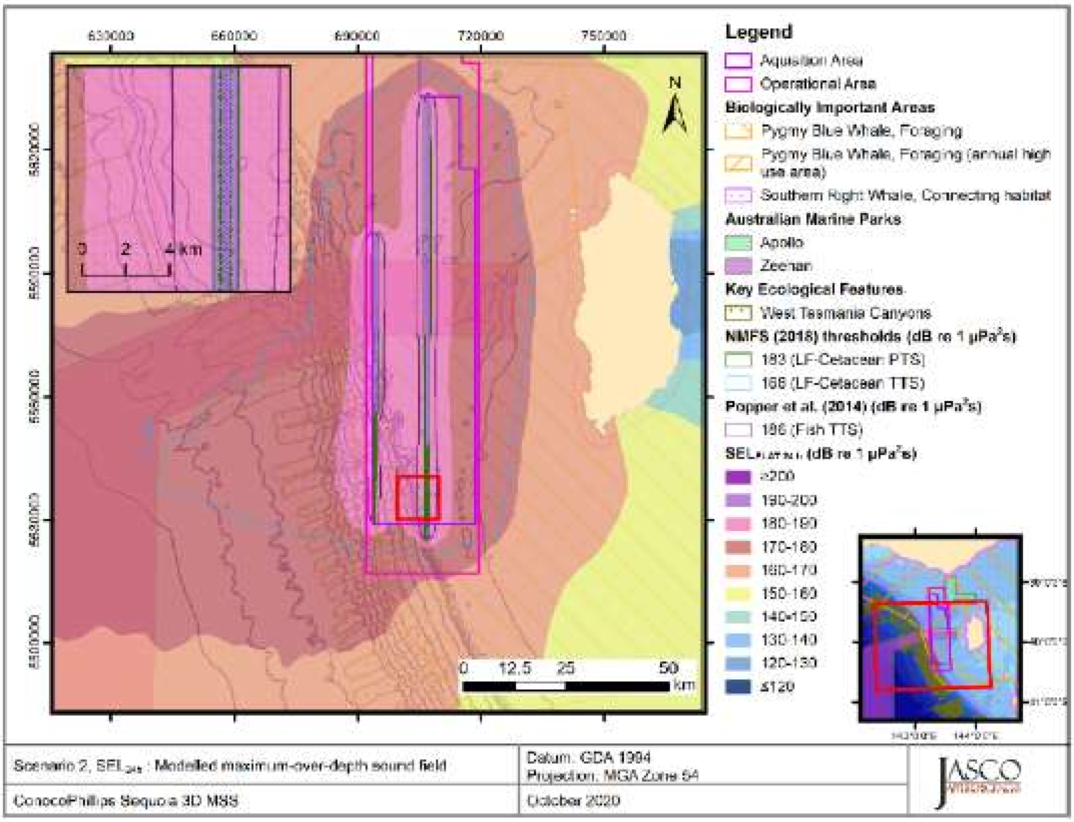


Figure 4-37: Acoustic modelling Scenario 2 sound level contour map showing unweighted maximum-over-depth SEL24h results

4.5.4. Impact Assessment – Other Low-Frequency Cetaceans

Table 4-53 details the other (not Blue Whale or Southern Right Whale) low-frequency cetaceans that may be present in the sound EMBAs. The following species will be evaluated in greater detail as they were identified as threatened under the EPBC Act and/or the PMST identify a biologically important behaviour:

- Fin Whale – listed as vulnerable and foraging, feeding or related behaviour likely to occur within area.
- Humpback Whale – listed as vulnerable.
- Pygmy Right Whale – foraging, feeding or related behaviour may occur within area.
- Sei Whale – listed as vulnerable and foraging, feeding or related behaviour likely to occur within area.

No BIAs were identified for these species within the sound EMBAs.

4.5.4.1. Existing Environment

Values

Fin Whales

The Fin Whale (EPBC Act: Vulnerable; listed Migratory) 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. Fin Whales regularly enter polar water, however, unlike Blue Whales and Minke Whales, Fin Whales are rarely seen close to ice

(DAWE, 2020d). It is likely that Fin Whales migrate between Australian waters and the following external waters: Antarctic feeding areas (the Southern Ocean); sub-Antarctic feeding areas (the Southern Subtropical Front); and tropical breeding areas (Indonesia, the northern Indian Ocean and southwest South Pacific Ocean waters) (DAWE, 2020d).

Breeding occurs between May-July and the location of breeding areas is unknown (DAWE, 2020d). 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 (DAWE, 2020d). 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 (DAWE, 2020d). Fin Whales frequently lunge or skim feed at or near the surface and they are known to dive to 230 m to feed.

The National Conservation Values Atlas does not identify any BIAs for the Fin Whale within Australian waters (DAWE, 2020a).

Gill et al (2015) reported 8 individual Fin Whales in 7 sightings between November and May for the survey period 2002 to 2013. The mean group size was 1.1 ± 0.4 individuals and the mean depth distribution in shelf waters of 162 ± 90 m. The species was observed to be feeding indicating the region is used at least opportunistically. Recorded encounter data per 1,000 km of survey distance for the months in which the Fin Whale was observed is listed below:

- November – 0.1 whales sighted;
- December – 0.14 whales sighted;
- January – 0.07 whales sighted; and
- February – 0.08 whales sighted.

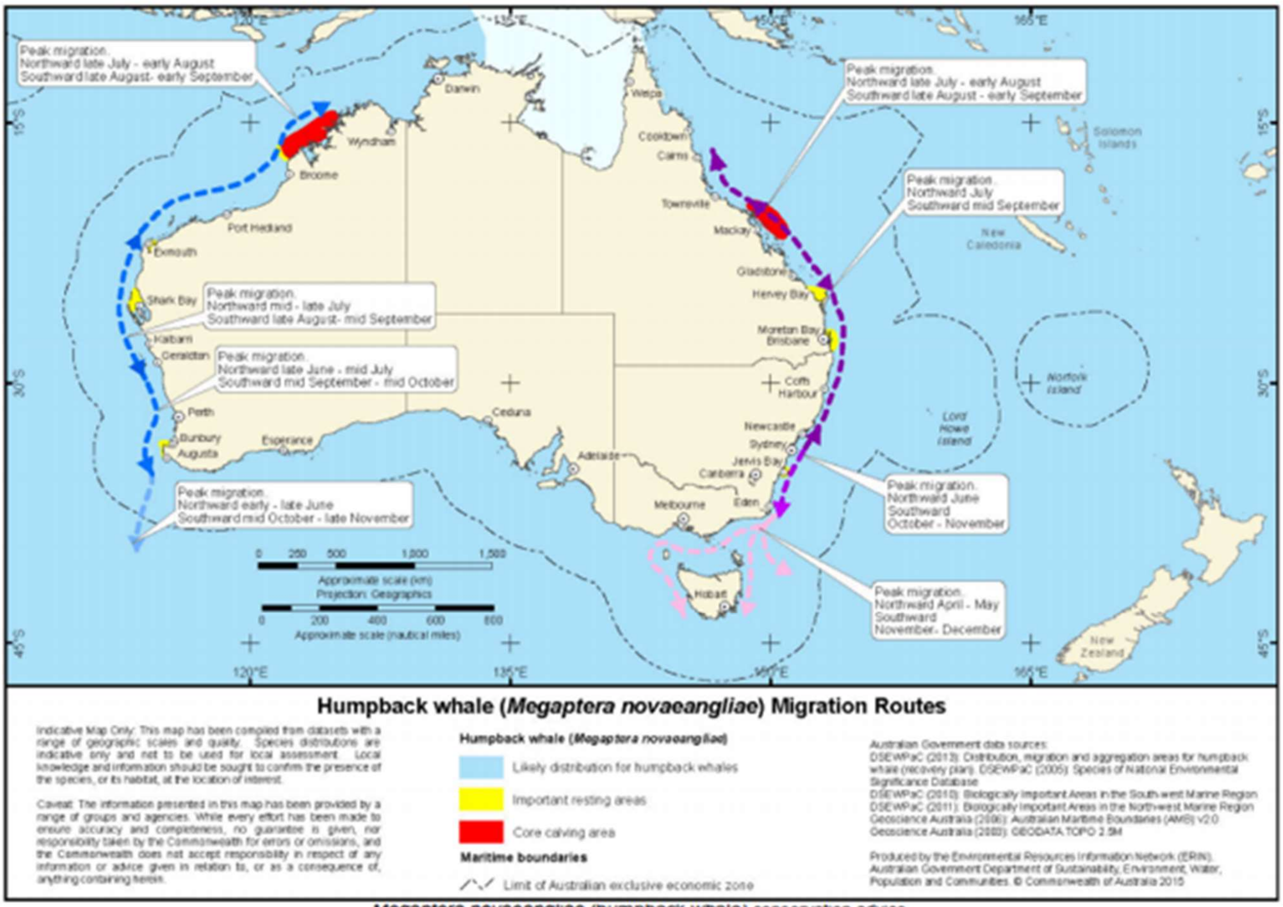
It is unlikely, based on its habitat preferences, sightings and upwelling data, that this species will be encountered during the proposed survey period (August – October).

Humpback Whales

Humpback Whales (*Megaptera novaeangliae*) are a migratory species found throughout Australian Antarctic waters and Commonwealth offshore waters (DAWE, 2020d). There are two subpopulations that occur within Australian waters: the west coast population and the east coast population (Schmitt et al 2014).

Both the east coast and west coast Australian populations make their annual migrations between their winter breeding areas in tropical waters along the east and west coast of Australia (15° S to 20° S) and their summer feeding areas in the Antarctic (south of 56° S) (Chittleborough, 1965; Dawbin, 1966). The species reaches southeast Australian waters in April to May on the northerly migration from Antarctica and then again on their southern migration pathway during November to December each year (TSSC, 2015c). The exact timing of the migration can vary depending on water temperature, sea ice and predation risk (DAWE, 2020d).

Figure 4-38 below shows the distribution of Humpback Whales along the coast of the Australian mainland, including areas of known calving, feeding and resting habitat. Feeding, resting or calving is not known to occur in Bass Strait (TSSC, 2015c) though migration through Bass Strait could occur (Figure 4-39). The nearest area that Humpback Whales are known to congregate and potentially forage is at the southern-most part of NSW near the eastern border of Victoria approximately 550 km north-east of the Sequoia MSS at Twofold Bay, Eden off the New South Wales south coast.

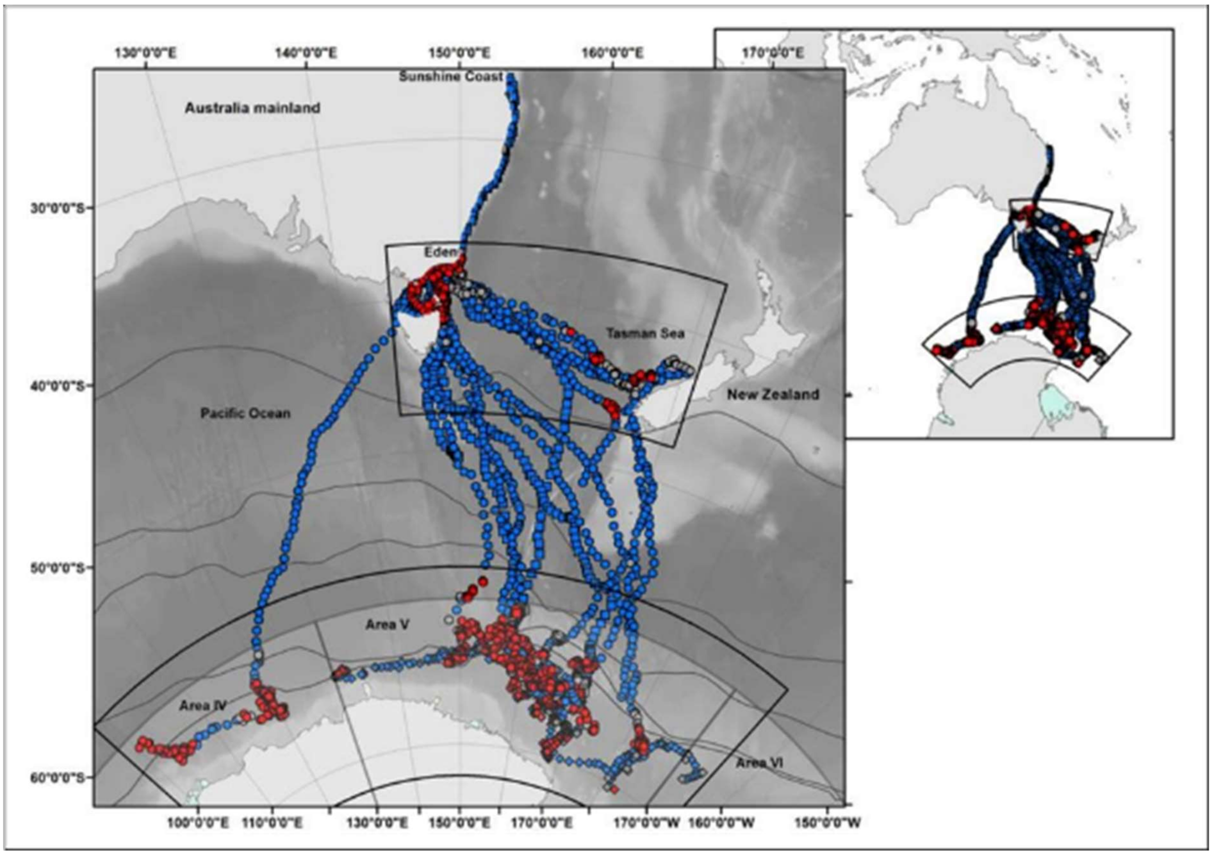


Megaptera novaeangliae (humpback whale) conservation advice

Source: TSSC (2015d)

Figure 4-38: Humpback Whale Distribution around Australia

The migratory pathways for this species are distinct along the eastern and western Australian coastlines with a lower presence in the Great Australian Bight (DEH, 2005a). This was verified in a report by Andrews-Goff et al (2018) which details a study on Humpback Whale migrations to Antarctic summer foraging grounds through the southwest Pacific Ocean. In the austral summer of 2008/09, 2009/10 and 2010/11, the migrations of Humpback Whales were tracked using satellite tagging technology (Andrews-Goff et al., 2018). 21 of the whales migrated south along the coastline and across Bass Strait during the month of October. Throughout November, 12 whales migrated south via the east coast of Tasmania, while one whale migrated via the west coast of Tasmania and continued in a south westerly direction into the Pacific Ocean and then moved onto the Antarctic feeding grounds (Andrews-Goff et al., 2018). Seven whales travelled eastwards into the Tasman Sea crossing the 160°E meridian whilst still in temperate waters. This study highlights the unlikeliness of the western coast of Tasmania and western Bass Strait to be frequently utilised for Humpback Whale migration. A visual representation of the tracking study by Andrews-Goff et al (2018) and the divergent pathways of Humpback Whale migration routes are presented in Figure 4-39.



Source: Andrews-Goff et al. (2018)

Figure 4-39: Migration pathways for 30 Humpback Whales satellite-tagged off the eastern coast of Australia

Pygmy Right Whale

Pygmy Right Whales (PRW) (*Caperea marginata*) are a little-studied baleen whale species found in temperate and sub-Antarctic waters in oceanic and inshore locations (DAWE, 2021d). Key localities for PRWs identified by Bannister et al (1996) include Bass Strait, south-eastern Tasmania, Kangaroo Island, southern Eyre Peninsula and possibly south-western Western Australia. These areas are all close to habitats rich in marine life and possibly the zooplankton upon which the PRW feeds (e.g. copepods and euphausiids) (Bannister et al. 1996).

No population estimates are available for Pygmy Right Whales globally, or in Australian waters (DAWE 2021d). However, given that the species has never been hunted commercially it is considered likely that they are not severely threatened (Cetacean Specialist Group, 1996; Kemper, 2002b). Pygmy Right Whales have primarily been recorded in areas associated with upwellings and with high zooplankton abundance, particularly copepods and small euphausiids which constitute their main prey (Kemper 2002a; Sekiguchi et al. 1992).

DAWE (2021d) reports that extremely limited life history data exists for the PRW with no known calving interval, mating season, and gestation period (Kemper, 2002b). A 1992 study by Pavey suggested a broad calving season between May and January in Australian waters but this remains unconfirmed (Kemper 2002a). Little is also known about the migration of PRWs in Australian waters, both spatially and temporally, however, they appear to have a circumpolar distribution, preferring water temperatures of between 5 °C and 20 °C (Baker 1985) and staying north of the Antarctic Convergence (Ross et al. 1975). Pygmy Right Whales do not appear to be deep divers, as recorded dive times are short (Matsuoka et al. 1996; Ross et al. 1975), implying that they primarily inhabit the pelagic zone of oceanic waters.

There are few confirmed sightings of PRWs at sea (Reilly et al., 2008), with DAWE (2021d) stating they are not very distinctive when viewed at sea which could account for the rarity in sightings.

Sei Whale

Sei Whales (EPBC Act: Vulnerable; listed Migratory) are primarily found in deep water oceanic habitats and their distribution, abundance and latitudinal migrations are largely determined by seasonal feeding and breeding cycles (TSSC, 2015e). These whales are thought to complete long annual seasonal migrations from subpolar summer feeding grounds to lower latitude winter breeding grounds (TSSC, 2015e); details of this migration and whether it involves the entire population are unknown.

Sei Whale global population is estimated to have declined by 80% over the previous three generation period (TSSC, 2015e).

In the Australian region, Sei Whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, New South Wales, Queensland, the Great Australian Bight, Northern Territory and Western Australia (TSSC, 2015e). There is no known mating or calving areas in Australian waters (TSSC, 2015e).

Sei Whales have been sighted 20 to 60 km offshore on the continental shelf in the Bonney Upwelling (128 km northwest of the Operational Area) opportunistically feeding (Gill et al., 2015). Gill et al (2015) observed 14 individual whales in 12 sightings between November and May for all surveys undertaken between 2002 to 2013. The mean group size was 1.3 ± 0.5 individuals and the mean depth distribution in shelf waters was 160 ± 137 m. The species was observed to be feeding during the surveys indicating the region is used for foraging at least opportunistically. Recorded sightings for the months of observation are listed below (per 1,000 km of surveyed distance) (no observations undertaken in months not listed):

- September – 0 whales sighted;
- October – 0 whales sighted;
- November – 0.25 whales sighted;
- December – 0.07 whales sighted;
- January – 0.04 whales sighted;
- February – 0.84 whales sighted;
- March – 0.19 whales sighted;
- April – 0 whales sighted; and
- May – 0.21 whales sighted.

The EPBC Act Conservation Values Atlas does not identify any BIA for this species within Australian waters (DAWE, 2020a). Based on available sighting and upwelling data, it is considered unlikely that this species occurs in the Operational Area during the Sequoia MSS period (August and October).

Sensitivities

There are three LF species listed as Vulnerable within the Sound EMBA (Table 4-53), in addition to the PBW and SRW which are listed as Endangered. Table 4-57 identifies key biological sensitivities which may influence species population resilience of those species.

Table 4-57: Sensitivities – Other LF Cetaceans

Receptor	Sensitivity description
Fin Whale	The Fin Whale (*Balaenoptera physalus*) is currently listed as a vulnerable species under the Commonwealth EPBC Act 1999. The species is eligible for this listing as a result of historical whaling which severely impacted the population size last century (DoE 2015c). The global population is estimated to have declined by more than 70% over three generations from 1929 – 2007 (DoE 2015c). According to the Conservation Advice for Fin Whales (DoE 2015c), it is a priority to continue research efforts in order to determine population abundance, trends and population structure for Fin Whales, and establish a long-term monitoring program in Australian waters, as well as describe the spatial and temporal distribution of Fin Whales and further define biologically important areas (feeding and breeding), and migratory routes within Australian and Antarctic waters. This information gap could be considered a sensitivity to the recoverability of the species. Along with the depleted population status from whaling activities, there are also several life cycle traits of Sei Whales which make them vulnerable to a wide range of anthropogenic threats; these include: • Slow reproductive rates (single calf with a mean interval of approximately 2.2 years and gestation period of 11 months) • Foraging grounds requiring high primary productivity • Long annual migration for foraging and breeding activities All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.
Humpback Whales	According to the DoE Conservation Advice (2015d), a 2014 review by Woinarski, Burbidge and Harrison evaluate the status of the Humpback Whale to be of Least Concern with modern population figures showing a rate of increase thought to be between 10.9-11% per year for the eastern Australian population and between 9.7-13% for the western Australian population (DoE 2015d). As a result of this rate of increase, the eastern Australian population is recovering with 2010 data estimating 14,522 absolute abundance from 22,000 – 25,000 pre-exploitation figures. However, the western Australian population estimates in 2008 are much closer to pre-exploitation figures with an approximate abundance of 26,100-28,830 Humpback Whales compared to 16,000-30,000 pre-exploitation. These figures have resulted in the submission of two separate papers recommending that Humpback Whales no longer meet the criteria for listing as threatened under the EPBC Act (DoE 2015d). Although the population is recovering from historical whaling activities, there are several life cycle traits of Humpback Whales which make them vulnerable to a wide range of anthropogenic threats; these include: • Slow reproductive rates (single calf with a mean interval of approximately 2.36 years and gestation taking 11.5 months) • Foraging grounds requiring high primary productivity Near global distribution with annual migration for foraging and breeding activities
Pygmy Right Whale	The PRW does not have a management plan or conservation advice identifying particular vulnerability or sensitivity information. However, they are listed as a migratory species under the Species Profile and Threats Database (SPRAT) (DAWE, 2021d). Spatial and temporal patchiness of the PRW make it difficult to estimate the biomass and biomass depletion levels. The PRW SPRAT profile (DAWE, 2021d) highlights that extremely limited life history data exists for the PRW, and no age estimates have been made (Kemper 2002b). Pygmy Right Whales reach sexual maturity at lengths greater than 5 m, but age at sexual maturity is unknown (Kemper 2002b). Further data is needed on the species to gain a better understanding of the distribution, abundance and life cycle history. This information gap could be considered a sensitivity as mitigation strategies are unable to be tailored to the PRW to ensure adequate protection of the species and its resources in Australian and nearby waters.
Sei Whale	The species is listed as Vulnerable as a result of historical whaling which severely impacted the population size last century (DoE 2015b). An updated global population assessment indicated that the overall population of mature Sei Whales was estimated to have declined by about 80% over the previous three generation period (= 70 years), with no direct evidence of a recent increase in the population (DoE 2015b).

	According to the Conservation Advice for Sei Whales (DoE 2015b), there is insufficient data on the species in Australian waters to determine abundance estimates, or an increase or decline in the population, and the full extent of their distribution in Australian waters is uncertain. To implement a range of Conservation Management Actions research needs to be undertaken as a priority to define the spatial and temporal distribution of Sei Whales and further define biologically important areas so that adaptive management and additional mitigation measures can be implemented if necessary (i.e. within defined foraging or breeding areas) (DoE 2015b). This gap in consolidated and accepted information could be considered a sensitivity to the recoverability of the species. Along with the depleted population status from whaling activities, there are also several life cycle traits of Sei Whales which make them vulnerable to a wide range of anthropogenic threats; these include: • High age at sexual maturity (10 years) • Slow reproductive rates (single calf every 2-3 years) • Foraging grounds requiring high primary productivity • Migration for foraging and breeding activities. All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.

Existing Pressures

Table 4-58 provides an overview of the key pressures for the LF cetaceans detailed in this section.

There are a range of anthropogenic threats that affect whales. The risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015e). Local pressures within the relevant EMBA are likely to include climate change and variability, marine debris – entanglement, vessel interference, and anthropogenic noise pollution.

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys.

Table 4-58: Existing Pressures – Other Low Frequency Cetaceans

Receptor	Sensitivity description
Fin Whale	There are a range of anthropogenic threats that affect Fin Whales. The risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015h). Key threats identified in the Conservation Advice (DoE 2015c) include: • Resumption of commercial whaling • Climate and oceanographic variability and change • Anthropogenic noise and acoustic disturbance (including cumulative impacts from previous and simultaneous activities in the area, i.e. seismic, drilling, vessels) • Vessel strike • Habitat degradation including port expansion, coastal development and aquaculture • Pollution (persistent toxic pollutants) • Prey depletion due to fisheries • Fisheries catch, entanglement and bycatch. Due to the long-lived nature of Fin Whales, as well as their highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire lifecycle causing a cumulative impact on the population. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017b).

Humpback Whale	In Australia, Humpback Whales are managed under the EPBC Act 1999 Conservation Advice (DoE 2015d). There are a range of anthropogenic threats that affect Humpback Whales. The risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015i). Key threats identified in the Conservation Advice (DoE 2015i) include: • Resumption of commercial whaling • Climate and oceanographic variability and change • Noise interference (including cumulative impacts from previous and simultaneous activities in the area, i.e. seismic, drilling, vessels) • Vessel disturbance and strike • Habitat degradation including port expansion and coastal development • Overharvesting of prey • Entanglement Due to the long-lived nature of Humpback Whales, as well as their highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire lifecycle causing a cumulative impact on the population. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017b).
Pygmy Right Whale	The SPRAT database recognises a gap in information on potential threats to PRW and recommends a range of actions put forward by Bannister et al (1996) and Ross (2006) to better understand these threats. However potential threats have been identified by SPRAT (DAWE, 2021d) and these include: • Opportunistic whaling • Bycatch • Entanglement
Sei Whale	There are a range of anthropogenic threats that affect Sei Whales. The risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015f). Key threats identified in the Conservation Advice (DoE 2015f) include: • Resumption of commercial whaling • Climate and oceanographic variability and change • Anthropogenic noise and acoustic disturbance (including cumulative impacts from previous and simultaneous activities in the area, i.e. seismic, drilling, vessels) • Vessel strike • Habitat degradation including pollution (increasing port expansion and coastal development) • Pollution (persistent toxic pollutants) • Prey depletion due to fisheries. Due to the long-lived nature of Sei Whales, as well as their highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire life cycle causing a cumulative impact on the population. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017b).

4.5.4.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to LF cetaceans have been evaluated in Table 4-59; having had regard to the legislative and other controls (4.5.1.5).

Table 4-59: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for Other LF Cetaceans

<table>
<tr><th>Emissions – Underwater Sound (Impulsive)</th><th>Consequence</th></tr>
<tr><td><u>Change in fauna behaviour</u>
Predicted maximum distances to sound exposure guidelines relevant to low-frequency whales (Table 4-52) are:
• Behavioural response: 11.1 km
The extent of the impact is predicted to be within a maximum distance of 11.1 km from the seismic source at any point in time during the Sequoia MSS acquisition between August and October.
The severity is assessed as Negligible (1) based on:
• The fin and sei whale’s conservation advice (TSSC, 2015e; TSSC, 2015d) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.
• The pygmy right whale Species Profile and Threats Database (DotEE, 2020) in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat.
• Based on the information available for fin, pygmy right and sei whales, foraging within the area of impact is linked to the Bonney Upwelling during January to April which is outside the timing of the Sequoia MSS. The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with the Blue Whale foraging period, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The Blue Whale foraging period is the same as for the fin, pygmy right and sei whales thus the absence of temporal overlap avoids impacts to these foraging whales.
• The humpback whale conservation advice (TSSC, 2015c) identified noise interference as a threat including seismic exploration. In the area of impact there is no overlap with the peak humpback migratory period (northbound April – May; southbound November – December). Outside of the peak period they there is a low probability of overlap given the preference for migrating along the edge of the continental shelf (in water depths of about 200 m).
• There are no BIAs for fin, humpback, pygmy right or sei whales within the area of impact.
• If individual whales are present in the area of impact at the time of the Sequoia MSS, the most likely impact is avoidance behaviour or masking of communications, which may add tens of kilometres to their migration. Such a marginal increase is not considered likely to significantly affect the metabolic demands of individuals whose migrations occur over thousands of kilometres.</td><td>Negligible (1)</td></tr>
<tr><td><u>Change in hearing via permanent and temporary threshold shift</u>
Predicted maximum distances to sound exposure guidelines relevant to low-frequency whales (Table 4-52) are:
• Temporary Threshold Shift (TTS)
    o PK Criteria: 70 m
    o SEL 24hr Criteria: 56.6 km in the offshore direction
    o SEL 24hr Criteria 25.9 km towards King Island
    o SEL 24hr Criteria 11.7 km towards the Victorian Coast
    o Total SEL 24hr area 6,524 km^2
• Permanent Threshold Shift (PTS)
    o PK Criteria: 30 m.
    o SEL 24hr Criteria: 1.18 km (319 km^2)
The extent of impact is predicted to be a maximum distance of 1.18 km for PTS and 56.6 km for TTS from the sound source for the duration of the Sequoia MSS acquisition between August and October.
The severity is assessed as Negligible (1) based on:</td><td>Negligible (1)</td></tr>
</table>

Emissions – Underwater Sound (Impulsive)	Consequence
• The distances to the per pulse criteria is 30 m for PTS and 70 m for TTS. Thus, as it would be unlikely for a whale to be within 30 m or 70 m of the seismic source, per pulse PTS impacts are not predicted to low-frequency whales. • The fin and sei whale's conservation advice (TSSC, 2015d; TSSC, 2015e) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large. • The pygmy right whale Species Profile and Threats Database (DotEE, 2020) in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat. • Based on the information available for fin, pygmy right and sei whales, foraging within the area of impact is linked to the Bonney Upwelling during January to April which is outside the timing of the Sequoia MSS. The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with the Blue Whale foraging period, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The Blue Whale foraging period is the same as for the fin, pygmy right and sei whales thus the absence of temporal overlap avoids impacts to these foraging whales. • The humpback whale conservation advice (TSSC, 2015c) identified noise interference as a threat including seismic exploration. In the area of impact there is no overlap with the peak humpback migratory period (northbound April – May; southbound November – December). Outside of the peak period they there is a low probability of overlap given the preference for migrating along the edge of the continental shelf (in water depths of about 200 m). • There are no BIAs for fin, humpback, pygmy right or sei whales within the area of impact.	

4.5.5. Impact Assessment – Mid- and High-Frequency Cetaceans

A review of Table 1-3 did not identify any mid-frequency or high-frequency whales as threatened under the EPBC Act or be undertaking a biologically important behaviour or have a biologically important area. However, the of deep-water canyons of the West Tasmania Canyons KEF may provide important foraging areas for sperm whales.

4.5.5.1. Existing Environment

Values

<u>*Sperm Whale*</u>

The Sperm Whale (*Physeter macrocephalus*) is a pelagic species with a worldwide distribution (DAWE 2021f). Preferring deep water, Sperm Whales are most common in submarine canyons at the edges of the continental shelf and mid-ocean, however, may occur close to coasts where water depths exceed 200 m (Bannister et al, 1996). As Sperm Whales tend to feed on deep water species such as oceanic cephalopods, medium and large-sized demersal fishes, including rays, sharks and many teleosts (DAWE, 2021f), Bannister et al. (1996) surmises that this habitat is most likely associated with concentrations of major food, particularly in areas of upwelling.

Sperm Whales have been recorded from all Australian states (Bannister et al. 1996). Females and young male Sperm Whales are restricted to warmer waters, generally north of approximately 45° S, while older males travel to and from colder waters and to the edge of the Antarctic pack-ice (DAWE, 2021f). There are no statistics on the Australian Sperm Whale population size, however, an estimate of the global population size is 300,000–450,000 whales (Whitehead 2002). Although this estimate is based on extrapolating surveyed areas to non-surveyed areas, without a systematic survey design, these are probably the best available and most current estimates of global Sperm Whale abundance (National Marine Fisheries Service 2006). In contrast, estimates of the pre-whaling (1712) Sperm Whale population size are about 1,267,000 individuals (Whitehead 2002a). This suggests that the current population is about 32% of the pre-whaling level and is therefore considerably depleted.

DAWE (2021f) reports that life history data for Sperm Whales has been obtained mainly from whaling specimens and observations made aboard catcher boats. Reproductive information is primarily based on non-Australian data. Sperm Whales are a long-lived species with a life expectancy in excess of 60 years (DAWE 2021f). Male Sperm Whales reach sexual maturity at between 18–21 years, while females are sexually mature at between 7–13 years old (Bannister et al, 1996). Breeding is seasonal with the prolonged period extending from late winter through to early summer (Whitehead 2002b) with calves mostly born in tropical and temperate waters between November and March (Bannister et al. 1996). No specific calving localities are recognised in Australian waters (DAWE 2021f).

Sperm whale strandings have been recorded off Tasmania but no records could be found of strandings on the east coast of King Island near the Operational Area.

Gill et al. (2015) reported for aerial surveys (2002 to 2013) 34 pods of the species (66 individuals) were identified. The mean group size was 1.9 ± 2.2 individuals located predominantly on the lower continental slope at a mean depth of 1,221 ± 628 m. Sperm whale observations did not observe calves which may indicate that the area is not important breeding of rearing young. Of the sightings made, 68% were solitary males, and the remainder were groups of 2-12 similarly sized animals, possibly bachelor schools.

Recorded encounter data is as follows (all months not listed had a zero-encounter rate):

- October – 1.7 whales sighted/1000 km survey distance;
- November – 1.2 whales sighted/1000 km survey distance;
- December – 0.23 whales sighted/1000 km survey distance;
- January – 0.53 whales sighted/1000 km survey distance;
- February – 0.08 whales sighted/1000 km survey distance;
- March – 0.13 whales sighted/1000 km survey distance;
- April – 0.75 whales sighted/1000 km survey distance;
- May – 0.85 whales sighted/1000 km survey distance.

Sensitivities

There are no mid-frequency or high-frequency whales listed as Endangered or Vulnerable within the Sound EMBA (Table 4-53). Table 4-60 identifies key biological sensitivities which may influence sperm whale population resilience.

Table 4-60: Sensitivities – MF and HF Cetaceans

Receptor	Sensitivity description
Sperm Whale	The Sperm Whale does not have a management plan or conservation advice identifying particular vulnerability or sensitivity information. However, they are listed as a migratory species under the Species Profile and Threats Database (SPRAT) (DAWE, 2021f). According to the SPRAT database (DAWE, 2021f), population estimates for the species present in Australian waters are unknown. However, extrapolated figures for global population size indicate the species is less than a third of the size of the pre-whaling level.

	Along with the depleted population status from whaling activities, there are also several life cycle traits of Sei Whales which could make them vulnerable to a wide range of anthropogenic threats; these include: • High age at sexual maturity (7-13 years for females and 18-21 years for males) • Slow reproductive rates (single calf every 4-6years) • Foraging grounds requiring high primary productivity • Cosmopolitan nature of the species and the ability to inhabit all oceans All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.

Existing Pressures

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys.

Receptor	Sensitivity description
Sperm Whale	The SPRAT database (DAWE, 2021f) recognises that the current and potential threats to the Sperm Whale are limited and it is likely that the global population of Sperm Whales is increasing. However, there are a range of anthropogenic threats that have the potential to effect Sperm Whales and the risk posed by these threats varies depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, and their population abundance and trend (DoE 2015b). Potential threats identified by the SPRAT database (DAWE, 2021f) include: • The possibility of illegal whaling or a resumption of legal whaling • Entanglement in fishing gear (including 'ghost nets') • Collision with ships • Negative responses to anthropogenic sounds • High pollutant levels. Due to the long-lived nature of Sperm Whales, as well as their highly dispersed habitat, they are subject to multiple threats acting simultaneously across their entire lifecycle causing a cumulative impact on the population. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017b).

4.5.5.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to mid-frequency or high-frequency cetaceans have been evaluated in Table 4-61; having had regard to the legislative and other controls (Section 4.5.1.5).

Table 4-61: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for MF and HF Cetaceans

Emissions – Underwater Sound (Impulsive)	Consequence
<u>*Change in fauna behaviour*</u> Predicted maximum distances to sound exposure guidelines relevant to mid-frequency whales and high-frequency whales (Table 4-52) are: • Behavioural response: 11.1 km The extent of impact is predicted to be a maximum distance of 11.1 km from the seismic source for a duration of the Sequoia MSS acquisition. Based on the maximum modelled horizontal distance for behavioural response of 11.1 km, the area where marine mammal behaviour may be affected by sound at any point in time (i.e. increased vigilance or potential avoidance) (Purser & Radford, 2011) is ~390 km^2 around the source, or ~1% of the Otway bioregion. The severity is assessed as **Minor (2)** based on:	**Minor (2)**

Emissions – Underwater Sound (Impulsive)	Consequence
• No mid-frequency or high frequency whales within the predicted area of impact were identified as being threatened under the EPBC Act, having a biologically important behaviour or having a biologically important area. • Temporally, there is no known period for Sperm Whale occurrence in Australian waters with sightings occurring in all Australian states and no data mentioned in the SPRAT database on migration timings. However, breeding occurs in tropical waters in late winter through to early summer (DAWE, 2021f). • Spatially, there is a low probability of overlap given Sperm Whales preference for water depths >300m. Bannister et al (1996) states Sperm Whales appear to be less concentrated close to the shelf edge and more widely dispersed offshore. • There are no BIAs for Sperm Whales in the sound EMBA, therefore the Sequoia MSS should not impact on any biologically important behaviours and the most likely impact will be avoidance behaviour or impaired ability to communicate. • Sperm whales are known to forage within the canyon systems of the western Tasmanian canyon system. The area of impact overlaps 2.8% of the West Tasmania Canyons KEF (13,560 km^2). • Sperm whale presence has been observed in the Otway Basin during October but not August or September (Gill et al, 2015). However, water depths where sightings occurred were predominantly on the lower continental slope at a mean depth of 1,221 ± 628 m. The area of impact overlaps 13.25 % of water depths > 600 m within the Mid-frequency EMBA.	

Change in hearing via permanent and temporary threshold shift
Predicted maximum distances to sound exposure guidelines relevant to mid-frequency whales (Table 4-52) are:
• Temporary Threshold Shift (TTS)
  o PK Criteria: Not Reached
  o SEL 24hr Criteria: 80 m (2.69 km^2)
• Permanent Threshold Shift (PTS)
  o PK Criteria: Not Reached
  o SEL 24hr Criteria: Not Reached
The extent of TTS impact is predicted to be a maximum distance of 80 m from the seismic source for the duration of the Sequoia MSS acquisition between August to October. The PTS Criteria is not reached for medium frequency cetaceans within the resolution of the model (20 m). The severity is assessed as **Negligible (1)** based on:
• The TTS and PTS per pulse (PK) criteria for mid-frequency whales was not reached.
• Impacts to mid-frequency whales are not predicted based on the distance of 80 m to the TTS 24hr criteria. Thus, as it would be unlikely for a whale to be within 80 m of the seismic source for a period of 24 hours, impacts are not predicted to mid-frequency whales.
• No mid-frequency whales within the predicted area of impact are identified as being threatened under the EPBC Act, having a biologically important behaviour or having a biologically important area.
Predicted maximum distances to sound exposure guidelines relevant to high-frequency whales (Table 4-52) are:
• Temporary Threshold Shift (TTS)
  o PK Criteria: 620 m
  o SEL 24hr Criteria: 320 m (98.3 km^2)
• Permanent Threshold Shift (PTS)
  o PK Criteria: 340 m.
	Negligible (1)

Emissions – Underwater Sound (Impulsive)	Consequence
o SEL 24hr Criteria: 80 m (3.26 km^2) The extent of TTS impact is predicted to be a maximum distance of 620 m from the seismic source and 340 m from the seismic source for PTS for the duration of the Sequoia MSS acquisition between August to October. The severity is assessed as Negligible (1) based on: • No high-frequency whales within the predicted area of impact are identified as being threatened under the EPBC Act, having a biologically important behaviour or having a biologically important area. • The TTS 24hr criteria was reached within 320 m of the seismic source and the PTS 24hr criteria within 80 m. It would be unlikely for a whale to be within 320 m or 80 m of the seismic source for a period of 24 hours. • Temporally, there is no known period for Sperm Whale occurrence in Australian waters with sightings occurring in all Australian states and no data mentioned in the SPRAT database on migration timings. However, breeding occurs in tropical waters in late winter through to early summer (DAWE, 2021f). • Spatially, there is a low probability of overlap given Sperm Whales preference for water depths >300m. Bannister et al (1996) states Sperm Whales appear to be less concentrated close to the shelf edge and more widely dispersed offshore. • There are no BIAs for Sperm Whales in the sound EMBA, therefore the Sequoia MSS should not impact on any biologically important behaviours and the most likely impact will be avoidance behaviour or impaired ability to communicate. • Sperm whales are known to forage within the canyon systems of the western Tasmanian canyon system. The area of impact overlaps ~0.72% of the West Tasmania Canyons KEF (13,560 km^2). • Sperm whale presence has been observed in the Otway Basin during October but not August or September (Gill et al, 2015) (refer to Values). However, water depths where sighting occurred were predominantly on the lower continental slope at a mean depth of 1,221 ± 628 m. The area of impact overlaps 13.25% of water depths > 600 m within the Mid-Frequency EMBA.	

4.5.6. Impact Assessment – Pinnipeds

4.5.6.1. Existing Environment

Values

There are two Otariid pinniped species that may occur within the Seismic Sound – Pinniped EMBA, Australia Fur-seal and New Zealand Fur-seal (both EPBC: Listed Marine). There are no Pinniped BIAs identified in the sound EMBAs (Table 4-53).

Neither species has a recovery plan or conservation advice, however both species profiles (SPRAT, 2020a; SPRAT, 2020b) refer to the Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans (2018) (DOEE, 2018).

Seals are identified as foraging in the Apollo AMP (DNP, 2013). However, there are no BIAs for seal species which intersect with any of the relevant EMBAs

The Australian Fur-seal (*Arctocephalus pusillus*) has a relatively restricted distribution around the islands of Bass Strait, parts of Tasmania and southern Victoria with no BIA in Bass Strait (DAWE, 2021d). There are 10 established breeding colonies of the Australian Fur-seal that are restricted to islands in the Bass Strait; six occurring off the coast of Victoria and four off the coast of Tasmania (Shaughnessy, 1999). The species prefers the rocky parts of islands with jumbled terrain and boulders and prefers smoother igneous rocks to rough limestone. There are no breeding colonies or haul our sites within the Operational Area, Vessel or Seismic Sound - Pinniped EMBA. The closest breeding colonies to the Operational Area are Reid Rocks (50 km east) and Lady Julie Percy Island (130 km north-west) (Shaughnessy, 1999). The closest haul-out sites are Kanowna Island (238 km east) and West Moncoeur Island (south of Wilson's Promontory, 255 km east).

Colonies are occupied year-round, but activity is greatest during the summer breeding season. Adult females give birth soon after coming ashore, mate about six days after giving birth, and then leave the colony to feed. They alternate periods at sea feeding with shore attendance bouts suckling their pups for several months. There is considerable variation in the time of weaning. Pups begin to forage effectively in June or July, supplementing their milk diet. Most are weaned by September or October, but a small proportion continue to suckle into their second year (Shaughnessy, 1999).

Their preferred habitat, especially for breeding, is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges. Fur-seals are also regularly seen resting and foraging on and around the petroleum production platforms off the Gippsland coast (DAWE, 2021d). They feed on small pelagic fish, squid and seabirds, including little penguins (Shaughnessy, 1999). Juvenile seals feed primarily in oceanic waters beyond the continental shelf, lactating females feed in mid-outer shelf waters (50-100 km from the colony) and adult males forage in deeper waters (Shaughnessy, 1999).

New Zealand Fur-seals are mostly found in central South Australian waters (Kangaroo Island to South Eyre Peninsula, outside the EMBA) 77% of their population is found here (Shaughnessy, 1999). The closest breeding colonies to the Operational Area are located at Cape Bridgewater (145 km north-west) and Lady Julia Percy Island (130 km north-west).

The temporal presence of the pinnipeds is shown in the Temporal Presence and Absence section of Appendix A, which shows their presence and early part of the breeding season overlaps with the Sequoia MSS timing.

Sensitivities

Australian Fur-seals are known to feed at fishing boats (Shaughnessy, 1999), making them vulnerable to interactions with fisheries equipment such as nets, lines, hooks and traps. Seals in the fishing grounds in western Tasmania feed on Blue Grenadier (*Macruronus novaezelandiae*), which is commercially fished in this area (Goldsworthy et al., 2002). Seals compete with fishers for fish that are the same size as those that are commercially targeted and conflicts between fishers and seals had been the cause of seal culls in the past. While culls are not considered appropriate now, there is an ongoing issue of seal bycatch in fisheries which target the Australian Fur-seal's preferred prey (DAWE, 2021d). Australian Fur-seals are also more likely to be more affected by oil spills than are sea lions or phocids (true seals), because they rely on clean fur for insulation, and this is likely to become fouled by oil (Shaughnessy, 1999; DAWE, 2021d).

Existing Pressures

Fur seals face a variety of anthropogenic threats. Commercial and recreational fishing may regard Fur-seals as competitors and pests (Shaughnessy 1999). Seals are known to interfere with sedentary mesh-net fisheries by damaging nets, mauling fish and allowing them to escape (DAWE, 2021d; Shaughnessy 1999). Seals that interfere with fishing gear may be shot by commercial and recreational fishermen, but there is no information regarding the extent of current illegal culling (DAWE, 2021d; Pemberton D & Shaughnessy P, 1993). It is reported that in August 2006, about 40 fur seals were shot by two fishermen on Kanowna Island in Wilsons Promontory National Park at the southernmost point of Victoria (DAWE, 2021d; Russell, 2006). There is also a relatively high incidence of entanglement in fishing equipment for the Australian Fur-seal (DAWE, 2021d; DOEE, 2018). At haul-out sites in southern Tasmania, the incidence of entanglement was 1.9%, and at Tenth Island in the Bass Strait, it was a minimum of 0.6% (DAWE, 2021d; Pemberton et al. 1992). At Seal Rocks, Victoria, a high incidence of entanglement (up to 1.2%) was also observed (DAWE, 2021d).

The SESSF which overlaps the Operational Area, operates under the Australian Sea Lion Management Strategy, implemented in 2010 (AFMA 2010). Patterson et al., (2020) reports that in 2019, 234 pinniped interactions were reported in logbooks for the CTS (168) and GHTS (66): 2 with Australian sea lions (1 alive; 1 dead), 28 with New Zealand fur seals (5 alive; 23 dead), 133 with Australian fur seals (22 alive, 111 dead) and 71 with seals of unknown species (14 alive; 57 dead). This is a decrease from the 284 interactions reported in 2018. In the CTS, 80% of all pinniped interactions in 2019 were reported from bottom-trawling operations; 10% were reported from Danish-seine operations and 6% from midwater seine.

The following pressures were identified for fur seals in the Marine Bioregional Plan for the South-West region, classified 'as potential concern:

- Sea-level rise
- Changes in sea temperature-effects of climate change (classified as 'of concern' for the Australian Sea Lion)
- Chang in oceanography
- Marine debris (classified as 'of concern' for the Australian Sea Lion)

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys.

4.5.6.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to pinnipeds have been evaluated in Table 4-62; having had regard to the legislative and other controls (4.5.1.5).

Table 4-62: Predicted Impact Levels – Emissions – Underwater Sound (Impulsive) for Pinnipeds

Emissions – Underwater Sound (Impulsive)	Consequence
Change in fauna behaviour Predicted maximum distances to sound exposure guidelines relevant to Pinnipeds are: • Behavioural response: 11.1 km The extent of the area of impact is predicted to be a maximum of 11.1 km from the seismic source for the duration of the Sequoia MSS acquisition between August and October. The severity is assessed as **Negligible (1)** based on: • There are no BIAs, aggregation or haul out areas for pinnipeds within the sound EMBA. • Few studies have been undertaken which document the reaction of pinnipeds to seismic sound (Table 4-51). These studies showed some pinnipeds showed avoidance to the seismic source, but their observed avoidance reactions are generally not as strong or consistent as cetaceans (LGL, 2009). Reactions to seismic activities, based on the small observed reaction of phocid pinnipeds (more sensitive to sound than otariids) to seismic activities (Harris et al, 2001) indicates that avoidance behaviour may occur. • The diversity of target prey and the predicted response of prey species (cephalopod, pelagic fish), which may be displaced as a result of seismic sounds, are not expected to limit foraging	Negligible (1)

Emissions – Underwater Sound (Impulsive)	Consequence
opportunities for pinnipeds which have a broad distribution area within Victorian and Tasmanian waters and no BIAs or foraging areas where identified within the area of impact.	

Change in hearing via permanent and temporary threshold shift
Predicted maximum distances to sound exposure guidelines relevant to otariid pinnipeds are:
• Temporary Threshold Shift (TTS)
  o PK Criteria: Not Reached
  o SEL 24hr Criteria: 80 m (3.14 km^2)
• Permanent Threshold Shift (PTS)
  o PK Criteria: Not Reached
  o SEL 24 hr Criteria: Not Reached
The extent of the impact is predicted to be a maximum distance of 80 m for TTS from the sound source for the duration of the Sequoia MSS acquisition between August and October. The severity is assessed as **Negligible (1)** based on:
• The per pulse criteria for PTS and TTS were not reached.
• The PTS 24hr criteria was not reached. The TTS 24hr criteria was reached within 80 m of the seismic source. It would be unlikely for a seal to be within 80 m of the seismic source for a period of 24 hours.
• There are no BIAs, aggregation or haul out areas for pinnipeds within the area of impact.
	Negligible (1)

4.5.7. Impact Assessment – All Marine Mammals – Underwater Sound (Continuous)

The values, sensitivities and existing pressures of marine mammals present in the relevant sound EMBAs are described in the sections above (Sections 4.5.2 to 4.5.6).

Based upon an understanding of the cause/effect pathway, predicted impact levels from Underwater Sound (Continuous) to all marine mammals have been evaluated in Table 4-63; having had regard to the legislative and other controls (Section 4.5.1.5).

Table 4-63: Predicted Impact Levels – Emissions – Underwater Sound (Continuous)

Emissions – Underwater Sound (Continuous)	Consequence
Change in fauna behaviour Predicted maximum distances to sound exposure guidelines relevant to all marine mammals for continuous underwater sound are: • Behavioural response: 1 km (3.14 km^2) The extent of impact is predicted to be a maximum horizontal distance of 1 km from a vessel for a duration of the Sequoia MSS. The severity is assessed as **Minor (2)** based on: • The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with Blue Whales, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The absence of temporal overlap avoids impacts to migration and foraging Blue Whales. • The timing of the Sequoia MSS acquisition does not overlap with the period when most pregnant females generally arrive in Australian waters during late May-July. The timing of the Sequoia MSS acquisition does overlap with the period when mothers with calves leave Australian waters during August – October. • Masking of communications and avoidance behaviour may be exhibited if SRWs are within the area of impact. This avoidance behaviour or impaired ability to communicate may add a kilometre to their migration from the Australian coast. Any disturbance on the behaviour of	Minor (2)

<table>
<tr><td>the mothers that could increase their energy expenditure (Christiansen et al. 2014a), will result in a reduction of energy available for their calf (Christiansen et al. 2014b).
Based on the information available for fin, pygmy right and sei whales, foraging within the area of impact is linked to the Bonney Upwelling during January to April which is outside the timing of the Sequoia MSS. The timing of the Sequoia MSS has been selected primarily to avoid temporal and spatial overlap with the Blue Whale foraging period, which is largely aligned to the timing of krill aggregations that result from the Bonney Upwelling. The Blue Whale foraging period is the same as for the fin, pygmy right and sei whales thus the absence of temporal overlap avoids impacts to these foraging whales.
Spatially, there is a low probability of overlap given Sperm Whales preference for water depths >300m. There are no BIAs for Sperm Whales in the area of impact, and though they may forage within the West Tasmania Canyons KEF impacts are predicted to be temporary when vessels are within 1 km of the KEF.
There are no BIAs, aggregation or haul out areas for pinnipeds within the area of impact.</td><td></td></tr>
</table>

4.5.8. Comparison of Predicted Impacts with Defined Acceptable Levels

Table 4-64 compares the predicted impact levels for marine mammals against the acceptable levels.

Table 4-64: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Marine Mammals

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th rowspan="2" colspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="8">Principles of ESD</td><td rowspan="8">Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.

Environmental impacts and risks have a worst-case consequence ranking less than Major (4).</td><td colspan="2">Cetaceans are not injured or displaced from foraging, aggregation and breeding grounds or migratory routes.
Pinnipeds are not injured or displaced from BIAs, aggregation or haul-out areas.</td><td rowspan="8">Yes</td></tr>
<tr><td>Severity</td><td>Behavioural disturbance</td></tr>
<tr><td>Extent</td><td>Operational area + 11.1 km for cetaceans and pinnipeds</td></tr>
<tr><td>Severity</td><td>TTS</td></tr>
<tr><td>Extent</td><td>Operational area
+ maximum of 56.9 km in offshore direction; 25.9 km towards King Island and 11.7 km towards Victorian Coast for LF cetaceans</td></tr>
<tr><td>Severity</td><td>PTS</td></tr>
<tr><td>Extent</td><td>Operational area
+ 1.18 km for LF cetaceans</td></tr>
<tr><td>Duration</td><td>Maximum 40 days (impulsive sound) and 78 days (continuous sound)</td></tr>
<tr><td>Principles of ESD</td><td>Enough appropriate information to understand impact/risk of</td><td colspan="2">There is moderate to high confidence in the prediction of impacts to marine mammals except for Southern Right</td><td>No</td></tr>
</table>

	serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	Whales. This needs to be assessed and managed further. See Table 4-65. The impact assessment is precautionary because: • Conservative acoustic modelling assumptions have been applied. • Additional acoustic modelling to determine impacts to Victorian coastal SRW BIAs used a location north of the acquisition area, and therefore closer to the Victorian coastal SRW BIAs, than where the seismic source will be at full power (i.e. the acquisition area). • The effect threshold distances have been applied from the boundary of the operational area rather than the acquisition area.	
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	The Zeehan AMP lists PBW and humpback whales in its key values (the AMP provides an important migration area for these species). As previously noted, the timing of the survey has been designed primarily to avoid temporal overlap with PBW migration and foraging, while the deeper waters that the humpback whales prefer to migrate along are outside the portion of the AMP intersected by the Operational Area. Relevant cetacean plans are: • Conservation Management Plan for the Blue Whale (DoE, 2015). • Conservation Management Plan for the SRW (DSEWPaC, 2012). • Conservation Advice for Megaptera novaeangliae (humpback whale) (TSSC, 2015c). • Conservation Advice for Balaenoptera borealis (sei whale) (TSSC, 2015e). • Conservation Advice for Balaenoptera physalus (fin whale) (TSSC, 2015d).	Yes
Biological	Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken that have no pathways to physical injury or physiological effects.	Cetaceans are not injured or displaced from foraging, aggregation and breeding grounds or migratory routes.	Yes
Ecological	No impact on key life functions, vital rates, and population parameters.	No effects beyond behavioural disturbance is predicted.	Yes
Economic	Not relevant.		
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM 11 - the sail line plan ensures the activity is clearly scoped and bounded.	Yes

<table>
<tr><td></td><td></td><td colspan="2">CM 4 - marine mammal observers (MMOs), and passive acoustic monitoring specialists will monitor for marine mammal presence and will follow CM 3, to ensure that impacts to marine mammals remain below the acceptable levels of impact.
CM3 - the marine mammal adaptive management procedure which implements Policy Statement 2.1 plus additional protection afforded to SRW and Blue Whales.
CM 2 – the SRW surveillance program provides data to feed into CM 3 the marine mammal adaptive management procedure.</td><td></td></tr>
<tr><td rowspan="6">ConocoPhillips Australia Policies</td><td rowspan="6">Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).</td><td>Blue Whales</td><td>Negligible (1)</td><td>Yes</td></tr>
<tr><td>Southern Right Whales</td><td>Moderate (3)</td><td>Uncertain</td></tr>
<tr><td>Other LF whales</td><td>Negligible (1)</td><td>Yes</td></tr>
<tr><td>MF and HF whales</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Pinnipeds</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>All other marine mammals</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Relevant Persons</td><td>Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons.

The views of public have been considered in the preparation of the EP.</td><td colspan="2">Claims and objections relevant to marine mammals have been considered in Section 3.4.

Comments were received expressing concern about impacts to cetaceans. ConocoPhillips Australia believes these concerns are largely addressed with the proposed timing of the survey (to temporally avoid PBW) and the implementation of standard and improved control measure to protect all whales.</td><td>Yes</td></tr>
<tr><td>International Standards</td><td>Relevant international, national, and industry standards have been considered and where relevant applied in the EP.</td><td colspan="2">Yes, see Table 4-54.</td><td>Yes</td></tr>
<tr><td>EPBC Program Requirements</td><td>The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td><td colspan="2">The Zeehan AMP lists PBW and humpback whales in its key values (the AMP provides an important migration area for these species). As previously noted, the timing of the survey has been designed primarily to avoid temporal overlap with PBW migration and foraging, while the deeper waters that the humpback whales prefer to migrate along are outside the portion of the AMP intersected by the Operational Area. Relevant cetacean plans are:
• Conservation Management Plan for the Blue Whale (DoE, 2015).
• Conservation Management Plan for the SRW (DSEWPaC, 2012).</td><td>Yes</td></tr>
</table>

		• Conservation Advice for Megaptera novaeangliae (humpback whale) (TSSC, 2015c). • Conservation Advice for Balaenoptera borealis (sei whale) (TSSC, 2015e). • • Conservation Advice for Balaenoptera physalus (fin whale) (TSSC, 2015d).	
Acceptability Summary			
Following completion of the impact assessment process, the environmental impacts to marine mammals arising from the identified aspects are acceptable because: • A variety of control measures will be employed to ensure the impact to marine mammals is ALARP, e.g. shut down on whale sightings, soft starts, MMOs, PAM and adaptive management processes. • EPBC Act policy Statement 2.1 plus industry standard control measures have been improved for blue whales and southern right whales because of their conservation status and the presence of cause-effect pathways that could lead to unacceptable impacts. • Following instruction from the Conservation Advice documents and Recovery Plans for each of the threatened cetacean species, anthropogenic noise and acoustic disturbance will not be a threat as appropriate consideration has been given to the timing and implementation of controls to minimise harm to an acceptable level. • The proposed timing of the survey from August to October was selected to avoid interactions with the most vulnerable marine mammals, additional control measures have been adopted to manage Southern Right Whale cow/calf interactions. • Pinnipeds and medium-high frequency cetaceans will benefit from the controls put in place for EPBC listed low-frequency cetaceans, i.e. increased pre-start observation duration, soft starts, MMOs, PAM.			

4.5.8.1. Predictive Uncertainty

Where there is predictive uncertainty in the impact assessment it is important to identify the source of that uncertainty and adopt appropriate control measures to ensure impacts will be of an acceptable level. This includes acknowledging scientific data gaps and assessing their significance in the context of this activity. Then, decisions about whether the uncertainty can be tolerated (i.e. the impact is below an acceptable level even with the worst extent of any uncertainty) or if efforts need to be made to address the uncertainty can be made. Table 4-65 considers the predictive uncertainty for SRW cows and calves.

Table 4-65: Assessment of predictive uncertainty in the impact assessment on SRW cows and calves.

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Physical effects	High	There are impulsive sound criteria for physical, physiological, and behavioural effects that are relevant to SRW in this region, that have been published in peer reviewed journals. There is some uncertainty about the sensitivity of cows and calves to sound.	The vulnerability of the species coupled with the criticality of calving to the recovery of the species results in a need to increase the confidence that impacts to SRW cow-calf pairs can be managed to below an acceptable level. Therefore, two actions are proposed in the presence of uncertainty. ConocoPhillips Australia will adopt CM 2 SRW and SRW cow-calf monitoring program and CM 3 Marine mammal adaptive management procedure, see Section 4.5.10 for details.
Physiological effects	Medium		
Behavioural effects	Low		
Key life function effects	Low	Given the sensitivity to sound, the vulnerability of	

Factor	Confidence Level	Reason for confidence level	Justification for action/inaction in presence of predictive uncertainty
Population effects	Medium	the species, and the importance of successful breeding to the recoverability of the species, and the behavioural uncertainties there is a low level of confidence in the effects on key life function and population effects.	
Distribution	Medium	Cow-calf pairs have been seen in other locations, but data is still considered sparse.	
Abundance	High	Although the number of breeding females is very low there is some confidence in the numbers.	
Habitat	High	Calm, shallow, and sheltered waters are known to be preferred.	
Trophic interactions	High	Interactions are well understood.	

The Sequoia MSS avoids the critical period for SRW calving when pregnant females and new calves would be at their most sensitive (AMMC, 2009). There is a low likelihood that cow-calf pairs migrating out of the calving areas or using the coastal connecting habitat on the west coast of King Island in August/September/October, may demonstrate avoidance behaviours (McCauley et al., 2000). However, based on the information provided and current research, there are no restricted migration corridors (SEWPC, 2012; Bannister et al., 1997) and thus the activity would not impact on the ability of animals to undertake migration.

Following consultation with a relevant SRW expert, a fit-for-purpose monitoring program for cow-calf pairs, a comprehensive marine mammal adaptive management procedure, and larger mitigation shut down zones (out to 3km) for SRWs (and PBWs) have all been put in place to account for uncertainty in the sensitivity of this species (and cows and calves in particular) to sound. A thorough assessment of the potential use of the interconnecting habitat at King Island by SRW cow-calf pairs will be completed before and during the survey in accordance with the SRW components of control measures 2, 3 and 4.

Disturbance to SRW cows and calves from the Sequoia MSS has been assessed for the potential for unacceptable behavioural impacts. Based on the nature and scale of the activity, the potential for behavioural disturbance to SRW in the (west) King Island coastal connecting habitat is considered unlikely, and if realised, impacts are assessed as negligible, and would be limited to a potential transient behavioural disturbance. Given the short temporal window over which sound levels will be increased, the comprehensive control measure in place to manage impacts and residual uncertainties, the absence of reports of SRW cows and calves utilising the western side of King Island for anything other than migration (AMMC, 2018), it is demonstrated that the activity can be conducted in a manner that is not inconsistent with the Conservation Management Plan for Southern Right Whales.

4.5.9. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Blue Whales continue to utilise the BIA without injury, and are not displaced from a foraging area; and
Receptor	• Southern Right Whales continue biologically important behaviours; and
Receptor	• Other low-frequency whales continue biologically important behaviours; and
Receptor	• Medium and high frequency whales continue biologically important behaviours; and
Receptor	• Pinnipeds continue biologically important behaviours; and
Receptor	• All other marine mammals continue biologically important behaviours; and
Impact	• Impacts are behavioural only with no pathway for impacts on key life functions, vital rates, and population parameters.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-66 which assesses whether the control measures for marine mammals are effective to meet the EPO.

Table 4-66: Control Measure Effectiveness – Marine Mammals

Measure	CM 11 - Sail line plan		
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment. Given the overlap with SRW presence in the ensonified area there are residual impacts that need further mitigation.		
Is the EPO achieved?	Partially		
Residual impacts requiring additional management	Behavioural effects to SRW cow-calf pairs.	TTS effects to any SRW and blue whales.	PTS effects beyond Policy Statement 2.1 distances.
Next Measures	CM 2 – SRW and SRW cow-calf monitoring program. CM 3 – Marine mammal adaptive management procedure.		CM 4 – Marine mammal observers (MMOs) and passive acoustic monitoring (PAM) operators and PS 4.3 increases the shut-down zone for blue whales and SRWs to 3 km.
Assessment of Effectiveness	CM2 allows for detection of SRW prior to and during the Sequoia MSS from aerial surveys, MMO/PAM operators, shore-based observations, to confirm presence and detection during the Sequoia MSS at King Island, Victorian coastline and in Operational Area. CM 3 is effective because: • It requires the generation of information relevant to understanding the presence and life stage awareness of SRW in the region. • It has relevant experts considering the information available from aerial surveys, MMO/PAM operators, shore-based observations, to recommend way to adapt the survey to minimise impacts. • It has specific scenarios with triggers in place for increased information gathering and increase adaption. It includes adaptions to acquire the lines in		Trained and qualified MMOs will provide daylight visual observations. While their range is limited to line of sight, they will be complimented by PAM operators which increases the range of detection and means night-time detection possible. MMOs and PAM operators will undertake to correlate observations during daylight hours to improve confidence in the application of PAMs at night and will implement Policy Statement 2.1 and increased shutdown zone.

	any sequence meaning that there is flexibility to move away from whale sightings/aggregations to minimise impacts, to shorten lines, and adopt/increase excise areas. • It requires documentation of adaptive decisions that can be reviewed to monitor effectiveness of the adaption measures previous taken. CM3 will be tested for effectiveness with the MMOs as part of CM 14.		
Residual impacts requiring additional management	None	None	None

4.5.10. Marine Mammal Adaptive Management Procedure

4.5.10.1. Purpose and Scope

The purpose of the Marine Mammal Adaptive Management Procedure is to detail how ConocoPhillips Australia will avoid and minimise impacts to marine mammals from anthropogenic noise during the Sequoia MSS. The purpose of this control measure is to facilitate communication and planning between shoreline and aerial surveillance teams, the Marine Mammal Observers (MMOs) and Passive Acoustic Monitoring (PAM) Operators and the vessel contractor to minimise impacts to marine mammals.

The Marine Mammal Adaptive Management Procedure focuses on mitigating potential impacts to sensitive marine mammals from underwater sound associated with seismic acquisition. Potential impacts to marine mammals from project aspects include: physical injury as permanent threshold shift (PTS) or temporary threshold shift (TTS) in hearing, behavioural disturbance which could deter whales from area, cause separation of mother and calf pairs or impact energetic behaviours critical for sensitive life stages (i.e. respiration and suckling rates), or cause masking of communication.

Given the temporal and spatial overlap with key sensitive species and the potential to impact biologically critical behaviours, this adaptive management procedure refers to mitigating impacts to Southern Right Whales and Blue Whales from underwater noise associated with the Sequoia MSS.

4.5.10.2. Assumptions

Assumptions have been made in creating this management procedure and procedure. Important assumptions have been listed below to make them explicit to users to assist in interpretation and implementation. If an aspect of this procedure is unclear, users should consider these assumptions in determining what action, if any, to take.

- Management of potential impacts to marine fauna from the Sequoia MSS are outlined in the Sequoia MSS EP, and this Marine Mammal Adaptive Management Procedure relates only to impacts from underwater sound from seismic acquisition to Southern Right Whales and Blue Whales.
- Compliance to Policy Statement 2.1 Interactions with Whales and Seismic Surveys (Policy Statement 2.1).
- Vessel Captain and seismic operators will take advice from MMOs to minimise sound impacts as long as it is safe to do so.

- Management zones are based on Policy Statement 2.1 and underwater acoustic modelling outputs specific to the Sequoia MSS undertaken by JASCO (EP Appendix E).
- Unless the classification of a Southern Right Whale can be validated through visual and photographic evidence, it is to be assumed that a Southern Right Whale sighting is a female and calf pair and additional mitigation measures apply.

If there is a lack of clarity, or residual uncertainty, about the instructions in this procedure, users are required to take actions that minimise sound impacts to whales, are precautionary, and keep impacts within the defined acceptable levels specified in the Environment Plan.

4.5.10.3. Environmental Performance Summary

There are two main components of the procedure; pre- and during survey monitoring actions and adaptive management responses. Details of how these components are intended to perform are outlined in Figure 4-40 and in Appendix A.

In summary, the procedure splits the area of impact into four (4) adaptive management areas (Table 4-67) and indicated in Figure 4-40. These have been developed from acoustic modelling predictions of distance to effect for TTS and behavioural disturbance and represent areas where the distance to effect is expected to be similar. The survey acquisition lines are labelled in Figure 4-41 to support the adaptive management procedure and actions.

Determining which lines can be acquired and in which order is dependent on:

1. the location of whales within an area zone(s) for adaptive management; and
2. the observed and predicted future behaviour of the whale(s) (i.e. resting, nursing, migrating)

Lines the further distance from known whale locations will be prioritised. Whales observed transiting through areas require immediate actions such as shut-downs and movement to other lines. Where alternative lines cannot be identified that reduce the impact, then acquisition cannot recommence until a calculated time has passed. The calculation method will be established and check by a member of the expert peer review panel.

Table 4-67: Adaptive Management Areas

AREA	Adaptive Management Area Description
1	Operational area towards the west coast of King Island
2	Operational are towards the south coast of Victoria
3	Operational area towards offshore waters
4	Operational are towards the waters off the west coast of Tasmania

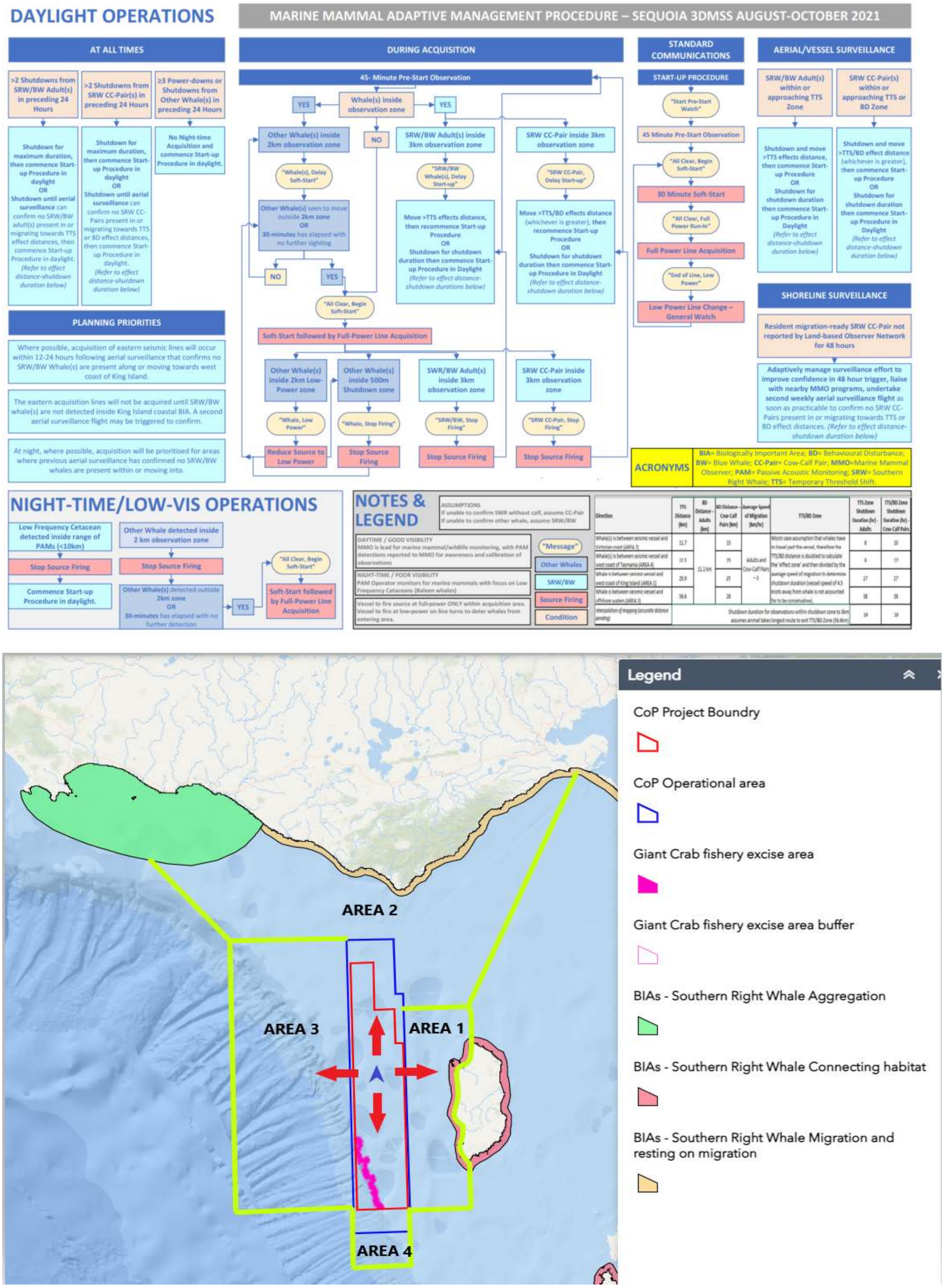


Figure 4-40: Indicative marine mammal adaptive management procedure flow chart and area zones for adaptive management

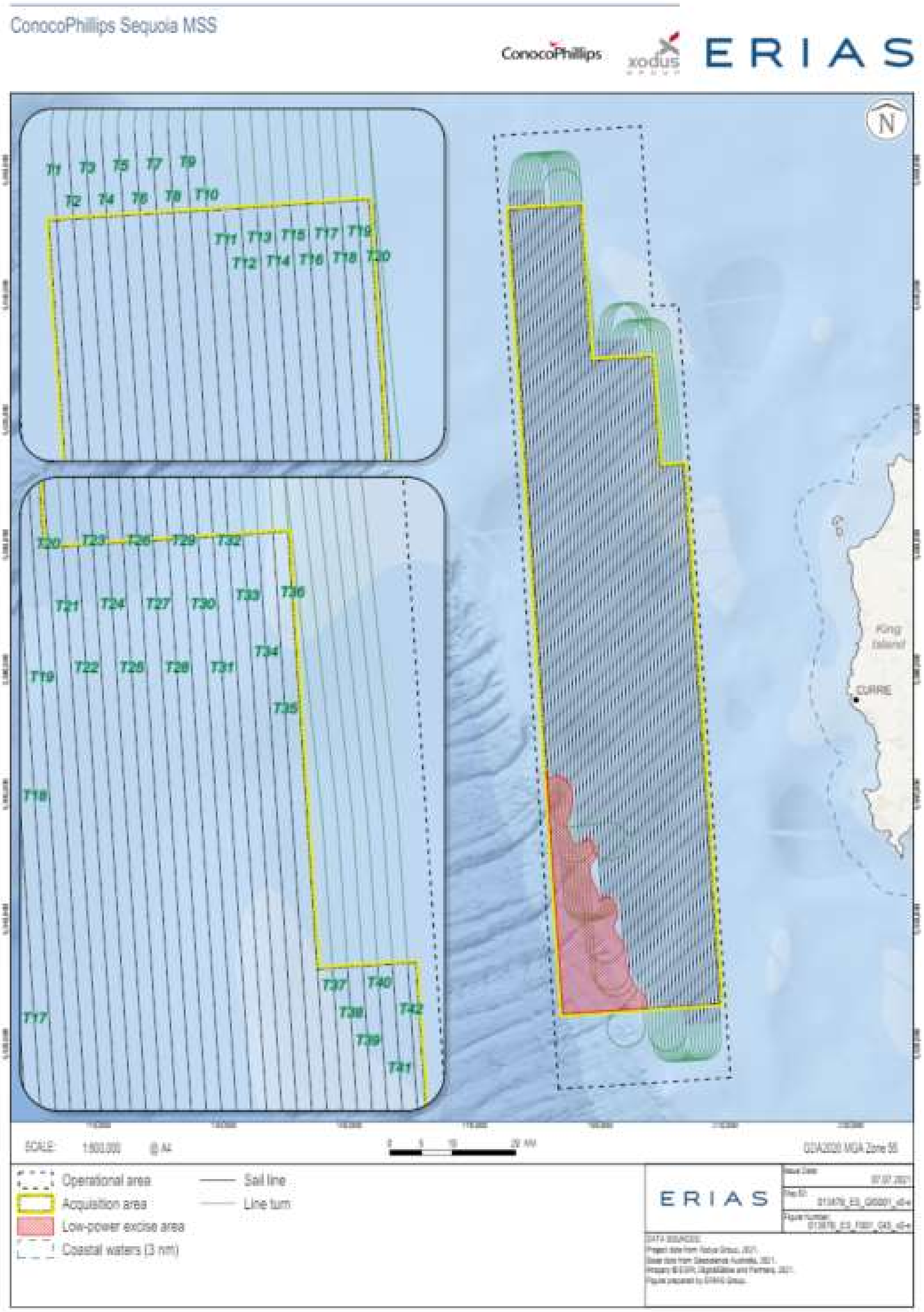


Figure 4-41: Acquisition lines for adaptive planning (Note: Sail-lines shown are indicative only and line run-ins and run-outs will not occur outside of the acquisition area.)

4.5.10.4. Expert Peer Review

As part of the procedure, a peer review panel is established to review the adaptive management procedure prior to commencement of the MSS and input on the implementation of the plan. The Peer review panel includes expert SRW scientist, ConocoPhillips project team and SRW surveillance program contractors - Fathom Pacific. The panel will review new information that becomes available and provide advice to ConocoPhillips Australia on Adaptive Management procedure methodology, triggers, actions, reporting and monitoring to minimise risk to whales. Information from SRW surveillance program will be delivered to the peer review panel and information will be used to re-design the survey tracks to be run to avoid whales that are in the vicinity.

The peer review panel will meet weekly (or more often if adaptive management actions are triggered and new information becomes available) to review SRW surveillance program weekly reports and advise on adaptive management actions.

4.6. Marine Reptiles

4.6.1. Scoping the Assessment

4.6.1.1. Defining the aspects that lead to impacts

Table 4-68 identifies the aspects and impacts that have the potential to impact marine reptiles as a result of the Sequoia MSS. Aspects and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible, or where no cause/effect pathway has been identified.

Appendix B provides a summary and justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (refer to Section 5 for Unplanned Aspects).

Table 4-68: Aspects and Impacts – Marine Reptiles

Aspects	Impacts	Marine Reptiles
Emissions – Underwater Sound (Continuous)	Injury/mortality to fauna	X
	Change in fauna behaviour	✓
Emissions – Underwater Sound (Impulsive)	Change in hearing via permanent and temporary threshold shift	✓
	Change in fauna behaviour	✓
	Injury/mortality to fauna	X
Emissions – Light	Change in fauna behaviour	✓
Emissions – Atmospheric	Change in fauna behaviour	X
Planned Discharges – Vessels	Injury/mortality to fauna	X
	Change in fauna behaviour	X

4.6.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-69 describes the cause and effect pathways / the source of the aspect identified for marine reptiles (Table 4-68).

Table 4-69: Cause and Effect Pathway – Marine Reptiles

Emissions – Underwater Sound (Continuous)
Underwater sound is generated from the survey and support vessels mainly by propeller and thruster cavitation, with a smaller fraction produced through the hull from engines, gearing, and other mechanical systems. Underwater sound is also generated by helicopters during take-off and landing on the survey vessel. Continuous sound generated by the Sequoia MSS has 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: • a change in fauna behaviour.
Emissions – Underwater Sound (Impulsive)
Underwater sound is generated with each pulse from the seismic source that produces high intensity, low-frequency impulsive sounds. Impulsive sound generated by the Sequoia MSS over duration has 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: • a change in fauna behaviour • a change in hearing via permanent and temporary threshold shift.
Emissions - Light
Throughout the Sequoia MSS, external lighting will be required on the survey vessel and support vessels for safe navigation and to facilitate safe working conditions. Vessel and facility lighting are considered standard practice. Lighting used during offshore operations is generally bright white light such as light emitting diodes, halogens, fluorescent and metal halide lights; and would be like lighting used by other offshore mariners (e.g. shipping and fishing). Light emissions generated by the Sequoia MSS have the potential to result in: • a change in ambient light. As a result of a change in ambient light, further impacts may occur to marine reptiles, including: • a change in fauna behaviour.

4.6.1.3. Defining the EMBA

Table 4-70 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact marine reptiles (Table 4-68). A summary of relevant studies supporting the source of the criteria used are provided in Section: EMBA for Marine Reptiles

Relevant Studies; and the sound effect criteria and modelled distances are in Section Sound Effect Criteria.
The EMBAs are shown in Figure 4-42.

Table 4-70: EMBA for Marine Reptiles

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Emissions – Underwater Sound (Continuous)	Vessel sound	Marine turtles may exhibit a response to vessel sound within the Operational Area based on the Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. 2014).	The Sound Exposure Guidelines for Fishes and Sea Turtles (Popper et al. (2014) detail qualitative guidelines for shipping and continuous sounds for turtles based on fish studies. From the guidelines marine turtles may exhibit: • Behavioural response when they are near a vessel (tens of metres) • Moderate response at intermediate ranges (hundreds of metres) from a vessel. • Low response far (thousands of meters) from a vessel.	Operational Area + 1 km
Emissions – Underwater Sound (Impulsive)	Seismic sound – Marine reptiles	The furthest distance to an acoustic threshold for turtles from the acoustic modelling (Koessler et al., 2020; Appendix E) is 5.43 km.	The maximum distances to the acoustic thresholds for turtles from the acoustic modelling are: • Behavioural response[1]: 1.66 km • Behavioural disturbance[2]: 5.43 km • PTS 24 hr3: 0.08 km • TTS 24 hr3: 0.5 km [1] NSF (2011) [2] McCauley et al. (2000) [3] Finneran et al. (2017)	Operational Area + 5.43 km
Emissions - Light	Light	The National Light Pollution Guidelines state an environmental impact assessment should be done if there is sensitive habitat within 20 km of the petroleum activity (DoEE, 2020). Light emissions are generated by artificial light on the vessels, while undertaking the petroleum activity. 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 DoEE (2020) has been used.	The 20 km buffer for considering important habitat is based on sky glow approximately 15 km from the nesting beach affecting flatback hatchling behaviour and light from an aluminium refinery disrupting turtle orientation 18 km away (DoEE, 2020).	Operational Area + 20 km radius

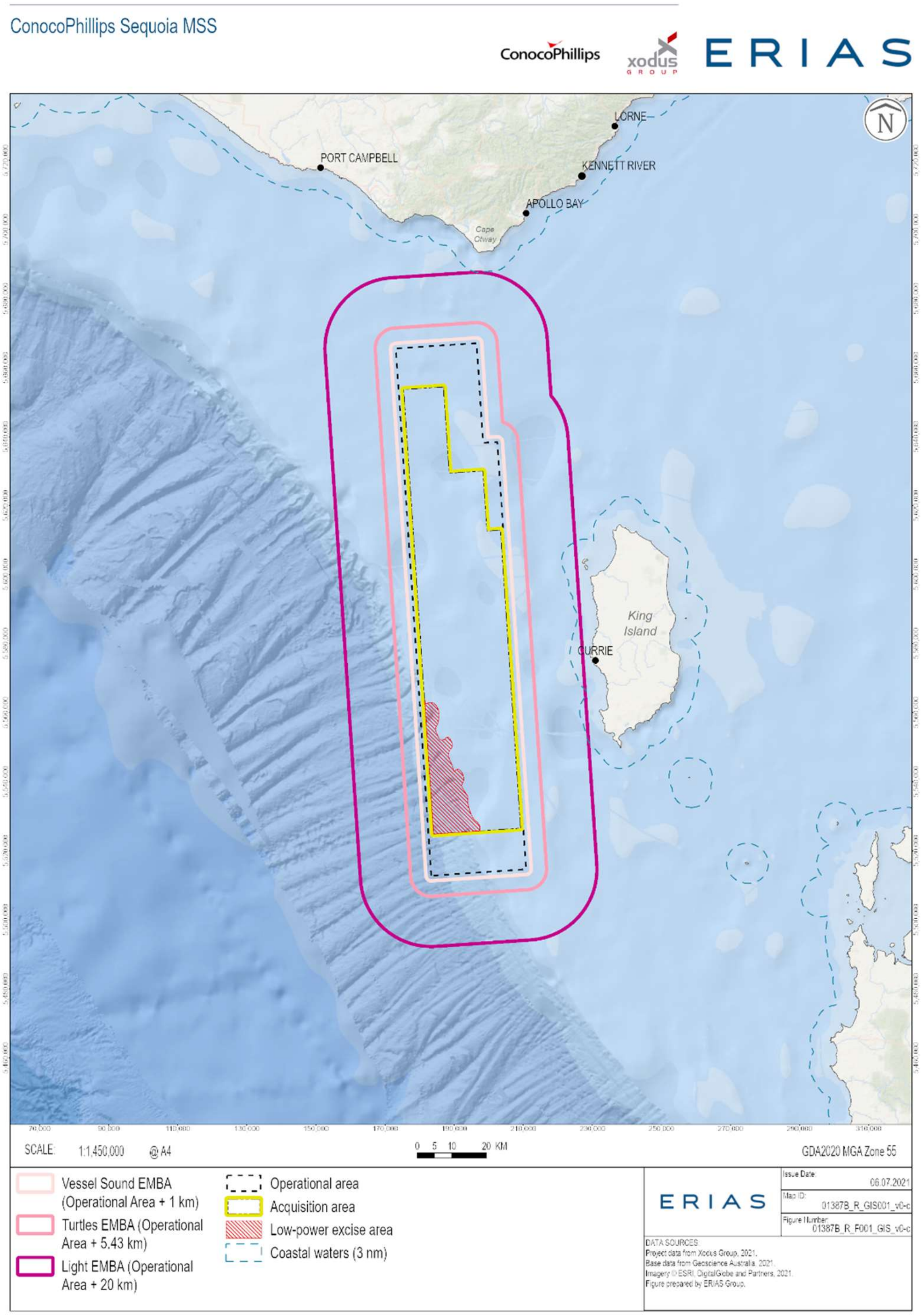


Figure 4-42: EMBA for Marine Reptiles

Relevant Studies

Nelms et al (2016) conducted a review of seismic surveys and turtles that considers the studies detailed below. A common theme is the complex nature of the studies, from the interpretation of behavioural responses, determining responses due to acoustic sources or vessel noise/presence, through to difficulties in visually detecting animals. Most studies examining the effect of seismic sound on marine turtles have focused on behavioural responses given that physiological impacts are more difficult to observe in living animals.

Sea turtles have been shown to avoid low-frequency sounds (Lenhardt, 1994) and sounds from an acoustic source (O'Hara and Wilcox, 1990), but these reports did not note received sound levels. Moein et al (1995) found that penned loggerhead sea turtles initially reacted to a single acoustic source but then showed low or no response to the sound (i.e., they may have become habituated to it). Caged green turtles and loggerhead turtles increased their swimming activity in response to an approaching acoustic source when the received sound pressure level was above 166 dB re 1 µPa and they behaved erratically when the received sound pressure level was approximately 175 dB re 1 µPa (McCauley et al., 2000). In lieu of any published behaviour criteria the results from McCauley et al. (2000) are used to assess behavioural response and disturbance.

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 mortality and potential mortal injury 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 (PTS) and (TTS). 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).

There is limited information on sea turtle hearing and the impacts of underwater sound (DoEE, 2017a). Morphological studies of green and loggerhead turtles (Ridgway et al., 1969; Wever, 1978, Lenhardt et al., 1985) found that the sea turtle ear is similar to other reptile ears but has some adaptations for underwater listening. A thick layer of fat may conduct sound to the ear in a similar manner as the fat in jawbones of odontocetes (Ketten et al., 1999), but sea turtles also retain an air cavity that presumably increases sensitivity to sound pressure. Sea turtles have lower underwater hearing thresholds than those in air, owing to resonance of the aforementioned middle ear cavity, and hence they hear best underwater (Willis, 2016).

Electrophysiological and behavioural studies on green and loggerhead sea turtles found their hearing frequency range to be 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., 2002, Lavender et al., 2012;2014), although these studies were all conducted in-air. Underwater audiograms are only available for three species. Two of these species, the red- eared slider (Christensen-Dalsgaard et al., 2012), the loggerhead turtle (Martin et al., 2012), both demonstrated higher sensitivity at around 500 Hz (Willis, 2016). Recent work on green turtles has refined their maximum underwater sensitivity to be between 200 and 400 Hz (Piniak et al., 2016). 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.

DoEE (2017a) states that turtles potentially use sound for navigation, locating prey and avoiding predators, and that Green, Leatherback and Hawksbill turtles can detect stimuli underwater and in air up to 1,600 Hz, but their greatest sensitivity appears to be between 50-400 Hz depending on the species. Loggerhead turtles have been found to have greatest sensitivity between 100-400 Hz.

Sound Effect Criteria

The criteria for behavioural response and disturbance, PTS and TTS and the distances at which acoustic modelling estimates they could be reached are provided in Table 4-71. The modelled distances for all single impulse sites are detailed in the acoustic modelling report (Appendix E).

Continuous sound was not modelled; the distance used (+1 km) was based on published studies (Relevant Studies section for Fish).

Table 4-71: Sound Effect Criteria and Modelled Distances – Marine Reptiles

	Behaviour		Temporary Threshold Shift (PTS)		Permanent Threshold Shift (PTS)	
Source of criteria	McCauley et al., 200b NSF 2011		Finneran et al. 2017		Finneran et al. 2017	
Justification for criteria	McCauley et al (2000) observed behavioural response in caged turtles at 166 dB SPL. Above 175 dB re 1 µPa, turtles have been observed to behave erratically, which was interpreted as an agitated state (NSF, 2011). This is interpreted as a behavioural disturbance. Both criteria are used in the modelling – response and behaviour. The Recovery Plan for Marine Turtles in Australia (DoEE, 2017) acknowledges the 166 dB re 1 µPa SPL reported by McCauley et al (2000) as the level that may result in a behavioural response to marine turtles.		Thresholds defined recently by Finneran et al (2017) for PTS and TTS in marine turtles have been adopted. The rationale is that sea turtles have best sensitivity at low frequencies and are known to have poor auditory sensitivity (Bartol & Ketten, 2006; Dow Piniak *et al*., 2012). Accordingly, TTS and PTS thresholds for turtles are likely more similar to those of fish than to marine mammals (Popper *et al*., 2014). Popper et al (2014) provides a scale of relative risk for recoverable injury and TTS. The scale assumes that recoverable injury and TTS are possible. The relative risk is defined as: • Near field (tens of meters) - high; • Intermediate field (hundreds of metres) – low; and • Far field (thousands of metres) – Low			
	Marine Reptiles					
	Behaviour		**Temporary Threshold Shift (PTS)**		**Permanent Threshold Shift (PTS)**	
	Per pulse	**Per pulse**	**Per pulse**	**Over 24 hrs**	**Per pulse**	**Over 24 hrs**
Criteria	175 dB SPL	166 dB SPL	226 dB PK	189 dB $SEL_{24}h$	232 dB PK	204 dB $SEL_{24}h$
Modelled distance R_{max}	1.66 km	5.43 km	Not reached[1]	500 m	Not reached[1]	80 m

[1]*Not reached within the limits of the modelling resolution (20m)*

4.6.1.4. Existing Environment

Multiple species (or species habitat) of marine reptile may occur within the relevant EMBAs. Table 4-72 identifies the presence, biologically important behaviour and protection status for each relevant EMBA. PMST records identified three marine reptile species protected under the EPBC Act potentially occurring in the relevant EMBAs.

The Southern Australian Sea Turtles database did not identify any turtles sighting records in the relevant EMBAs (CIE, 2020). The presence of most species within the relevant EMBAs are expected to be of a transitory nature only. Marine turtles have a highly migratory life history and rely on both marine and terrestrial habitats.

There were no BIAs identified for marine reptiles within the relevant EMBAs.

The Yellow-bellied sea snake (*Pelarnis platurus*) is known to be present in waters off the Victorian coast; however, sea snakes are not expected to be encountered within the relevant EMBAs and were not identified in the PMST search.

Values and Sensitivities

Table 4-72 describes the values and sensitivities of marine reptiles within the relevant EMBAs.

Marine reptiles are not identified as a major conservation value of Zeehan or Apollo Marine Parks.

Table 4-72: Marine Reptile species that may occur within the relevant EMBAs, biologically important behaviour and protection status

Scientific name	Common name	Type of Presence/Biologically important behaviour - EMBA				BIA / habitat critical to the survival of the species	EPBC Status / Protection Level			
		Operational Area	Vessel Sound	Seismic Sound – Marine Reptiles	Light	BIA	Threatened Species*	Migratory Species*	Listed Marine Species*	EPBC Management Plan
Caretta caretta	Loggerhead Turtle	LO	LO	LO	LO	-	E	✓	✓	Recovery Plan for Marine Turtles in Australia 2017-2027 (DoEE, 2017a)
Chelonia mydas	Green Turtle	KO	KO	KO	KO	-	V	✓	✓	
Dermochelys coriacea	Leatherback Turtle	KO	LO	LO	LO	-	E	✓	✓	

Type of Presence:		Threatened Species:	
MO	*Species of species habitat may occur within area*	V	Vulnerable
LO	*Species or species habitat likely to occur within area*	E	Endangered
KO	*Species or species habitat known to occur within area*	CE	Critically Endangered

*✓= Listed Migratory/Marine species; *= Matter of National Environmental Significance*

Source: PMST; Appendix J

4.6.1.5. Legislative Requirements

Table 4-73 identifies the minimum legislative and other requirements that are relevant to marine reptiles. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-73: Other Requirements for Marine Reptiles

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislation	Commonwealth *Navigation Act 2012* and the various Marine Orders (as appropriate to vessel class) enacted under this Act	Regulates navigation and shipping including Safety of Life at Sea (SOLAS), including specific requirements for navigational lighting. Although the Act does not apply to the operation of petroleum facilities, it may apply to some support vessels.	Environmental impact assessment for aspects on marine reptiles has been completed in this EP. Cumulative environmental impact assessment for light and underwater sound emissions on marine reptiles has been completed in Section 4.6.2. Adoption of control measures refer to Environmental Performance section in Appendix A).
	Facility Safety Cases, required by OPGGS Act 2006	A safety case is a document produced by the operator of a facility, and assessed by NOPSEMA, which: • Identifies the hazards and risks • Describes how the risks are controlled • Describes the safety management system in place to ensure the controls are effectively and consistently applied.	
Guidelines	National Light Pollution Guidelines (CoA 2020)	The aim of the Guidelines is that artificial light will be managed so wildlife is: • Not disrupted within, nor displaced from, important habitat • 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.	
	EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guideline	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 (DEWHA, 2008b).	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
EPBC Management Plans	Recovery plan for Marine Turtles in Australia (CoA 2017a)	Identifies light pollution as a threat. Action Area A8 (minimise light pollution) relevant management actions: • 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 • Develop and implement best practice light management guidelines for existing and future developments adjacent to marine turtle nesting beaches • Identify the cumulative impact on turtles from multiple sources of onshore and offshore light pollution	
		Identifies sound interference as a threat. Relevant information to sound: • Given that the impacts of sound are unknown, 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. • 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.	
EPBC Management Plans	South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013)	The Plan identifies light pollution associated with offshore mining operations and other offshore activities as a threat to the AMP network.	

4.6.2. Impact Assessment – Marine Reptiles

4.6.2.1. Existing Environment

Values

Multiple species (or species habitat) of marine reptile may occur within the EMBA (Table 4-72; Appendix J). The presence of most species, within the relevant EMBAs, are expected to be of a transitory nature only. There were no biologically important behaviours (e.g. breeding, foraging) identified for the 3 species that may be present.

There are no nesting or internesting areas identified as habitat critical to the survival of marine turtles identified in the waters of southern Australia (DoEE, 2017a).

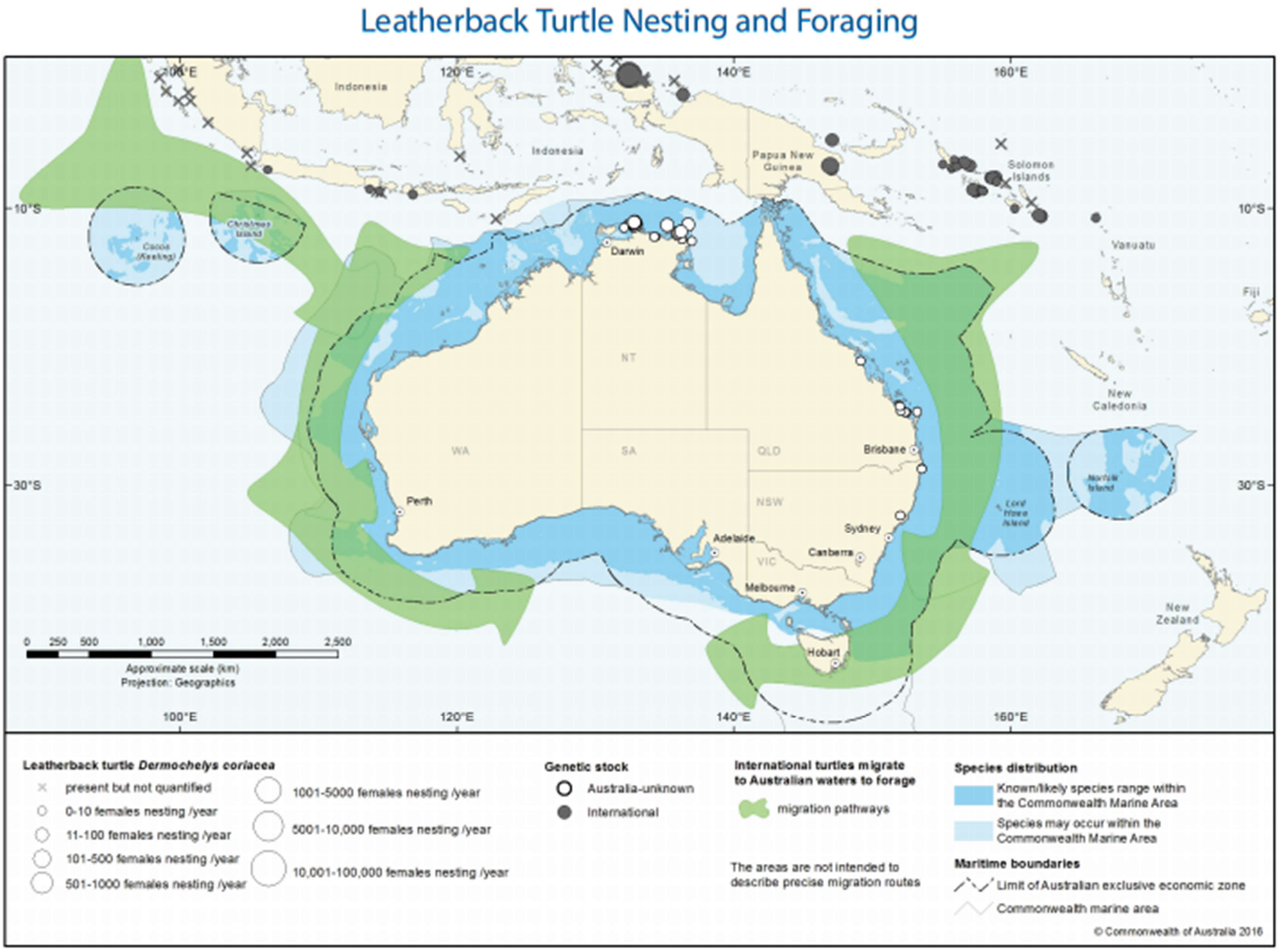
The Loggerhead Turtle (EPBC Act: Endangered) is globally distributed in sub-tropical waters (Limpus, 2008a), including those of eastern, northern and western Australia (DoEE, 2017a), and are rarely sighted off the Victorian coast. The main Australian breeding areas for Loggerhead turtles are generally confined to southern Queensland and Western Australia (Cogger et al., 1993). Loggerhead turtles will migrate over distances in excess of 1,000 km but show a strong fidelity to their feeding and breeding areas (Limpus, 2008a).

No known Loggerhead foraging areas have been identified in Victorian waters although foraging areas have been infrequently identified in waters off SA (DoEE, 2017a). The DoEE (2017a) maps the Loggerhead turtle as having a known or likely range within Bass Strait, but given this species' preference for sub-tropical waters, it is unlikely to be encountered in the relevant EMBAs.

The Green Turtle (EPBC Act: Vulnerable) is distributed in sub-tropical and tropical waters around the world (Limpus, 2008b; DoEE, 2017a). In Australia, they nest, forage and migrate across tropical northern Australia. There are no known nesting or foraging grounds for Green turtles in Victoria, and they occur only as rare vagrants (DoEE, 2017a). The DAWE (2020d) maps the green turtle as having a known or likely range within Bass Strait, with only one sighting of the species recorded in the region (CIE, 2020).

The Leatherback Turtle (EPBC Act: Endangered) is widely distributed throughout tropical, sub-tropical and temperate waters of Australia (DoEE, 2017a), including in oceanic waters and continental shelf waters along the coast of southern Australia (Limpus, 2009). More so than other marine turtles' species, the Leatherback turtle utilises cold water foraging areas, with the species most commonly reported foraging along the coastal waters of central eastern Australia (southern Queensland to central NSW), southeast Australia (Tasmania, Victoria and eastern SA), and southwestern WA (Limpus, 2009). 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, 2017a).

Leatherbacks feed on soft-bodied invertebrates, including jellyfish (Limpus, 2009). No major nesting has been recorded in Victoria or Tasmania, with isolated nesting recorded in the Northern Territory, Queensland and northern NSW (DoEE, 2017a). The DAWE (2020d) maps the Leatherback turtles as having a known or likely range within Bass Strait, and a migration pathway in southern waters with 34 sightings of the species recorded in the EMBA (CIE, 2020). The waters of the relevant EMBAs do not represent critical habitat for the species, though it is possible it may occur in low numbers during upwelling (Figure 4-43).



Source: DoEE 2017a (Recovery Plan). Green arrows represent turtles nesting outside Australia and foraging within Australian waters.

Figure 4-43: Leatherback Turtle nesting and foraging sites

The Sequoia MSS window (August to October) does not coincide with peak period for turtles. Refer to Appendix A for temporal presence in the relevant EMBAs.

Sensitivities

Two of the turtle species that may be present in the relevant EMBAs are Endangered; and one is Vulnerable. The life history traits of marine turtles make them vulnerable to a wide range of anthropogenic threats; which include late maturation, high natural mortality of hatchlings and small juveniles, strong fidelity to breeding areas, migrating over long distances, and use of both terrestrial and marine environments to complete their lifecycle (DoEE, 2020). All these traits mean that they are slow to recover from population declines and are vulnerable to a wide range of threats.

As marine turtles return to the region where they were hatched in order to breed, there are discrete genetic stocks within each species, which if lost, cannot be replaced (DoEE, 2020).

Existing Pressures

The turtle species identified in Table 1-3 are managed under the Recovery Plan for Marine Turtles in Australia (DoEE, 2017a). There are a range of anthropogenic threats that affect Australian marine turtles. The risk posed by these threats vary depending on the habitats occupied by each species, timing of habitat occupancy, life cycle stage affected, abundance and trends in nesting and foraging numbers.

Key threats identified in the Recovery Plan include climate change and variability, marine debris, chemical and terrestrial discharge, international take, terrestrial predation, fisheries bycatch, light pollution, habitat modification through infrastructure/coastal development and dredging and trawling, Indigenous take, vessel disturbance, sound interference, recreational activities and disease and pathogens (DoEE, 2017a).

Light pollution was identified as a high-risk threat because artificial light can disrupt critical behaviours such as adult nesting and hatchling orientation, sea-finding and dispersal, and can reduce the reproductive viability of turtle stocks (DoEE, 2020).

Because marine turtles are long lived and have highly dispersed life history requirements, they are subject to multiple threats acting simultaneously across their entire life cycle causing a cumulative impact on a stock. Similarly, multiple threats may occur at the same time and location and thus provide an interactive impact (DoEE, 2017a). The stock status of the Leatherback Turtle, which is the most likely to be present in the EMBAs, is declining.

Local pressures within the relevant EMBA are likely to include climate change and variability, marine debris – entanglement, anthropogenic sound and light pollution.

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys.

4.6.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to marine reptiles have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (refer to Section 4.6.1.5).

Table 4-74: Predicted Impact Levels – Underwater Sound (Continuous) for Marine Reptiles

Emissions – Underwater Sound (Continuous)	Consequence
Change in fauna behaviour Predicted maximum distances to sound exposure guidelines relevant to all marine mammals for continuous underwater sound are: • Behavioural response: 1 km The Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) identifies sound interference as a threat to turtles. It details that exposure to chronic (continuous) loud sound in the marine environment may lead to avoidance of important habitat. Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to sea turtles from vessel sound. There are currently no quantitative exposure guideline or criteria for marine turtles for continuous sound such as those generated by vessels. Popper et al. (2014) found that there was insufficient data available and instead suggested general distances to assess potential impacts. Using semi-quantitative analysis, Popper et al. (2014) suggests that there is a low risk to marine turtles from shipping and continuous sound except for TTS near (10s of metres) to the sound source, and masking at near, intermediate (hundreds of metres) and far (thousands of metres) distances and behaviour at near and intermediate distances from the sound source. Based on this information avoidance behaviour may occur within the hundreds of metres from the vessel. Three marine turtle species may occur within the Operational Area though no BIAs or habitat critical to the survival of the species were identified.	Minor (2)

The extent of the area of impact is predicted to be within hundreds of metres of the vessels while the Sequoia MSS is undertaken. The severity is assessed as minor based on: • The Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat and no marine turtle important habits are located within the Operational Area. • Avoidance behaviour may occur within the Operational Area where no marine turtle important habits are located. • There is no direct evidence of mortality or potential mortality to turtles from continuous vessel sound.	

Table 4-75: Predicted Impact Levels – Underwater Sound (Impulsive) for Marine Reptiles

Emissions – Underwater Sound (Impulsive)	Consequence
Change in fauna behaviour Predicted maximum distances to sound exposure guidelines for relevant to marine reptiles (Section 4.6.1.3) are: • Behavioural response: 5.43 km Three marine turtle species may occur within the Operational Area though no BIAs or habitat critical to the survival of the species were identified. The extent of the area of impact is predicted to be a maximum of 5.43 km from the acoustic source while the Sequoia MSS acquisition is being undertaken. The severity is assessed as **Minor (2)** based on: • The Recovery Plan for Marine Turtles in Australia (DoEE, 201a7) details that acute noise generated by activities such as seismic activity, or temporary exposure to loud noise, may result in avoidance of important habitats. There are no BIAs or habitat critical to the survival of turtle species within the predicted area of impact, thus avoidance of important habitats is not predicted. • Based on the maximum modelled horizontal distance for behavioural response of 5.43 km, the area where marine turtle behaviour may be affected by sound at any point in time (i.e. increase swimming or practice avoidance based upon caged turtles) (McCauley et al, 2003) is 93 km^2 around the source, or 0.25% of the Otway bioregion. • The area of impact does not represent key foraging, breeding, migration or aggregation areas for marine turtles and marine turtle presence in the predicted area of impact is expected to be representative of their wide distribution in southern Australian waters during the survey acquisition period. • Sound impacts at any time will be localised and temporary around the survey vessel given its constant movement affecting only individual turtles at any one time (no significant population exposure). • Soft starts will be implemented for the Sequoia MSS acquisition in accordance with EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guidelines. Though this document is specifically designed for interactions with cetaceans, the Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) states that soft start provision may also afford protection for marine turtles. While transient encounter with individual turtles, primarily Leatherback Turtles, is possible within the Sequoia MSS area, behavioural impacts are predicted to be localised, temporary and recoverable.	Minor (2)

Change in hearing via Permanent and Temporary Threshold Shift
The extent of the area of impact is predicted to be a maximum of 80 m for PTS and 500 m for TTS from the acoustic source while the Sequoia MSS acquisition is undertaken. The acoustic modelling (Koessler et al., 2020; Appendix E) predicts the exposure area for the PTS effects criteria, the area within which residing turtles could experience PTS over a 24-hour period, is 3.26 km^2. This represents less than 0.01% of the Otway bioregion. The acoustic modelling (Koessler et al., 2020; Appendix E) predicts the exposure area for the TTS effects criteria (i.e. area within which residing turtles could experience TTS over a 24-hour period) is 145 km^2, representing 0.4% of the Otway bioregion.
The severity is assessed as **Minor (2)** based on:
• PTS and TTS are not predicted as the:
  ◦ per-pulse TTS and PTS criteria were not reached.
  ◦ the PTS and TTS 24hr cumulative sound exposure levels, though reached at 80 m and 500 m, respectively, would only result in PTS or TTS impacts if a turtle remained within those distances of the acoustic source for 24 hrs. As there are no BIAs, habitat critical to the survival of the species and no biologically important behaviours identified for turtles within the predicted area of impact,
	Minor (2)

the presence of turtles is expected to be transient and unlikely to result in cumulative sound exposure levels above the PTS or TTS thresholds. • The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) details that acute noise such as generated by activities such as seismic activity, or temporary exposure to loud noise, may result in some situations in physical damage. Based on the acoustic modelling physical injury or hearing impairment is not predicted for the Sequoia MSS acquisition. • The area of impact does not represent key foraging, breeding, migration or aggregation areas for marine turtles and marine turtle presence in the area of impact is expected to be representative of their wide distribution in southern Australian waters in the survey acquisition period. • The likelihood of encounter with Leatherback Turtles known to feed on pelagic soft-bodied creatures in cooler temperate waters, typically associated with upwelling events, is low given the survey timing and the small area within the Otway bioregion which is affected on a transitory basis. • Soft starts will be implemented for the Sequoia MSS acquisition in accordance with EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guidelines. Though this document is specifically designed for interactions with cetaceans, the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017) states that soft start provision may also afford protection for marine turtles. Localised, temporary impacts may occur to individual turtles if present near the array on start-up. However, the implementation of soft-start procedures is expected to reduce the likelihood of this occurring. No population level impacts are expected.	

Table 4-76: Predicted Impact Levels – Emissions – Light

Emissions – Light	Consequence
<u>Change in fauna behaviour</u> 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 (DoEE, 2020; DoEE, 2017a). 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 (DoEE, 2020). Hatchlings have been observed to respond to artificial light up to 18 km away during sea finding (DoEE, 2020). The nearest shoreline to the activity (King Island) is ~18 km from the Operational Area. There are no turtle nesting beaches in this area so the potential for disruption to turtle nesting, hatchling orientation, sea-finding and dispersal behaviour is expected to be negligible Although the PMST search shows that three marine turtle species may be present in the Light EMBA, their presence is likely to be transitory. The Light EMBA does not intersect with any BIA or critical habitat for any of these turtle species. The extent of the area of impact is predicted to be a maximum of 20 km from the light source when there may be vessels present for the Sequoia MSS. The severity is assessed as **Negligible (1)** based on: • The Recovery Plan for Marine Turtles in Australia (DoEE, 2017a) identifies light pollution as a threat to nesting turtles and hatchlings. Light has 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). • The area of impact does not represent key foraging, breeding, migration or aggregation areas for marine turtles; and marine turtle presence in the Light EMBA is expected to be representative of their wide distribution in southern Australian waters in the survey acquisition period. • Changes to biologically important behaviours (such as nesting, hatchling orientation, sea-finding and dispersal behaviour) for marine turtles are not expected to occur.	Negligible (1)

4.6.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-77 compares the predicted impact levels for marine reptiles against the acceptable levels.

Table 4-77: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Marine Reptiles

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th colspan="2" rowspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="4">Principles of ESD</td><td rowspan="4">Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.

Environmental impacts and risks have a worst-case consequence ranking less than Major (4).</td><td colspan="2">Predicted impacts are temporary, reversible, and small-scale for both light and sound.</td><td rowspan="4">Yes</td></tr>
<tr><td>Severity</td><td>Behavioural disturbance.</td></tr>
<tr><td>Extent</td><td>Operational Area + 5.43 km for sound.
Operational Area + 20 km for light.</td></tr>
<tr><td>Duration</td><td>Maximum of 38 days (sound) and 78 days (light).</td></tr>
<tr><td>Principles of ESD</td><td>Enough appropriate information to understand impact/risk of serious/irreversible environmental damage.

Application of the precautionary principle in the presence of scientific uncertainty.</td><td colspan="2">There is high confidence in the prediction of impacts to marine reptiles.</td><td>Yes</td></tr>
<tr><td>Principles of ESD</td><td>EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td><td colspan="2">Recovery plan for Marine Turtles in Australia (CoA 2017a): 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 was identified within or adjacent to the Light EMBA.</td><td>Yes</td></tr>
<tr><td>Biological</td><td>No effect to biologically important behaviours of individuals.</td><td colspan="2">Changes to biologically important behaviours are not predicted to occur.</td><td>Yes</td></tr>
<tr><td>Ecological</td><td>No impact on key life functions, vital rates, and population parameters.</td><td colspan="2">Behavioural disturbance is not predicted to result in changes to predator-prey dynamics, spatial distribution, migration, reproduction or changes in population dynamics.</td><td>Yes</td></tr>
<tr><td>Economic</td><td colspan="4">Not relevant.</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.</td><td colspan="2">CM 11 - the sail line plan ensures the activity is clearly scoped and bounded.
CM 5 – vessels fitted with shrouded lights to prevent light spill or directional lighting.</td><td>Yes</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).</td><td>Marine Reptiles</td><td>Minor (2)</td><td>Yes</td></tr>
</table>

Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to marine reptiles have been considered in Section 3.4. No public comments were made in relation to marine reptiles.	Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	The management actions listed for seabirds in The National Light Pollution Guidelines for Wildlife (DoEE, 2020) have been considered. MMOs will implement Policy Statement 2.1 which includes soft-starts that afford some protection to marine reptiles.	Yes

Acceptability Summary
Following completion of the impact assessment process, the environmental impacts to marine reptiles arising from the identified aspects are acceptable because: • There is no direct evidence of mortality or potential mortality to turtles from continuous vessel or seismic sound. • There are no turtle BIAs or habitat critical to the survival of marine turtles within or adjacent to the sound or light EMBAs. • Sound and light impacts are predicted to be localised and temporary around the vessels and seismic source given they are in constant movement. • Turtles may show increased swimming behaviour as the seismic source approaches resulting in them moving away from the sound source, an avoidance response, and then resuming normal activity.

4.6.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP and ensure that lighting is kept to the minimum needs for safe operations and navigation so that:
Receptor	• Marine reptiles continue biologically important behaviours; and
Impact	• Impacts are behavioural only with no pathway for impacts on key life functions, vital rates, and population parameters.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-78 which assesses whether the control measures for marine reptiles are effective to meet the EPO.

Table 4-78: Control Measure Effectiveness – Marine Reptiles

Measure	**CM 11 - Sail line plan**
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.
Is the EPO achieved?	Partially

Residual impacts requiring additional management	This CM only covers the impacts from impulsive sound and the spatial extent of light impacts. It lacks methods of reducing the severity of light impacts.	
Next Measure	CM 5 – Project vessels, PS 5.11.	CM 7 – Marine assurance system
Assessment of Effectiveness	Vessels fitted with shrouded lights to prevent light spill or directional lighting.	Ensures that maritime law is being complied with.
Is the EPO achieved?	Yes	Yes
Residual impacts requiring additional management	None	

4.7. Commercial Fisheries

4.7.1. Scoping the Assessment

4.7.1.1. Defining the aspects that lead to impacts

Table 4-79 identifies the aspects and impacts that have the potential to impact commercial fisheries as a result of the Sequoia MSS. Aspects and impacts marked 'X' are predicted to have cause/effect pathway or negligible consequence (less than Minor) and have not been discussed further in this chapter.

This section assesses the presence of the survey vessel, survey equipment and support vessels within the Operational Area. The ecological and biological impact of underwater sound from the Sequoia MSS on the target species of commercial fishers are addressed in Section 4.2 – Invertebrates and Sections 4.3 – Fish.

Appendix B provides a summary and justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 – Unplanned Aspects).

Table 4-79: Aspects and Impacts – Commercial Fisheries

Aspects	Impacts	Commercial Fisheries
Interference with Other Marine Users	Changes to the functions, interests or activities of other users	✓

4.7.1.2. Defining the EMBA

Table 4-80 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact commercial fisheries.

The source of the aspect is described in Section 4.7.1.3.

The EMBA relevant for commercial fisheries is the Operational Area.

Table 4-80: EMBA for Commercial Fisheries

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Interference with Other Marine Users	Presence of survey vessel, survey equipment and support vessels	Interference with other marine users can occur from the presence of the survey vessel, streamers and support vessels.	The Sequoia MSS activities will be undertaken within the Operational Area.	Operational Area

4.7.1.3. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-81 describes the cause and effect pathways / the source of the aspect identified for commercial fisheries (Table 4-79).

Table 4-81: Cause and Effect Pathway – Commercial Fisheries

Interference with Other Marine Users
Interference with Other Marine Users can occur as a result of the presence of the survey vessel, deployed survey equipment and support vessels within the Operational Area. Interference can result in: • changes to the functions, interests or activities of other users

4.7.1.4. Existing Environment

Multiple fisheries from three fishing management jurisdictions (Commonwealth, Victorian and Tasmanian) may occur within the Operational Area (Table 4-83):

- Eleven Commonwealth fisheries
- Five Victorian fisheries
- Two Tasmanian fisheries.

Values and Sensitivities

To understand the value and sensitivities of the commercial fisheries ConocoPhillips Australia commissioned SETFIA and Fishwell Consulting to provide information on the fisheries and sectors that operate in and around the Sequoia MSS Operational Area and also review a previous SETFIA and Fishwell Consulting report commissioned for 3D Oil (SETFIA 2018, 2020; Appendix F). This assessment details the fisheries that overlap with the Sequoia MSS Operational Area and the fisheries catch and value relevant to the Sequoia MSS Operational Area.

SETFIA and Fishwell Consulting (2020) did not identify any catch for the Southern Squid Jig Fishery within the Operational Area for the last 10 years. Mapping in the State of the Fishery Report 2020 (Patterson et al., 2020) indicates the Sequoia MSS Operational Area overlaps the total area fished during the 2019 but not the area where there is fish intensity or catch which aligns with the SETFIA report which did not identify catch for this fishery within the Sequoia MSS Operational Area.

Those fisheries that have been identified as fishing within the Operational Area within the past five years are considered in this impact assessment. Fisheries that overlap the Operational Area but did not fish within the Operational Area within the past five years were not considered for impact assessment.

Existing Pressures

COVID 19 Restrictions

COVID-19 has had a significant impact on Australia's fisheries and aquaculture industry. The impact has been complex and resulted from both demand-side disruptions to domestic and international markets and supply-side disruptions from social distancing measures across fishing and aquaculture activities and issues in crewing vessels and sourcing inputs in some sectors (DAWE, 2021a).

For example, the timing of the COVID-19 outbreak in China coincided with the peak export period for Australian rock lobster Rock Lobster—the Chinese Lunar New Year celebration period. In January 2020 the outbreak in China resulted in export orders falling significantly (Mobsby, Steven & Curtotti 2020). The resultant collapse in export demand and limited opportunities for alternative markets is estimated to have resulted in production value for Rock Lobster falling by 25% in 2019 – 20 to $544 million (DAWE, 2021a).

Some impacts have been mitigated as select segments of the industry have adjusted to the pandemic, such as by pivoting from food service to retail sales. However, despite these mitigating actions, lower demand for much of the sector is estimated to have reduced the gross value of Australian fisheries and aquaculture production (GVP) to $3.11 billion in 2019–20. This represents a $258 million (or 8%) downward revision from the December 2019 outlook (DAWE, 2021a).

The value of fisheries and aquaculture production is not expected to return to pre-2019–20 levels over the projection period due to the ongoing effects of COVID-19. GVP in 2020–21 is expected to decline to $2.94 billion (down 6% from 2019–20) in real dollars, before commencing a slow recovery (DAWE, 2021a). Fisheries reports from the DPIPWE are not yet available for the period covering the pandemic.

Fisheries Regulation

The nature of commercial fisheries is that it is an extractive industry. Biomass is taken from the population and sustainably managed by the various Commonwealth and State fisheries regulators. Commercial fishers are subject to various management measures that govern the catch in a given period. Those management measures vary by fishery and include measures such as quotas and licenses, catch sizes, fishing seasons, and zoning. The extent to which a stock can be fished is monitored by the relevant regulator who has responsibility for implementing and adjusting these measures in consideration of the existing environmental pressures exerted on a stock. The productivity and profitability of commercial fishers are directly affected by the decisions of their regulators, historical catch, and the resilience of biomass to fishing.

International Relations

Political and trade relations between Australia and the export markets of commercial fisheries have significant influence on the profitability of commercial fisheries. Typically, almost all of Victoria's commercial Rock Lobster catch is exported to international markets, predominantly in Asia. However political events of 2020 have currently resulted in a shift of the primary market back to domestic sales. For example, China accounted for around 91% of Australian Rock Lobster exports in 2019 and 2020 and the resumption of Rock Lobster exports to China is the key uncertainty for the forward projections (DAWE, 2021a).

Climate Change

CSIRO was commissioning to undertake a review of how climate change may affect Australian fisheries in a summary report (CSIRO, 2018) they identified that changes have already occurred, and the sensitivity and models predict that there will be strong differences in the level of effects and responses across different species and food webs. Demersal food webs, those species that live near to or amongst habitats on the seabed, appear to be more strongly affected by climate change. Invertebrates, who are amongst Australia's most valuable target species, are particularly sensitive. Pelagic food webs, where species live up in the water column, appear less sensitive and may even benefit from the environmental changes. Both Commonwealth and State fisheries will face changes in gross value as a result of climate change effecting both the fish stocks and (potentially) the behaviour of the fishers.

Cumulative impacts from previous and simultaneous activities in the area

Refer to Appendix A Cumulative Impact Assessment for information and assessment of cumulative impacts from other seismic surveys in the area.

4.7.1.5. Legislative Requirements

Table 4-82 identifies the minimum legislative and other requirements that are relevant to commercial fisheries. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-82: Other Requirements – Commercial Fisheries

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia Survey
Cwth Legislation	Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act)	Section 280 of the OPGGS Act requires that the Sequoia MSS must be carried out in a manner that does not interfere with fishing to a greater extent than is necessary for the reasonable exercise of the rights and performance of ConocoPhillips Australia.	The activity has been designed in such a way that minimises the overlap with fishing activities and control measures will be implemented to manage any residual interference.
Cwth Legislation	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009	These regulations require consultation with relevant persons who may be affected by the activity.	See Chapter 3

Table 4-83: Presence of commercial fisheries and fishing activity within the Operational Area

Fishery	Recorded fishing in the Operational Area in the last 5 years
Commonwealth	
Bass Strait Central Zone Scallop Fishery (BSCZSF)	X
Eastern Skipjack Tuna Fishery (ESTF)	X
Eastern Tuna and Billfish Fishery (ETBF)	X
Small Pelagic Fishery (SPF)	X
Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)	✓
Southern and Eastern Scalefish and Shark Fishery – Shark Gillnet Sector and Shark Hook Sector (SESSF – CGS/CSHS)	✓
Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector (SESSF – SHS)	✓
Southern Bluefin Tuna Fishery (SBTF)	X
Southern Squid Jig Fishery (SSJF)	X
Victorian	
Abalone	X
Giant Crab Fishery	✓
Rock Lobster Fishery	✓
Wrasse Fishery	X
Tasmanian	
Giant Crab Fishery	✓
Rock Lobster Fishery	✓

✓= data suggests active fishing has taken place within the survey area within the last five years

Source: Sources: Patterson et al (2020, 2019, 2018; 2017; 2016), SETFIA and Fishwell Consulting (2020), VFA (2021), DPIPWE (2021).

4.7.2. Impact Assessment

4.7.2.1. Existing Environment

Values and Sensitivities (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 3 nm from the coast out to the 200 nm limit (the Australian Fishing Zone (AFZ)).

Table 4-83 details that there has been fishing activity in the last five years for three Commonwealth-managed fisheries within the Operational Area.

For the Commonwealth-managed fisheries that actively fish within the Operational Area, information is provided consisting of catch and effort data from the Fisheries Status Reports (Patterson et al., 2020, 2019, 2018, 2017, 2016) and the SETFIA and Fishwell Consulting reports (2018, 2020).

Southern and Eastern Scalefish and Shark Fishery – Shark Gillnet and Shark Hook Sector (SESSF – CGS/CSHS)

The Shark Gillnet Sector (Figure 4-44) and Shark Hook Sector (Figure 4-45) use demersal gillnet and longline to target Gummy Sharks and are restricted to waters shallower than 183 m (SETFIA and Fishwell Consulting, 2018). Fishery catch statistics for this sector are provided in Table 4-84.

Table 4-84: Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector (SEEF – CGS/CSHS)

Title	Description
Primary landing ports	Adelaide, Port Lincoln, Robe (SA); Lakes Entrance, San Remo, Port Welshpool (Vic); Devonport, Hobart (Tas)
Target species	Gummy shark (*Mustelus antarcticus*) is the key target species, with bycatch of Elephant Fish (*Callorhinchus milii*), Sawshark (*Pristiophorus cirratus*, *P. nudipinnis*), and School Shark (*Galeorhinus galeus*). Gummy shark made up ~80% of the catch in the 2019-20 fishing season.
Fishing season	12-month season begins 1st May. SETFIA and Fishwell Consulting (2020) reports highest catch totals for the fishery in November, March and April and lowest in June, April and December.
Licences Active vessels (2019-2020)	74 permits / 71 active vessels
Recent catch within fishery	• 2019-20 – 2,201 tonnes with no value assigned • 2018-19 – 2,126 tonnes worth $23.6 million • 2017-18 – 2,216 tonnes worth $19.1 million. • 2016-17 – 2,118 tonnes worth $18.3 million • 2015-16 – 2,233 tonnes worth $18.4 million.
Catch in Operational Area	**Shark Gillnet Sector:** Over the last 10 years, an average annual catch of 6.3 tonnes valued at $39,000 has been taken from the Operational Area. This represents 1% of the catch taken for the Shark Gillnet and Shark Hook Sector (SETFIA and Fishwell Consulting, 2020). Figure 4-44 shows low fishing intensity (net length <150 m/km^2) to both the north and eastern extents of the Operational Area but with the majority of low to high fishing intensity to the east of the Operational Area.

Title	Description
	Shark Hook Sector: Over the last 10 years, an annual average catch of 5.2 tonnes worth $37,000 has been taken from the Operational Area (Note: These figures are for the Shark Hook Sector and the Scalefish Hook Sector as detailed in SETFIA and Fishwell Consulting and Fishwell Consulting (2020)). This represents 1% of the catch taken for the Shark Gillnet and Shark Hook Sector (SETFIA and Fishwell Consulting, 2020). Figure 4-45 shows that low to high intensity fishing occurs in coastal waters to the north-east of Tasmania and west to Victoria outside of the Operational Area.
Harvest strategy	The four principle target species are managed under the SESSF Harvest Strategy Framework (AFMA, 2020). There is also the School Shark Stock Rebuilding Strategy (AFMA, 2015) whereby school shark is subject to an incidental catch limit, and other measures to reduce targeting and catch. Spatial closures are implemented across the fishery to protect school shark breeding populations, pupping and nursery areas, and school and gummy shark habitat, and to promote the recovery of upper-slope dogfish stocks.
Sensitivities	Sea level rise and changes in sea temperature associated with climate change may negatively affect the main stocks of the target species, the Gummy Shark, because the habitats that Gummy Shark use as nursery and feeding grounds are potentially sensitive to such effects (Hobday et al., 2007).
Existing pressures	Fishing pressure has been identified as the key threat for school shark in south eastern Australia, with historical fishing effort having depleted stocks to below 20% of unfished levels. Stocks of other principle target species are not currently subject to overfishing and therefore of less concern (Patterson, 2020).
Stakeholder concerns	Through consultation SETFIA recommended that ConocoPhillips Australia have in place an adjustment protocol that addressed displacement as a result of the Sequoia MSS.

Sources: Patterson et al (2020, 2019, 2018; 2017; 2016), SETFIA and Fishwell Consulting (2020); AFMA (2015; 2019)

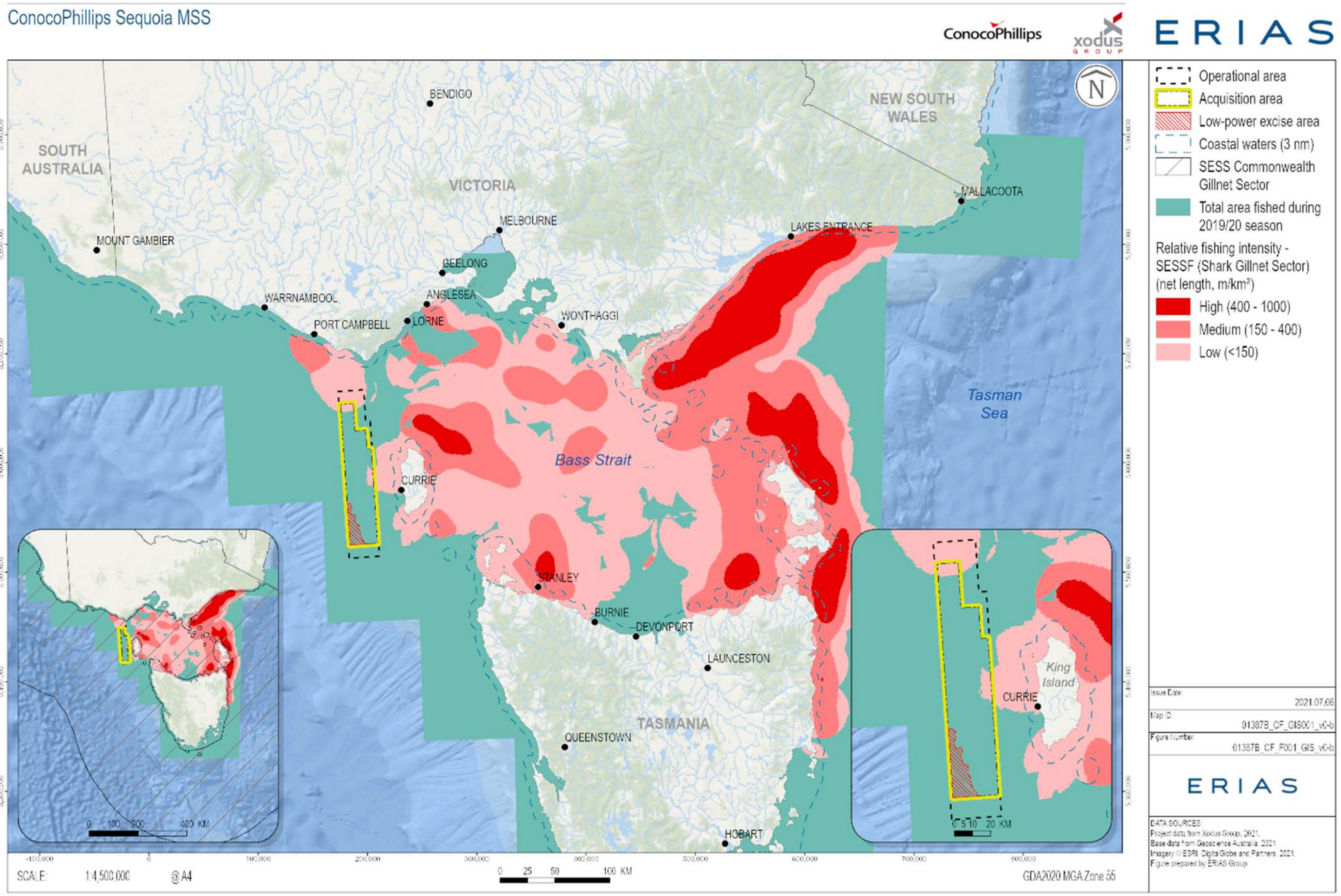


Figure 4-44: Boundary and Fishing Intensity in the SESSF – Shark Gillnet Sector

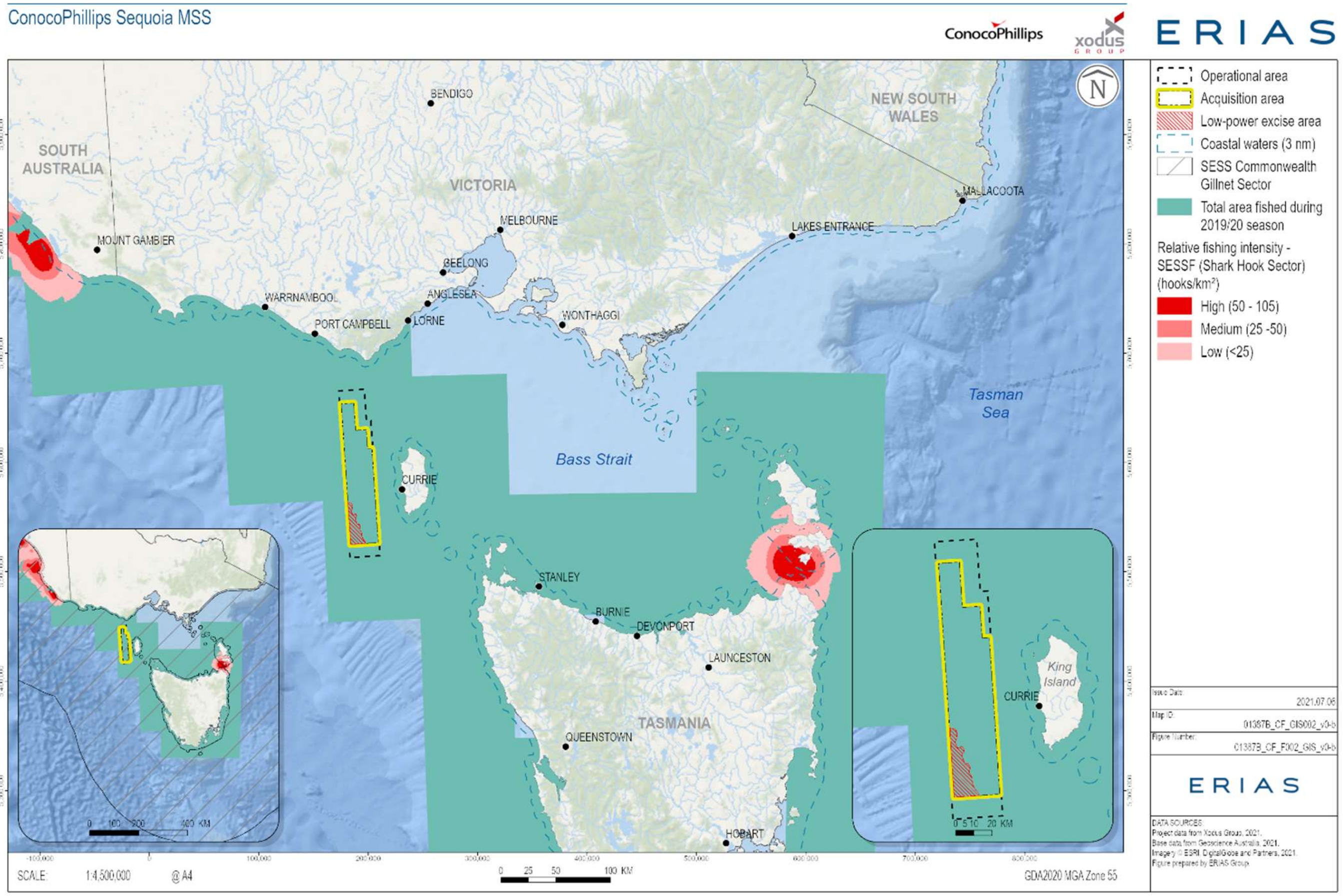


Figure 4-45: Boundary and Fishing Intensity in the SESSF – Shark Hook Sector

Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)

The Commonwealth Trawl Sector (CTS) of the SESSF lies in AFZ waters extending from Cape Jervis (SA) around the Victorian, Tasmanian and NSW coastlines northward to Barranjoey Point (Figure 4-46 and

Figure 4-47). This sector utilises demersal otter-board trawl and Danish-seine equipment to target demersal species. The waters south-west of King Island are fished by the otter-board sector (Patterson et al., 2020, Figure 4-46) and Danish-seine vessels fish to the east of King Island (Patterson et al., 2020, Figure 4-47). SETFIA and Fishwell Consulting (2020) detailed that from their experience otter-board trawlers often tow in a straight line along the depth contour and there was significant effort on the shelf break that passed through the Operational Area.

Fishery catch statistics for this sector are provided in Table 4-85.

Table 4-85: Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS

Aspects	Description
Primary landing ports	Eden, Sydney and Ulladulla (NSW); Hobart (Tas); Lakes Entrance and Portland (Vic)
Target species	Key species targeted are: Blue Grenadier (*Macruronus novaezelandiae*), Tiger Flathead (*Neoplatycephalus richardsoni*), Orange Roughy (*Hoplostethus atlanticus*)—eastern zone, Pink Ling (*Genypterus blacodes*) and Eastern School Whiting (*Sillago flindersi*)
Fishing season	12-month season begins 1st May. Otter trawl catch from the Operational Area is highest in March and November and lowest in June, April and December (SETFIA and Fishwell Consulting, 2020).
Boat statutory fishing rights^ / active vessels (2019-2020)	57 trawl fishing rights / 30 active trawl vessels.
Recent catch within fishery*	• 2019-20 – 13,148 tonnes with no value assigned. • 2018-19 – 8,454 tonnes worth $49.47 million. • 2017-18 – 8,631 tonnes worth $41.86 million. • 2016-17 – 8,691 tonnes, worth $46.42 million. • 2015-16 – 9,025 tonnes, worth $41.5 million.
Catch in Operational Area	Over the last 10 years, an annual average catch of 79 tonnes worth $322,000 has been taken from the Operational Area. This represents 1% of the catch of the whole fishery (SETFIA and Fishwell Consulting, 2020). Figure 4-46 shows low to medium otter board fishing intensity within the southern section of the Operational Area. Figure 4-47 shows low to high Danish-seine fishing activity to the east of the Operational Area.
Harvest strategy	Harvest Strategies (HSF) are in place for all 34 species and subject to quota (including target and nontarget species) in the SESSF. The HSF uses a tiered approach designed to apply different types of assessments and cater for different amount of data available for different stocks. The HSF adopts increased levels of precaution that correspond to increasing levels of uncertainty about stock status, in order to reduce the level of risk associated with uncertainty. In this approach, each stock is assessed using one of three types of assessment depending on the amount and type of information available to assess stock status, where Tier 1 represents the highest quality of information available (i.e. a robust integrated quantitative stock assessment) (AFMA, 2020).
Sensitivities	The SHS also targets Gummy Shark, see CGS/CSHS above. Orange Roughy are listed as Conservation Dependent under the EPBC Act and are managed under AFMA's Orange Roughy Rebuilding Strategy.

Aspects	Description
Existing pressures	Target species include the gummy shark plus the Eastern School Whiting and Tiger Flathead (*P. richardsoni*). All primary target species within the SESSF – CTS identified within the South Eastern Australia biological stock are classified as a sustainable stock (Patterson et al. 2020).
Stakeholder concerns	Through consultation SETFIA recommended that ConocoPhillips Australia have in place an adjustment protocol that addressed displacement as a result of the Sequoia MSS.

Sources: Patterson et al (2020, 2019, 2018; 2017; 2016), SETFIA and Fishwell Consulting (2020); AFMA, 2015; 2019)

** Scalehook Shark Sector is reported along with Commonwealth Trawl Sector as most stocks are shared (Emery et al. 2020)*

^ Statutory fishing rights allow fishers to fish in the fishery and catch the fish species that are under a quota. The amount of quota an operator is allocated depends on the amount of rights they hold. The amount of quota changes every year. Statutory fishing rights are transferable between fishers, they may also be known as individually transferable quota (AFMA, 2021).

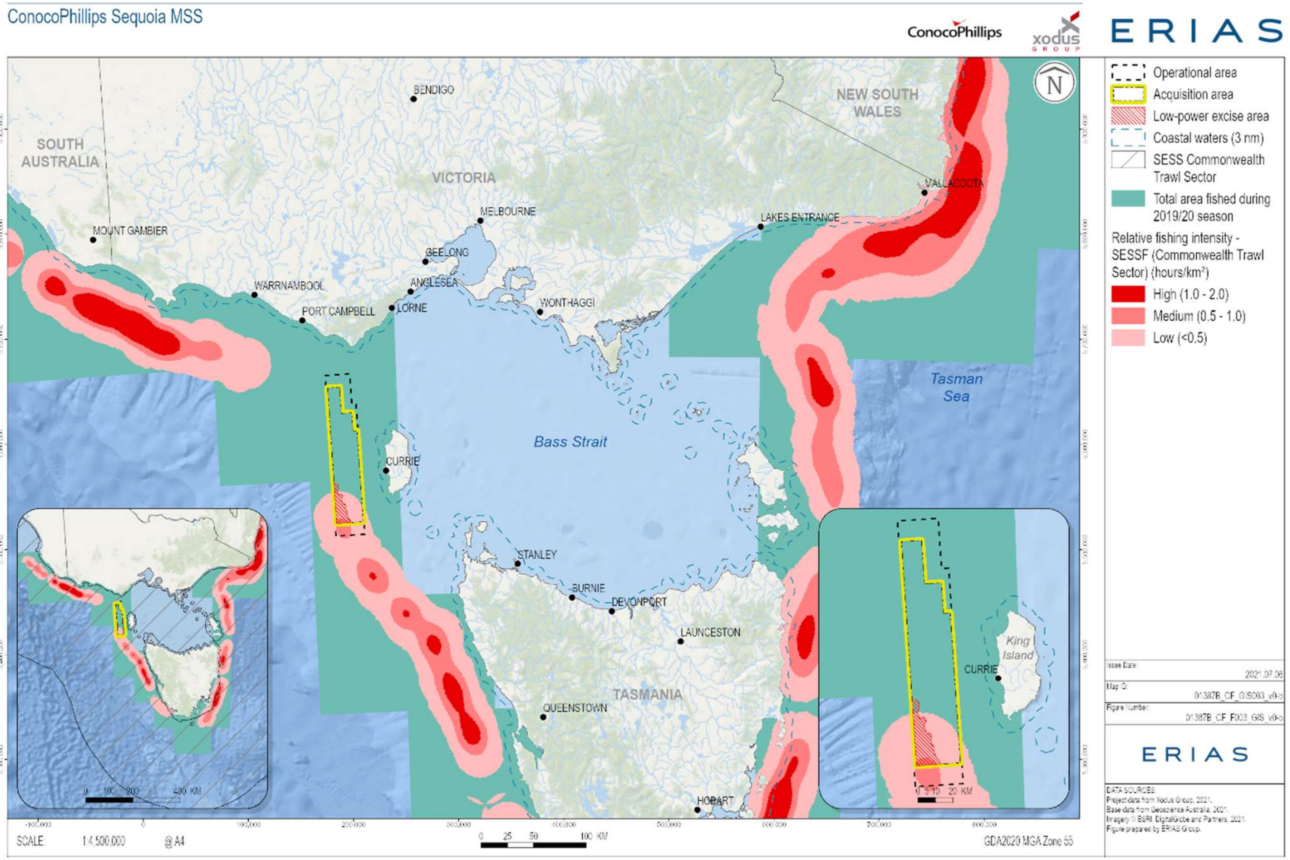


Figure 4-46: Boundary and Fishing Intensity in the SESSF Commonwealth Trawl Sector (otter board)

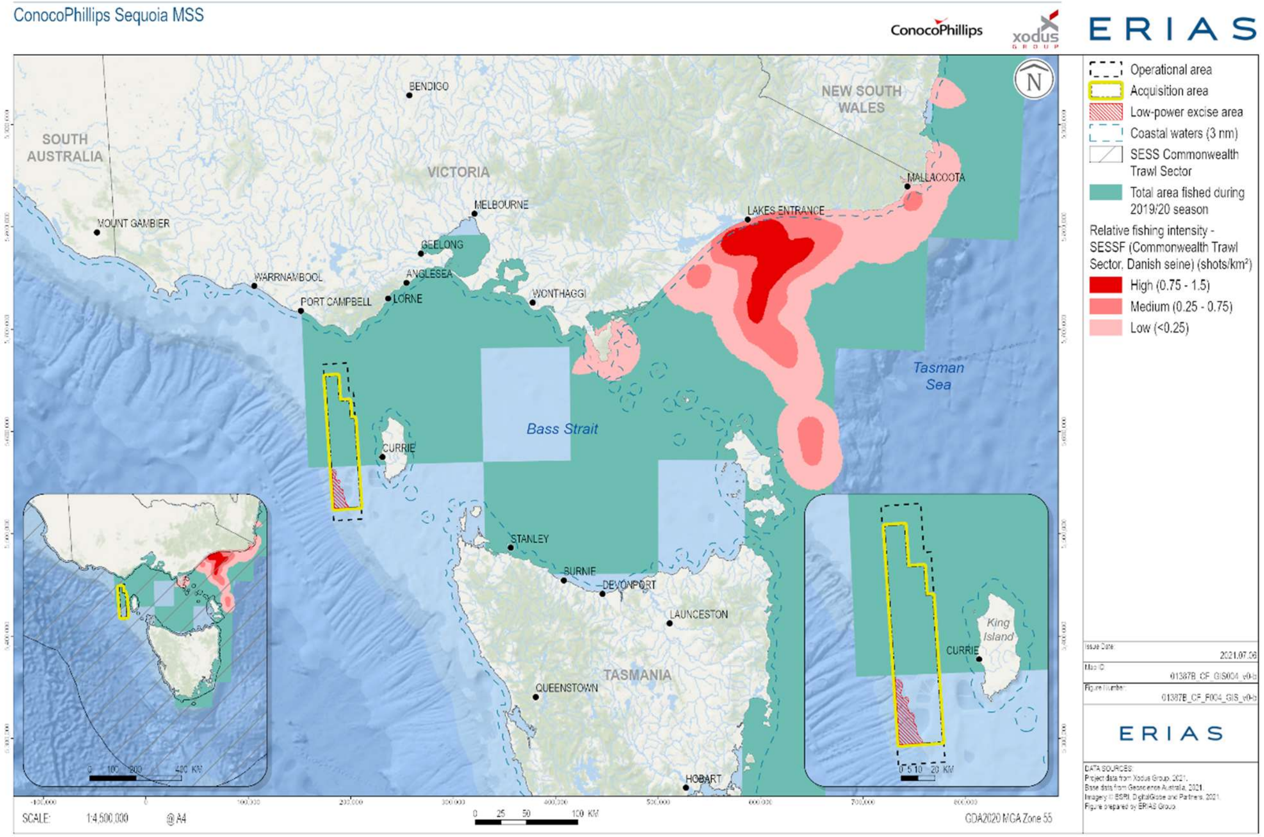


Figure 4-47: Boundary and Fishing Intensity in the SESSF Commonwealth Trawl Sector (Danish-seine)

Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector (SESSF – SHS)

The Scalefish Hook Sector uses demersal longlines to target Pink Ling (*Genypterus blacodes*) and Blue-eye Trevalla (*Hyperoglyphe antarctica*) and is restricted to waters deeper than 183 m (SETFIA and Fishwell Consulting, 2018). Fishery catch statistics for this sector are provided in Table 4-86.

Table 4-86: Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector (SESSF – SHS)

Aspects	Description
Primary landing ports	Adelaide, Port Lincoln, Robe (South Australia); Devonport, Hobart (Tasmania); Lakes Entrance, San Remo, Port Welshpool (Victoria)
Target species	Elephantfish (*Callorhinchus milii*); Gummy Shark (*Mustelus antarcticus*); Sawshark (*Pristiophorus cirratus, P. nudipinnis*); School Shark (*Galeorhinus galeus*)
Fishing season	12-month season begins 1st May with highest effort highest from January to July.
Permits / active vessels (2019-2020)	Gillnet: 61 permits / 35 active vessels Hook: 13 permits / 36 active vessels
Recent catch within fishery*	• 2019-20 – 13,148 tonnes with no value assigned. • 2018-19 – 8,454 tonnes worth $49.47 million. • 2017-18 – 8,631 tonnes worth $41.86 million. • 2016-17 – 8,691 tonnes, worth $46.42 million. • 2015-16 – 9,025 tonnes, worth $41.5 million.
Catch in Operational Area	Over the last 10 years, an annual average catch of 5.2 tonnes worth $37,000 has been taken from the Operational Area (Note: These figures are for the Shark Hook Sector and the Scalefish Hook Sector as detailed in SETFIA and Fishwell Consulting (2020)). This represents <1% of the catch of the Scalefish Hook Sector (SETFIA and Fishwell Consulting, 2020). Figure 4-48 shows low to high fishing activity to the east of Tasmania outside the Operational Area.
Harvest strategy	As per the Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)
Sensitivities	The SESSF – SHS also targets Gummy Shark, see SESSF - CGS/CSHS above. No other sensitivities were identified for the SESSF – CTS fishery.
Existing pressures	The School Shark is a target species within the SESSF – SHS, see SESSF – CGS/CSHS above for current fishing pressure. Other target species within the fishery (Elephantfish, Gummy Shark, Sawshark) identified within the South Eastern Australia biological stock are classified as a sustainable stock (Patterson et al. 2020).
Stakeholder concerns	Through consultation SETFIA recommended that ConocoPhillips Australia have in place an adjustment protocol that addressed displacement as a result of the Sequoia MSS.

Sources: Patterson et al (2020, 2019, 2018; 2017; 2016), SETFIA and Fishwell Consulting (2020); AFMA, 2015; 2019)

**The Scalefish Hook Sector is reported with the SHS is reported along with CTS as most stocks are shared (Emery et al. 2020)*

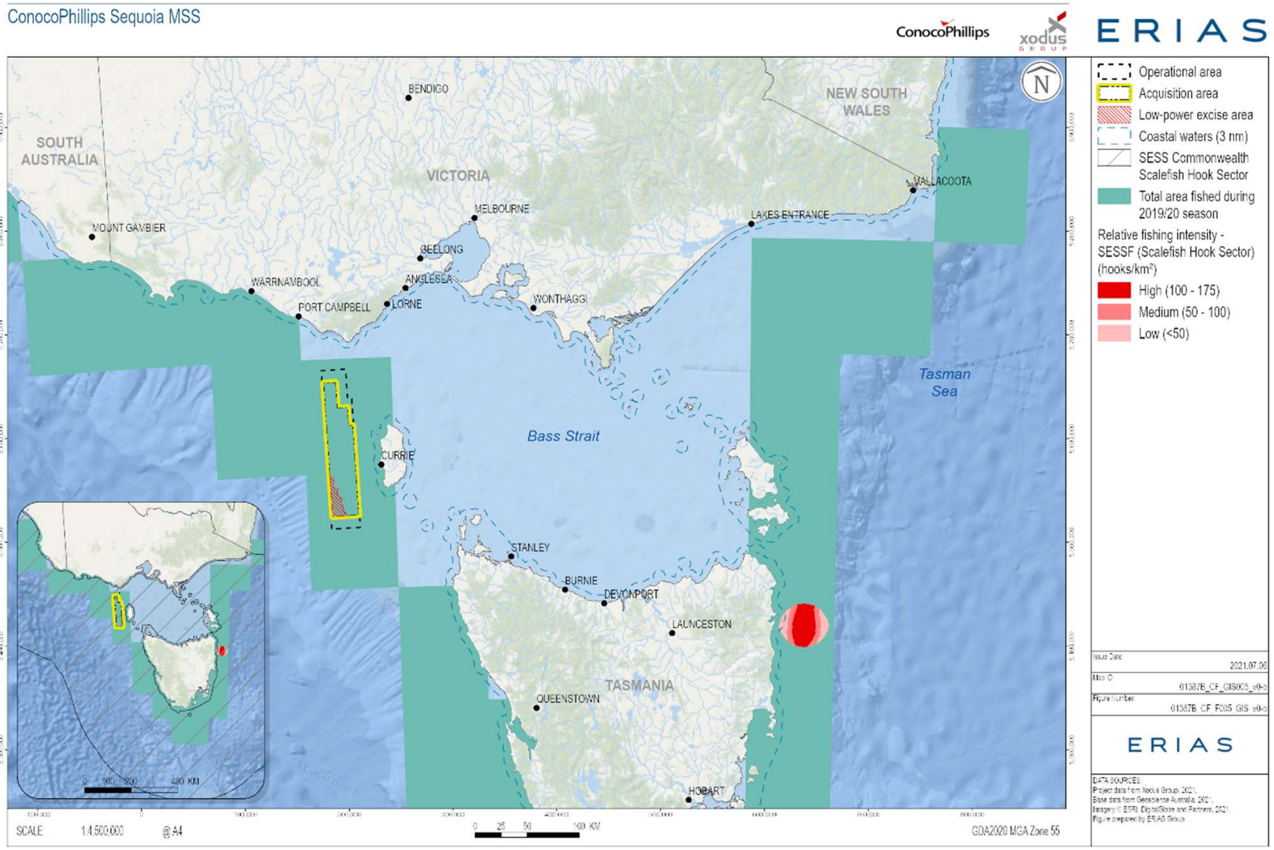


Figure 4-48: Boundary and fishing intensity in the SESSF – Scalefish Hook Sector

Values and Sensitivities (Victorian Fisheries)

Victorian fisheries are managed by the Victorian Fisheries Authority (VFA). VFA jurisdiction extends offshore to 3 nautical miles. By agreement with the Commonwealth, the VFA also manages some fisheries beyond this limit.

For Victorian managed fisheries that actively fish within the Operational Area, information is provided consisting of catch and effort data from the Fisheries Status Reports published by VFA and the SETFIA report (SETFIA and Fishwell Consulting, 2020).

Table 4-87 details the fishery seasons and highest fishing intensity for the Victorian fisheries that have catch effort within the Operational Area.

Table 4-87: Indicative Victorian commercial fishery seasons and catch intensities

Fishery		Jan	Feb	Mar	Apr	Ma y	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Giant Crab	Fishery – males												
	Fishery – females												
	Highest catch* rates (CPUE)												
Southern Rock Lobster	Fishery – males												
	Fishery – females												
	Highest catch rates (CPUE)												
Green = Fishery Open. Yellow = Fishery Closed. Red = Highest catch rates									Survey Window				

**unreported due to low number (<5) operators, however Tasmanian fishery catch is highest December to February and lowest from June to October (Mills et al., 2006).*

Source: Mills et al., 2006; VFA (2020); SETFIA and Fishwell Consulting (2018, 2020)

Giant Crab Fishery

The Victorian Giant Crab Fishery has the same fishing boundaries as the Victorian Rock Lobster Fishery (Figure 4-49). Giant Crab (*Pseudocarcinus gigas*). The fishery targets Giant Crab using baited lobster pots in depths of 150 – 300 m (SETFIA and Fishwell Consulting, 2020).

Since the introduction of quota management in the Giant Crab Fishery in 2001, there have been <5 dedicated fishers active in the fishery and up to 20 fishers annually reporting Giant Crab catch as by-product from Rock Lobster fishing (VFA, 2021a). Fishery catch statistics for the Giant Crab Fishery are provided in Table 4-88.

Details on Giant Crab ecology are described in Invertebrates (see Section 4.2.3).

Table 4-88: Victorian Giant Crab

Aspects	Description
Primary landing ports	Portland, Port Fairy, Warrnambool, Port Campbell, Apollo Bay.

Aspects	Description
Target species	Giant Crab (*Pseudocarcinus gigas*)
Fishing season	Fishing closures: • 15 September to 15 November: protect males during moult • 1 June to 15 November: protect females while breeding and in berry (with eggs attached)
Licences / Active vessels (2019-2020)	Maximum 30 but as of 2020, there were 11 fishery access licenses with <5 active vessels.
Recent catch within fishery*	Catches of Giant Crab over the whole fishery for the last five seasons were: • 2018/19 – 10.5 t • 2017/18 – 9.8 t • 2016/17 – 10.0 t • 2015/16 – 10.0 t • 2014/15 – 10.5 t
Overlap with Operational Area	The Operational Area intersects the Apollo Bay region of the Victorian Giant Crab Fishery. The Operational Area intersects 2.56% of the total fishery area.
Catch in Operational Area	Over the last 10 years, an annual average catch of 1.6 tonnes worth $161,000 has been taken from the Operational Area. This represents 16.3% of the total catch of the whole fishery SETFIA and Fishwell Consulting (2020). Seasonal catch not available due to due to low number (<5) operators however, SETFIA and Fishwell Consulting (2020) report highest is between December to February.
Sensitivities	Recruitment of the Giant Crab is not distributed evenly over the fishery with some areas appearing to have higher juvenile abundance than others. This is not a function of habitat but appears to be related to larval drift and thus movement by currents (DEPIV 2014). Changes in ocean currents resulting from climate change or upwelling events may affect this process and recruitment.
Existing pressures	The Giant Crab within the Victorian management area is classified as a sustainable stock and not subject to overfishing (FRDC 2018f). See also Existing Pressures section.
Stakeholder concerns	Via consultation SIV considers all fishers consulted in this process are 'directly impacted' by the Sequoia MSS as they are licenced to operate in the area – whether they have catch history in the area or not. All are displaced from this area if it a no-go zone during the survey operations. They also raised issues around impacts from fishers being displaced from their fishing area and having to fish elsewhere and how this would be included in a compensation/quota retirement process. SIV recommended that ConocoPhillips Australia have in place an adjustment protocol that addressed displacement as a result of the Sequoia MSS.

Source: VFA (2020). SETFIA and Fishwell Consulting (2020).

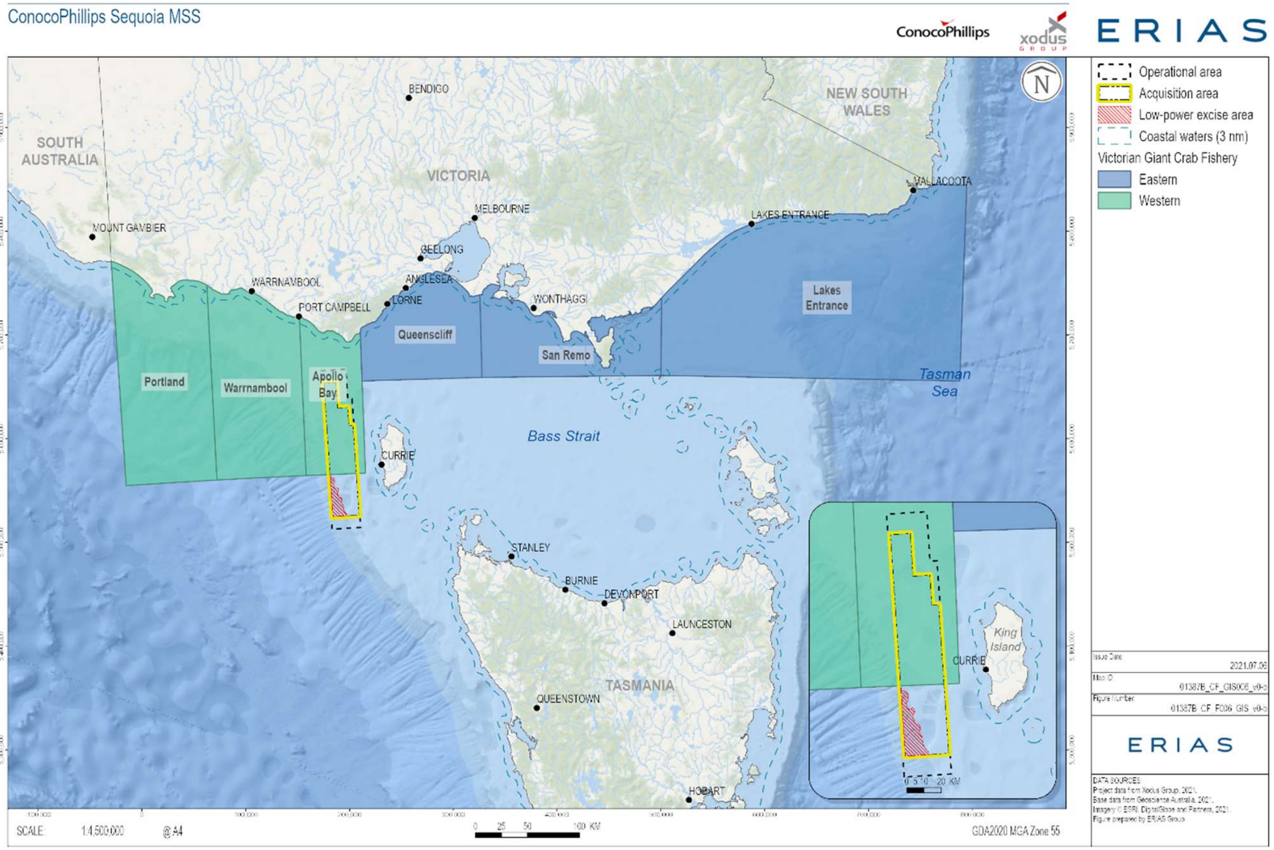


Figure 4-49: Boundary of the Victorian Giant Crab Fishery and overlap with Operational Area

Rock Lobster Fishery

The Victorian Rock Lobster Fishery extends from the Victorian coastline to latitude 40oS (between 140°57.9'S and 143°40' E) and 39°12'S (between 143°40'E and 150°20'E) (Figure 4-50). The Operational Area lies within the 'western zone' of this fishery defined as the area between Apollo Bay and the SA/Victorian border. The fishery primarily targets the Southern Rock Lobster (SRL) (*Jasus edwardsii*) using baited lobster pots (SETFIA and Fishwell Consulting 2018). SRL are fished from coastal reefs in waters up to ~150 m water depth with most of the catch coming from inshore waters less than 100 m deep (DEWHA, 2007). Pots are generally set and retrieved each day and marked with a surface buoy. Fishery catch statistics for this sector are provided in Table 4-89.

Details on SRL ecology are described in Invertebrates see Section 4.2.2.

Table 4-89: Victorian Southern Rock Lobster

Aspects	Description
Primary landing ports	Portland, Port Fairy, Warrnambool, Port Campbell, Apollo Bay
Target species	Southern Rock Lobster (*Jasus edwardsii*)
Fishing season	Fishery closed: • 15 September to 15 November: protect males during moulting period • 1 June to 15 November: protect females in berry (with eggs attached)
Licences Active vessels (2019-2020) - (Western Zone)	Maximum number licences: 71. 41 active vessels (2017/18) In 2018/19 the average number of days fished by each vessel was 53 (VFA 2020a).
Recent catch within fishery*	Catches for the western zone for the last five available seasons: • 2018/19 – 245 t valued at $22 million • 2017/18 – 230 t valued at $18.6 million • 2016/17 – 209 t valued at $16.5 million • 2015/16 – 230 t valued at $19.4 million • 2014/15 – 230 t valued at $19.2 million
Overlap with Operational Area	The Operational Area intersects 2.6% of the western zone of the fishery.
Catch in Operational Area	Over the last 10 years, an average annual catch of 13 tonnes worth $1,280,000 has been taken from the Operational Area. This represents 5.2% of the total catch of the whole fishery (SETFIA and Fishwell Consulting 2020). Seasonal catch not available due to due to low number (<5) operators however, SETFIA and Fishwell Consulting (2020) report highest is between December to February.
Sensitivities	SRL species recruitment and growth can vary from year to year depending on environmental changes including water temperature and movement of oceanic currents (Bruce et al., 2007) and hence impact catch availability.
Existing pressures	The SRL fishery within the Victorian management area is classified as a sustainable stock and not subject to overfishing (FRDC, 2018g). See also Existing Pressures section.
Stakeholder concerns	Via consultation SIV considers all fishers consulted in this process are 'directly impacted' by the Sequoia MSS as they are licenced to operate in the area – whether they have catch history in the area or not. All are displaced from this area if it a no-go zone during the survey operations. They also raised issues around impacts from fishers being displaced from their fishing area and having to fish elsewhere and how this would be included in a compensation/quota retirement process. SIV

Aspects	Description
	recommended that ConocoPhillips Australia have in place an adjustment protocol that addressed displacement as a result of the Sequoia MSS.

Source: VFA (2020). SETFIA and Fishwell Consulting (2020).

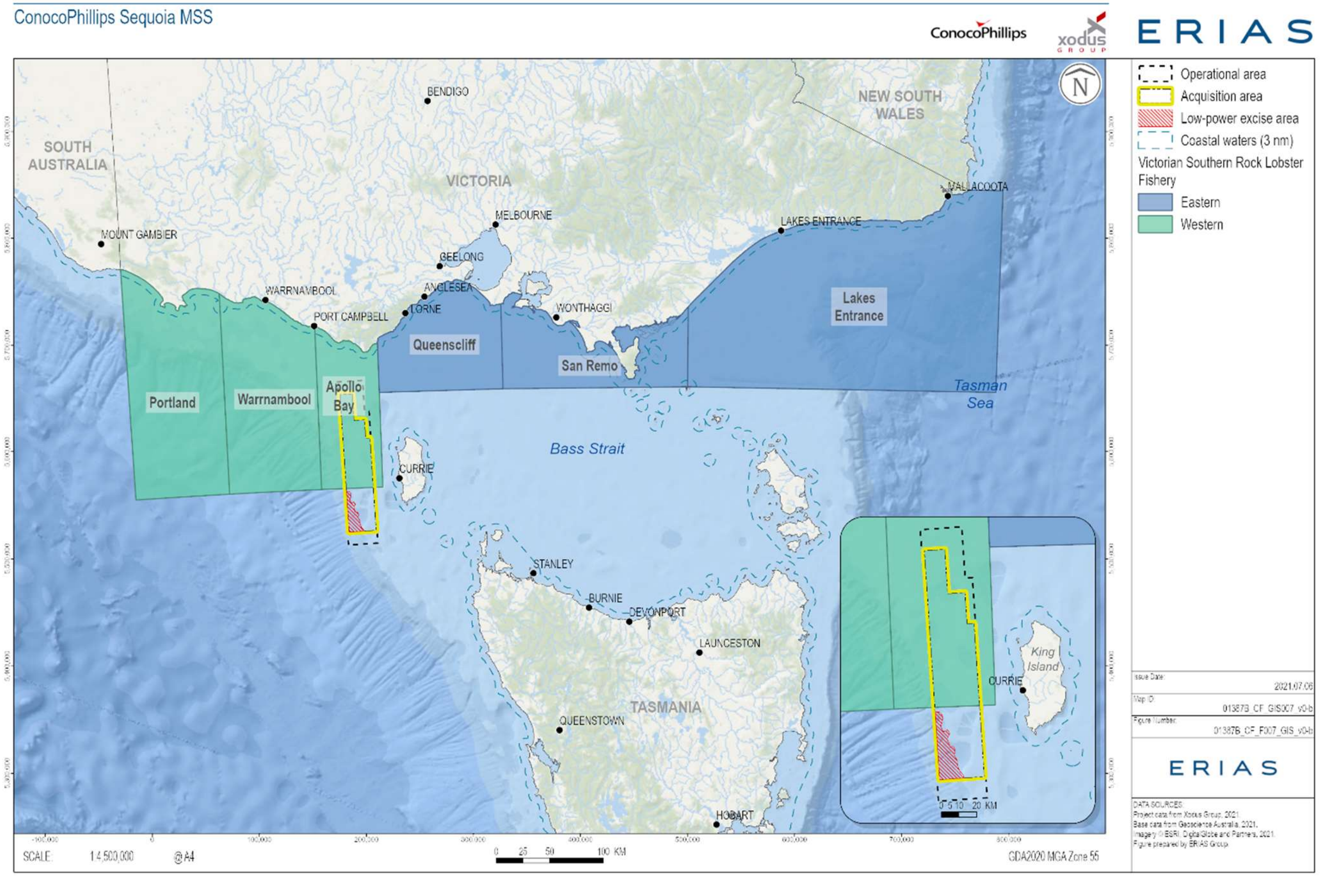


Figure 4-50: Boundary of the Victorian Rock Lobster Fishery and overlap with the Operational Area

Values and Sensitivities (Tasmanian Fisheries)

For Tasmanian managed fisheries that actively fish within the Operational Area, information is provided consisting of catch and effort data from the Fisheries Status Reports published by the Tasmanian Department of Primary Industries, Parks, Waters and Environment (DPIPWE) and the SETFIA report (SETFIA and Fishwell Consulting, 2020).

Table 4-90 details the fishery seasons and highest fishing intensity for the Tasmanian fisheries that have catch effort within the Operational Area.

Table 4-90: Indicative Tasmanian commercial fishery seasons and catch intensities

Fishery		**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Giant Crab	Fishery – males												
	Fishery – females												
	Highest catch rates (CPUE)												
Southern Rock Lobster	Fishery – males												
	Fishery – females												
	Highest catch rates (CPUE)												
Green = Fishery Open; Yellow = Fishery Closed; Red = Highest catch rates									Survey Window				

Source: DPIPWE 2020; SETFIA and Fishwell Consulting (2020)

Giant Crab Fishery

The Tasmanian Giant Crab Fishery operates in State and Commonwealth waters surrounding Tasmania in waters south of 39° 12′, and out to 200 nautical miles from the coastline and has the same fishing management boundaries as the Tasmanian Rock Lobster Fishery. Most fishing takes place on the edge of the continental slope using baited steel traps (SETFIA and Fishwell Consulting, 2018) (Figure 4-51). The Tasmanian Giant Crab fishery is a comparatively small fishery with the annual harvest set at 20.7 tonnes but with a high landed value of ~$2 million (DPIPWE, 2021). Tasmanian Giant Crab fishery details are detailed in Table 4-91.

Details on Giant Grab ecology are described in Invertebrates see Section 4.2.3.

Table 4-91: Tasmanian Giant Crab

Aspects	**Description**
Primary landing ports	North-west Tasmania: Currie Harbour, Grassie Harbour, Smithton, Stanley, Strahan, Wynyard Fishery (Giant Crab) Rules 2013)
Target species	Giant Crab (*Pseudocarcinus gigas*)
Fishing season	Fishing Season:

Aspects	Description
	• Males – Open all Year • Females - Fishing closure from 1 June to 15 November to protect females while breeding and in berry (with eggs attached)
Licences Active vessels (2019)	No information was available for the number of vessels or licences within the Operational Area. From DPIPWE (2019): For 2018/2019 a total of 78 licences were currently issued with some fishers holding more than one giant crab licence. The fishery is linked to the Tasmanian Rock Lobster Fishery through the requirement to hold a Rock Lobster licence as well as a Giant Crab licence to target giant crab. 42 Giant Crab licence are listed with a vessel. 18 vessels reported a catch of Giant Crab during the 2018/19 season of which six recorded catch of greater than 1 t and three took greater than 50% of the landed catch for the 2018/19 season.
Recent catch within fishery*	Catches for the last five seasons for the whole fishery were: • 2018/19 – 20 t • 2017/18 – 16 t • 2016/17 – 30 t • 2015/16 – 20 t • 2014/15 – 23 t
Catch in Operational Area	In the 2020-21 season, catch within the Giant Crab Fishery was lowest from August to December and highest from January to February (DPIPWE, 2021). Over the last 10 years, an average annual catch of 7.4 tonnes worth $737,000 has been taken from the Operational Area. This represents 39% of the total catch of the whole fishery (SETFIA and Fishwell Consulting 2020). Seasonal data for the Operational Area cannot be provided due to confidentiality, however SETFIA and Fishwell Consulting (2020) report that catches across the entire fishery are highest during January to March.
Sensitivities	See Values and Sensitivities (Victorian Fisheries) section
Existing pressures	The Status of Australian Fish Stocks classifies the Tasmanian Giant Crab stock as depleted. DPIPWE have implemented reductions in total allowable catch (TAC) since 2006 in response to declining catch rates. Lack of appropriate biological data of the stock in the Tasmanian Giant Crab Fishery and the unknown extent to which trawling activities impact on Giant Crab stock and the species natural habitat, are the main factors limiting the understanding of the declining catch rate trend (DoEE 2019). See Values and Sensitivities (Victorian Fisheries) section.
Stakeholder concerns	TSIC recommended that ConocoPhillips Australia should put in place a compensation protocol that addressed displacement of potentially impacted fishers. DPIPWE recommended excising the entire south-west corner of the Operational Area to preserve the sustainability of the fishery.

Sources: DPIPWE, 2020. SETFIA and Fishwell Consulting, 2020.

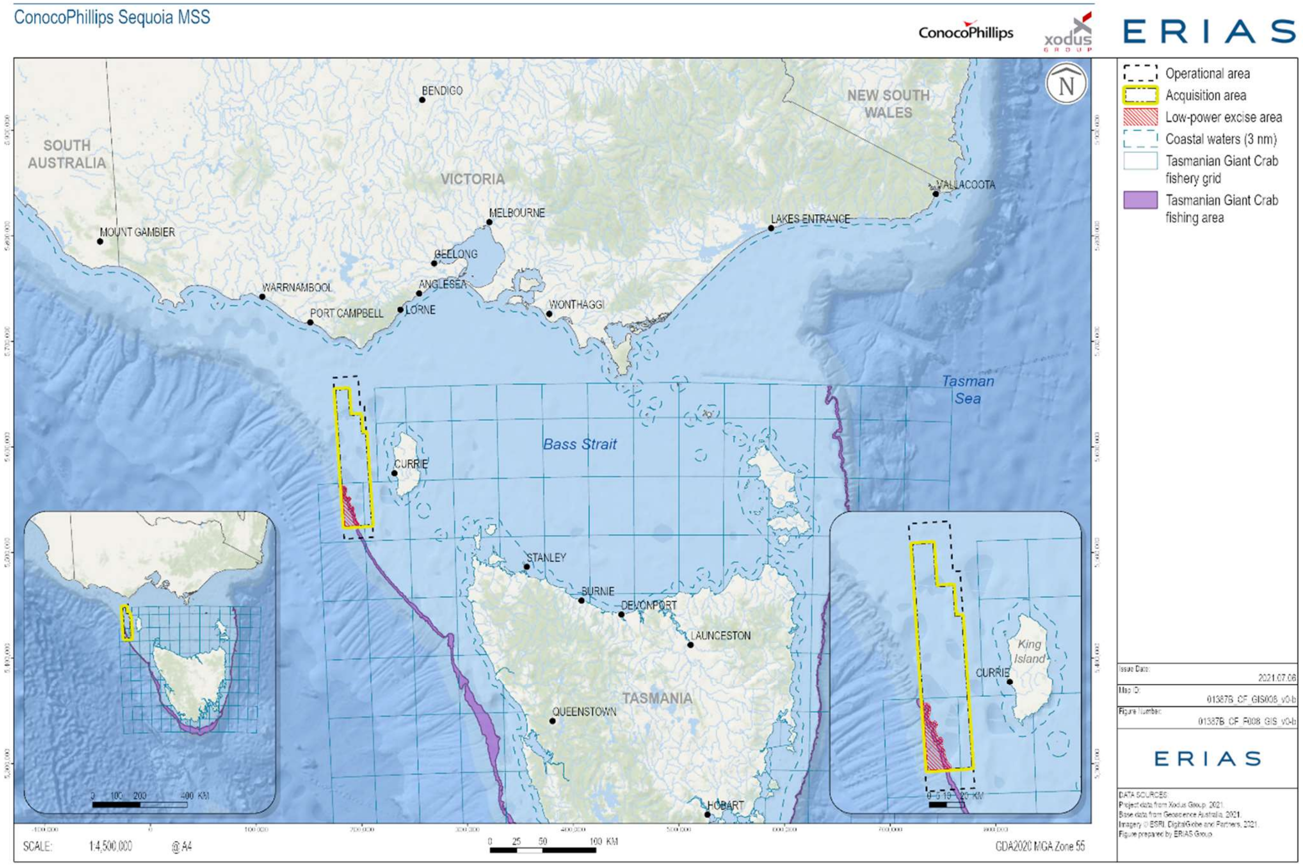


Figure 4-51: Boundary of the Tasmanian Giant Crab Fishery and overlap with Operational Area

Rock Lobster Fishery

The Tasmanian Rock Lobster Fishery operates in State and Commonwealth waters surrounding Tasmania. Since 1986 the Tasmanian Government has had jurisdiction of the fishery in waters south of 39° 12’, and out to 200 nautical miles from the coastline by way of an Offshore Constitutional Settlement with the Commonwealth Government. The fishery is divided into 11 regions as detailed in Figure 4-52. The fishery primarily targets the Southern Rock Lobster (SRL) (*Jasus edwardsii*) using baited lobster pots (SETFIA and Fishwell Consulting, 2018). Most of the catch comes from 0 – 40 m water depths on coastal reefs, however, some catch is taken as deep as 200 m (SETFIA and Fishwell Consulting, 2018). Pots are generally set and retrieved each day and marked with a surface buoy. Fishery catch statistics for this sector are provided in Table 4-92.

Details on SRL ecology are described in Invertebrates see Section 4.2.2.

Table 4-92: Tasmanian Southern Rock Lobster

Aspects	Description
Primary landing ports	North-west Tasmania: Currie Harbour, Grassie Harbour, Smithton, Stanley, Strahan, Wynyard
Target species	Southern Rock Lobster (*Jasus edwardsii*)
Fishing season (2020 – 2021)	Fishing Season: • Males: closed 1 October to 15 November for all state waters (except for September closed region which is outside of Operational Area) to protect males during moulting period. • Females: closed 1 May 2021 to 15 November 2020 (except for East Coast stock rebuilding zone which is outside of Operational Area (Tasmanian Government 2020) to protect females in berry (with eggs attached).
Licences Active vessels (2019-2020)	194 licenced vessels in 2017/18. With the number operating within Operational Area <5.
Recent catch within fishery*	Catches of the Rock Lobster commercial fishery for the last five seasons for the whole fishery (subject to available data) were: • 2018/19 – 1,050 t • 2017/18 – 1,050 t • 2016/17 – 1,050 t • 2015/16 – 1,050 t • 2014/15 – 1,050 t
Overlap with Operational Area	The survey area intersects 1.6% of the total fishery area.
Catch in Operational Area	Over the last 10 years, an annual average catch of 2.4 tonnes worth $238,000 has been taken from the Operational Area. This represents <1% of the total catch for the whole fishery (SETFIA and Fishwell Consulting, 2020). Seasonal data for the Operational Area cannot be provided due to confidentiality, however SETFIA and Fishwell Consulting (2020) report that catches across the entire fishery are highest during December to April.
Sensitivities	See Values and Sensitivities (Victorian Fisheries) section.
Existing pressures	The SRL fishery within the Victorian management area is classified as a sustainable stock and not subject to overfishing (FRDC, 2018g). See Values and Sensitivities (Victorian Fisheries) section.

Aspects	Description
Stakeholder concerns	TSIC recommended that ConocoPhillips Australia put in place a compensation protocol to address displacement of potentially impacted fishers.

Sources: DPIPWE, 2020. SETFIA and Fishwell Consulting, 2020

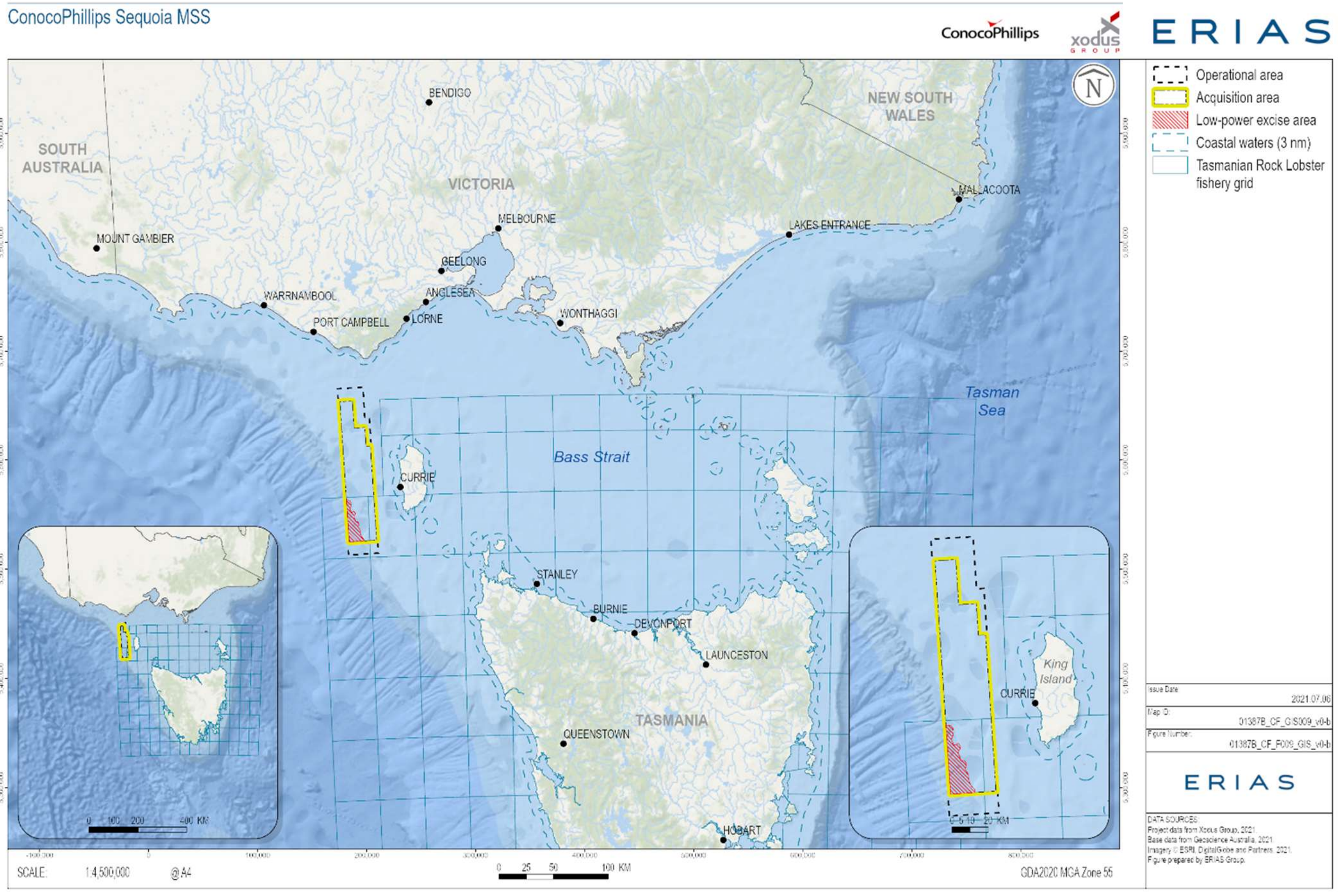


Figure 4-52: Boundary and reporting blocks of the Tasmanian Rock Lobster Fishery and overlap with the Operational Area

4.7.3. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to commercial fisheries have been evaluated in the tables below; having had regard to the legislative and other controls (Section 4.7.1.5).

Table 4-93: Predicted Impact Levels – Commercial Fisheries

Interference with Other Marine Users	Consequence
(see below)	**Minor (2)**

Changes to the functions, interests or activities of other users

The survey vessel and streamers require an exclusion zone during deployment of the streamers and during acquisition to ensure the safety of the survey vessel and commercial fishing vessels due to the limited manoeuvrability of the survey vessel.

The potential impacts of interference with commercial fishers are:

- Diversion of commercial fishing vessels from their navigation paths potentially resulting in longer sail times and greater fuel consumption.
- Displacement of commercial fishers from fishing area potentially resulting in longer sail times, greater fuel consumption and a change in catch.
- Damage to or loss of fishing equipment potentially resulting in a change to catch.

This could potentially impact the three Commonwealth and four state fisheries that have recorded catch data in the Operational Area within the last 5 years.

A summary of the total yearly revenue for each of these fisheries taken from the Operational Area is detailed in Table 4-94 along with the highest catch rate months.

Table 4-94: Percentage yearly revenue for Commonwealth fisheries from the Operational Area and highest catch rate periods

Fishery	Number of vessels within Operational Area	% of fisheries' total annual revenue from the Operational Area.	Highest catch rate periods
SESSF – Commonwealth Trawl Sector (SESSF – CTS)	Average of 7	1%	March and November - outside Sequoia MSS timing.
SESSF – Shark Gillnet Sector and Shark Hook Sector (SESSF – CGS/CSHS)	< 5*	1%	March, April and November - outside Sequoia MSS timing.
SESSF – Scalefish Hook Sector (SESSF – SHS)	< 5*	<1%	January to July - outside Sequoia MSS timing.
Victorian Giant Crab	< 5*	16%	Between December and February - outside Sequoia MSS timing.
Victorian Southern Rock Lobster	< 5*	5.2%	
Tasmanian Giant Crab	< 5*	39%	January to March - outside Sequoia MSS timing.
Tasmanian Southern Rock Lobster	< 5*	<1%	December to April - outside Sequoia MSS timing.

*Source: SETFIA and Fishwell Consulting, 2020. * based on data is confidential where <5 vessels have made records of catch and effort.*

<u>Diversion of commercial fishing vessels</u> If commercial fishing vessels are transiting through the Operational Area, they may have to detour to go around the survey vessel and streamers. This could amount to a detour of ~ 7 km to go around the vessel and streamers. If the vessel is transiting it is likely to be moving at a minimum of 20 knots (37 km/hr) thus it would take approximately 11 minutes to detour around the vessel and streamers. This is unlikely to result in a significant longer sail time or increase in fuel use. Commercial fishers will be notified via Notice to Mariners and through pre-start notifications from ConocoPhillips Australia of when the survey will be undertaken in the Operational Area allowing transiting commercial fishing vessels to plan their transit to avoid increase travel time and distance. <u>Displacement of commercial fishers</u> The survey vessel and streamers require other vessels including commercial fishing vessel to maintain a safe distance. Also pots or gill nets cannot be placed in the area while acquisition is occurring to avoid entanglement of both survey and fisher equipment. This can result in commercial fishers not being able to fish in an area where they normally fish while the acquisition is being undertaken in the fishing area. Given the mobile and flexible nature of the Sequoia MSS and commercial fishing activities there is potential for multiple displacement events. The period of displacement could be up to several days depending on the location of fishing and fishing equipment and the sail line direction. This is considering some fishers leaving set gear in place for ~24 hours (soak time) plus the need for flexibility in the seismic survey and order of acquisition lines (i.e. minimise impacts on whales, infills) This can lead to fishers having to move to another fishing area that may be at a greater distance or less productive. Despite the potential for multiple events the displacement is not expected to extend to the whole survey period. In addition, commercial fishers will be notified via Notice to Mariners and through pre-start notifications from ConocoPhillips Australia of when the survey will be undertaken in the Operational Area allowing commercial fishing vessels to plan their activities outside of the predicted displacement areas. There are various types of displacement of commercial fishers possible depending on the adaption ConocoPhillips requires to manage other environmental sensitivities, the fishing method, fishing closures, and the catchability effects on target species. Where these effects result in commercial losses to fishers they should be compensated. <u>Damage to or loss of fishing equipment</u> If fishing equipment such as pots and nets are place within the survey vessel and streamer exclusion zone there is potential for them to become entangle in the streamers, resulting in damage or loss. In addition to the cost of repairing or replacing this equipment, it could also result in loss of income from the loss of catch. *Predicted level of impact:* The extent of the area of impact is predicted to be within the Operational Area (between August and October) with vessels present for the Sequoia MSS. The severity is assessed as Minor (2) based on: • The predicted impact is localised to the Operational Area, short-term and recoverable. • Though the Sequoia MSS an exclusion zone, where displacement would occur, is only required during deployment of the streamers and acquisition due to the limited manoeuvrability of the survey vessel. • Displacement from areas will only be required until the acquisition in an area is complete which depending on the area maybe several days rather than the whole survey period. • The Sequoia MMS timing (between August and October) avoids the highest catch rate periods for the fisheries that have catch effort within the Operational Area. • Displacement of fishing activities can be avoided by coordinating each party's activities so as not to restrict either party. *SESSF – Commonwealth Trawl Sector* • On average, between 2010 and 2020 seven vessels recorded catch data from the Commonwealth Trawl Sector within the Operational Area during the scheduled Sequoia MSS timing of 1 August to 31 October (SETFIA and Fishwell Consulting, 2020). • The highest catch rates for the fishery occur in March and November which is outside the Sequoia MSS timing.	

Interference with Other Marine Users	Consequence
• There is no Danish-seine fishing within the Operational Area (Figure 4-47; SETFIA and Fishwell Consulting, 2020). • Low to medium fishing intensity is recorded for otter-board trawling in the south-west corner of the Operational Area (Figure 4-47). In addition, the percentage total annual revenue from the area of overlap of the Commonwealth Trawl Sector and the Operational Area is 1% (Table 4-94) indicating that there is a low level of fishing activity within the Operational Area. • SETFIA and Fishwell Consulting (2020) detailed that from their experience otter-board trawlers often tow in a straight line along the depth contour. Otter-board trawling occurs at the shelf-break and along the continental slop in the south-west of the Operational Area (Figure 4-46 and Figure 4-47). If fishing were to occur in these areas during the Sequoia MSS, displacement of activities can be avoided by coordinating each party's activities so as not to restrict either party. Potential impacts will be in a localised area and short-term in the order of hours as the survey vessel and streamers move from the area of overlap. Displacement for fishers will only be required until the acquisition in an area is complete which will only be several days rather than the whole survey period. *SESSF – Shark Gillnet Sector and Shark Hook Sector and Scalefish Hook Sectors* • The number of vessels that recorded catch in the Shark Gillnet Sector and Shark Hook Sector and Scalefish Hook Sectors within the Operational Area during the scheduled Sequoia MSS timing of 1 August to 31 October is not known but is <5 based on AFMA confidentiality agreements require that catch and effort data remains confidential where <5 vessels have made records (SETFIA and Fishwell Consulting, 2020). • The highest catch rates for the Shark Gillnet Sector and Shark Hook Sector fishery occurs in March, April and November and for the Scalefish Hook Sector's between January to July (SETFIA and Fishwell Consulting, 2020). For both fisheries the highest catch rates occur outside the Sequoia MSS timing. • The Shark Gillnet Sector are restricted to waters shallower than 183 m with low fishing intensity has been recorded in a small area in the north and east within the operational area in 2019/2020 (Figure 4-44). The percentage total annual revenue from the area of overlap of the Shark Gillnet Sector with the Operational Area is 1%. • The Shark Hook Sector recorded no fishing intensity in the Operational Area in the 2019/2020 season (Figure 4-45) or for the last 5 years (Patterson et al., 2020, 2019, 2018; 2017; 2016). • The Scalefish Hook Sector recorded no fishing intensity in the Operational Area in the 2019/2020 season (Figure 4-48) or for the last 5 years (Patterson et al., 2020, 2019, 2018; 2017; 2016). • Based on the low number of fishing vessels and low fishing intensity in the Operational Area during the timing of the Sequoia MSS, if fishing were to occur in the Operational Area during the Sequoia MSS, displacement of activities and damage to fishing equipment can be avoided by coordinating each party's activities so as not to restrict either party. Potential impacts will be in a localised area and short-term in the order of hours as the survey vessel and streamers move from the area of overlap. Displacement for fishers will only be required until the acquisition in an area is complete which will only be several days rather than the whole survey period. *Victorian Rock Lobster and Giant Crab Fisheries* • The number of vessels that recorded catch in the Victorian Rock Lobster and Giant Crab fisheries within the Operational Area during the scheduled Sequoia MSS timing of 1 August to 31 October is not known but is <5 (SETFIA and Fishwell Consulting, 2020). • The highest catch rates for the Giant Crab fishery occurs between January to March with the SRL fishery highest catch rates between December to April (SETFIA and Fishwell Consulting, 2020). Via consultation VFA noted that for the SRL fishery the key fishing period was from	

Interference with Other Marine Users	Consequence
November through to March. For both fisheries the highest catch rates and key fishing periods occur outside the Sequoia MSS timing. • The percentage of total annual revenue from the Operational Area for the Giant Crab and SRL fisheries are 16% and 5%, respectively. However, these values represent the whole fishing season. • The Sequoia MMS is scheduled to coincide with part or total closures of both the Giant Crab and SRL fisheries. The Giant Crab fishery is closed for male Giant Crabs between 15 September to 15 November covering part of the Sequoia MSS timing. The closure for berried female Giant Crabs is from 1 June to 15 November which covers the whole Sequoia MSS timing. The Victorian SRL fishery has the same closures for both male and females as the Giant Crab. • The location of where Giant Crab and SRL fishing occurs is not known due to the low, < 5 vessels occurring in the fisheries. The Giant Crab fishery uses baited lobster pots in water depths of 150 – 300 m (SETFIA and Fishwell Consulting, 2020) and the Rock Lobster fishery uses pots in coastal reefs in waters up to ~150 m water depth with most of the catch coming from inshore waters less than 100 m deep (DEWHA, 2007). Pots are generally set and retrieved each day and marked with a surface buoy. • The Operational Area intersects 2.56% of the Apollo Bay region of the Victorian Giant Crab Fishery and 2.6% of the western zone of the SRL fishery. • Based on the low number of fishing vessels and low fishing intensity in the Operational Area during the timing of the Sequoia MSS, if fishing were to occur in the Operational Area during the Sequoia MSS, displacement of activities and damage to fishing equipment can be avoided by coordinating each party's activities so as not to restrict either party. Potential impacts will be in a localised area and short-term in the order of days as the survey vessel and streamers move from the area of overlap. *Tasmanian Rock Lobster and Giant Crab Fisheries* • The number of vessels that recorded catch in the Tasmanian Rock Lobster and Giant Crab fisheries within the Operational Area during the scheduled Sequoia MSS timing of 1 August to 31 October is not known but is <5 (SETFIA and Fishwell Consulting, 2020). • The highest catch rates for the Giant Crab fishery occurs between January to March with the SRL fishery highest catch rates between December to April (SETFIA and Fishwell Consulting, 2020). For both fisheries the highest catch rates occur outside the Sequoia MSS timing. • The percentage of total annual revenue from the Operational Area for the Giant Crab and SRL fishery areas are 39% and <1%, respectively. However, these values represent the whole fishing season. • The Sequoia MMS is scheduled to coincide with part or total closures of both the Giant Crab and SRL fisheries. The Giant Crab fishery has no closure period, but female Giant Crab cannot be taken from 1 May to 15 November which covers the Sequoia MSS timing. The SRL fishery has closures for males between 1 October to 15 November covering part of the Sequoia MSS timing. The closure for female SRL is from 1 May to 15 November which covers the Sequoia MSS timing. • For the Giant Crab fishery as there is a low number of fishing vessels, fishing occurs within a small area within the Operational Area (Figure 4-51) and the timing of the Sequoia MSS avoids the period of highest catch rates, displacement of activities and damage to fishing equipment can be avoided by coordinating each party's activities so as not to restrict either party. Potential impacts will be in a localised area and short-term in the order of days as the survey vessel and streamers move from the area of overlap.	

Interference with Other Marine Users	Consequence
○ For ecological reasons explained in section 4.2.3 an excise area has been applied over the fishing grounds and known Giant Crab habitat resulting in no effect on catchability of Giant Crab. • For the SRL fishery as there is a low number of fishing vessels, fishing effort is low within the Operational Area (,1% of the total annual revenue from the Operational Area) and the timing of the Sequoia MSS avoids the period of highest catch rates, displacement of activities and damage to fishing equipment can be avoided by coordinating each party's activities so as not to restrict either party. Potential impacts will be in a localised area and short-term in the order of days as the survey vessel and streamers move from the area of overlap.	

Commercial Fishing – Catch and Abundance Effect Studies

Some effort to relate fishing catch data to MSS effects has been undertaken, but to date none of the Australian efforts to relate catch data with MSS have yielded significant results. Elsewhere, the potential effects of seismic operations on fish distribution, local abundance or catch has been examined for some teleost species with varying results (Carroll et al., 2017).

A range of behavioural responses have been observed 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 MSS) has been shown to cause changes in schooling patterns and distribution (Engas et al., 1996; Engas and Lokkeborg, 2002; Slotte et al., 2004; Lokkeborg et al., 2012a; Popper at al., 2014; Streever et al, 2016) potentially reducing the availability of commercially valuable species or recreationally targeted species.

The following studies have relevance to fish species with respect to their catchability:

- The effects of an MSS on demersal long-line and trawl catch rates of Atlantic cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*) in Norway after a MSS were shown to fall by 45% and 70% respectively five days after survey completion (Engas et al., 1996). Based upon this decline Engas 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 airgun (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 airgun 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 Pena et al. (2013) observing real-time behaviours of pelagic herring schools exposed to an acoustic source approaching from a distance of 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 airgun stimulus and an increased tolerance to seismic shooting.
- Catch studies undertaken as part of a MSS 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

Interference with Other Marine Users	Consequence

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 August 2020, the Fish Research and Development Corporation (FRDC) released preliminary results of a Multiple Before-After Control-Impact (BACI) experiment that they funded to investigate the effects of a 3D MSS in eastern Bass Strait on Danish Seine catch rates (Fishwell Consulting, 2020). The key targets for this Danish Seine fishery in the areas of the MSS are flathead (Platycephalus sp.) and whiting (Sillago sp.). The research found that average catches of whiting at impact sites were 0.5% of those of the control sites. For flathead, zero catches comprised 2% of records in the control sites and 22% of records in the impact sites (Fishwell Consulting, 2020). In response to media reports about this study, the IAGC (2020) responded with the following:

- This is a preliminary and incomplete report, with the research to be finalised in March 2021
- It refers to changes in catch rates during Phase 1 of a 4-phase study (a 6-week period)
- It is based on a limited number of samples taken in a few specific locations (not the whole survey area) and is therefore not representative of the entire survey area
- There is no evidence that the lowered catch rate would persist after the MSS or is indicative of population-level effects
- Relative catch indices for both species in the years preceding the MSS were highly variable (temporally and spatially), and that relative catch index is a measure of catch per effort, not an absolute measure of abundance
- That fish are constantly detecting and responding to environmental stimuli and that movement away from sound is normal and consistent with previous research, but it does not indicate that the response is biologically significant (i.e., have a bearing on the long-term health, fecundity or survival of an individual fish or population).

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 fish 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 and 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 and Gason (2006) undertook a statistical analysis of catch per unit effort (CPUE) data collected over nearly 30 years in the Victorian SRL fishery (in southwest Victoria) that showed no influence of historical 2D and 3D MSS activity. Analyses looked at short-term (weekly) and long-term variations (up to 7 years) in CPUE to determine whether changes were correlated with the MSS. 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 season and so would have interacted with adult lobsters and larvae in the same way that the proposed Sequoia 3DMSS may. 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.

- 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 (Pecten fumatus) and doughboy (Mimachlamys asperrima) scallops 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).

<table>
<tr><th>Interference with Other Marine Users</th><th>Consequence</th></tr>
<tr><th>Commercial Fishing – Catch and Abundance</th><th>Consequence</th></tr>
<tr><td>As there is a moderate risk of a change in fish behaviour at distances far (thousands of metres) from the source, there is a potential for fish to be less abundant in the area of impact and not available to be caught. This may occur while the Sequoia MSS is undertaken. The severity is assessed as minor based on:
• The Sequoia MSS overlaps up to 1% of the following fisheries annual revenue (SETFIA, 2020; Appendix F):
  o SESSF Shark Gillnet Sector and Shark Hook Sector
  o SESSF Scalefish Hook Sector
  o SESSF Commonwealth Trawl Sector
  o Tasmanian Rock Lobster Fishery
• Total catch for the SESSF fisheries that overlap the Sequoia MSS are lowest during the timing of the survey from August to October:
  o The SESSF Shark Gillnet Sector and Shark Hook Sector SETFIA (2020) reports highest catch totals for the fishery in November, March and April and lowest in June, April and December.
  o The SESSF Scalefish Hook Sector SETFIA (2020) reports highest catch effort is January to July.
  o The SESSF Commonwealth Trawl Sector SETFIA (2020) reports highest catch totals in March and November and Trawl Sector lowest in June, April and December.
• Total catch for Crab and Lobster fisheries that overlap the Sequoia MSS are highest outside of the survey window of August to October:
  o Victorian Giant Crab and SRL Fishery SETFIA (2020) reports highest catch totals between December to February
  o Tasmanian Giant Crab Fishery SETFIA (2020) reports highest catch totals between January to February
Tasmanian SRL Fishery SETFIA (2020) reports highest catch totals between January to March.Studies to date on the effects of seismic surveys on species caught by the SESSF Gillnet Sector and Shark Hook Sector, Scalefish Hook Sector and Trawl Sector support previous studies in which the effects of seismic surveys on catch seem transitory and vary among species and gear types. Studies on invertebrate species found no significant differences catch rates caused by potential seismic impacts.</td><td>Minor (2)</td></tr>
</table>

4.7.4. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-95 compares the predicted impact levels for marine reptiles against the acceptable levels.

Table 4-95: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Commercial Fisheries

Defined Acceptable Levels		Predicted Impact Level	Is the predicted impact below the defined acceptable level?
Factor	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.	Not relevant.	Yes

	Environmental impacts and risks have a worst-case consequence ranking less than Major (4).			
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction of impacts to commercial fisheries.		Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	Not relevant.		Yes
Biological	Not relevant.			
Ecological	Not relevant.			
Economic	No interference with others to an extent greater than is necessary for the execution of the Sequoia MSS.	Changes are temporary and have been lowered by following the consultation process described in Section 3. Commercial fishing seasons have been avoided as much as possible noting the bias for protecting SRL and GC fishing resources.		Yes
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM 1 - the fisheries and community liaison programme include notifications for interactions with commercial fishers. CM 11 - the sail line plan ensures the activity is clearly scoped and bounded. CM 13 - the adjustment protocol will be negotiated with the relevant fishing industry associations.		Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).	Commercial Fisheries	Minor (2)	Yes
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to other marine users have been considered in Section 3.4. No public comments were made in relation to commercial fishers.		Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Maritime law dictates the standards that apply to interactions on the water between any vessels.		Yes
Acceptability Summary				

Following completion of the impact assessment process, the environmental impacts to other marine arising from the identified aspects are acceptable because: • Adherence to shipping regulations are well understood (i.e. Navigation Act 2012, AMSA orders, appropriate qualifications, notice to mariners, navigational lighting and shapes). • Required shipping deviations would be minor and thus have negligible impact on travel times or fuel use. • Pre survey consultation to ensure all other users are informed of activities (commercial fishers, fishery authorities AFMA/VFA/DPIPWE). • Activities to take place outside of the peak fishing seasons for Southern Rock Lobster and Giant Crab Fishery • Sound impacts on fish, invertebrates and zooplankton/larvae well understood. • Standard seismic design and best practice implemented with soft starts, reduced spatial overlap and excise areas. • Fishery compensation payment claims considered from relevant stakeholders.

4.7.5. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Commercial fisheries remain sustainable; and
Impact	• Impacts are limited to interference to no greater extent than is necessary to meet survey objectives.
Impact	• Impacts are such that commercial fishers are no worse off as a result of the Sequoia MSS.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-96 which assesses whether the control measures for commercial fisheries are effective to meet the EPO.

Table 4-96: Control Measure Effectiveness – Commercial Fisheries

Measure	CM 11 - Sail line plan		
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.		
Is the EPO achieved?	Partially		
Residual impacts requiring additional management	The sail line plan includes an area of GC habitat which has high productivity.	The sail line plan only manages the spatial extent of the survey it does not manage interactions with commercial fishers.	The sail line plan needs to be communicated.
Next Measure	PS 11.2 – GC excise area.	CM 13 – Adjustment protocol	CM 1 – Fisheries and community liaison program
Assessment of Effectiveness	The adoption of a GC excise area where the sound source is limited to 'low-power' mode affords additional protection to GC in productive habitat.	The Adjustment Protocol will be negotiated with peak fishing associations to ensure that any claims of fishers can be assessed and compensated for. There are performance standards in place that govern the minimum levels of effectiveness for CM13 while it is still under consideration	The liaison program includes a suite of measures to ensure that the outcomes of the NOPSEMA assessment are communicated to community groups and that during the activity relevant persons are continually informed about the progress and changes to

		between ConocoPhillips Australia and the fishing associations.	Sequoia MSS in close to real-time.
Is the EPO achieved?	Yes	Yes	Yes
Residual impacts requiring additional management	None		

4.8. Other Marine Users

4.8.1. Scoping of Assessment

4.8.1.1. Defining the aspects that lead to impact

Table 4-97 identifies the aspects and impacts that have the potential to impact other marine users as a result of the Sequoia MSS. Aspects and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible (1); or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further. Unplanned events which increase threats to the environment are collated and assessed in separate chapters (Section 5 – Unplanned).

Table 4-97: Aspects and Impacts – Other Marine Users

Aspects	Impacts	Other Marine Users
Interference with Other Marine Users	Changes to the functions, interests or activities of other users	✓

4.8.1.2. Cause and Effect Pathway

An assessment was carried out to identify potential interactions between the petroleum activity and the receiving environment through the identification of environmental aspects. Table 4-97 describes the cause and effect pathways / the source of the aspect identified for other marine users.

Table 4-98: Cause and Effect Pathway – Other Marine Users

Interference with Other Marine Users
Interference with commercial shipping is the result of the presence of the survey vessel, deployed survey equipment and support vessels within the operational EMBA. The presence of the Sequoia MSS has the potential to result in the following change to a physical receptor: • Changes to the functions, interests or activities of other users
Emissions – Underwater Sound (Impulsive)
Underwater sound is generated with each pulse from the seismic source that produces high intensity, low-frequency impulsive sounds. Impulsive sound generated by the Sequoia MSS has the potential to result in this impact: • Changes to the functions, interests or activities of other users

4.8.1.3. Defining the EMBA

Table 4-99 describes how the EMBA has been defined for the aspects and impacts that have been identified to potentially impact other marine users (Table 4-97).

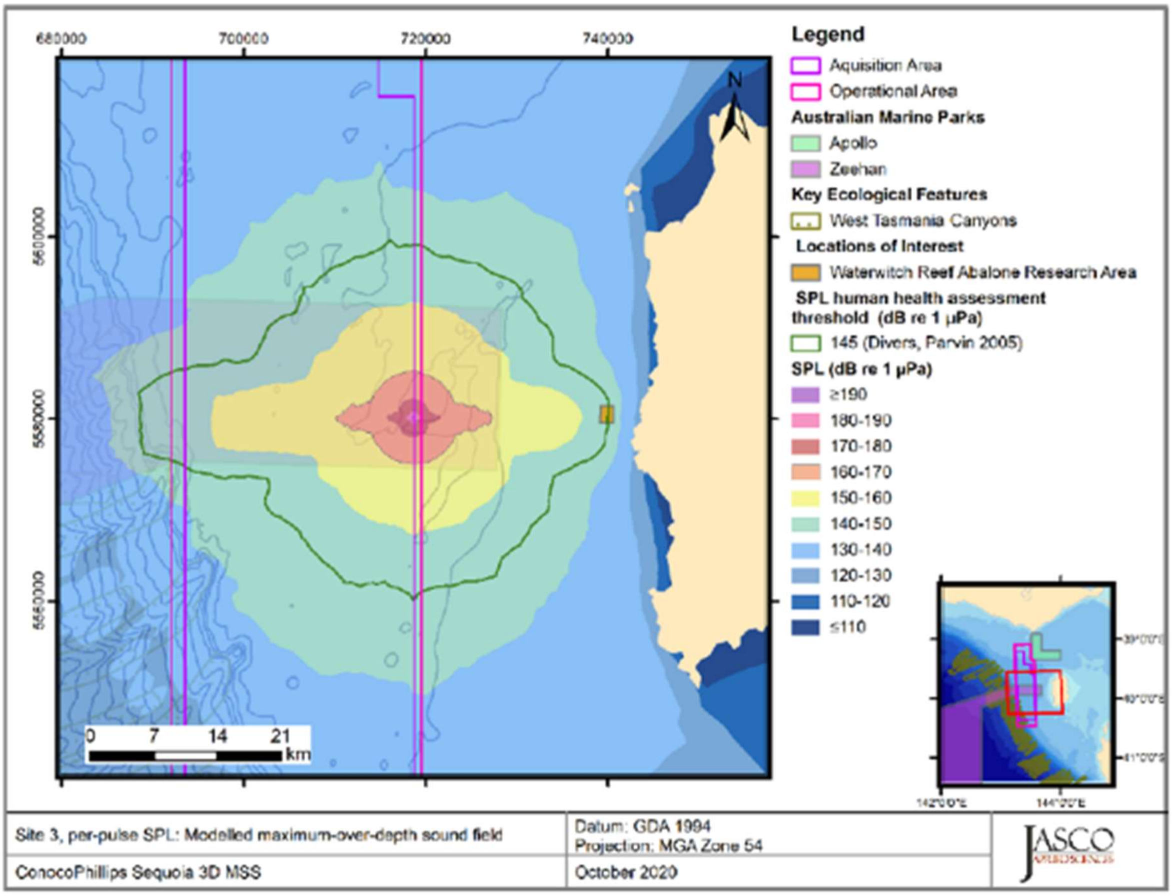
The source of the aspect is described further in Section 4.8.1.2.

The EMBAs relevant for other marine users are shown in Figure 4-54.

Acoustic modelling for the Sequoia MSS (JASCO, 2019) derived the maximum (R_{max}) horizontal distances from the source array to modelled-over-depth SPL isopleth (145 dB re 1µPa) for human diver health thresholds (Parvin, 2005) at three modelling sites. The maximum distance at which the SPL 145 dB re 1µPa threshold occurred from the Operational Area was modelled at 41.9 km (Site 2). However, individual modelling sites within the JASCO (2019) report shows the SPL 145 dB re 1µPa threshold being reached offshore from King Island (Figure 4-53). As a conservative approach the spatial extent of the EMBA for seismic sound on commercial and recreational divers has been expanded to 45 km from the Operational Area to align with the Diving Medical Advisory Committee's guidance note DMAC 12 (DMAC, 2020).

Table 4-99: EMBAs for Other Marine Users

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Interference with Other Marine Users	Vessel activities within the Operational Area	To avoid changes to the functions, interests or activities of other users	As per this EP the Sequoia MSS activities will be undertaken within the Operational Area.	Operational Area
Emissions – Underwater Sound (Impulsive)	Seismic sound – Commercial and recreational divers	To avoid injury or disturbance to commercial and recreational divers	DMAC 12 – Safe Diving Distance from Seismic Surveying Operations (DMAC 12, 2019) details where diving and seismic activity are scheduled to occur within 45 km, 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.	Operation area + 45 km



Source: JASCO (2019)

Figure 4-53: Sound level contour map showing the unweighted maximum-over-depth sound field in 10 dB steps, and the isopleth for the human divers health assessment threshold at Site 3

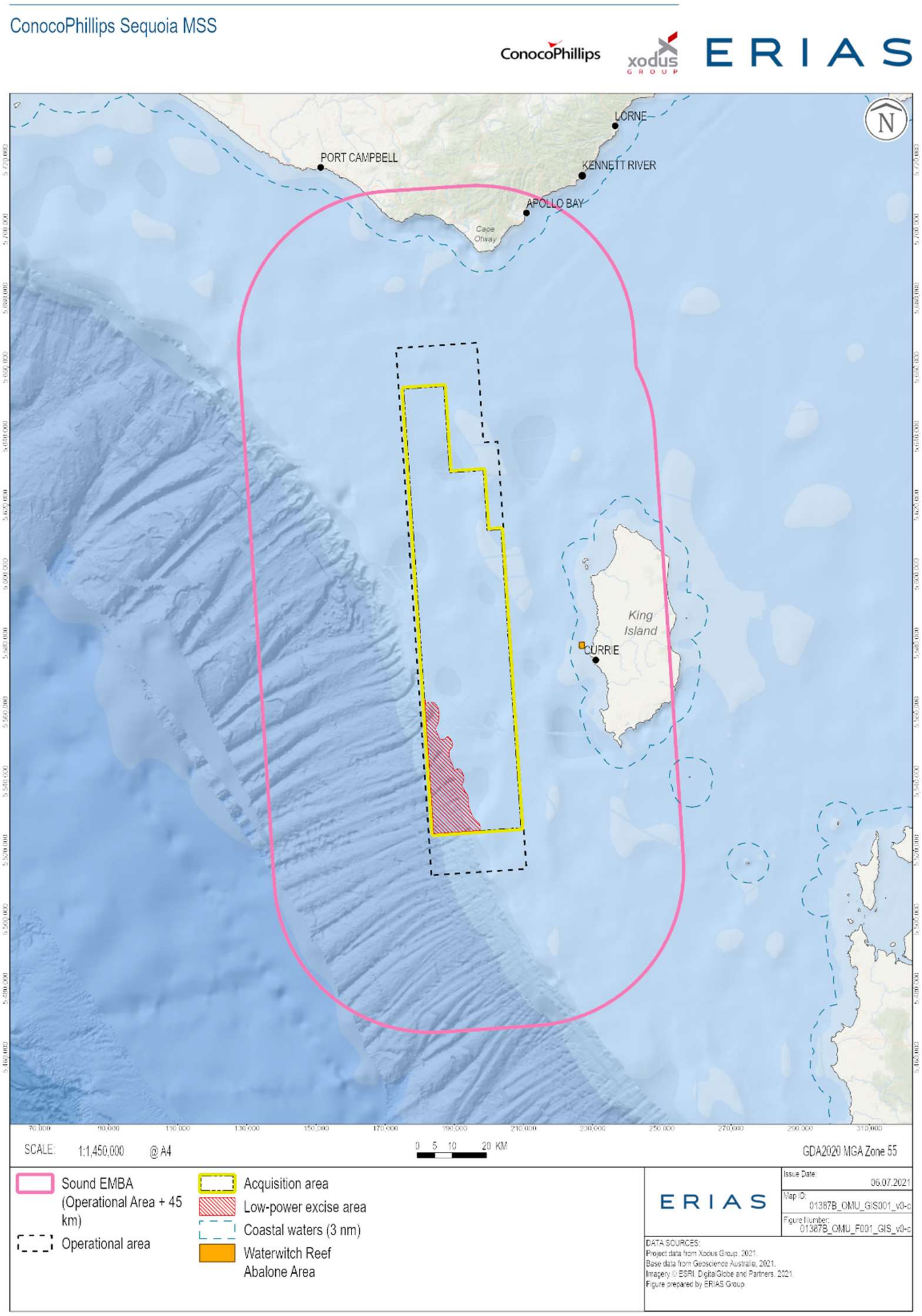


Figure 4-54: EMBAs relevant for Other Marine Users

4.8.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required depends on whether the environment or receptor affected is formally managed, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

Multiple other marine users may occur within the relevant EMBAs with Table 4-100 identifying the presence, and activities for each.

The presence of most other marine users within the relevant EMBAs such as commercial shipping, defence activities and divers are expected to be of a transitory and/or temporary nature only.

Values and Sensitivities

Table 4-100 describes the values and sensitivities of other marine users within the relevant EMBAs.

Table 4-100: Other Marine Users that may occur within the EMBAs

Other Marine Users	Type of Presence / Activity – EMBA	
	Operational Area	Seismic sound – Commercial and recreational divers
Commercial Shipping	Shipping transiting through area	X
Defence activities including unexploded ordnance (UXO)	Shipping transit through area. Designated UXO area	X
Offshore energy exploration and production	Previous and future seismic operations	X
Recreational and commercial diving	None	Likely to occur at nearby reefs at King Island

Source: AMSA (2020), DoD (2020) and DPIPWE (2021)

4.8.1.5. Legislative Requirements

Table 4-101 identifies the minimum legislative and other requirements that are relevant to Other Marine Users. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 4-101: Other Requirements – Other Marine Users

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislation	OPGGS Act 2006 (Cth)	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 and performance of the duties of the person.	The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS. Adoption of the following control measures:

Legislation	*Navigation Act 2012* (Cth)	Covers international ship and seafarer safety, protect the marine environment where it relates to shipping and the actions of seafarers in Australian waters. Of relevance are: • Chapter 6 (Safety of navigation), particularly Part 3 (Prevention of collisions). • AMSA Marine Orders Part 21 (Safety of Navigation and Emergency Procedures). • AMSA Marine Orders Part 27 (Safety of Navigation and Radio Equipment). • AMSA Marine Order Part 30 (Prevention of Collisions).	Adoption of control measures (refer to Environmental Performance section in Appendix A)
Guidelines	Environmental management in the upstream oil and gas industry (IOGP-IPIECA, 2020)	• Develop exclusion zones in consultation with key stakeholders, including local fishing 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.	
Guidelines	Environmental, Health and Safety Guidelines for Offshore Oil and Gas Development (World Bank Group, 2015)	Includes information relevant to seismic exploration, exploratory and production drilling, development and production activities, offshore pipeline operations, offshore transportation, tanker loading and unloading, ancillary and support operations, and decommissioning. Of specific relevance is Ship Collision (item 120) – to avoid collisions with third-party and support-vessels, offshore facilities [interpreted to include the survey vessel] should be equipped with navigational aids that meet national and international requirements.	
Guidelines	Environmental Manual for Worldwide Geophysical Operations (IAGC, 2013)	Provides guidance for all kinds of geophysical surveys. Of particular relevance are: • 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.	

4.8.2. Impact Assessment – Commercial Shipping

4.8.2.1. Existing Environment

Values

The South-east Marine Region (which includes Bass Strait) is one of the busiest shipping regions in Australia (DoE, 2015a). Shipping consists of international and coastal cargo trade, passenger services and cargo and vehicular ferry services across Bass Strait (DoE, 2015b)

The Operational Area lies to the south of the main shipping route that runs east/west along Australia's southern coastline. The survey vessel when operating in the northern sections of the Operational Area will encounter heavier concentrations of transiting commercial shipping (Figure 4-55).

A smaller route used by vessels that transit east/west into Bass Strait between King Island and the Fleurieu Group of islands is also present.

Based off the extract of shipping traffic recorded by AMSA during August 2020 for the Operational Area and western Bass Strait, a total of 206 ships passed through this area during August (Table 4-102). The majority of these (127) are cargo ships with tankers being the second most frequent (39). Based on this data, an average of seven ships per day pass through the waters of the Operational Area.

Table 4-102: Summary of shipping traffic recorded by AMSA in August 2020 in waters within and adjacent to the Operational Area

Vessel type	Count
Cargo ship	127
Tanker	39
Fisher	6
Other	4
Total	206

Source: AMSA (2020)

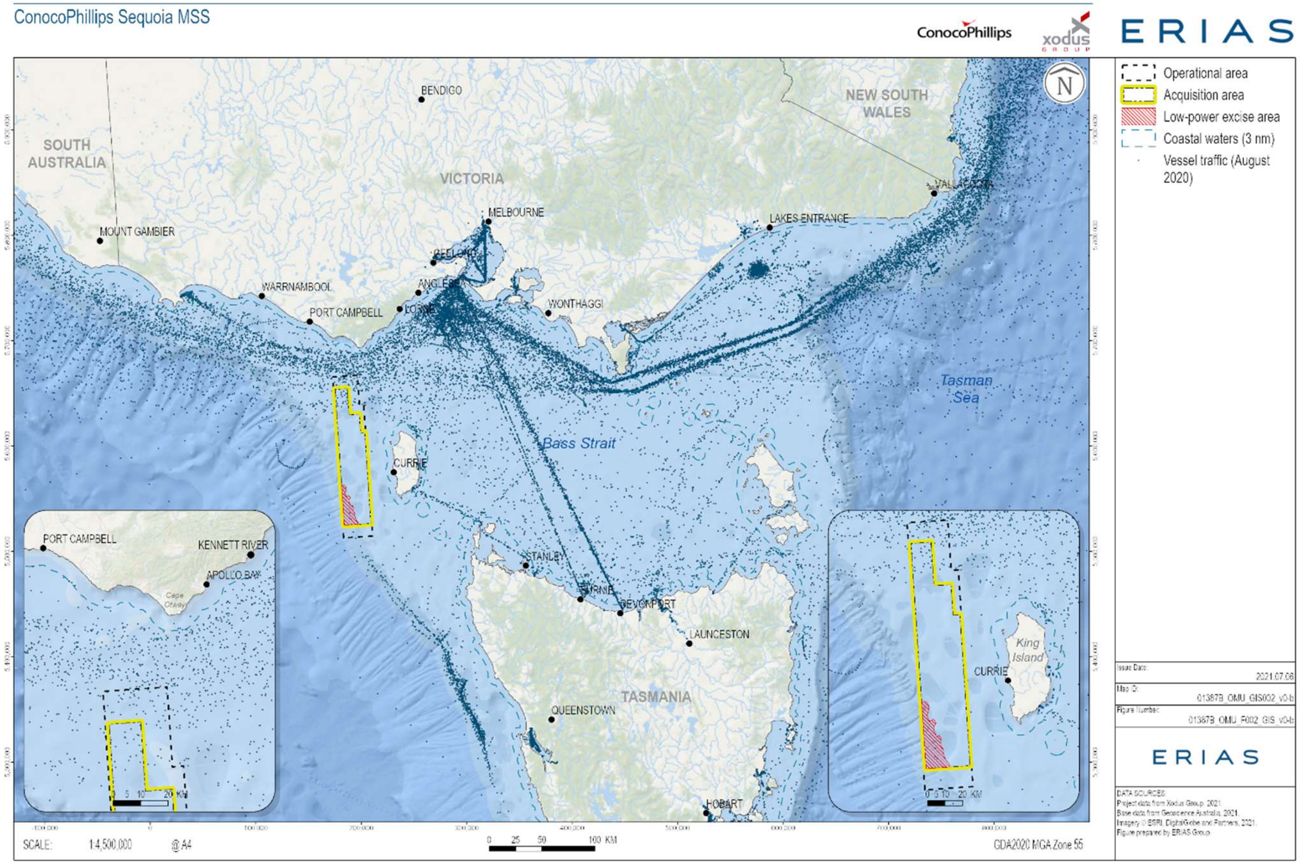


Figure 4-55: Commercial shipping activities within the Operational Area

Sensitivities

Trade tensions can and do cause trade patterns to shift, with the search for alternative markets and suppliers resulting in a redirection of flows away from China towards other markets, especially in southeast Asian countries. New additional tariffs are estimated to have cut maritime trade by 0.5% in 2019, however, overall impacts have so far been mitigated by increased trading opportunities in alternative markets (UNCTAD, 2020).

Existing Pressures

The global health and economic crisis triggered by the COVID-19 pandemic has impacted maritime transport and trade and significantly affected growth prospects. The United Nations Conference on Trade and Development (UNCTAD) projects the volume of international maritime trade to fall by 4.1% in 2020. Amid supply-chain disruptions, demand contractions and global economic uncertainty caused by the pandemic, the global economy was severely affected by a twin supply and demand shock. These trends unfolded against the backdrop of an already weaker 2019 that saw international maritime trade lose further momentum (UNCTAD, 2020).

4.8.2.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to commercial shipping have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.8.1.5).

Table 4-103: Predicted Impact Levels – Interference with Other Marine Users (Commercial Shipping)

Interference with Other Marine Users (Commercial Shipping)	Consequence
<u>*Changes to the functions, interests or activities of other users*</u> The known and potential impacts of interference with commercial shipping are: • Collision potential with third-party vessels (and damage in the case of collision) • Diversion of third-party vessels from their navigation paths (resulting in longer sail times and greater fuel consumption). The Operational Area is situated ~9 km south of the major east west shipping route in the Bass Straight Figure 4-55). In addition, the smaller vessel route between the between King Island and the Fleurieu Group of islands is also outside of the Operational Area. The survey vessel may encounter heavier concentrations of transiting commercial shipping when operating in the northern sections of the Operational Area, however, Table 4-102 shows that on average only seven vessels pass through the Operational Area per day. The Sequoia MSS is of a relatively short duration. Therefore, interactions between the survey, support vessels and commercial shipping is likely to be minimal. All vessels involved with the Sequoia MSS will adhere to the appropriate navigational requirements (Table 4-101) and prior notice of survey operations will be undertaken in the form of a Notice to Mariners. In addition, as the survey vessel will be restricted in her ability to manoeuvre, it will display appropriate lights and shapes in compliance with the International Regulations for Preventing Collisions at Sea 1972 (COLREGS). Communications will be maintained with other marine users during survey operations. The survey vessel will be travelling at slow speeds during operations (~4 knots or ~7.4 km/hr) and will be highly visible to other marine traffic due to its size. In the unlikely scenario that the survey vessel does encounter merchant vessels, the inability of the survey vessel to take sudden evasive action with streamers trailing means that the support vessels would engage the third-party vessel to change course. This could amount to a detour for the commercial vessel of ~ 7 km to go around the survey vessel and streamers. If the vessel is transiting it is likely to be moving at a minimum of 20 knots (37 km/hr) thus it would take approximately 12 minutes to detour around the vessel and streamers. This is unlikely to result in a significant longer sail time or increase in fuel use. Commercial shipping will be notified via a Notice to Mariners of when the survey will be undertaken in the Operational Area	Minor

allowing transiting commercial shipping vessels to plan their transit to avoid increase travel time and distance. The extent of the area of impact is predicted to be within the Operational Area (between August and October) with vessels present for the Sequoia MSS. The severity is assessed as **Minor (2**) based on: • The predicted impact is localised to the Operational Area, and short-term and recoverable • Commercial shipping is not financially disadvantage if they cannot transit through the area due the survey • The presence and duration of the survey will be well known through Marine Notices and stakeholder consultation • The time and cost for vessel diversions.	

4.8.3. Impact Assessment – Defence Activities

4.8.3.1. Existing Environment

Values

The south-east marine region is important for a range of defence activities particularly training exercises. Australian Defence Force (ADF) activities in the region include transit of naval vessels, training exercises, shipbuilding and repair, hydrographic survey, surveillance and enforcement and search and rescue (DoE, 2015b). No defence practice, training or protected areas were identified within the Operational Area (Figure 4-56; Figure 4-57).

Unexploded ordnance (UXO) are a by-product of past training activities undertaken by the ADF. The Department of Defence's (DoD) interactive Unexploded Ordnance in Australia map (DoD, 2020) was used to determine locations that are at risk of hosting UXO within the vicinity of the Operational Area.

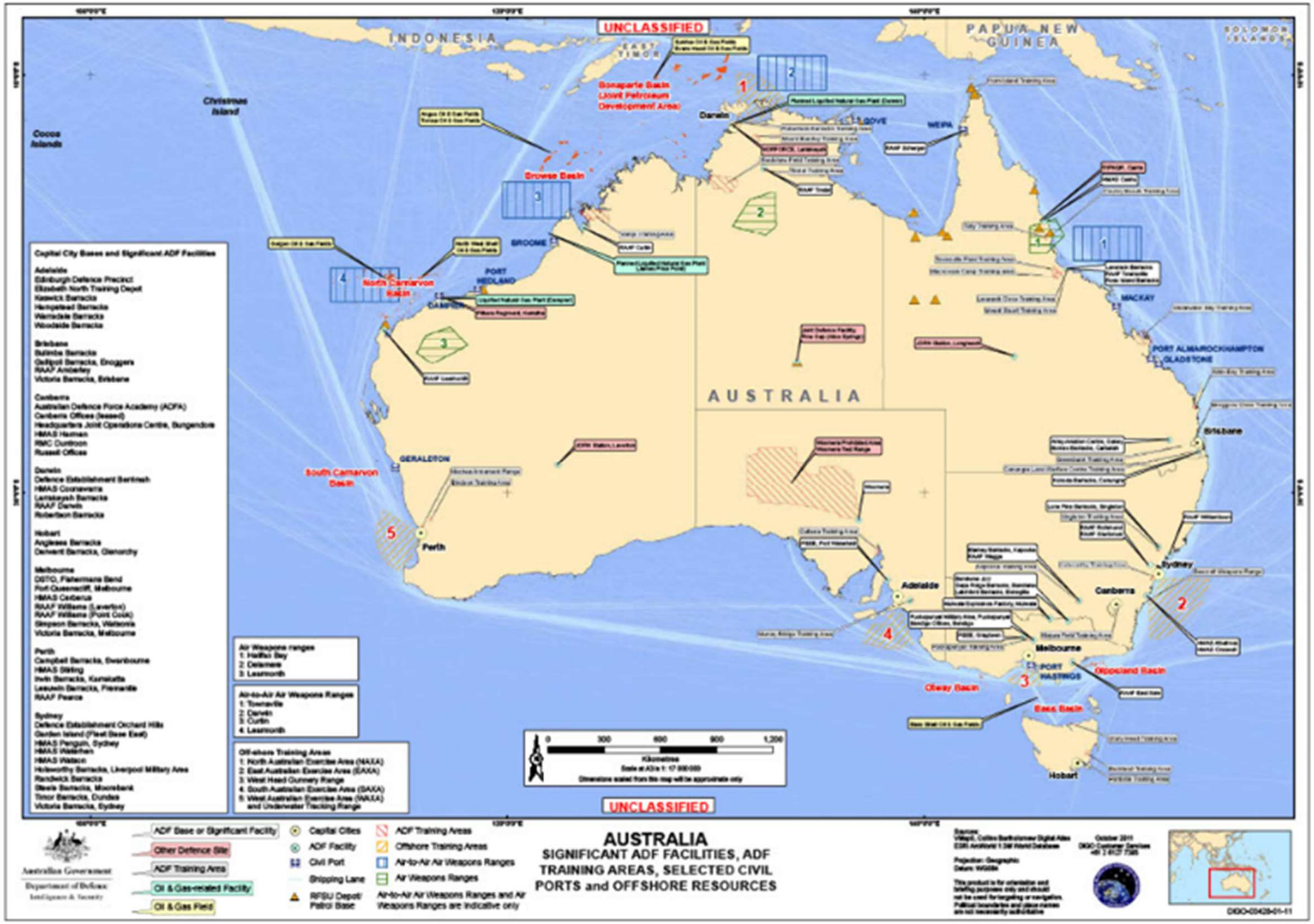
Following discussions with the Directorate of Contamination Assessment Remediation and Management Infrastructure Division, Estate & Infrastructure Group (DoD EIG, 2021, approved meeting notes within Appendix D) it was confirmed to ConocoPhillips that one area designated as having an UXO category of Slight Potential intersects the Operational Area (Figure 4-57):

- Area 1052 – former air-to-air firing range. Air-to-air training activities conducted within these bounds. Majority of ammunition would have been Ball (non-high explosive). The ADF states that the risk to the MSS from this ammunition is negligible (UXO Category: *Slight Potential)* (DoD EIG, 2021).

The three closest UXO sites identified outside of the Operational Area are summarised below and displayed in Figure 4-57 (DoD EIG, 2021):

- SDG087 Sea Dumping – King Island (~30 km from Operational Area). This site is an area used for the dumping at sea of ordnance and other items. This site was used for the dumping at sea of ammunition including cartridges, projectiles and fuses (UXO Category: *Other Sea Dumping Sites*)
- SDC006 Sea Dumping – Off King Island (~52 km from Operational Area). This site is an area used for the dumping at sea of ordnance and other items. This site was used for the dumping of chemical munitions including 1,634 tons of chemical munitions (UXO Category: *Other Sea Dumping Sites*)

- SDG136 Sea Dumping – Victorian Coast (~65 km from Operational Area). This site is an area used for the dumping at sea of ordnance and other items. Site of post WWII Sea Dumping Activity (UXO Category: *Other Sea Dumping Sites*).



Source: DoD (2011)

Figure 4-56: Significant ADF Facilities and Training Areas

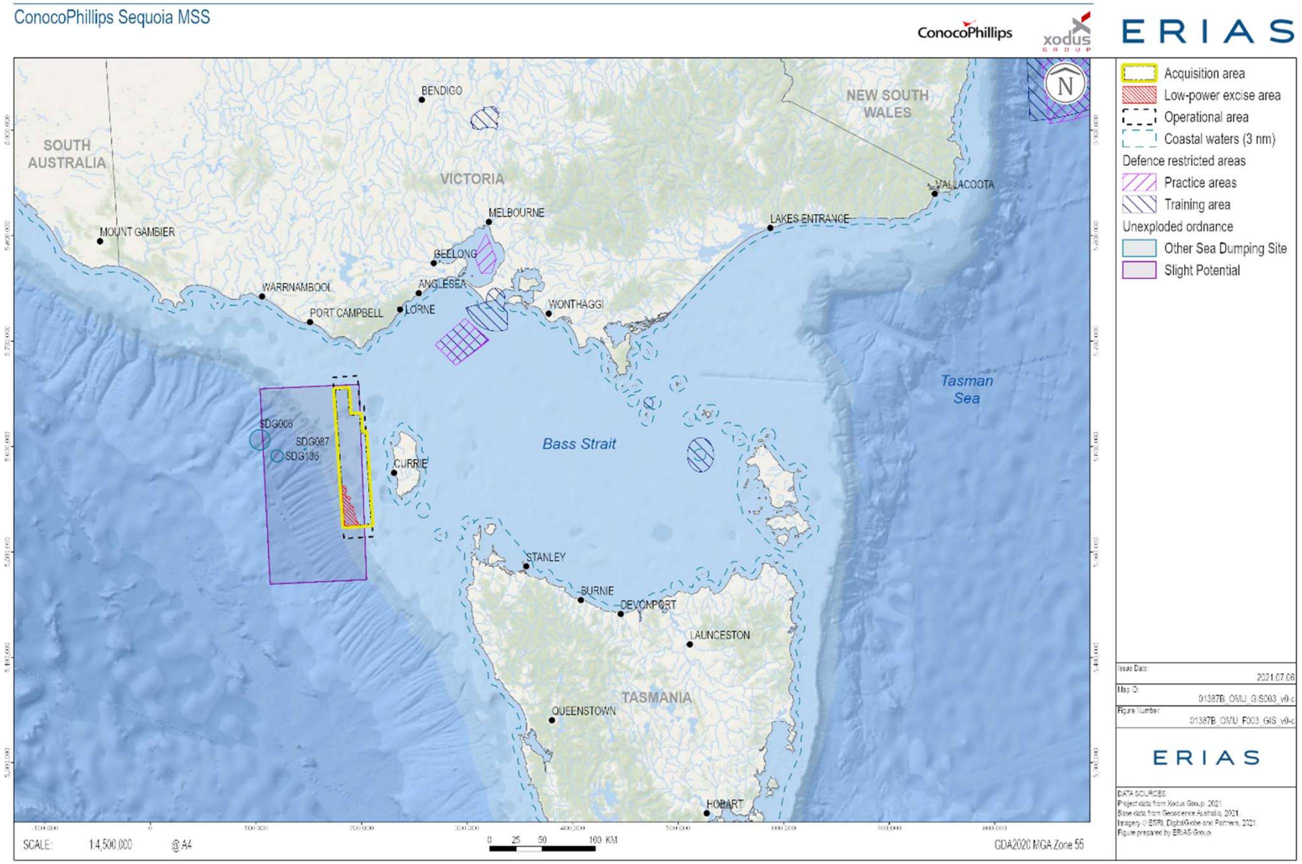


Figure 4-57: Defence Activities intersected by the Operational Area

Existing Pressures and Sensitivities

There is currently an ongoing gap between the demands of the Australian military marine sector and available skills to sustain viability. Demands of both military requirements can at times exceed the supply of adequately skilled personnel (DoD, 2008).

There is currently very little spare capacity in the global maritime industry and almost none in Australia for commercial shipping to provide support to Australian Defence Force (ADF) operations (DoD, 2008). An ongoing trend for larger cellular container plus larger crude and bulk carriers has resulted in a decline in the number of suitable ships to support ADF operations. In addition, the Australian Shipping Register has shown declines in the number of suitable Australian flagged ships. As it would not be possible to requisition foreign-owned property the ADF could face transport shortages during planned operations (DoD, 2008).

4.8.3.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to defence activities have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.8.1.5).

Interference with Other Marine Users -	Consequence
<u>Changes to the functions, interests or activities of other users</u> As described in the Existing Environment section (and illustrated in Figure 4-56 and Figure 4-57), there are no known ADF training, practice or prohibited areas that intersect with the Operational Area, therefore no impact on defence activities from the Sequoia MSS is expected. Existing Environment section and Figure 4-57 detail known areas of UXO within the vicinity of the Sequoia 3DMSS. The three closest sea dumping sites (SDG087, SDC006, SDG136) are positioned outside of the Operational Area. As all Sequoia MSS activities will be within the boundaries of the Operational Area no interaction with these three dumping sites will occur. The Operational Area is overlapped by a former air-to-air firing range listed as *Area 1052 - former air-to-air firing range*. Following a meeting between DoD and ConocoPhillips Australia (Stakeholder Holder Feedback 11/09/2020 Appendix D) a DoD spokesperson stated that the risk to the Sequoia MSS from this ammunition is negligible (*UXO Category: Slight Potential*). Acquisition for the Sequoia MSS is being undertaken in water depths ranging between 90 m and 1,000 m. No survey equipment will contact the seabed with the deepest depth reached by deployed equipment being 20 – 25 m for a multi-component streamer or 7 – 8 m without a multi-component streamer (Section 2). There will be a minimum vertical separation of between 65 m and 83 m between the streamers and the seabed, depending on the streamer used. Therefore, there will be no physical interaction between deployed survey equipment and any UXO on the seabed within the Operational Area. The extent of the area of impact is predicted to be within the Operational Area (between August and October) with defence activities for the Sequoia MSS. The severity is assessed as **Minor (2)** based on: • The predicted impact is localised to the Operational Area, and short-term • Defence Activities are not financially disadvantage if they cannot operate in the area due to the survey • The presence and duration of the survey will be well known through Marine Notices and stakeholder consultation • The time and cost for vessel diversions.	Minor (2)

4.8.4. Impact Assessment – Offshore Production Activities

4.8.4.1. Existing Environment

Values

There is no oil and gas infrastructure within the Operational Area (Figure 4-58). The closest developments are the Otway Gas Field Development, operated by Beach Energy, located 70 km south of Port Campbell and 25 km west of the nearest Operational Area boundary. This consists of a the remotely operated Thylacine platform, offshore and onshore pipelines and a gas processing plant located 6.4 km northeast of Port Campbell. Over its operating life, the development is expected to supply 950 billion cubic feet (bcf) of raw gas, 885 PJ of sales gas, 12.2 million barrels of condensate and 1.7 million tonnes of LPG to the market. The fields are estimated to contain sufficient natural gas to provide more than 10% of current annual demand in south-eastern Australia over a period of 10 years. First gas sales commenced September 2007 (Cooper, 2017).

In 2016, Origin (now Beach Energy) also completed its Halladale and Blackwatch gas field development. The Halladale production well is located 13 km north of the Netherby production well. It was directionally drilled from an adjacent onshore location, with a pipeline laid between the onshore drill site and the Iona Gas Plant (Cooper, 2017).

The Minerva Gas Development is operated by Cooper Energy (previously BHP Billiton) and commenced production in April 2005. This consists of two subsea wells in shallow waters (60 m deep and 10 km from the coast) that are tied back to an onshore gas plant (4.5 km inland) via a single pipeline. The gas plant has the capacity to produce 150 TJ gas and 600 barrels of condensate per day (Cooper, 2017).

The Casino-Henry-Netherby Field Development, operated by Cooper Energy (previously Santos), is located 17–25 km offshore from Port Campbell in water depth ranging from 65–71 m. The offshore development consists of 4 subsea wells which transport gas via a 250mm gas pipeline to the Iona Gas Plant (Cooper Energy, 2020).

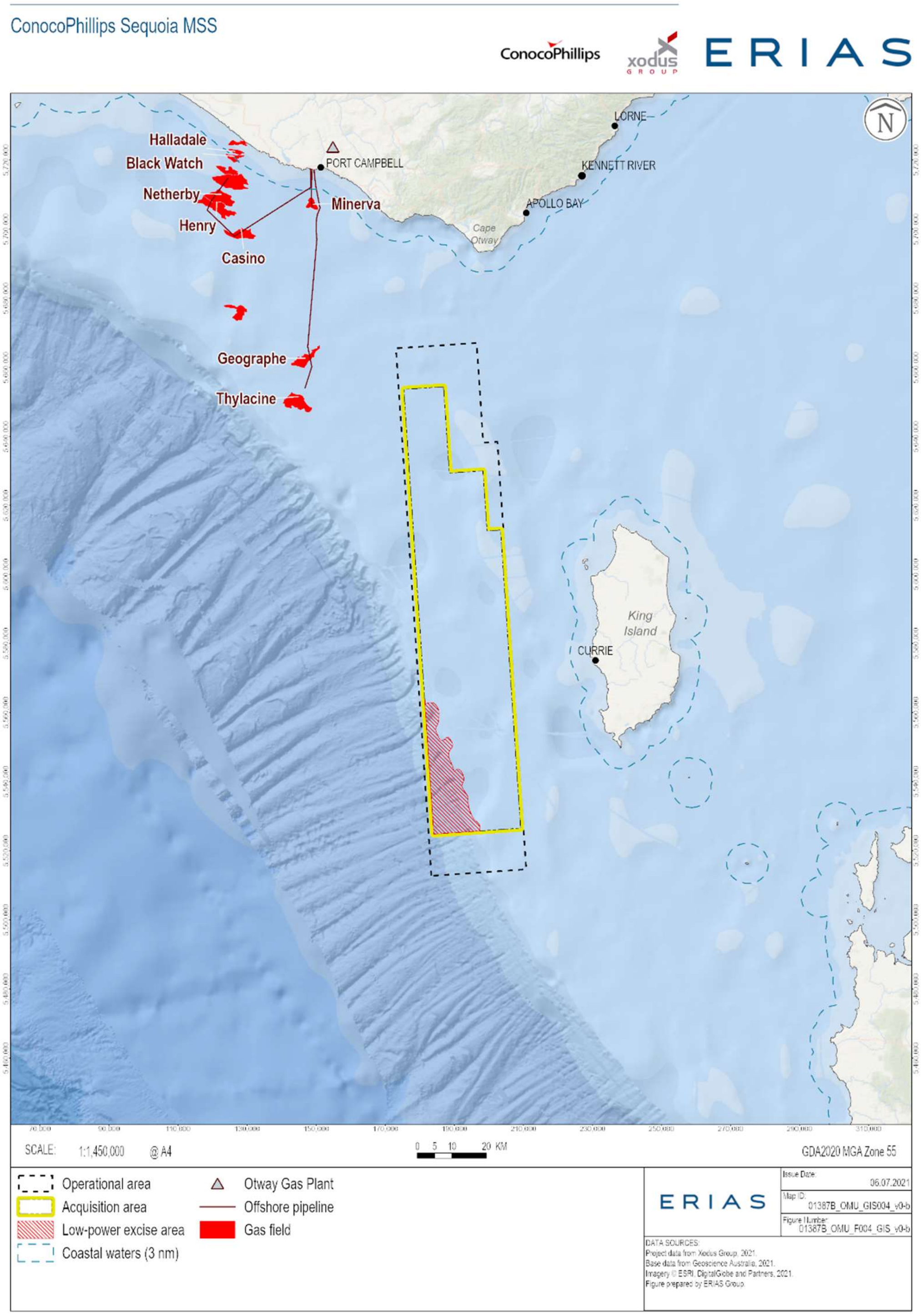


Figure 4-58: Bass Strait Offshore Infrastructure within the vicinity of the Operational Area

Existing Pressure and Sensitivity

While much of the offshore oil and gas industry is slowly rebounding, the seismic vessel survey market continues to be challenging for those contractors that still remain active with several companies having exited the market, filed bankruptcy, and sold their fleet (Offshore, 2019).

Local pressures on the offshore energy exploration industry can included overlapping proposed seismic surveys. A review of environmental plans on the NOPSEMA website found the following approved plans that have or may occur within the vicinity of the Operational Area and may also displace or have an impact on offshore energy exploration industry (Table 4-104; Figure 4-59).

Table 4-104: Seismic Environment Plans within the vicinity of the Operational Area

Activity	Description	Distance from Operational Area	Temporal overlap
Otway Basin 2DMC Marine Seismic Survey	Schlumberger Australia Pty Limited (Schlumberger) proposed to acquire Otway Basin 2DMC MSS, with an estimated survey duration of 100 days which will be acquired in the period from November 2019 to June 2020 (SLR 2019). Project was completed in 2020.	0.07% overlap	None
Otway Deep Marine Seismic Survey	Geophysical company TGS (previously Spectrum Geo) has proposed to undertake the Otway Deep three-dimensional (3D) marine seismic survey (MSS) in the Commonwealth waters of the Otway Basin. The duration of the activity is proposed as a maximum of 120 days per survey season between 1 October 2018 to end February 2022. The survey season was defined as the window from the beginning of October to end of February, with avoidance of the period from 1 March to end of September (RPS, 2019). At the time of writing this survey has not commenced and is not planned to occur in October 2021.	0.34% overlap	None
Dorrigo 3D Marine Seismic Survey	3D Oil Limited proposed to undertake the Dorrigo three-dimensional (3D) marine seismic survey (MSS) in the Commonwealth waters of the Otway Basin within Exploration Permit T/49P which lies adjacent to Tasmania. The Dorrigo MSS was expected to take up to 35 days between 1 September and 31 October 2019 (3D Oil, 2019). The Sequoia MSS replaces this activity.	NA	None
Prion Seismic Survey	Beach Energy is planning to undertake a three-dimensional (3D) marine seismic survey (the Prion Survey) to enable assessment of the natural gas reservoirs in Commonwealth offshore retention licenses T/RL2, T/RL3, T/RL4 and T/RL5. The survey will take around 50 days, subject to weather. According to the EP Summary, it is expected to be completed between October 2020 and December 2021, with timing to be confirmed after consultation with stakeholders, receipt of regulatory approvals, and confirmation of vessel availability. The EP was submitted in January and is under assessment. ConocoPhillips Australia have attempted to confirm whether this survey will go ahead in 2021. There is currently only one seismic survey vessel contracted to operate within Australian	~112 km Opposite side of King Island	None

Activity	Description	Distance from Operational Area	Temporal overlap
	waters during the latter half of 2021; and that vessel has been contracted by ConocoPhillips Australia. Therefore, it is ConocoPhillips Australia's understanding that it is very unlikely that the Prion seismic survey could occur concurrently with the Sequoia MSS.		
Activity - T/30P Geophysical and Geotechnical Seabed Survey	Beach Energy propose to undertake a geophysical and geotechnical survey (site survey) over a portion of their T/30P permit and open acreage in the Otway Basin in Commonwealth waters. It includes High resolution two-dimensional shallow reflective imaging (2D survey) to inform shallow gas hazards. The EP was accepted by NOPSEMA in January 2021. The surveys were proposed to be undertake between 1 February and 30 June 2021. However, the survey has not been undertaken; and it is not possible to undertake the survey within the timeframe specified in the EP. Therefore, it is unlikely that this survey will go ahead in 2021.	~33 km	None

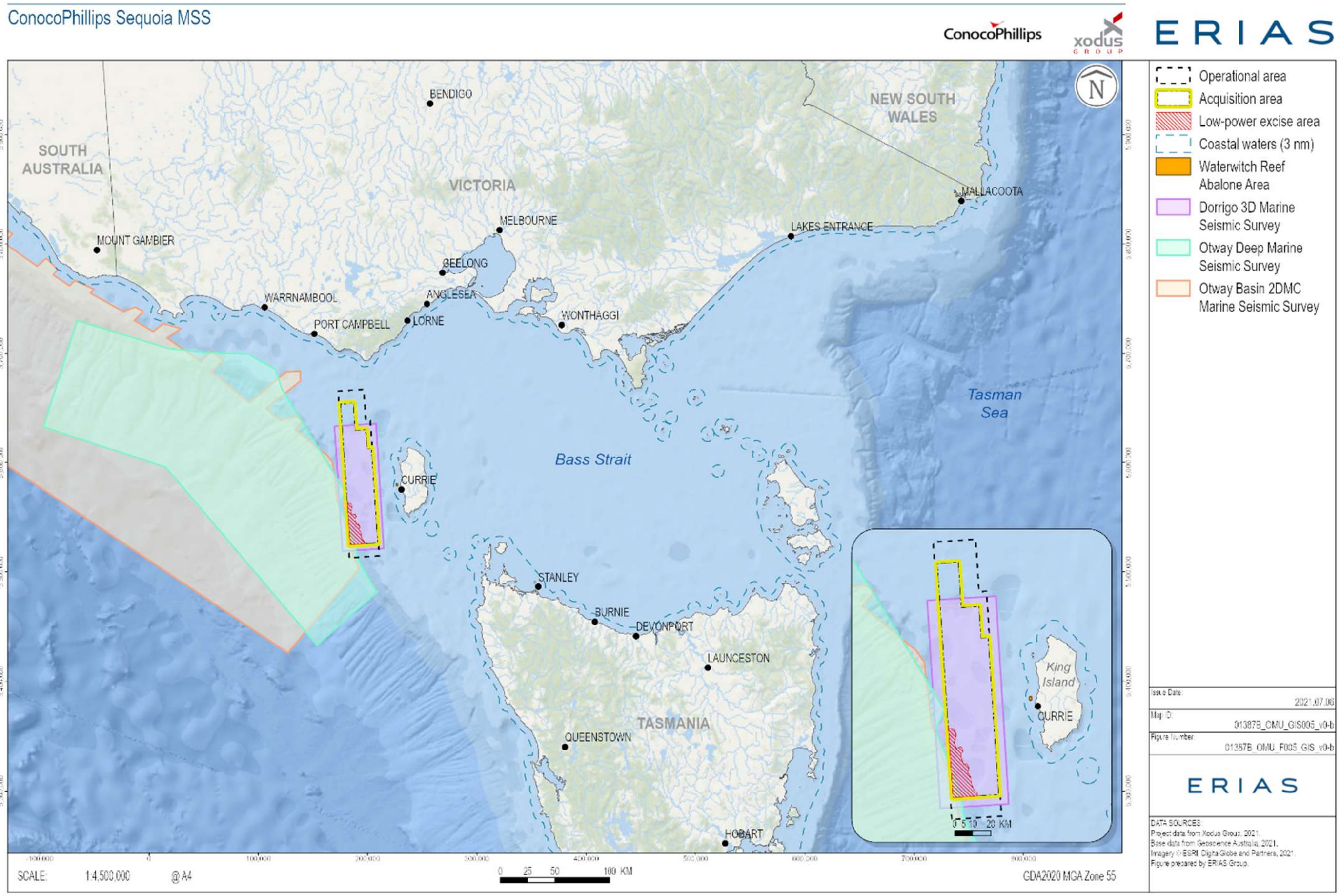


Figure 4-59: Overlap of historic and approved seismic surveys with Operational Area

4.8.4.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to offshore energy exploration and production have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.8.1.5).

Table 4-105: Predicted Impact Levels – Interference with Other Marine Users (Offshore energy exploration and production)

Interference with Other Marine Users	Consequence
Changes to the functions, interests or activities of other users As described in the Existing Environment section (and illustrated in Figure 4-59), there is no oil and gas infrastructure within the Operational Area. As all Sequoia MSS survey activities will be within the boundaries of the Operational Area so no interference with offshore energy production will occur. Table 4-104 and Figure 4-59 details a search of the NOPSEMA website for approved environmental plans (EPs) or those under assessment detailing seismic exploration within the vicinity of the Sequoia MSS. All three of the EPs found during the search had Operational Areas that intersected with the Sequoia MSS Operational Area (Figure 4-59). The Otway Basin 2DMC Marine Seismic Survey was completed in 2020 and so no interference with this survey from activities from the Sequoia MSS are possible. The Otway Deep Marine Seismic Survey was due to be conducted between 1 October 2018 to the end of February 2022. At the time of writing no activities have taken place, with no proposed plan to do so during the Sequoia MSS survey window. The Dorrigo 3D Marine Seismic Survey was expected to be conducted between 1 September and 31 October 2019 but this survey did not proceed as ConocoPhillips Australia has farmed into an 80% share of the Sequoia permit area (T/49P). The extent of the area of impact is predicted to be within the Operational Area (between August and October) on offshore energy exploration and production. The severity is assessed as **Minor (2)** based on: • The predicted impact is localised to the Operational Area, and short-term • Offshore energy exploration and production are not financially disadvantage if they cannot operate in the area due to the survey • The presence and duration of the survey will be well known through Marine Notices and stakeholder consultation • The lack of petroleum facilities within the Operational Area • Review of approved survey EPs within the vicinity of the Operational Area.	Minor (2)

4.8.5. Impact Assessment – Recreational and Commercial Diving

4.8.5.1. Existing Environment

Values

Both the Tasmanian Commercial Dive Fishery and Tasmanian Abalone Fishery are conducted utilising divers operating on low pressure surface air supplies (hookah). The seismic EMBA (Operational Area +45 km) overlaps the Tasmanian Commercial Dive Fishery (Northern Zone) and the Abalone Fishery (Northern Zone) (Figure 4-60).

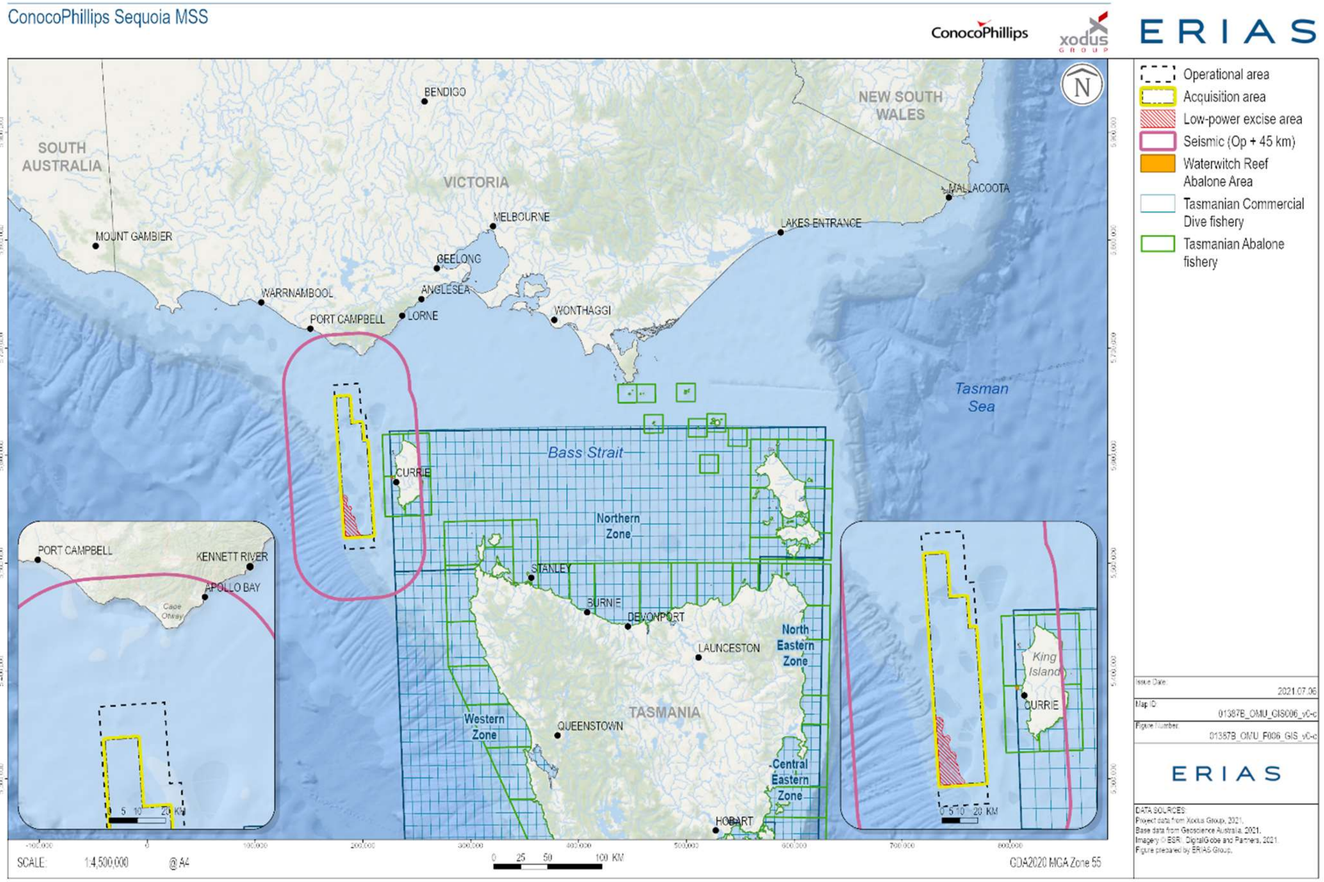


Figure 4-60: Commercial Diving Fisheries within the seismic EMBA

Tasmanian Commercial Dive Fishery

A number of different species are harvested under the commercial dive fishery in Tasmania which include:

- Short Spined Sea Urchin
- Long Spined Sea Urchin
- Periwinkles

The licensing year runs from 1 September to 31 August in the following year. There is no quota allocated to divers for any species in the commercial dive fishery except for the Short Spined Sea Urchin and Periwinkles where there is a 'first in first served' policy. When the total allowable catch is reached in a zone, that zone is closed until the following licensing year. Over the five zones of the fishery there are currently 52 commercial dive licences (DPIPWE, 2020a).

Short Spined Sea Urchin

The commercial harvest of Short Spined Sea Urchin in Tasmania can be traced back to the 1960s, however, a sustained fishery commenced in the 1980s (Hayward, 2013). Short Spined Sea Urchin is traditionally the most valuable and, therefore, preferred target species harvested by the commercial dive fishery in Tasmania. The fishing season is generally from late July until February when the roe is at the highest quality and maximum profitability (IMAS, 2021). The TAC for the Short Spined Sea Urchin at King Island for the 2020/21 season is 3 tonnes. As of the 24 March 2021 zero tonnes had been harvested (DPIPWE, 2021).

Long Spined Sea Urchin

The Long Spined Sea Urchin has been harvested commercially in Tasmania since 2009. The annual catch remained below 100 tonnes until increasing to 185 tonnes in 2018 and 560 tonnes in 2019. This emerging fishery has expanded to be the third largest in Tasmania per wet tonnage harvested (IMAS, 2021). The TAC for the Long Spined Sea Urchin is listed for the whole of Tasmania at 356 tonnes. As of 24 March 2021, 176 tonnes had been harvested (DPIPWE, 2021).

Periwinkle Fishery

The commercial periwinkle fishery has been operating in Tasmania for almost 40 years as part of the commercial dive fishery. Commercial catches have fluctuated throughout the history of the fishery, largely as a result of fishers entering and exiting the industry and/or switching targets to fish alternate species. Most of the catch is taken from the south-east and north-east coasts of Tasmania, with catch rates higher in the south-east than the north-east. The TAC for the Periwinkle at King Island for the 2020/21 season is 3 tonnes. As of the 24 March 2021 zero tonnes had been harvested (DPIPWE, 2021).

Tasmanian Abalone Fishery

The Tasmanian Abalone Fishery operates in Tasmanian coastal waters as defined in (Figure 4-60). Abalone harvesting around King Island is classified as the 'northern zone'. The majority of Abalone fishing grounds are visited by both commercial and recreational divers, and there are limited areas where local divers fish in isolation. Where local and visiting divers overlap spatially, local divers typically fish early in the year. Mundy & Jones (2017) also note changes in the fishing season from winter to late summer. There are six abalone fishing zones on the west coast of King Island (1A, B, C and 3 A, B, C).

The Tasmanian Abalone fishery focuses predominantly on Blacklip Abalone (Haliotis rubra), with Greenlip Abalone (H. laevigata) typically accounting for around 5% of the total wild harvest in Tasmania (Mundy & Jones, 2017). The fishery is a major contributor to the Tasmanian economy and is the largest wild Abalone fishery in the world contributing around 25% of the annual harvest (DPIPWE, 2018). The total value of the Tasmanian abalone fishery in 2015-16 was $79.7M (ABARES, 2018). Total estimated landings for the 2019 Tasmanian abalone fishery were 1140.0 t of Blacklip and 109.2 t of Greenlip, from a total allowable commercial catch (TACC) of 1267.0 t. The Northern Zone TACC for 2020 was reduced from 99.7 t to 74.8 t (Mundy and McAllister 2020).

The Waterwitch Reef Abalone Research area is located on the northwest coast of King Island (Figure 4-60). Within this area, there is no taking of any fish by diving or swimming underwater and entering those waters for the purpose of diving or swimming underwater is prohibited (DPIPWE, 2018). The Waterwitch Reef Research Area provides a comparison of changes in biological parameters between fished and unfished sites (Tarbath and Officer, 2003). This research area is located ~19.6 km from the nearest Sequoia MSS operational boundary and 20.5 km from the Acquisition Area. Table 4-106 provides additional detail on the Abalone Fishery.

Table 4-106: Abalone Fishery

Aspects	Description
Target species	Blacklip Abalone (*Haliotis rubra*), with Greenlip Abalone (*H. laevigata*)
Fishing season	Greenlip Abalone fishery – State waters off the north-east and north-west coasts of Tasmania closed from 1 January 2021 to 30 June 2021. Blacklip Abalone – No closures identified within the Northern Zone fishing blocks surrounding King Island.
Licences	121
Recent catch within fishery	Total state-wide catch of the abalone fishery for the last five seasons (subject to available data) were: • 2019 – 1,140 t • 2018 – 1,310 t. • 2017 – 1,561 t. • 2016 – 1,694 t. • 2015 – 1,855 t.
Catch in Seismic EMBA	Abalone harvest on the west coast of King Island in 2016 (Block 1 and 3) was 52 t of Blacklip Abalone (27.5% TACC) and 3 t of Greenlip Abalone (2% TACC) (Mundy & Jones, 2017) or approximately $2.6M in revenue. Individual catch records were not available in the 2020 status report (Mundy and McAllister 2020) The abalone fishery is open all year round, however the predominant harvest period of Blacklip Abalone is between July and December and for Greenlip Abalone, January to June. On King Island abalone is targeted by two divers (KIRDO, 2018).
Stakeholder concerns	ConocoPhillips Australia is still trying to make contact with the abalone divers on King Island.

Source: DPIPWE (2021), Mundy and McAllister (2020)

Recreational Diving

King Island is known for several wreck sites and the Waterwitch Reef. According to the King Island Council (2016) 2% of all visitors to the island undertake diving or snorkelling activities. The west coast of King Island, including Waterwitch Reef, is situated within the seismic EMBA of the SPL isopleth 145 dB re 1µPa (Figure 4-54).

Existing Pressures and Sensitivities

The DoEE (2016) states that the commercial dive fishery is conducted in a manner that does not lead to overfishing and that stocks are not currently overfished. However, the Tasmania Northern Zone Abalone Fishery is classified as a depleting stock (FRDC, 2018l).

Whilst Abalone Viral Ganglioneuritis (AVG) a viral disease that affects the nervous system of abalone. is not currently an issue in Tasmanian waters an outbreak of AVG in could have a major impact on the economy and on recreational opportunities (DPIPWE, 2021).

4.8.5.2. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from each relevant aspect to recreational and commercial divers have been evaluated in the tables below for each aspect; having had regard to the legislative and other controls (Section 4.8.1.5).

Table 4-107: Predicted impact levels – Emissions – Underwater Sound (Impulsive)

Emissions – Underwater Sound (Impulsive)	Consequence
<u>*Changes to the functions, interests or activities of other users*</u> Commercial and recreational divers may operate within the Seismic sound – Commercial and recreational divers EMBA (which is the Operational Area + 45 km). The EMBA overlaps part of the Victorian coast coastline and King Island, which supports commercial diving for abalone. The abalone fishery is open all year round, however the predominant harvest period of Blacklip Abalone is between July and December and for Greenlip Abalone, January to June. by diving (Mundy & Jones, 2017). On King Island abalone is targeted by only two divers (KIRDO, 2018). The closest abalone area to the Sequoia MSS area is the Waterwitch Reef Abalone Research Area located ~20.5 km from the nearest acquisition line and ~19.5 km from the nearest Operational Area boundary. Diving is generally prohibited within this area as it used to compare fished and unfished sites. However, it is the closest area to the Operational Area where commercial diving may occur. Studies undertaken on low frequency (100 – 600 Hz) underwater sounds to divers by the US Department of Navy identified received sound levels below 160 dB re 1 µPa (SPL) was not expected to cause physiological damage to a diver and concluded that received SPLs of 157 dB re 1 µPa did not produce physiological damage in humans. An aversion reaction, subjectively reported as "very severe" by 2% of divers, was documented at 148 dB re 1 µPa (SPL). On this basis, the threshold was scaled back by 3 dB (a 50% reduction in signal strength) to provide a suitable margin of safety against psychological aversion for divers (US Department of Navy, 2001). Interim conservative and protective guidance for the operation of low frequency sound sources in the presence of recreational or commercial divers is recommended not to exceed a received level of 145 dB re 1 µPa (SPL) (US Department of Navy, 2001). Parvin *et al*. (2005) also provides recommended guidance on received SPLs to divers for the frequency band 500-2500 Hz of 145 dB re 1 µPa. There are no regulations in Australia that prescribe exclusion zones for diving around an operating seismic vessel, however there is international guidance by the Diving Medical Advisory Committee (DMAC). DMAC (2011) issued guidance on the proximity of diving operations from seismic survey operations. This guidance recommends that where diving and seismic activity occurs within 10 km, a joint risk assessment should be conducted between both parties and a simultaneous operations plan developed. Acoustic modelling undertaken by for the Sequoia MSS (JASCO, 2019) showed the maximum distance at which the SPL 145 dB re 1µPa threshold occurred from the Operational Area was modelled at 41.9 km (Site 2). As a conservative approach a 45 km boundary was used to assess the EMBA. However, individual modelling sites within the JASCO (2019) report shows the SPL 145 dB re 1µPa threshold occurs offshore from King Island (Figure 1 1). Modelling showed that the array directionality and frequency content coupled with the bathymetry had a considerable effect on propagation at longer	Moderate (3)

distances. This resulted in generally larger lobes of sound energy extending into the deeper waters to the west of the Operational Area. Modelling showed that within shallow waters very low energy frequencies of the seismic source do not propagate as they would in deeper water. Whilst the 145 dB re 1µPa (SPL) sound threshold for divers overlaps the Waterwitch Reef Abalone Research Area this will only occur when the source is on the two or possibly three most eastern lines and over a distance of ~12 km. Assuming the vessel is travelling at a speed of 4 knots (7.4 km/hr) this results in the diver threshold being exceeded at the Waterwitch Reef Abalone Research Area for a period of ~1 hour 36 minutes per line (maximum three lines). Existing Environment section details fisheries that use commercial divers within the sound EMBA. Of the three invertebrate species taken in the commercial fishery two have recorded no catch in the latest status report (DPIPWE, 2021). KIRDO (2018) also reports that the abalone fishery on King Island is open all year round, with the predominant harvest period of Blacklip Abalone between July and December and Greenlip Abalone, January to June but only targeted by two commercial divers. The Operational Area closest distance to the Victorian coast is 26 km and the closest sail line 37 km. Therefore, the sound threshold level for divers of SPL 145 dB re 1µPa is not expected to reach the Victorian coast due to the propagation of LF sound in shallow waters as described previously. For recreational diving activity close to the shore, the seismic acoustic pulse may be heard, particularly if the weather and sea is calm and the survey vessel is travelling in the eastern areas of the Operational Area. However, given the sound attenuation described previously, it is also not expected that any hearing impact for recreational shore divers will occur. The extent of the area of impact is predicted to be on the most western coastal areas of King Island within a short period (>2 hours for three lines) over the duration of the activity (between August and October) on commercial diving activities. The severity is assessed as **Moderate (3)** based on: • The predicted impact is localised to a small area for a period of >2hours (maximum 3 lines) over the scheduled survey period • Commercial fishers are not financially disadvantage if they cannot operate in the area due to the survey • The presence and duration of the survey will be well known through Marine Notices and stakeholder consultation • Injury to recreational and commercial divers.	

4.8.6. Comparison of Predicted Impact with Defined Acceptable Levels

Table 4-108: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Other Marine UsersTable 4-108 compares the predicted impact levels for other marine users against the acceptable levels.

Table 4-108: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Other Marine Users

Defined Acceptable Levels		Predicted Impact Level	Is the predicted impact below the defined acceptable level?
Factor	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Not relevant.	Yes
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage.	There is high confidence in the prediction of impacts to other marine users.	Yes

<table>
<tr><th colspan="2">Defined Acceptable Levels</th><th colspan="2" rowspan="2">Predicted Impact Level</th><th rowspan="2">Is the predicted impact below the defined acceptable level?</th></tr>
<tr><th>Factor</th><th>Level</th></tr>
<tr><td rowspan="2">Principles of ESD</td><td>Application of the precautionary principle in the presence of scientific uncertainty.</td><td colspan="2" rowspan="2">Not relevant.</td><td rowspan="2">Yes</td></tr>
<tr><td>EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.</td></tr>
<tr><td>Biological</td><td colspan="4">Not relevant.</td></tr>
<tr><td>Ecological</td><td colspan="4">Not relevant.</td></tr>
<tr><td>Economic</td><td>No interference with others to an extent greater than is necessary for the execution of the Sequoia MSS.</td><td colspan="2">Changes are temporary and have been lowered by following the consultation process described in Section 3</td><td>Yes</td></tr>
<tr><td>ConocoPhillips Australia Policies</td><td>All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.</td><td colspan="2">CM 1 - the fisheries and community liaison programme include notifications for other marine users.
CM 11 - the sail line plan ensures the activity is clearly scoped and bounded.</td><td>Yes</td></tr>
<tr><td rowspan="4">ConocoPhillips Australia Policies</td><td rowspan="4">Environmental impacts and risks are consistent with environmental policies such that residual environmental impacts will be below a rating of Major (4).</td><td>Commercial Shipping</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Defence Activities</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Offshore Petroleum Titleholders</td><td>Minor (2)</td><td>Yes</td></tr>
<tr><td>Recreational & Commercial Diving</td><td>Moderate (3)</td><td>Yes</td></tr>
<tr><td>Relevant Persons</td><td>Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons.

The views of public have been considered in the preparation of the EP.</td><td colspan="2">Claims and objections relevant to other marine users have been considered in Section 3

No public comments were made in relation to other marine users.</td><td>Yes</td></tr>
<tr><td>International Standards</td><td>Relevant international, national, and industry standards have been considered and where relevant applied in the EP.</td><td colspan="2">ConocoPhillips Australia will endeavour to develop a SIMOPS plan to manage interactions with abalone divers that is consistent with the DMAC guidelines.</td><td>Yes</td></tr>
<tr><td colspan="5">Acceptability Summary</td></tr>
</table>

Defined Acceptable Levels		Predicted Impact Level	Is the predicted impact below the defined acceptable level?
Factor	Level		

Following completion of the impact assessment process, the environmental impacts to other marine arising from the identified aspects are acceptable because:

- Adherence to shipping regulations are well understood (i.e. Navigation Act 2012, AMSA orders. Appropriate qualifications, notice to mariners, navigational lighting and shapes)
- Required shipping deviations would be minor and thus have negligible impact on travel times or fuel use
- Pre survey consultation to ensure all other users are informed of activities (commercial fishers, fishery authorities VFA/DPIPWE, Dept. of Defense, AHO)
- Sound impacts of commercial divers well understood and will be managed (CM 1)

4.8.7. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Receptor	• Other marine users continue to use the marine environment; and
Impact	• Impacts are a limited to interference to no greater extent than is necessary to meet survey objectives.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 4-109 which assesses whether the control measures for other marine users are effective to meet the EPO.

Table 4-109: Control Measure Effectiveness – Other Marine Users

Measure	CM 11 - Sail line plan
Assessment of Effectiveness	This control measure is directly relevant to the management of the relevant environmental aspect. It ensures that the activity accepted by NOPSEMA is complied with. It includes clear limits on the activity areas and seismic sound source size that underpin the basis of the impact assessment.
Is the EPO achieved?	Partially
Residual impacts requiring additional management	The sail line plan needs to be communicated.
Next Measure	CM 1 – Fisheries and community liaison program
Assessment of Effectiveness	The liaison program includes a suite of measures to ensure that the outcomes of the NOPSEMA assessment are communicated to community groups and that during the activity relevant persons are continually informed about the progress and changes to Sequoia MSS in close to real-time.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

5. Unplanned Aspects

5.1. Loss of Materials or Waste Overboard

5.1.1. Scoping the Assessment

5.1.1.1. Cause and Effect Pathway

Loss of Materials and Waste Overboard may result from:

- Seismic survey – Streamers and survey vessel
- Support activities - Vessel activities.

The Sequoia MSS will use a seismic vessel, and up to three support vessels. Up to three vessel/s will be present in the Operational Area for the whole survey; with likely one supply vessel that will transit between the Operational Area and the port. Vessels transiting to and from the Operational Area are not included in the scope of this EP and operate under the *Navigation Act 2012*.

Small quantities of hazardous and non-hazardous materials are used during routine vessel operations and maintenance, and consequently result in waste generation requiring handled and storage on the vessel.

The Sequoia MSS has procedures in place to ensure solid and liquid hazardous and non-hazardous wastes are appropriately handled and stored onboard. Waste will be offloaded from the survey vessel to the support vessel, for safe disposal onshore via port facilities at a licensed facility. The handling and storage of materials and waste has the potential to result in accidental overboard discharge of materials or wastes where procedures have not been followed, human error or rough seas are experienced, resulting in items rolling off or being blown off the deck into the marine environment. Such losses of materials and wastes overboard can have subsequent impacts to marine fauna and other marine users (Section 4.1 to 4.8).

The following non-hazardous wastes are expected to be generated by vessels taking part in the Sequoia MSS, and have the potential to be accidentally dropped or disposed overboard due to overfull bins, crane operator error or improper storage or handling:

- Paper and cardboard
- Wooden pallets
- Scrap steel, metal and aluminium
- Glass
- Foam (e.g. ear plugs)
- Plastics (e.g. hard hats).

The following hazardous materials (defined as a substance or object that exhibits hazardous characteristics, is no longer fit for its intended use and requires disposal, and as outlined in Annex III to the Basel Convention, may be toxic, flammable, explosive and poisonous) and wastes are expected to be generated through the use of consumable products, and may be accidentally dropped or lost overboard as a result of leaks, overfilling of tanks or emergency disconnection of hoses:

- Hydrocarbon-contaminated materials (e.g., oily rags, pipe dope, oil filters)
- Batteries, empty paint cans, aerosol cans and fluorescent tubes
- Personal protective equipment (PPE)

Small volumes of miscellaneous chemicals (less than 1000 L).

Larger dropped material or objects (and that may contain hazardous or non-hazardous materials) may also be lost to the sea through accidents (e.g. crane operation) include:

- Streamers
- Sea containers
- Towed equipment (e.g. streamers, acoustic sources, paravanes for streamer steering, and source signature recording hydrophone)
- Entire skip bins/crates.

5.1.1.2. Defining the Impacts

Table 5-1 identifies the impacts and receptors that have the potential to be impacted by an losses of materials and wastes overboard as a result of the Sequoia MSS. Receptors and impacts marked 'X' are subject to risk that are predicted to have a consequence considered as less than Negligible (1) / or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further.

Table 5-1: Aspect and Impacts – Loss of Materials or Waste Overboard

Impacts	Ecological					Social	
	Benthic Assemblage	Birds	Fish	Marine mammals	Marine reptiles	Commercial Fisheries	Other Marine Users
Injury/mortality to fauna	X	✓	✓	✓	✓	X	X
Change in habitat	✓	X	X	X	X	X	X
Changes to the functions, interests or activities of other users	X	X	X	X	X	✓	✓

5.1.1.3. Defining the EMBA

Table 5-2 describes how the EMBA has been defined for the receptors and impacts that have the potential to be impacted by loss of materials and wastes overboard (Table 5-1).

Table 5-2: EMBA for Loss of Materials or Waste Overboard

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Loss of materials and wastes overboard	Operational Area	Extent of EMBA is limited to boundary of the petroleum activity (Operational Area).	Direct impact bound to within defined boundaries of petroleum activity.	Operational Area

5.1.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups of fish depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

The values, sensitivities and existing pressures of the relevant receptors (receptor groups identified in Table 5-1) in the Operational Area have been described in the following sections:

- Fish (Section 4.3)
- Birds (Section 4.4)
- Marine Mammals (Section 4.5)
- Marine Reptiles (Section 4.6)
- Commercial Fisheries (Section 4.7)
- Other Marine Users (Section 4.8)

The Operational Area intersects with BIAs for:

- White Shark – distribution
- Blue Whale – foraging
- Antipodean Albatross – known foraging
- Wandering Albatross – known foraging
- Buller's Albatross Pacific – known foraging
- Shy Albatross – likely foraging
- Campbell Albatross – known foraging
- Black-browed Albatross – known foraging
- Indian Yellow-nosed Albatross – known foraging
- Wedge-tailed Shearwater – likely foraging (August – May)
- Short-tailed Shearwater – known foraging (September – May)
- White-faced Storm Petrel – known foraging
- Common Diving Petrel – known foraging (all year)

There are no BIAs identified for marine reptiles within the Operational Area.

The Operational Area intersects the Multiple Use Zone (IUCN VI) of the Zeehan Marine Park.

The Zeehan AMP has been identified as an important migration area for Blue and Humpback Whales (DNP, 2013). Further description about the general environment and ecosystem function of the South-east Marine Region is provided in Appendix H.

5.1.1.5. Legislative Requirements

Table 5-3 identifies the minimum legislative and other requirements that are relevant to Loss of Materials or Waste. Legislative and other requirements specific to relevant receptors are described in receptor sections (Section 4). EPBC management plans that have waste or marine debris identified as a key threat are included in Table 5-3.

The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 5-3: Other Requirements for Loss of Materials or Waste Overboard

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS

Legislation	*Navigation Act 2012*	Regulates navigation and shipping including Safety of Life at Sea (SOLAS), including specific requirements for navigational lighting. Although the Act does not apply to the operation of petroleum facilities, it may apply to some support vessels.	Adoption of control measures refer to Environmental Performance section in Appendix A)
Legislation	*Protection of the Sea (Prevention of Pollution from Ships) Act 1983* • Part III (Prevention of pollution by noxious substances) • Part IIIA (Prevention of pollution by packaged harmful substances) • Part IIIC (Prevention of pollution by garbage)	Regulates ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. It requires that ships >400 gross tonnes have pollution emergency plans. Several MO are enacted under this Act relating to offshore petroleum activities, including: • MO 91: Marine Pollution Prevention – Oil • MO 93: Marine Pollution Prevention – Noxious liquid substances • MO 94: Marine Pollution Prevention – Packaged harmful substances • MO 95: Marine Pollution Prevention – Garbage • MO 96: Marine Pollution Prevention – Sewage • MO 97: Marine Pollution Prevention – Air Pollution • MO 98: Marine Pollution Prevention – Anti-fouling Systems. The survey vessel (and support vessels if >400 gross tonnes) will adhere to the relevant MOs by having a SMPEP, Oil Record Book and Garbage Management Plan in place and implemented, along with international pollution prevention certificates verifying compliance with oil, air pollution and sewage measures.	
Legislation	AMSA Marine Orders Part 94 (Marine pollution prevention – packaged harmful substances) 2014	Marine order 94 sets out the requirements for preventing harmful substances carried by regulated Australian vessels, domestic commercial vessels and Australian recreation vessels from entering the marine environment, including: • Management of harmful substances in packaged • Form washing substances overboard • Notifying and reporting an incident.	
Legislation	AMSA Marine Orders Part 95 (Marine pollution prevention – garbage) 2018	Marine order 95 sets out the requirements for: • Management of cargo residues • Discharge of animal carcasses • Garbage management plans • Garbage record books.	
Guideline	Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Marine Life (DoEE, 2018)	Details harmful marine debris impacts on a range of marine life, including protected species of birds (Section 4.4), sharks (Section 4.3), turtles (Section 4.6) and marine mammals (Section 4.5). DoEE (2018) defines harmful marine debris to include all plastics and other types of debris from domestic or international sources that may cause harm to vertebrate marine wildlife. This includes land	

		sourced plastic garbage (e.g. bags, bottles, ropes, fibreglass, piping, insulation, paints and adhesives), derelict fishing gear from recreational and commercial fishing activities and ship-sourced, solid nonbiodegradable floating materials lost or disposed of at sea.	
EPBC Management Plans	National Recovery Plan for Threatened Albatross and Giant Petrels 2011-2016 (DSEWPC, 2011)	Identify marine pollution is a threat. No explicit relevant objectives or management actions.	
EPBC Management Plans	Draft Wildlife Conservation Plan for Seabirds (CoA 2019)	Identifies pollution, including marine debris as a threat. Objective 2: Seabirds and their habitats are protected and managed in Australia. No explicit relevant objectives or management actions.	
EPBC Management Plans	Conservation advice *Rhincodon typus* (Whale Shark) (TSSC 2015d)	Identified marine debris as a threat. No explicit relevant objectives or management actions.	
EPBC Management Plans	Conservation Advice *Megaptera novaeangliae* Humpback Whale (TSSC 2015c)	Identifies entanglement from marine debris as a threat. No explicit relevant objectives or management actions.	
EPBC Management Plans	Recovery plan for marine turtles in Australia (DoEE 2017a)	A3. Reduce the impacts from marine debris: Support the implementation of the EPBC Act Threat Abatement Plan for the impacts of marine debris on vertebrate marine life.	
EPBC Management Plans	Other Recovery Plans: • White Shark • Orange-bellied Parrot	Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community. Marine debris not identified as a threat to White Shark and Orange-bellied Parrot.	
EPBC Management Plans	Other Conservation Advices: • Hooded Plovers • Curlew Sandpiper • Eastern Curlew • Red Knot • Humpback Whales • Sei Whale • Fin Whale	Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a newly listed species or ecological community. Marine debris not identified as a threat to Curlew Sandpiper, Eastern Curlew, Red Knot, Sei Whale and Fin Whale.	
EPBC Management Plans	South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (DNP, 2013)	Identifies marine debris as a threat to the AMP network.	

5.1.2. Risk Assessment

5.1.2.1. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from losses of materials and wastes overboard, marine benthic assemblages, fauna and users have been evaluated in the tables below for each relevant receptor; with regard to the legislative and other controls (Section 5.1.1.5).

Table 5-4: Predicted Impact Levels – Marine Fauna

Losses of materials and wastes overboard	Risk Level
Injury/mortality to marine fauna An unplanned discharge of solid waste may impact marine fauna through ingestion and entanglement of waste. Marine fauna including cetaceans, turtles and seabirds 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). Plastics have been implicated in the deaths of a number of marine species including marine mammals and turtles, due to ingestion. Turtles and seabirds in particular are often subject to such impacts, with entanglement being a relatively common occurrence and plastic waste being mistaken as food (i.e. plastic bags as jellyfish). It is recognised that 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, cited in DoEE 2018). During Sequoia MSS, material or waste generated lost overboard creating a risk of ingestion or entanglement for marine fauna is expected to be largely associated with accommodation facilities (i.e. food packaging), with very limited amounts of wastes/materials posing high risk of entanglement (i.e. rope, netting, packaging straps). Given the limited duration, number and size of vessels involved in the petroleum activity, and that there is no bulk transfer of wastes or chemicals at sea anticipated, the opportunity for loss of materials or wastes is reduced. Unplanned seabed disturbance from dropped objects are most likely to be from small handheld tools, chains, anchors, pipes and chemical containers (<5 m^2). Seabed disturbance resulting from these dropped objects is likely to be very localised and may result in a change in habitat through localised sedimentation and possible permanent modification of the seabed. It is more unlikely that larger dropped objects such as bins occur. However, in the event larger objects are lost overboard and not retrievable (e.g. by crane or ROV), these items may permanently disturbance to small areas of seabed (up to 5 m^2), resulting in localised loss of benthic assemblages and in turn impacting benthic fauna in the immediate vicinity. Seabed substrates can rapidly recover from temporary and localised impacts. The benthic habitats (further described in Appendix H) in the Operational Area are broadly similar to those elsewhere in the region (e.g., extensive sandy seabed), so impacts to small and very localised areas of seabed are not expected to result in the long-term loss of benthic habitat or species diversity or abundance. Where a dropped object cannot be retrieved it is likely that the object will be colonised and will therefore offset any loss of local benthic habitat. Note that potential for streamers sinking to the seafloor is not considered a credible risk due it being commonplace for streamers to have recovery units, which prevent streamers from sinking. Hazardous materials released to the sea cause pollution and contamination, with either direct or indirect effects on marine organisms. Small accidental releases associated with equipment fail and has been further discussed in Section 5.4 – MDO release. Solid hazardous materials, such as paint cans containing paint residue, batteries and so forth, would settle on the seabed if dropped overboard. Over time, this may result in the leaching of hazardous materials to the seabed, which could result in the adjacent substrate becoming toxic and unsuitable for colonisation by benthic fauna. The benthic habitats of the Operational Area are broadly similar to those	Low

elsewhere in the region (e.g., extensive sandy seabed), so impacts therefore very localised areas of seabed are not expected to not result in the long-term loss of benthic habitat or species diversity or abundance. Release of solid hazardous waste are not expected to impact shorebirds, turtles or whales due to fauna behaviours and limited interaction with benthic habitat (i.e. migrate through, flying over, water column feeding).
 	
The extent of the area of impact is predicted to immediately adjacent to the vessels and streamers (non-buoyant releases) operating within the Operational Area, to further afield (buoyant releases), due to local currents and winds. The consequence of losses of materials and wastes overboard causing injury / mortality to individual fauna has been assessed as **Minor** (2), based on:
 	
• Materials or waste accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement.
• The Recovery Plans for species identified as present in the Operational Area identify marine pollution, entanglement or ingestion as a key threat including the following:
  o National Recovery Plan for Threatened Albatross and Giant Petrels 2011-2016 (DSEWPC, 2011 identify marine pollution is a threat, however no habitat critical to the survival overlap Operational Area.
  o Conservation Advice for Hooded Plovers (DoE, 2014) identifies ingestion of marine debris as a threat that requires reducing inshore debris.
  o Conservation Advice for Humpback Whales (TSSC, 2015c) and the Conservation Management Plan for the Blue Whale and Southern Right Whale (DoE, 2015; DSEWPaC, 2012) identify marine debris as a threat, but there are no conservation management actions identified.
  o The Recovery Plan for Marine Turtles in Australia (CoA, 2017) identified marine debris as a threat however no BIAs or critical habitat to the survival of the species were identified.
• The magnitude of potential risk associated with this petroleum activity is considered to result in short-term and localized impacts to marine fauna at an individual level; and given the Operational Area represents a small portion of the total BIA for species identified, no population level impact is expected.
• In addition, species identified with BIA overlapping the EMBA are expected to be largely transitory or short term in nature. BIAs for the following intersect with the Operational Area:
  o EPBC Listed White Shark Breeding, foraging and distribution BIA and presence within the Operational Area is expected to be transitory in nature, no overlap with habitats critical to survival and the Recovery Plan for the White Shark (CoA, 2013) does not identify waste or marine debris as a threat.
  o EPBC Act listed Migratory seabird BIA including Antipodean Albatross (0.11% overlap Foraging), Black-browed Albatross (0.24% overlap Foraging), Buller's albatross (0.6% overlap Foraging), Campbell Albatross (0.24% overlap Foraging), Shy albatross (0.34% overlap Foraging), Wandering Albatross (0.39% overlap Foraging) and their presence within the Operational Area is expected to be short-term in nature, no overlap with habitats critical to survival (DSEWPC, 2011) and any risk would be limited to individual level impacts.
  o EPBC Act listed non migratory (resident) seabird BIA including White-faced Storm-Petrel Foraging BIA [0.07% overlap] and presence within the Operational Area is expected to be short-term in nature and limited to individual level impacts.
  o EPBC listed migratory Pygmy Blue Whale foraging BIA and overlaps with a portion of the high use foraging area (5.76% overlap Foraging) and known foraging areas (1.08% overlap Foraging). However, Pygmy Blue Whales have been reported by Gill (2020) to feed predominantly between January to April with seasonal variation. Whereby whales have been sighted during November and December in eastern areas of the Bonney Upwelling.
 	
Vessel management systems address dropped object, waste storage and chemical handling and storage ((Environmental Performance section of Appendix A). These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned release of waste is very low if an incident occurred, it would be restricted to individual fauna and unlikely to impede the recovery of a protected species.	

Table 5-5: Predicted Impact Levels – Commercial Fisheries and Other Users

Losses of materials and wastes overboard	Risk Level
Changes to the functions, interests or activities of other users In the event a buoyant object is accidentally released and cannot be recovered by a vessel, the buoyant object may present a navigation or entanglement hazard to commercial fishers and other marine users in the region. Further the buoyant objects may become non-buoyant overtime and sink to the seabed, where it may present a snagging hazard on the seafloor for commercial trawling activities and create potential risk to vessel safety and damage fishing equipment or may require commercial fishers to avoid a highly localised area for a period of time to avoid interaction. Shipments to and from the survey vessel will be stored in 10ft mini-containers. These will be lifted onboard the seismic vessel, emptied and returned to supply vessel. All containers will be properly 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 large pieces of equipment such as streamers could result in entanglement with other marine user's infrastructure or equipment (i.e. fishing gear). Historically there have been reports that seismic streamers have become entangled with a production platform; however, there are no oil and gas infrastructure in the vicinity of the Operational Area. However, the presence of streamers recovery units, reduced streamer recovery time and hence other marine users exposure to this risk. The extent of the area of impact is predicted to be immediately adjacent to the vessels, with the duration of this risk being limited to the time taken to recover lost object/material or to notify relevant authorities (with risk limited to duration of petroleum activity). The consequence of loss of materials or waste overboard resulting in a change to the functions, interests or activities of commercial fishers has been assessed as **Minor (2),** based on: • Buoyant or non-buoyant dropped objects that may pose a threat to commercial fisheries and other users' infrastructure are limited to larger objects (i.e. seismic streamers, containers). Such risk is considered unlikely to present a significant hazard based on limited exposure and clear communication with other marine users. • There is some commercial shipping through the Operational Area, but otherwise use is relatively limited by other marine users. Any impacts would be restricted to individual marine users. • Operational Area represents a small portion of the total available fishing area available to commercial fishers and is expected to only affect individual fishers rather than entire fleet and fishing season. Vessel procedures are in place to reduce risk of losing materials and waste overboard and are well understood and well-practiced in marine industries. There will be a maximum of three smaller vessels involved in the petroleum activity as such has limited generation of waste. The likelihood is assessed as **Remote**, given that the consequence of a lost material is not expected to affect an entire fishery fleet or season and that vessels will have appropriate management systems in place to reduce opportunity material/waste to be lost due to non-human factors (i.e. bad weather).	Low

5.1.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 5-6 compares the predicted impact levels for loss of materials or waste overboard against the acceptable levels.

Table 5-6: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Loss of Materials or Waste Overboard

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage.	Not relevant.	Yes

Defined Acceptable Levels		Predicted Risk Level		Is the predicted impact below the defined acceptable level?
Source	Level			
	Environmental impacts and risks have a worst-case consequence ranking less than Major (4).			
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction.		Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	Marine pollution is a threat identified in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice for humpback whales (TSSC, 2015c) and the Conservation Management Plan for the Blue Whale (DoE, 2015d) identify marine debris as a threat, but there are no conservation management actions to counter this. The conservation advice for hooded plovers (DoE, 2014) identifies ingestion of marine debris as a threat that requires reducing inshore debris. Objective one of the Threat Abatement Plan for the Impacts of Marine Debris on Vertebrate Wildlife of Australia's coasts and oceans (DoEE, 2018), which is to contribute to the long-term prevention of the incidence of harmful marine debris.		Yes
Biological	No materials or waste lost overboard.	No materials or waste lost overboard.		Yes
Ecological				
Economic				
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM 7 - the marine assurance system ensures that the vessels comply with maritime law. CM 12 – marine assurance is monitored by ConocoPhillips representative on board the vessel.		Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental risks will be at or below significant.	Likelihood	Remote	
		Consequence	Minor	
		Risk	Low	Yes

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	There were no objections or claims raised relevant to this risk. No public comments were made in relation to risk.	Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 5-3 Garbage Management Plans are a requirement under maritime law.	Yes
Acceptability Summary			
Following completion of the risk assessment process, the environmental risk arising from the loss of materials or wastes overboard are acceptable because: • The risks associated with loss of materials or waste is well understood. • The good practice controls are well defined, well-practiced, and known to be effective. • Level of risk is low.			

5.1.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Risk	• There is no materials or waste lost overboard.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 5-7 which assesses whether the control measures for loss of materials or waste overboard are effective to meet the EPO.

Table 5-7: Control Measure Effectiveness – Loss of Materials or Waste Overboard

Measures	CM 7 - Marine assurance system and CM 12 – company representatives
Assessment of Effectiveness	ConocoPhillips will contract vessels to carry out the Sequoia MSS. It is the contractor's responsibility to comply with all maritime laws and the requirements applied through the EP. The marine assurance system is how ConocoPhillips ensures that its contracted vessels comply with these laws. These control measures are considered effective because it includes pre-acceptance audits and is monitored daily by ConocoPhillips representatives on board the vessel.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None.

5.2. Vessel Collision with Marine Fauna

5.2.1. Scoping the Assessment

5.2.1.1. Cause and Effect Pathway

Vessel collision with marine fauna may result from:

- Seismic survey - Streamers
- Support activities - Vessel activities.

The Sequoia MSS will use a seismic vessel, and up to three support vessels. Up to three vessels will be present in the Operational Area for the whole survey; with likely one supply vessel that will transit between the Operational Area and the port. Vessels transiting to and from the Operational Area are not included in the scope of this EP and operate under the Navigation Act 2012.

The physical presence of vessels within the marine environment has the potential to interact with marine fauna through such means as a collision. Ship strike can result in impact trauma or propeller wounds, which may cause injury or mortality to marine fauna. Collisions between larger vessels with reduced manoeuvrability and large, slow-moving cetaceans occur more frequently where high vessel traffic and cetacean habitat occurs (Whale and Dolphin Conservation Society, 2006).

Loss of large pieces of equipment such as streamers, in theory could result in fauna entanglement. However, during seismic surveys, streamers are towed, resulting in a level of tautness that would not enable entanglement of fauna. Further there have been no reported cases of marine fauna becoming entangled in the streamers in Australian waters. Thus, this cause effect pathway for entanglement of fauna in streamers while being towed has been determined to be not credible. 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. Thus, there is no cause effect pathway for entrapment of turtles in streamer buoys.

If streamers are lost, each streamer will have depth controllers and emergency recovery units, maintaining equipment's buoyancy and enabling location tracking and rapid recovery. Based on use of these devices as industry standard, entanglement of fauna in streamers where lost, has been determined to not be credible. Refer to Section 5.1 for assessment of risks of fauna entanglement associated with loss of materials and waste.

5.2.1.2. Defining the Impacts

Table 5-8 identifies the impacts and receptors that have the potential to be impacted by an unplanned MOD release as a result of the Sequoia MSS. Receptors and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible (1) / or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further.

Table 5-8: Aspects and Impacts – Vessel Collision with Marine Fauna

Impacts	Invertebrates	Birds	Fish	Marine mammals	Marine reptiles
Injury / mortality to fauna	X	X	✓	✓	✓

5.2.1.3. Defining the EMBA

Table 5-9 describes how the EMBA has been defined for the receptors and impacts that have been identified to be potentially impacted by Vessel collision with marine fauna (Table 5-8).

Table 5-9: EMBA for Vessel Collision with Marine Fauna

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Vessel collision with marine fauna	Operational Area	The risk to marine fauna is posed by the physical presence of a moving vessels.	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017) identified relevant risks of vessel strike.	Operational Area

5.2.1.4. Existing Environment

The description of existing environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the species/sub-groups of fish depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

Greater detail is included for threatened species.

The values, sensitivities and existing pressures of the relevant receptors in the Operational Area have been described in Sections 4.3 (Fish), 4.4 (Birds), 4.5 (Marine Mammals) and 4.6 (Reptiles).

The Operational Area intersects with BIAs for:

- White Shark foraging, breeding and distribution
- Blue Whale foraging
- SRW known core range.

There are no BIAs identified for marine reptiles within the Operational Area.

The Operational Area intersects the Multiple Use Zone (IUCN VI) of the Zeehan Marine Park.

The Zeehan AMP has been identified as an important migration area for Blue and Humpback Whales (DNP, 2013).

5.2.1.5. Legislative Requirements

Table 5-10 identifies the minimum legislative and other requirements that are relevant to an unplanned MDO release. Legislative and other requirements specific to relevant receptors are described in receptor sections (Section 4). Further description about the general environment and ecosystem function of the South-east Marine Region is provided in Appendix H.

Table 5-10: Other Requirements for Vessel Collision with Marine Fauna

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislation	EPBC Regulations 2000 Part 8 Division 8.1 Interacting with cetaceans	Provides for the protection and conservation of cetaceans, including: • Exclusion and cautions zones around cetaceans and calves	The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
		• Speed restrictions • Avoidance actions • Posting a lookout • Aircraft heights.	Adoption of control measures (refer to Environmental Performance section in Appendix A)
Legislation	EPBC Act Part 13 Division 3 – Whales and other cetaceans	Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected within the Australian Whale Sanctuary, which includes all Commonwealth waters from the state waters limit out to the boundary of the Exclusive Economic Zone. Section 229 of the EPBC Act makes it an offence to kill, injure or interfere with a cetacean within the Australia Whale Sanctuary. All states and territories also protect whales and dolphins within their waters.	
Guidelines	National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (DoEE, 2017b)	Objectives is to acquire data, determine risks of vessel strike, and identify mitigation measures, with the target audience being government agencies.	
EPBC Management Plans	Conservation Management Plan for the Blue Whale (DoE 2015b)	Identifies vessel collision as a key threat. No explicit relevant objectives. Management action A5: addressing vessel collisions: • Develop a national ship strike strategy that quantifies vessel movements within the distribution ranges of southern right whales and outlines appropriate mitigation measures that reduce impacts from vessel collisions.	
EPBC Management Plans	Conservation Management Plan for the Southern Right Whale 2011–2021 (DSEWPaC 2012)	Identifies vessel collision as a key threat. 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. Management action A5: addressing vessel collisions: • Develop a national ship strike strategy that quantifies vessel movements within the distribution ranges of southern right whales and outlines appropriate mitigation measures that reduce impacts from vessel collisions.	
EPBC Management Plans	Conservation Advice for Balaenoptera borealis (Sei Whale) (TSSC 2015f)	Identifies vessel strike as a key threat. No explicit relevant objectives. Management action: Minimising vessel collisions: • Develop a national vessel strike strategy that investigates the risk of vessel strikes on Sei Whales and also identifies potential mitigation measures. • Ensure all vessel strike incidents are reported in the National Vessel Strike Database	
EPBC Management Plans	Conservation Advice for *Balaenoptera physalus*	Identifies vessel collision as a key threat. No explicit relevant objectives. Management action: Minimising vessel collisions:	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
	(Fin Whale) (TSSC 2015b)	• Develop a national vessel strike strategy that investigates the risk of vessel strikes on Sei Whales and also identifies potential mitigation measures. • Ensure all vessel strike incidents are reported in the National Vessel Strike Database	
EPBC Management Plans	Recovery plan for Marine Turtles in Australia (DoEE, 2017a)	Identifies vessel collision as a key threat. No explicit relevant objectives or management actions.	
EPBC Management Plans	Recovery Plans / Conservation Advices for other listed threatened and/or migratory MNES species	Recovery Plans / Conservation Advices for other marine reptile species that may occur in the relevant EMBAs do not identify vessel collision or entanglement with marine fauna as a key threat; or have any explicit relevant objectives or management actions.	

5.2.2. Risk Assessment

5.2.2.1. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from Vessel collision with marine fauna have been evaluated in the tables below for each relevant receptor; having had regard to the legislative and other controls (Section 5.2.1.5).

Table 5-11: Predicted Impacts Levels – Fish

Vessel collision with Marine Fauna	Risk Level
Injury/mortality to marine fauna Studies have found that fauna mortality in the event of a vessel strike is directly linked to vessel speed (Jensen and Silber 2004; Laist et al. 2001) with the most severe injuries caused by vessels travelling faster than 14 knots. Vessel movements within the Operational Area are likely to be conducted in clear waters and at slow speeds (4 knots). However, there is limited data regarding strikes to fish species such as White Sharks, possibly due to lack of collisions being noticed and lack of reporting (Peel et al. 2016) The EPBC PMST lists seven species of fish as threatened that may or are known to occur within the Operational Area EMBA. The Operational Area intersects with a foraging, breeding and distribution BIA for the White Shark (EPBC: Vulnerable). The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPC, 2013) and the National Recovery Plan for the Australian Grayling (DSE, 2008) do not identify vessel collision as a threat. All EPBC PMST listed fish species are highly mobile and expected to have largely transitory presence within the EMBA, therefore, none are expected to be subject to vessel collision. It is expected that most fish (including sharks and rays) will exhibit avoidance behaviour from a sound source if it reaches levels that may cause behavioural or physiological effects, thus the likelihood of getting close enough for a collision is very low. Vessel movements in the Operational Area will be slow (~4.5 knots), and the total number of vessels within the EMBA will be maximum of three vessels. The area of impact is predicted to be limited to the area immediately adjacent to the vessels while the Sequoia MSS is undertaken. The consequence of vessel collision with marine fauna causing injury / mortality to individual fish has been assessed as **Minor** (2), based on: • The Recovery Plans for species identified as present in the Operational Area do not identify vessel collision as a key threat. • The breeding and foraging BIA for the White Shark does not intersect with the Operational Area.	Low

• it is expected that most fish (including sharks and rays) will exhibit avoidance behaviour from a sound source if it reaches levels that may cause behavioural or physiological effects, thus the likelihood of getting close enough for a collision is very low. • Given that the magnitude of potential impacts is considered to result in short-term and localised impacts to fish on an individual level; the Operational Area represents a small portion of the total White Shark BIA; and that vessel movements within the Operational Project Area are expected to be slow and limited. Vessel movements in the Operational Area will be slow, and there are only three number of vessels. The likelihood is assessed as **Remote**, given that the consequence of a strike on a single animal will not greatly affect the overall population and that vessel movements within the Operational Area are expected to be slow and limited.	

Table 5-12: Predicted Impact Levels - Birds

Vessel collision with Marine Fauna	Risk Level
Injury/mortality to marine fauna The risk of vessel collision to birds is only to those species who spend extended periods of time on the water within the Operational Area. According to Carter (2020), the Little Penguin is a species known to spend weeks at a time away at sea feeding and resting in the waves. However, their closest foraging BIA is ~15 km from the Operational Area and it is considered unlikely for the species to be in the vicinity of the vessels. The Little Penguin does not have a threatened species listing or a recovery plan which indicates the population is at a stable status. Vessel movements in the Operational Area will be slow (~4.5 knots), and there are only up to three vessels in the Operational Area. The likelihood is assessed as **Remote**, given that the consequence of a strike on a single animal will not greatly affect the overall population and that vessel movements within the Operational Area are expected to be slow and limited.	Low

Table 5-13: Predicted Impacts Levels – Marine Mammals

Vessel collision with Marine Fauna	Risk Level
Injury/mortality to marine fauna Cetaceans and pinnipeds are naturally inquisitive marine mammals that are often attracted to offshore vessels, and dolphins commonly ‘bow ride’ with offshore vessels. The reaction of whales to the approach of a vessel is quite variable. Some species remain motionless when in the vicinity of a vessel while others are known to be curious and often approach ships that have stopped or are slow moving, although they generally do not approach, and sometimes avoid, faster moving ships (Richardson *et al*., 1995). Collisions between vessels and cetaceans occur more frequently where high vessel traffic and cetacean habitat coincide (WDCS, 2006). There have been recorded instances of cetacean deaths in Australian waters (e.g., a Bryde’s whale in Bass Strait in 1992), though the data indicates this is more likely to be associated with container ships and fast ferries (WDCS, 2006). Some cetacean species, such as Humpback Whales, can detect and change course to avoid a vessel (WDCS, 2006). The Australian National Marine Safety Committee (NMSC) reports that during 2009, there was one report of a vessel collision with an animal (species not defined) (NMSC, 2010). The DoE (2015a) reports that there were two blue whale strandings in the Bonney Upwelling (western Victoria) with suspected ship strike injuries visible. When the vessels are stationary or slow moving, the risk of collision with cetaceans is extremely low, as the vessel sizes and underwater noise ‘footprint’ will alert cetaceans to its presence and thus elicit avoidance. Laist et al (2001) identifies that larger vessels moving in excess of 10 knots may cause fatal or severe injuries to cetaceans with the most severe injuries caused by vessels travelling faster than 14 knots. When the source and support vessels are operating within the Operational Area, they will be travelling typically 4.5 knots (8.3 km/hr) while acquiring seismic data or will be stationery, so the risk associated with fast moving vessels is minimised for this activity. There may be an emergency situation whereby a support vessel is required to increase its speed (e.g., in response to a person overboard).	Low

<table>
<tr><th></th><th></th></tr>
<tr><td>Slow travel speeds combined with the low likelihood of presence of Southern Right Whales, Humpback Whales and Pygmy Blue Whales in and around the Operational Area during the proposed survey period, makes it highly unlikely that vessel strike with threatened whale species will occur. Humpback Whales and Blue Whales have been identified as major conservation values of the Zeehan Marine Park.

The Australian and New Zealand fur-seals are highly agile species that haul themselves onto rocks and oil and gas platform structures (jackets). As such, it is likely that they will be able to avoid seismic streamers (especially with horizontal separation between the streamers being approximately 75 m).

Peel et al (2016) reviewed vessel strike data (2000-2015) for marine species in Australian waters and identified the following:
• Whales including the Humpback, Pygmy Blue, Antarctic Blue, Southern Right, Dwarf Minke, Antarctic Minke, Fin, Bryde’s, Pygmy Right, Sperm, Pygmy Sperm and Pilot species were identified as having interacted with vessels. The Humpback Whale exhibited the highest incidence of interaction followed by the Southern Right Whale, and these species may be present in the waters of the survey area during the survey period.
• Dolphins including the Australian humpback, common bottlenose, Indo-pacific bottlenose and Risso’s dolphin species were also identified as interacting with vessels. The common bottlenose dolphin exhibited the highest incidence of interaction. A number of these species may reside in or pass through the waters of the survey area.
• There were no vessel interaction reports during the period for either the Australian or New Zealand fur- seal. There have been incidents of seals being injured by boat propellers, however all indications are rather than ‘boat strike’ these can be attributed to be the seal interacting/playing with a boat, with a number of experts indicating the incidence of boat strike for seals is very low.

The extent of the area of impact is predicted to be immediately adjacent to the vessels and streamers while the Sequoia MSS is undertaken. The consequence of vessel collision with marine fauna causing injury / mortality to individual marine mammals has been assessed as Minor (1), based on:
• Low numbers of whales have been sighted in the Bass Strait region (Section 4.5), and any presence during the survey is likely individuals transiting.
• The foraging BIA for the Blue Whale intersects with the Operational Area.
• The Operational Area is within a known core range of the SRW
• Slow travel speeds combined with the low likelihood of presence of Southern Right Whales, Humpback Whales and Pygmy Blue Whales in and around the Operational Area during the proposed survey period, makes it highly unlikely that vessel strike with threatened whale species will occur.

Vessel movements in the Operational Area will be slow (~4.5 knots), and there are only up to three vessels in the Operational Area. The likelihood is assessed as Remote, given that the consequence of a strike on a single animal will not greatly affect the overall population and that vessel movements within the Operational Area are expected to be slow and limited.</td><td></td></tr>
</table>

Table 5-14: Predicted Impact Levels – Marine Reptiles

<table>
<tr><th>Vessel collision with Marine Fauna</th><th>Risk Level</th></tr>
<tr><td><u>Injury/mortality to marine fauna</u>

Vessel disturbance is listed as a threat in the Recovery Plan for Marine Turtles of Australia 2017 (DoEE, 2017a). There is limited data regarding strikes to fauna such as turtles, possibly due to lack of collisions being noticed and lack of reporting (Peel et al. 2016). The Green and Loggerhead Turtle exhibited the highest incident of interaction (Peel et al, 2016).

Turtles are most vulnerable to vessel strike whilst resting or returning to the surface to breath. However, turtles have been shown to spend only 3 to 6% of their time at the surface with dive times of between 15 to 60 minutes (Milton and Lutz 2003).

However, Hazel et al. (2007) also states that most turtles cannot be relied upon to avoid vessels travelling faster than 4 km/h. Vessel movements within the Operational Area are likely to be conducted in clear waters and at slow speed (~4.5 knots), therefore turtles are likely to exhibit avoidance behaviour from slow-moving vessels.</td><td>Low</td></tr>
</table>

Three marine turtle species may occur within the Operational Area though no BIAs or habitat critical to the survival of the species were identified. The extent of the area of impact is predicted to be immediately adjacent to the vessels and streamers while the Sequoia MSS is undertaken. The consequence of vessel collision with marine fauna causing injury / mortality to individual marine reptiles has been assessed as **Minor** (1), based on: • The Recovery Plan for Marine Turtles in Australia (DoEE, 2017) identifies vessel disturbance as a key threat • There are no marine turtle important habits or BIAs are located within the Operational Area • Avoidance behaviour due to underwater noise may occur within the Operational Area. Vessel movements in the Operational Area will be slow (~4.5 knots), and there are only up to three vessels in the Operational Area. The likelihood is assessed as **Remote**, given that the consequence of a strike on a single animal will not greatly affect the overall population and that vessel movements within the Operational Area are expected to be slow and limited.	

5.2.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 5-15 compares the predicted impact levels for Marine Reptiles against the acceptable levels.

Table 5-15: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Vessel Collision with Marine Fauna

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Planned activities not expected to result in vessel collision.	Yes
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction.	Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	Vessel collisions (and/or entanglements) are listed as a threat to cetaceans in the: • Conservation Management Plan for the Southern Right Whale (DSEWPC, 2012b); • Conservation Management Plan for the Blue Whale (DoE, 2015a); • Conservation advice for the sei whale (TSSC, 2015b); • Conservation advice for the fin whale (TSSC, 2015c); and • Conservation advice for the humpback whale (TSSC, 2015d).	Yes
Biological		There is a medium residual risk because the behaviour of marine	Yes

Defined Acceptable Levels		Predicted Risk Level		Is the predicted impact below the defined acceptable level?
Source	Level			
Ecological Economic	No death or injury to listed threatened and migratory species resulting from the Sequoia MSS.	mammals cannot be controlled. However, with the control measures adopted, the likelihood of a collision causing death or injury is remote.		
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM4 - the MMOs and passive acoustic monitoring specialists will monitor for marine mammal presence and will follow CM 3, to ensure that the risk of collision with marine fauna is significantly reduced. CM3 - the marine mammal adaptive management procedure.		Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental risks will be at or below significant.	Likelihood	Remote	
		Consequence	Moderate	
		Risk	Medium	Yes
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to vessel collision with marine fauna have been considered in Section 3.4. No public comments were made in relation to vessel collision with marine fauna.		Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 5-10.		Yes

Acceptability Summary
Following completion of the risk assessment process, the environmental risk of collision with marine mammals from the vessel operations is acceptable because: • The low speed of the survey and support vessels, along with the timing of the Sequoia MSS to avoid peak whale migrations for several species, makes it unlikely that vessel collision or entanglement with marine mammals will occur. • Vessel operations will be compliant with all laws relating to cetaceans i.e. EPBC Regulations 2000. • If vessel collision or entanglement does occur to individual animals, it will be reported into the National Ship Strike Database and an investigation into the incident will be conducted with support from a whale expert, with recommendation implemented.

5.2.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Risk	• There is no death or injury to listed threatened and migratory species resulting from vessel strike from the seismic survey.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 5-16 which assesses whether the control measures for vessel collision with marine fauna are effective to meet the EPO.

Table 5-16: Control Measure Effectiveness – Vessel Collision with Marine Fauna

Measures	CM 4 – Marine mammal observers (MMOs) and CM 3 – Marine mammal adaptive management procedure
Assessment of Effectiveness	Dedicated marine mammal observers and an activity-specific procedure for protecting marine mammals mean that avoidance behaviours of both the marine mammal and Sequoia MSS vessels will significantly reduce the risk of vessel collision with marine fauna. These control measures are less effective at night or in low visibility where there is increased reliance on the marine mammal to exhibit avoidance behaviour. The adoption of PAM operators during night-time and low visibility reduce this risk to some extent.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

5.3. Introduction of IMS

5.3.1. Scoping the Assessment

5.3.1.1. Cause and Effect Pathway

Introduction of Invasive Marine Species (IMS) may result from:

- Seismic survey - Streamers
- Support activities - Vessel activities.

The following activities have the potential to result in the introduction of IMS in the Operational Area:

- Discharge of vessel ballast water
- Translocation of foreign species through biofouling on vessel hulls, niches (e.g. thruster tunnels, sea chests) or in-water equipment (e.g. seismic source arrays and streamers).

The Sequoia MSS will use a seismic vessel, and at least two support/chase vessels. Three vessels will be present in the Operational Area for the duration of the survey; with likely one supply vessel that will transit between the Operational Area and the port. Vessels transiting to and from the Operational Area are not included in the scope of this EP and operate under the Navigation Act 2012.

IMS could be transported to the Sequoia MSS Area via:

- Mobilisation of the selected survey vessel to the Operational Area from its previous contract in the North-West Shelf (NWS) in Western Australia
- Transit of locally sourced support vessels between Victorian ports to Operational Area (expected once every two weeks for the survey duration).

If IMS is introduced to the Operational Area by one of these pathways, it is also possible that support vessels conveyances between the Operational Area and the coastal waters could act as a vector for IMS spread from the Operational Area into coastal areas / port environments.

The Department of Agriculture, Water and the Environment (DAWE formerly DAWR, 2018) defines marine pests (referred to in this EP as IMS) as:

- Non-native marine plants or animals that harm Australia’s marine environment, social amenity or industries that use the marine environment, or have the potential to do so if they were to be introduced, established (that is, forming self-sustaining populations) or spread in Australia’s marine environment.

DAWE ensure international vessels arriving in Australian territory comply with International Health Regulations and manage biosecurity risks through pre-arrival reporting, assessment and inspection. For the entire time an international vessel is in Australian waters, it must accurately report information in accordance with Section 193 of the Biosecurity Act 2015 to DAWE, including information on ballast water and biofouling. For commercial vessel, reporting obligations are met once vessel pre-arrival information has been submitted in the Maritime Arrivals Reporting system (MARS). Pre-arrival reporting in MARS ensures that the biosecurity risk of each vessel entering Australian waters is assessed and managed. Where vessel reporting does not meet DAWE‘s standards additional directions or corrective actions will be issued by a biosecurity officer.

Under the Biosecurity Act 2015, all international vessels become subject to biosecurity control on entering Australian territorial seas. Vessels subject to biosecurity control must only enter Australia at ports that have been determined as first points of entry (FPOE) under section 229 of the Biosecurity Act 2015. Conoco Phillips Australia have confirmed that prior to mobilising to the Otway region, the selected survey vessel has:

- Undertaken mandatory pre-arrival reporting using DAWE's Maritime Arrivals Reporting System (MARS)
- Received advice on biosecurity, pratique and berthing conditions from DAWE
- Entered Australia at the designated Port of Dampier in March 2021.

In addition to DAWE's requirements, Australian state and territory governments also have biosecurity requirements.

Ballast Water

DAWR estimates that ballast water is responsible for 30% of all marine pest incursions into Australian waters (DAWR, 2018) and declares that all saltwater from ports or coastal waters outside Australia's territorial seas presents a high risk of introducing foreign marine pests into Australia (DAWE, 2020). DAWR (2018) notes that the movement of vessels and marine infrastructure is the primary pathway for the introduction of IMS.

The survey and support vessels may ballast and de-ballast to improve stability, even out vessel stresses and adjust vessel draft, list and trim, regarding the weight of equipment on board at any time. During the uptake of ballast water from the surrounding environment, it is possible for a vessel to take in water that contains planktonic biota, including holoplankton, gametes, spores and larvae. This biota may then be discharged at the vessel's new location during ballast water exchange. The risk of species introduction is greatest when coastal water is taken up in one location and discharged at another with similar physical and environmental characteristics (MIAL 2020).

DAWE administers the Australian Ballast Water Management Requirements (ABWMR) (DAWE 2020, Version 8), which provide for Australia's commitment to the International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) (IMO 2017). DAWE is the lead agency for the management of ballast water and sediments on international vessels under the Commonwealth Biosecurity Act 2015. All international vessels are required to manage ballast water in accordance with the ABWMR and the Biosecurity (Ballast Water and Sediment) Determination 2017. Australian legislation also extends application of the requirements of the International Convention to domestic vessel activities – which includes a requirement for vessels servicing the offshore resources sector to manage ballast water. In addition to vessels entering Australian waters declaring information regarding the management of ballast water to biosecurity officers using MARS, they are also required to:

- Manage ballast water between Australian ports
- Carry a Ballast Water Management Plan and Ballast Water Management Certificate and maintain ballast water records
- Have installed and use an International Maritime Organisation (IMO)-approved ballast water management system to meet new ballast water discharge standards.

These arrangements prohibit the discharge of high-risk ballast water within Australian territorial seas (within 12 NM of Australian territories) including Australian ports.

During the Sequoia MSS, vessels may be required to undertake ballast water exchange on route to and within the Operational Area. The selected survey vessel is expected to be arriving in to the Otway region from the North-West Shelf.

Biofouling

Biofouling is the accumulation of aquatic microorganisms, algae, plants and animals on vessel hulls and submerged surfaces. More than 250 non-indigenous marine species have established in Australian waters, with research indicating that biofouling has been responsible for more foreign marine introductions than ballast water (DAWE, 2020).

The time a vessel spends in a location (residence time) has an influence on the likelihood of species attachment or uptake at a source. The longer a vessel sits in any one location, the more likely it is to be colonised by biofouling species. The length of time a vessel spends stationary can also impact on the performance of some types of antifouling coatings (MIAL 2020).

Biofouling is managed under the Commonwealth Biosecurity Act 2015, via the National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry (NBMG) (DAFF 2009). These guidelines align with the internationally-agreed 2011 Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species (the IMO Biofouling Guidelines; IMO 2011).

IMS are thought to be one of the most serious anthropogenic threats to global marine biodiversity (Wells 2018). However, successful IMS colonisation requires these three stages (Marine Pest Sectoral Committee 2018):

- Colonisation and establishment of the marine pest on a vector (vessel, equipment or structure) in a donor region (a home port, harbour or coastal project site where a marine pest is established)
- Survival of the settled marine pests on the vector during the voyage from the donor to the recipient region
- Colonisation (for example, by reproduction or dislodgement) of the recipient region by the marine pest, followed by successful establishment of a viable new local population.

The risk of an IMS being able to successfully establish itself will depend on depth, distance from the coast, water movement and latitude. The probability of successful IMS settlement and recruitment will decrease in well-mixed, deep ocean waters away from coastal habitats. An IMS travelling through several latitudes will also have to survive significant temperature and salinity changes. The Australian Government Bureau of Resource Sciences (BRS) established that the relative risk of an IMS 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.

In comparison, the Operational Area is ~15 nm from the Victorian Coast and ~12 nm from King Island.

Within Australia, over 250 exotic marine species have been introduced with most having little impact, but some species have become aggressive pests in certain locations (DoA 2019). The typical habitat of the seven species currently listed on the Marine Pest website (DoA 2021) is shallow marine waters.

ConocoPhillips Australia Marine Risk Management

The ConocoPhillips Global Marine Risk Management Standard (GM-STD-MA-003) requires marine assurance approval for all vessels prior to the commencement of the charter and for the duration of activities performed for ConocoPhillips. The marine vetting and audit process for offshore vessels, details the requirements and procedures that are used to ensure that risks involved in marine activities are effectively managed, consistent with ConocoPhillips's vision for safety, health, environment, reliability and efficiency. These documents are not intended to provide an all-inclusive list of requirements, but rather establish the expectations and processes by which ConocoPhillips can ensure that vessels are fit for purpose, suitable for the nominated scope of works, and comply with and are operated in accordance with applicable local, national and international regulations, industry guidelines, standards and/or contractual arrangements.

ConocoPhillips's vetting process requires contracted vessels to complete the Offshore Vessel Inspection Database (OVID) process. OVID is a web-based inspection tool and database of inspection reports, underpinned by trained and accredited inspectors. Typically, an OVID member company commissions an offshore vessel inspection and an OVID accredited inspector then accesses the vessel particulars from the OVID database along with the appropriate Offshore Vessel Inspection Questionnaire (OVIQ). The inspection covers the vessel's management systems as well as how the vessel operates including ballast water management. The inspection report is then sent to the vessel operator for comment and corrective action and uploaded to the OVID database.

In line with the requirements to ensure applicable local, national and international regulations, industry guidelines, standards and/or contractual arrangements for the Sequoia MSS are met, ConocoPhillips Australia provided a list of additional requirements for assessment as part of the OVID process including assessment of:

- International ballast water management certificates including methods used
- Ballast water (and sediments) management plans
- Ballast water record keeping
- Recent IMS inspections
- Biofouling record books
- International anti-fouling system certificates and details on type of systems installed

An IMS Risk Assessment process must be conducted on all vessels and immersible equipment, prior to initial mobilisation into the operational area.

The purpose of this process is to:

- validate compliance with regulatory biosecurity requirements (Commonwealth and State)
- quantify the potential IMS risk profile of vessels and immersible equipment
- identify potential deficiencies of IMS controls
- identify additional controls to be implemented prior to deployment to the operational area to manage IMS risk, and
- prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).

The risk assessment is conducted by a qualified IMS inspector prior to initial mobilisation of vessels and immersible equipment to the operational area. A qualified IMS inspector is one that is listed by the WA Department of Primary Industries and Regional Development (Fisheries) to be suitably qualified to undertake vessel biofouling inspections (https://www.fish.wa.gov.au/Sustainability-and-

Environment/Aquatic-Biosecurity/Vessels-And-Ports/Pages/Biofouling-Inspectors.aspx). The WA listing is used in-lieu of a Commonwealth or Victorian process being in place.

The IMS risk assessment process evaluates:

- compliance with relevant IMO and regulatory requirements under the Commonwealth Biosecurity Act 2015 and/or relevant Australian State or Territory legislation
- age, type and condition of the vessel/immersible equipment and history since previous inspection.
- previous cleaning and inspection undertaken and the outcomes of previous inspections
- assessment of internal niches with potential to harbour IMS
- origin of the vessel/immersible equipment including potential for exposure to IMS
- translocation risk based upon source location in relation to activity location – both in relation to the water depth/proximity to land at the point of origin and the potential survivorship of IMS from the point of origin to the operational area
- mobilisation method – whether dry or in-water (including duration of low-speed transit through high or uncertain risk areas)
- the application, age and condition of antifouling coatings on vessels
- the presence and condition of internal biofouling control treatment systems for key internal seawater systems
- the vessel's Biofouling Management Plan and record book, and
- the vessel's Ballast Water Management Plan and record book.

Where the vessel/immersible equipment have been deemed low-risk by the IMS inspector, no further management measures are required, and the vessel/immersible equipment may be deployed into the operational area.

Where the vessel/immersible equipment have been deemed high, moderate or uncertain risk by the IMS inspector, a vessel inspection will be undertaken by the IMS inspector. If IMS are identified or it is uncertain if IMS are present, cleaning will be undertaken and the vessel/immersible equipment deemed low-risk by the IMS inspector prior to deployment to the operational area.

During the Sequoia MSS immersible equipment will be cleaned of any biofouling whenever it is bought onboard the vessel.

Any potential IMS material observed during the pre-mobilisation inspections or the survey will be reported to DAWE and treated as per DAWE instructions.

5.3.1.2. Defining the Impacts

Table 5-17 identifies the impacts and receptors that have the potential to be impacted by an unplanned introduction of an invasive marine species as a result of the Sequoia MSS. Receptors and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible (1) / or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further.

Table 5-17: Aspects and Impacts – Introduction of IMS

Impacts	Benthic Assemblage	Invertebrates	Commercial Fisheries
Change in ecosystem dynamics	✓	✓	
Changes to the functions, interests or activities of other users			✓

5.3.1.3. Defining the EMBA

Table 5-18 describes how the EMBA has been defined for the receptors and impacts that have been identified to be potentially impacted by the introduction of an invasive marine species (Table 5-17).

Table 5-18: EMBA for Introduction of IMS

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
Introduction of IMS	Operational Area	The risk of the introduction of IMS to the area is posed by the physical presence of vessels and streamers.	Commonwealth *Biosecurity Act 2015*	Operational Area The extent of the introduction of IMS is localised. If IMS are able to successfully establish, and then spread, the extent may become more widespread.

5.3.1.4. Existing Environment

The values, sensitivities and existing pressures of the relevant receptors in the Operational Area have been described in Appendix H, Section 4.2 – Invertebrates and Section 4.7 – Commercial Fisheries.

It is widely recognised that marine pests can become invasive and cause significant impacts on economic, ecological, social and cultural values of marine environments. Impacts can include the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities (Brusati and Grosholz, 2007).

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.

Invasive marine species known to occur were identified from 'www.marinepests.gov.au' (DAWE, 2019), which details ports around Australia with established invasive marine species. The survey vessel will mobilise to the Otway region from its previous contract in the NWS. Marine pests known to occur and ports likely to be used (Port Hedland, Dampier, Fremantle, Adelaide, Melbourne, Hobart, Portland) (DAWE, 2019) are detailed in Table 5-19.

Table 5-19: Marine pests known to occur in ports relevant to the Sequoia MSS

Marine Pest	Description	Port Hedland	Dampier	Fremantle	Adelaide	Melbourne	Portland	Hobart
Asian date mussel (*Musculista senhousia*)	Prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna.	-	-	Known	Known	Known	Known	-
European fan worms (*Sabella spallanzannii*)	Attaches to hard surfaces, artificial structures and soft sediments, preferring sheltered waters up to 30 m deep. It reached Port Phillip Bay in the mid-1980s and is a nuisance fouler (Parks Victoria, 2020).	-	-	Known	Known	Known	Known	-
European shore crab (*Carcinus maenas*)	Prefers intertidal areas, bays, estuaries, mudflats and subtidal seagrass beds, but occurs in waters up to 60 m deep. It is widespread across Victorian intertidal reef and common in Western Port.	-	-	-	Known	Known	-	Known
Japanese kelp (*Undaria pinnatifida*)	Occupies cold temperate oceanic waters up to 20 m deep, growing on rock, reef, stones and artificial structures. It rapidly forms dense forests and overgrows native species. It first established in Port Phillip Bay in the 1980s (Parks Victoria, 2020).	-	-	-	-	Known	-	Known
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 known to be present in the Port Phillip and the Western Port region.	-	-	-	-	-	-	Known
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).	-	-	-	-	Known	-	Known

Marine Pest	Description	Port Hedland	Dampier	Fremantle	Adelaide	Melbourne	Portland	Hobart
	It is thought to have been introduced through ballast water from Japan.							
Aquarium Caulerpa (*Caulerpa taxifolia*)	Can overgrow native species and degrade fish habitats. Found in estuaries, coastal lagoons and bays. Native to northern Australia, from Port Denison, Western Australia to Southport, Queensland. Can be a pest in some southern locations. Established in some parts of New South Wales and South Australia.	-	-	-	Known	-	-	-
Asian shore crab (*Hemigrapsus sanguineus*)	Established in Victoria. Asian shore crabs were detected in Port Phillip Bay in 2020. Generally found hard substrates in intertidal areas, under rocks, shells, debris or artificial structures.	-	-	-	-	Known	-	-

Source: www.marinepests.gov.au) DAWE, 2019) accessed on 25/05/21

Species that are not known to occur but are identified to watch for at relevant ports (DAWE, 2019), are:

- Asian green mussel *(Perna viridis)*
- American slipper limpet *(Crepidula fornicate)*
- Asian basket clam *(Corbula (Potamocorbula) amurensis)*
- Black striped false mussel *(Mytilopsis sallei)*
- Chinese mitten crab *(Eriocheir sinensis)*
- Asian paddle crab *(Charybdis japonica)*
- Rapa or veined whelk *(Rapana venosa)*
- Soft shell or long-necked clam *(Mya arenaria* and *Mya japonica)*
- Charru mussel *(Mytella strigata)*

5.3.1.5. Legislative Requirements

Table 5-20 identifies the minimum legislative and other requirements that are relevant to an introduction of IMS. Legislative and other requirements specific to relevant receptors are described in Appendix H, Section 4.2 – Invertebrates and Section 4.7 – Commercial Fisheries. The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 5-20: Other Requirements for Introduction of IMS

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
Legislation	Commonwealth *Biosecurity Act 2015*	Biosecurity obligations administered by the Department of Agriculture include ballast water and biofouling requirements, specifically: • 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 including the DoF (2019) Biofouling Risk Assessment Tool, which may lead to IMS inspections by suitably qualified personnel • antifouling system certification for vessels is current and in accordance with AMSA Marine Order Part 98 (Antifouling systems)	The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS. Adoption of control measures (refer to Environmental Performance section in Appendix A)
Legislation	Biosecurity (Ballast Water and Sediment) Determination 2017 and the Australian Ballast Water Management Requirements Version 8 (DAWE 2020)	The International Convention on the Control and Management of Ship's Ballast Water and Sediment (Ballast Water Management Convention) applies to waters out to 200 nm and is given effect in Australia through the Biosecurity Act 2015, Biosecurity (Ballast Water and Sediment) Determination 2017 and the Australian Ballast Water Management Requirements. Australian Ballast Water Management Requirements including ballast water treated via a ballast water treatment system (with Type Approval Certificate) and ballast water record system will be maintained with all ballast water discharges to be reported. Vessels moving between Australian ports and offshore installations, within Australian waters, will manage ballast water in accordance with Australia's domestic ballast water requirements. The acceptable area for a ballast water exchange between an installation and an Australian port is in sea areas >500 m from the offshore installation, and >12 nm from the nearest land (as per DAWE, Australian Ballast Water Management Requirements Version 8).	
Legislation	National biofouling management guidelines for the petroleum production and exploration industry (DAFF 2009a)	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. Aligns with the IMO Biofouling Guidelines (below).	
Legislation	Environment Protection Act 1970 (& various regulations)	Controls discharges and emissions to the environment within Victoria (state and territorial waters) protect Victorian State waters from marine pests introduced via domestic ballast water, ballast • Water management arrangements applying to all ships in State and Territorial waters must be	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
		observed as per the Environment Protection (Ships' Ballast Water) Regulations 2006, Waste Management Policy (Ships' Ballast Water) and the Protocol for Environmental Management. • High-risk domestic ballast water (ballast water that originates from an Australian port or within the territorial sea of Australia (to 12 NM)), regardless of the source, must not be discharged into Victorian State. • Ship masters must undertake a ballast water risk assessment on a voyage by voyage basis to assess risk level provide accurate and comprehensive information to the EPA on the status and risk of origin of ballast water contained on their ships (i.e. domestic/international), and to manage domestic ballast water discharges with EPA written approval. Administered by the Environment Protection Authority (EPA).	
Guidelines	2011 Guidelines for the Control and Management of Ships Biofouling to Minimise the Transfer of Invasive Aquatic Species (the IMO Biofouling Guidelines; IMO 2011)	Provides internationally agreed guidance on how to minimise biofouling on vessels through application of biofouling prevention measures and hull husbandry practices provide a basis upon which operators can develop a vessel-specific biofouling management plan (BFMP) which: • Provides specific details of the antifouling technology used, including antifouling paints and 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.	
Guidelines	MarinePestPlan 2018-2023: National Strategic Plan for Marine Pest Biosecurity (2018-2023) (CoA 2018)	Provides Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capacity to manage the threat of marine pests over five years. The key relevant objective is to minimise the risk of marine pest introduction, establishment and spread.	
Guidelines	Reducing marine pest biosecurity risks	The intent of this Information Paper is to:	

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia MSS
	through good practice biofouling management (NOPSEMA 2020d)	• Clarify biosecurity requirements relevant to offshore activities • Provide coordinated good practice advice that is consistent with the expectations of all jurisdictions responsible for regulating biofouling management within the Australian marine environment • Support the industry's contribution to marine pest risk management consistent with Australia's MarinePestPlan 018-2023 (CoA 2018).	
Guidelines	Marine Biosecurity Management of Vessels Servicing the Offshore Industry (MIAL 2020)	Reference case developed by Maritime Industry Australia Ltd (MIAL) for use in the development of EPs by titleholders for offshore resource activities located in Commonwealth waters. NOPSEMA provided a Regulatory Advice Statement to assist with its application to offshore projects. The reference case applies to vessels used in the offshore resources industry; and not to offshore installations or trading ships (such as the MOPU, and export or shuttle tankers). It has been used as guidance where appropriate.	

5.3.2. Risk Assessment

5.3.2.1. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from the introduction of IMS have been evaluated in the tables below for each relevant receptor; having had regard to the legislative and other controls (5.3.1.5).

Table 5-21: Predicted Impact Levels – Benthic Assemblages and Invertebrates

Introduction of IMS	Risk Level
Change in ecosystem dynamics The introduction (and subsequent establishment and spread) of an IMS 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 IMS introduction are: • Benthic Assemblages (sponges, bryozoans etc.) • KEFs (West Tasmania Canyons) • Invertebrates. The Operational Area does not present a benthic habitat or community structure that is favourable to IMS survival (Appendix H). The Operational Area is in waters >90 m and therefore very low light levels are expected at the seabed. IMS typically require light to survive and thrive, which will be minimal at the seabed within the Operational Area. Due to the lack of light at the seabed of the Operational Area, the presence of marine flora is not expected. The majority of the pest species listed in Table 5-19 inhabit shallow waters and coastal habitats. Therefore, they are very unlikely to be able to colonise the benthic habitat within the Operational Area due to the deeper depths present. Only a small proportion of IMS become invasive (Wells 2018) with the risk of an IMS being able to successfully establish itself depending on depth, distance from the coast, water movement and latitude.	Medium

Introduction of IMS	Risk Level
However, 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 survey vessels will not be stationary for long periods of time within the Operational. No anchoring will take place within the Operational Area therefore there will no contact with the seabed reducing the risk of translocating an IMS to the seabed. All subsea survey equipment is stored on the vessel so an IMS 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 an IMS is unlikely. With the Operational Area ~15 nm from Victoria and ~12 nm from King Island BRS (2007) estimates indicate that the chance of colonisation of an IMS is 8%. However, as detailed in Section 5.3.1.4, 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 90 to >1000 m. Vessels that will operate within the Operational Area as part of the Sequoia MSS will all be subject to Australian legislation including ballast water management and the Commonwealth *Biosecurity Act 2015* and additional control measures as detailed in Table 5-20. The ConocoPhillips Australia marine risk management processes will ensure contracted vessels follow standards designed to both prevent the introduction of IMS but also to detect and eradicate species able to survive in local conditions. There are no protected benthic assemblage species within the that are listed within the EPBC PMST (Appendix J). 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 (DAWE, 202ob). Again, due to the depths of these values the possibility of an IMS becoming established is negligible. No EPBC listed invertebrates species where identified from the PMST Repot for the Sequoia MSS Operational Area. However, two commercially fished species are present – the Giant Crab (*Pseudocarcinus gigas*) and the Southern Rock Lobster (SRL) (*Jasus edwardsii*). Whilst the Giant Crab fishery in Tasmania is a deleted stock current pressures do not include invasive marine species (FRDC, 2018f). The Victorian Giant Crab fishery and the SRL fisheries are a sustainable stock with the FRDC not reporting impacts by IMS species (FRDC, 2018f, 2018g). The extent of the area of risk is predicted to be on the seabed and within the water column within the Operational Area. The consequence of introducing an IMS to benthic assemblages causing a change in ecosystem dynamics has been assessed as **Major (3),** based on: • An IMS introduced to the benthic environment may cause a change in ecosystem dynamics by the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities. • An IMS may become a pest displacing native species, dominating habitats or causing algal blooms. • There are no EPBC management plans for benthic and invertebrate species. • There is a low risk of IMS transported to the Operational Area. • There is a low risk of spread into local habitats. • Procedures are in place to detect and eradicate or species is unable to survive in local conditions. Vessel management systems address IMS (Environmental Performance section of Appendix A). These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of an IMS it would be unable to colonize the benthic substrate due to the deep and well mixed waters within the Operational Area.	

Table 5-22: Predicted Impact Levels – Commercial Fisheries

<table>
<tr><th>Introduction of IMS</th><th>Risk Level</th></tr>
<tr><td>
<u>Changes to the functions, interests or activities of other users</u>
The introduction of an IMS 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 commercial fisheries is likely to be localised (isolated locations if there is no spread); but may become more widespread if colonisation and spread occurs.
The introduction of an IMS in the Operational Area is unlikely to impact on fisheries within the region. Management areas for seven State and eleven Commonwealth-managed fisheries intersect with the Operational Area but historical fishing effort data shows that only the following fisheries may be active in the area (Section 4.7):

Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector (SESSF – CTS)
Southern and Eastern Scalefish and Shark Fishery – Shark Gillnet Sector and Shark Hook Sector (SESSF – CGS/CSHS)
Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector (SESSF – SHS)
Victorian Giant Crab and Southern Lobster Fisheries
Tasmanian Giant Crab and Southern Lobster Fisheries

As previously detailed in Table 5-21, environmental conditions at the Operational Area are not suited to the successful introduction and colonisation of an IMS with waters >90 m, due to very low light levels (with IMS typically requiring light to survive and thrive), and well mixed seas. The Operational Area is relatively remote from the closest shoreline being ~22 km away at King Island. All the pest species detailed in Section 5.3.1.4 inhabit shallow waters and coastal habitats. Therefore, they are extremely unlikely to be able to colonise the benthic habitat within the Operational Area and spread to adjacent fisheries. Australian Legislation, guidelines and additional control measures prevent the introduction of an IMS have been previously detailed in Table 5-21.
None of the fisheries listed above currently list IMS as a threat. Whilst Southern Rock lobster is suspectable to tail fan necrosis, caused by combination of a number of 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 an IMS.
The extent of the area of risk is predicted to be on commercial fisheries overlapping the operational area and within the water column within the Operational Area. The consequence of introducing an IMS to commercial fisheries and causing a change in ecosystem dynamics has been assessed as Major (3), based on:

An IMS introduced to the benthic environment may cause a change in ecosystem dynamics by the introduction of new diseases, altering ecosystem processes and reducing biodiversity, causing major economic loss and disrupting human activities.
An IMS may become a pest displacing native species, dominating habitats or causing algal blooms.
There are no EPBC management plans for commercial fish species
There is a low risk of IMS transported to the Operational Area
There is a low risk of spread into local habitats
Procedures are in place to detect and eradicate or species is unable to survive in local conditions

Vessel management systems address IMS (Environmental Performance section of Appendix A). These systems are well practiced and well understood. The likelihood is assessed as Remote, given the occurrence of an IMS it would be unable to colonise the seabed present in the Operational due to the deep and well mixed waters, and subsequently impact commercial fisheries.
</td><td>Medium</td></tr>
</table>

5.3.3. Comparison of Predicted Impact with Defined Acceptable Levels

Table 5-23 compares the predicted impact levels for IMS against the acceptable levels.

Table 5-23: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Introduction of IMS

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Planned activities not expected to result in introduction of IMS.	Yes
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction.	Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	No relevance to IMS (See Appendix A).	Yes
Biological Ecological Economic	No invasive marine species introduced, established or spread at any sensitive location attributable to the activity.	Vessels and immersible equipment will have a low risk of invasive marine species prior to deployment to the operational area.	Yes
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM6 - the IMS risk assessment process ensures that an assessment of IMS risk is completed and vessels and in-water equipment are assessed by a qualified IMS inspector as having a low risk of invasive marine species prior to deployment to the operational area. CM7 - the marine assurance system, ensures that project vessels meet all maritime laws and includes vessel vetting to validate CM6.	Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental risks will be at or below significant.	Likelihood: Remote Consequence: Major Risk: Medium	Yes
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons.	Claims and objections relevant to IMS have been considered in Section 3.4. No public comments were made in relation to IMS.	Yes

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
	The views of public have been considered in the preparation of the EP.		
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 5-20.	Yes
Acceptability Summary			
Following completion of the risk assessment process, the environmental risk arising from the introduction of an IMS are acceptable because: • The impacts and vectors associated with IMS introduction are well known. • Vessel contractor pre-qualification, IMS risk assessment process and vetting will be undertaken. • Vessels and in-water equipment will be assessed by a qualified IMS inspector as having a low risk of invasive marine species prior to deployment to the operational area. • Regulatory guidelines controlling vectors are in place (including but not limited to the National Biofouling Management Guidance for the Petroleum Production and Exploration Industry, IAFS Certificate, IMO guidelines, Ballast water regulations and management, AQIS, DAWE Biosecurity & Compliance Group).			

5.3.4. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Risk	• There are no invasive marine species introduced, established or spread attributable to the activity.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 5-24 which assesses whether the control measures for introduction of invasive marine species are effective to meet the EPO.

Table 5-24: Control Measure Effectiveness – Introduction of IMS

Measures	CM 7 – Marine assurance system
Assessment of Effectiveness	The marine assurance system has several performance standards that reduce risks of the introduction of invasive marine species (IMS). These are focused on anti-fouling systems and ballast water management. Risks are increased where vessels last port of call was overseas which will not be the case for the Sequoia MSS. There are additional measures that can be taken to reduce the risk of introducing IMS further such as hull inspections and dry docking that are not explicitly required or assessed by the marine assurance system. The marine assurance system ensures the Sequoia MSS vessels comply with maritime law but does not sufficiently cover all immersible equipment.
Is the EPO achieved?	Partially
Residual impacts requiring additional management	Further consideration of the status of vessel and immersible equipment and additional measures to reduce this risk need to be considered in a risk assessment process.
Next Measure	CM 6 – IMS Risk Assessment Process

Measures	CM 7 – Marine assurance system
Assessment of Effectiveness	This process mandates an IMS risk assessment be conducted on vessels/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. This may require measures including inspection and cleaning to ensure that vessels/immersible equipment will be of a low-risk prior to mobilisation to the operational area.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

5.4. MDO Release

5.4.1. Scoping the Assessment

5.4.1.1. Cause and Effect Pathway

A release of Marine Diesel Oil (MDO) may result from:

- Vessel activities.

The Sequoia MSS will use a survey vessel, and up to three support vessels. Up to two will likely be present in the Operational Area for the whole survey; with likely one supply vessel that will transit between the Operational Area to port.

All vessels will carry quantities of hydrocarbons as fuel for propulsion and/or power generation, including MDO.

There are three potential sources of an accidental release of MDO:

- Vessel refuelling
- Equipment failure (i.e. small volumes of hydrocarbons, hydraulic oils and lubricants)
- Vessel-to-vessel collision.

Vessel grounding is not considered credible due to the water depths (~90 m) and absence of submerged features in the Operational Area.

A vessel collision typically occurs as a result of:

- Mechanical failure/loss of Dynamic Positioning (DP) system
- Navigational error
- Foundering due to weather.

Vessel collision has been identified as the worst-case credible spill scenario AMSA's Technical guidelines for preparing contingency plans for Marine and Coastal Facilities (AMSA, 2015).

Therefore, this scenario is used for the purposes of impact assessment and is carried through into spill modelling (Section 5.4.2.1).

Table 5-25: Potential Maximum Credible Spill Scenarios for MDO Release

Cause	Description	AMSA Basis of Credible Volume	Maximum Credible Volume and Duration
Vessel	Equipment failure (i.e. small volumes of hydrocarbons, hydraulic oils and lubricants)	N/A	~1 m^3 minor leak
Refuelling	Bulk transfer and bunkering: • partial or total failure of bulk transfer hose or fittings • failure of dry-break couplings • accidental spills during refuelling of hydraulic hoses	~50 m^3 of MDO during bunkering – i.e. transfer rate x 15 minutes	<10 m^3
Vessel collision	A vessel collision could lead to loss of containment event and subsequent release of fuel. This could	Volume of largest fuel tank. Largest vessel tank on board any vessel used for Sequoia	Total volume of 373 m^3

Cause	Description	AMSA Basis of Credible Volume	Maximum Credible Volume and Duration
	occur between any of the vessels in the field – i.e. support and seismic vessel; or a third-party vessel. Based on the IMO's decision to implement a 0.50% sulphur cap on marine fuel from 2020, the assumption is being made that there will be no MDOs, which have sulphur levels much higher than this cap, in use or stored on board any of the contracted vessels.	MSS, that is credible to be contacted in a collision.	released over 6 hours.

5.4.2. Defining the Impacts

A change in water or sediment quality from an MDO release has the potential to result in the impacts to receptors identified in Table 5-26.

Receptors and impacts marked 'X' are subject to impacts that are predicted to have a consequence considered as less than Negligible (1); or where no cause/effect pathway has been identified.

Appendix B provides justification for those aspects not evaluated further.

Table 5-26: Aspects and Impacts – MDO Release

Impacts	Benthic assemblages	Plankton	Invertebrates	Birds	Fish	Marine mammals	Marine reptiles	Commercial Fisheries	Other Marine Users	Coastal habitats and communities
Change in fauna behaviour			✓	✓	✓	✓	✓			
Injury/mortality to fauna		✓	✓	✓	✓	✓	✓			
Change in habitat / ecosystem dynamics	✓									✓
Changes to the functions, interests or activities of other users								✓	✓	
Change in aesthetic value									✓	

5.4.2.1. Spill Modelling and Exposure Assessment

Spill modelling has been used to predict the possible trajectories and fate of an accidental release of MDO from a vessel collision (RPS 2020; Appendix G). Oil spill modelling was undertaken using SIMAP, a three-dimensional oil spill trajectory and weathering model, which is designed to simulate the transport, spreading and weathering of specific oil types under the influence of changing meteorological and oceanographic forces.

The spill scenario, oil characteristics and behaviours, environmental thresholds for impact assessment and predicted exposures are summarised in Section 5.4.2.2 below.

5.4.2.2. Oil Spill Trajectory Modelling Scenario

To understand the risks posed by a MDO spill, RPS was commissioned to undertake oil spill trajectory modelling (OSTM) using the scenario of a release of 373 m3 of MDO at the sea surface over six hours at random locations within the operational area (RPS, 2020), using the MDO properties outlined in Table 5-27.

Due to the size of the operational area, the 100 spills were modelled within the operational area from 100 randomly selected release locations situated approximately 5.5 - 10 km apart. Table 5-28outlines the key OSTM inputs for the MDO spill scenario.

Table 5-27: Summary of the MDO Characteristics

Characteristic	Details			
Density (kg/m^3)	829.1 at 15°C			
API	37.6			
Dynamic viscosity (cP)	4.0 at 25°C			
Pour point (°C)	-14			
Oil property category	Group II			
Oil persistence classification	Light persistent oil			
Component	**Volatiles**	**Semi-volatiles**	**Low Volatiles**	**Residual Oil**
Boiling Point (°C)	< 180	180-265	265-380	> 380
MDO (%)	6.0	34.6	54.4	5.0
Persistence	Non-persistent			Persistent

Table 5-28: Summary of MDO Spill OSTM Inputs

Parameter	Details
Oil Type	MDO
Total spill volume	373 m^3
Release type	Sea surface
Release duration	6 hours
Release rate	Instantaneous
Weather conditions	Annualised
Simulation duration	28 days
Release location	One randomly-selected location within the Operational Area modelled for each of the 100 simulations
Modelled exposure thresholds	Refer Table 5-29

5.4.2.3. Environmental Exposure Thresholds

Oil is a mixture of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, these components have varying fates and impacts (French-McCay, 2018). The following components were modelled and used within the impact assessment:

- Floating (surface)
- In-water (dissolved and entrained)
- Shoreline accumulation.

Air-breathing marine wildlife (e.g. birds, mammals and turtles) are primarily affected by floating oil and/or oil accumulated on a shoreline, whereas fish and invertebrates are primarily affected by entrained and dissolved oil components (French-McCay, 2016).

The exposure values used in the spill modelling and impact assessment are described in Table 5-29. The thresholds used herein are based on the NOPSEMA Environment Bulletin – Oil spill modelling (NOPSEMA 2019) and literature (e.g. French et al. 1996 and French-McCay, 2009). The threshold justifications are detailed in Section 3.2 of the spill modelling report and were assessed against a range of sensitive receptors detailed in Section 3.4 of that report (Appendix G; RPS, 2020).

Table 5-29: Hydrocarbon Exposure Thresholds

Exposure level	Threshold	Description
Surface (floating)		
Low	1 g/m^2	Approximates range of socio-economic effects and establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
Moderate	10 g/m^{2} *	Approximates lower limit for harmful exposures to birds and marine mammals.
High	50 g/m^2	Approximates surface oil slick and informs response planning
Shoreline accumulation		
Low	10 g/m^2	Predicts potential for some socio-economic impact based on potential for exceedance of water quality triggers
Moderate	100 g/m^{2} *	Loading predicts area likely to require clean-up effort
High	1,000 g/m^2	Loading predicts area likely to require intensive clean-up effort
Dissolved (in water)		
Low	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
Moderate	50 ppb	Approximates potential toxic effects, particularly sublethal effects to sensitive species
High	400 ppb	Approximates toxic effects including lethal effects to sensitive species
Entrained (in water)		
Low	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers
Moderate	100 ppb	As appropriate given oil characteristics for informing risk evaluation

** also used to define the threshold for actional oil*

5.4.2.4. MDO Behaviour and Weathering

The following points summarise the nature and behaviour of MDO, based on NOAA (2012) and APASA (2012):

- MDO is dominated by n-alkane hydrocarbons that give diesel its unique compression ignition characteristics and usually consist of carbon chain C11-C28 but may vary depending upon specifications (e.g., winter vs. summer grades).
- While MDOs are generally considered to be non-persistent oils, many can contain a small percentage (approximately 3-7%) by volume of hydrocarbons that are classified as 'persistent'

under the International Oil Pollution Compensation (IOPC) Fund definition (i.e., greater than 5% boiling above 370°C) (see Table 1 3).

- Diesel fuels are light, refined petroleum products with a relatively narrow boiling range, meaning 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).
- Diesel fuels are much lighter than water, so it is not possible for diesel oil 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.
- Minor quantities of PAHs are present in MDO.
- When spilled on water, MDO spreads very quickly to a thin film and generally has a low viscosity that can result in hydrocarbons becoming physically dispersed as fine droplets into the water column when winds exceed 10 knots.
- Droplets of MDO that are naturally, or chemically dispersed sub-surface behave quite differently to oil on the sea surface. Diesel droplets will move 100% with the currents under water but on the surface are affected by both wind and currents.
- Natural dispersion of MDOs will reduce the hydrocarbons available to evaporate into the air. Although this reduces the volume of hydrocarbons on the water surface, it increases the level of hydrocarbons able to be inhaled. this increased hydrocarbon vapour exposure can affect any air breathing animal including whales, dolphins, seals and turtles.
- The environmental effects of MDOs spills are not as visually obvious as those of heavy fuel oils (HFO) or crude oils. Diesel oil is considered to have a higher aquatic toxicity in comparison to many other crude oils due to the:
    - High percentage of toxic, water-soluble components (such as BTEX and PAH);
    - Higher potential to naturally entrain in the water column (compared to HFO);
    - Higher solubility in water; and
    - Higher potential to bioaccumulate in organisms.
    - Diesel fuel oils are not very sticky or viscous compared to black oils. When diesel oil strands on a shoreline, it generally penetrates porous sediments quickly, but is also washed off quickly by waves.

In order to illustrate the behaviour of the MDO, generalised weathering tests were conducted, considering, both calm and variable wind conditions (RPS, 2020). Under a constant 5 knot wind case scenario approximately 41% of the oil was predicted to evaporate within 36 hours. While under the variable-wind case, where the winds are of greater strength, entrainment into the water column is shown to be significant. Within approximately 6 hours, around 73% of the oil mass was forecast to have entrained and 26% had evaporated, leaving only a small proportion floating on the water surface (<1%). The increased level of entrainment in the variable-wind case will result in a higher percentage of biological and photochemical degradation, where the decay of the floating oil and oil droplets in the water column occurs at an approximate rate of 0.43% per day with an accumulated total of ~4.3% after 10 days, in comparison to a rate of ~0.1% per day and an accumulated total of 1.3% after 10 days in the constant-wind case. Given the large proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay and/or evaporate over time scales of several weeks to a few months.

Under these calm conditions the majority of the remaining oil on the water surface is predicted to weather at a slower rate compared to entrained portions due to the longer-chain compounds with higher boiling points. Evaporation of the residual compounds will slow significantly, and they will then be subject to more gradual decay through biological and photochemical processes. Figure 5-1 presents the fates and weathering graph for the single spill trajectory for the largest area of floating oil and shows that evaporation accounts for 45% (or 168 m2) of the MDO weathering; and that this occurs within the first few hours. No oil was predicted to remain on the sea surface at the completion of the 28-day modelling period.

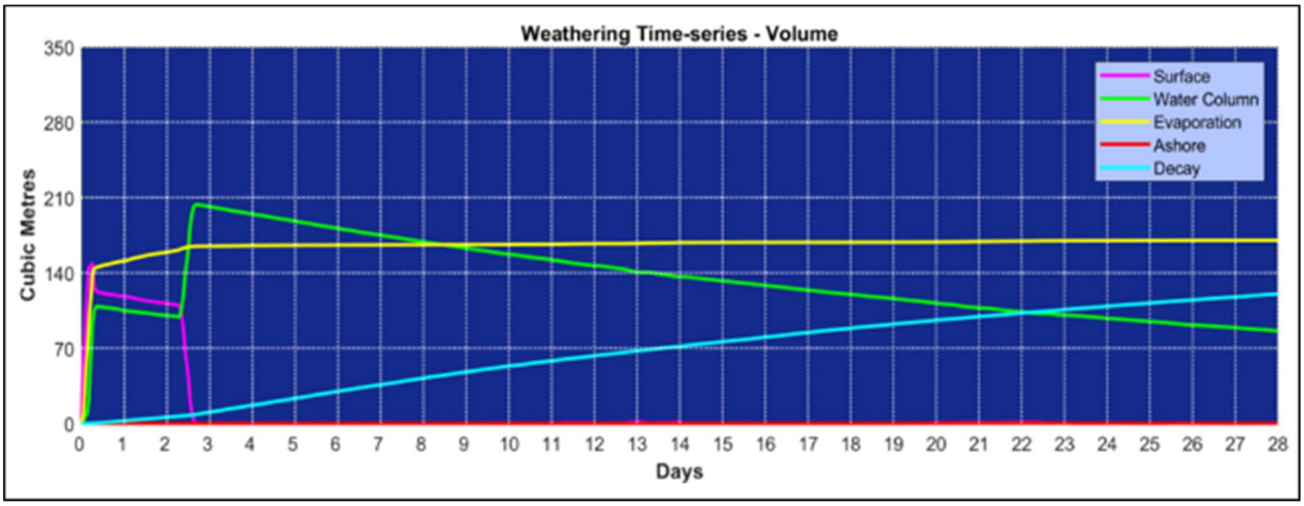


Figure 5-1: Predicted weathering and fates graph for the largest area of floating oil single spill trajectory. Results are based on a 373 m3 surface release of MDO over 6 hours, in the event of a vessel fuel tank rupture, tracked for 28 days, starting 08:00 am 25th June 2009

5.4.2.5. Defining the EMBA

Five EMBAs have been defined for the purposes of MDO release risk assessment (Table 1 6). This is an amalgamation of 100 spill simulations with different metocean conditions and is not representative of a single spill simulation. It represents the outer limit within which any single spill simulation may occur.

The EMBAs is shown in Figure 5-2 represents worst-case spatial extent of low threshold and has been used to set limits of existing environment description.

Table 5-30: EMBA Thresholds and Description

EMBA	Source of EMBA (threshold)	Description
Worst-case EMBA	Worst-case outer extent of Low thresholds for all exposures (surface, shoreline, dissolved and entrained hydrocarbons)	Informs limits of existing environment description provided in Appendix H, as informed by change in ambient water quality.
Surface (floating) exposure EMBA	Surface oil low exposure threshold (1 g/m^2)	Informs the spill response visual area in the event a hydrocarbon release. Precautionary to reflect impacts to aesthetic values and subsequent socio-economic impacts.
Shoreline exposure EMBA	Shoreline accumulation low exposure threshold (10 g/m^2)	Informs areas of detectable hydrocarbon accumulation. Noting however this threshold does not indicate actionable oil accumulation.

Dissolved (in water) EMBA	Dissolved low exposure threshold (10 ppb)	Informs areas of detectable hydrocarbon accumulation. Noting however this threshold does not indicate actionable oil accumulation.
Entrained (in water) EMBA	Entrained oil low exposure threshold (10 ppb)	Informs areas of detectable hydrocarbon accumulation. Noting however this threshold does not indicate actionable oil accumulation.

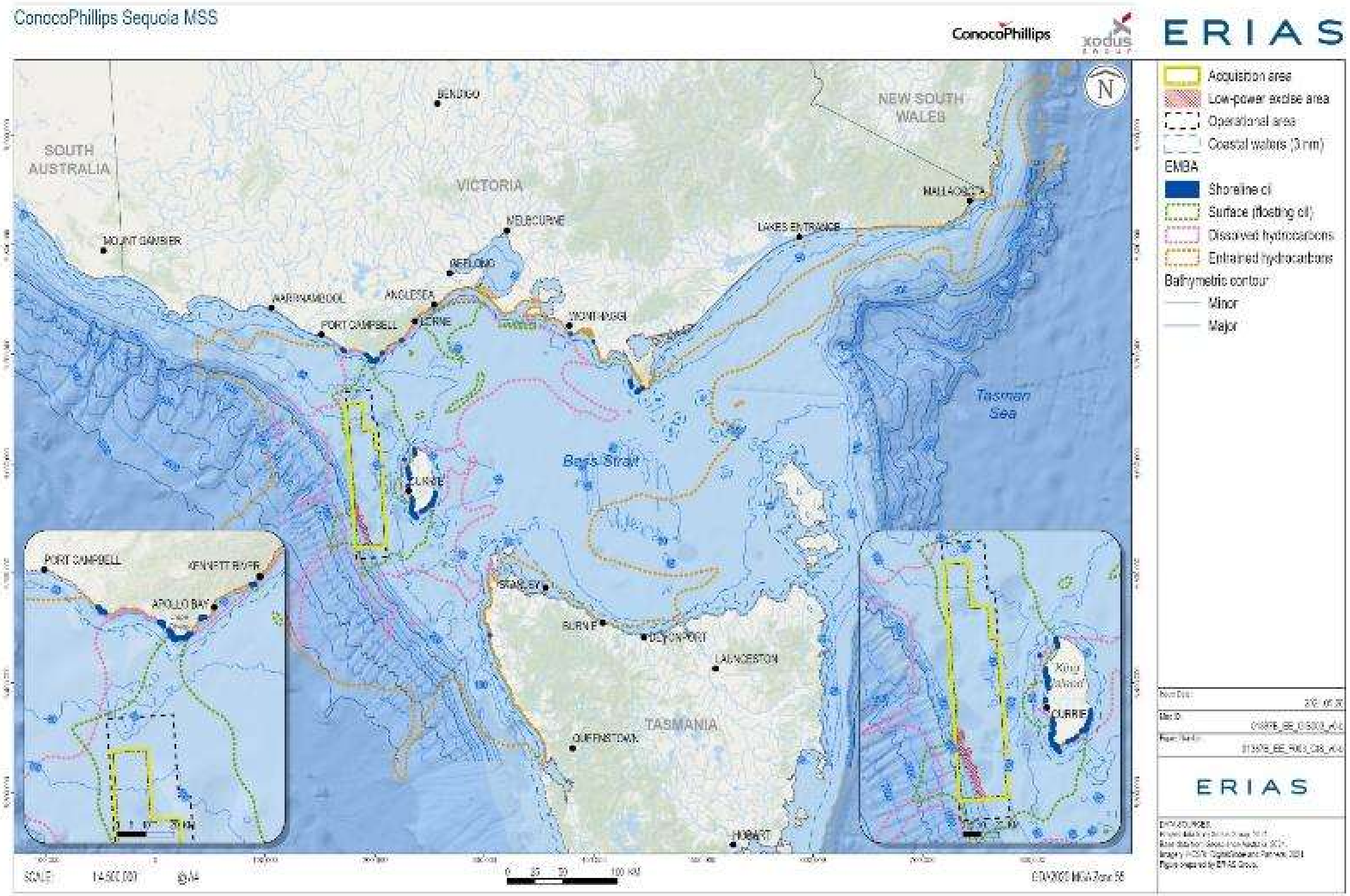


Figure 5-2: Visible EMBA or worst-case outer extent of Low thresholds for all hydrocarbon exposure (surface, shoreline, dissolved and entrained)

Surface (Floating) Exposure Results

Table 5-31 summarises the potential floating oil exposure to individual receptors. Noting conservative EMBA has been used via adoption of 10 g/m2 exposure threshold to inform spatial extent.

Floating oil at impact threshold was predicted at two AMPs (Apollo and Zeehan), one KEF (West Tasmania Canyons), one NP (Point Addis) and two MNPs (Bunurong Marine Park, Wilsons Promontory Marine Reserve).

The purpose of the surface thresholds is described in Table 5-30.

Figure 5-2 presents the EMBA of floating oil exposure of the 100 simulations and Figure 5-4 shows the predicted zone of potential floating oil exposure over the entire simulation for the identified deterministic trajectory that resulted in the largest area of floating oil.

Table 5-31: Summary of surface (floating) oil spill modelling results for the MDO spill scenario thresholds

Receptor		Probability of exposure (%)			Minimum time to contact (days)		
		Low (visible) threshold	Moderate (impact) threshold	High threshold	Low (visible) threshold	Moderate (impact) threshold	High threshold
Australian Marine Park (AMP)	Apollo AMP	14	2	1	0.13	0.42	0.42
	Zeehan AMP	23	14	14	0.04	0.04	0.04
Key ecological feature (KEF)	West Tasmania Canyons	12	10	-	0.04	0.04	-
Marine national park (MNP)	Point Addis	1	-	-	4.75	-	-
National park (NP)	Bunurong Marine Park	1	-	-	4.00	-	-
	Wilsons Promontory Marine Reserve	1	-	-	6.67	-	-
LGA Nearshore	Bass Coast	1	-	-	4.00	-	-
	Colac Otway	2	-	-	1.63	-	-
	Glennie Group	1	-	-	6.67	-	-
	King Island	7	-	-	1.79	-	-
Sub-LGA Nearshore	Apollo Bay	1	-	-	1.75	-	-
	Cape Otway West	1	-	-	1.63	-	-
	Cape Patton	1	-	-	1.96	-	-
	Venus Bay	1	-	-	4.00	-	-
State Waters	Tasmania State Waters	7	-	-	1.63	-	-

	Victoria State Waters	5	-	-	1.63	-	-

Probabilities based on spills originating from any locations within the MSS Operational Area

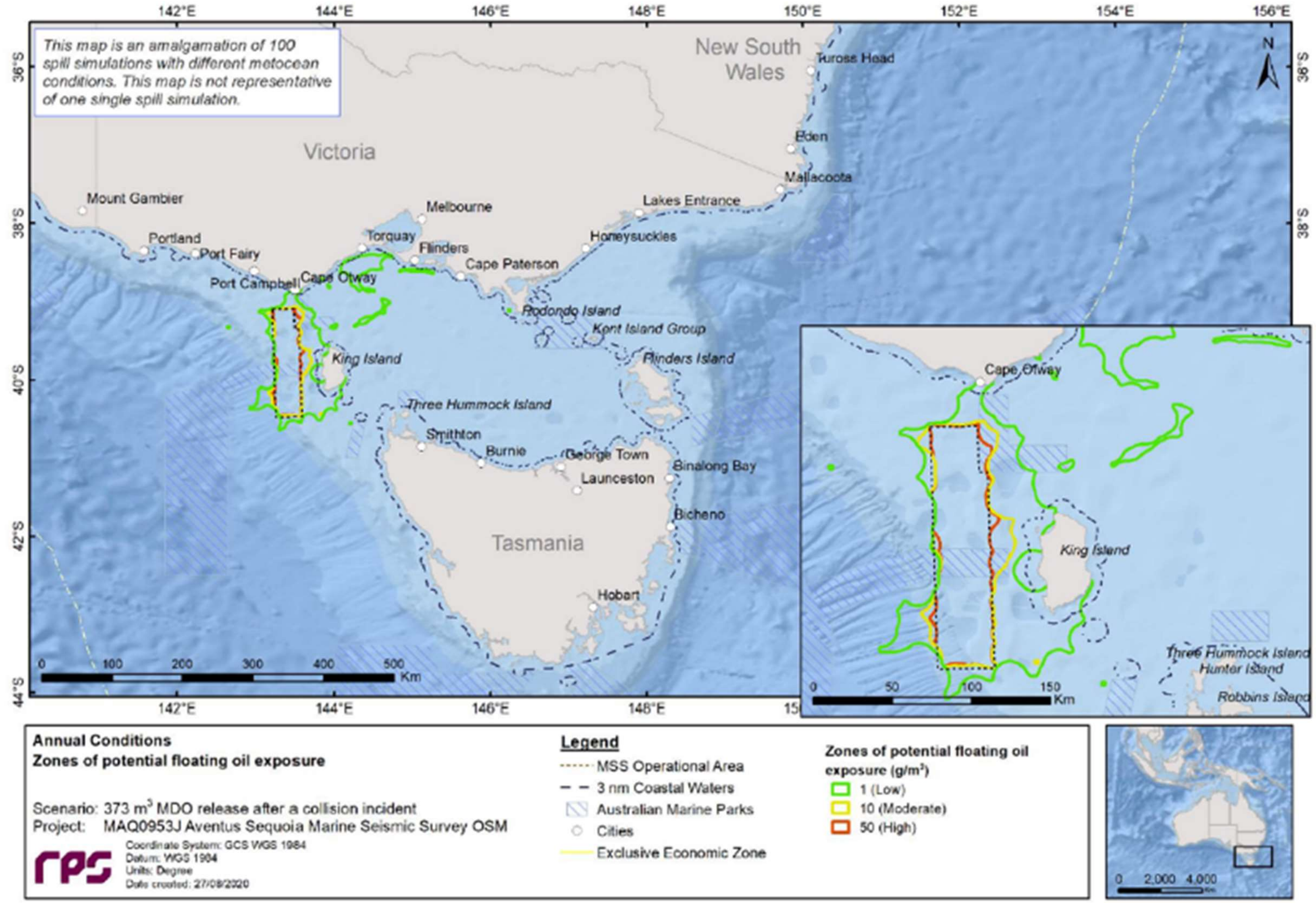


Figure 5-3: Predicted surface (floating) oil Spill EMBA resulting from 373 m³ MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

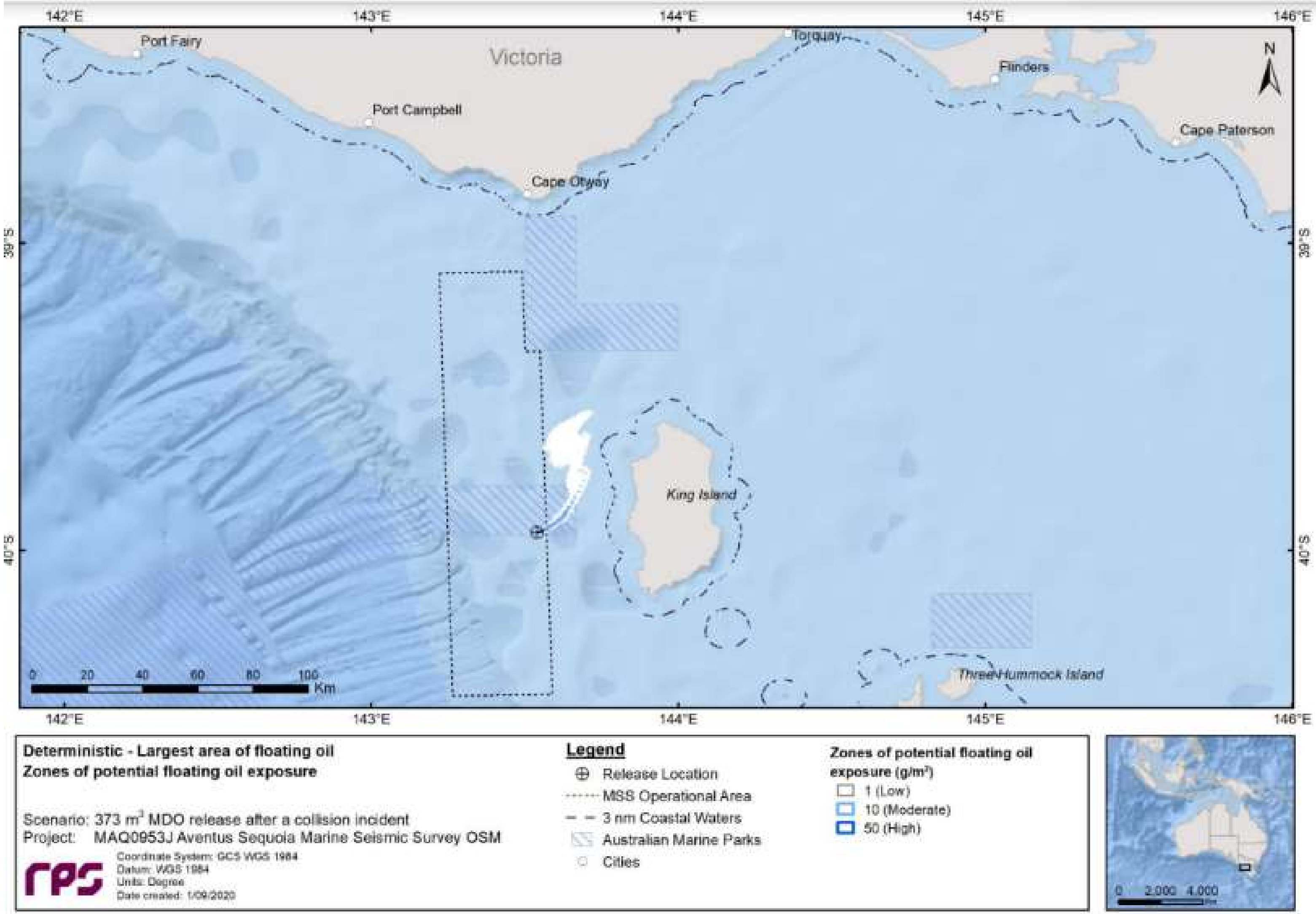


Figure 5-4 Predicted zones of surface (floating) oil over the entire simulation for the identified deterministic trajectory that resulted in the largest area of floating oil

Shoreline Exposure Results

The shoreline spill modelling results are summarised below, and shoreline exposure is provided in Figure 5-5.

The stochastic modelling demonstrated potential oil accumulation on the western, northern and south-eastern coastline of King Island and isolated areas along the Port Campbell, Cape Otway and Wilson Promontory coasts (Figure 5-3). The maximum potential shoreline loading from a single spill simulation were also modelled and are illustrated in Figure 5-6.

The quickest time before shoreline accumulation was predicted at moderate threshold was 2 days at Cape Otway and Colac Otway. Moderate exposure of shoreline contact at King Island was predicted by 3.04 days, with the longest length of shoreline contacted above the moderate threshold being 8.4 km with volume of 27. 6 m3 at Colac Otway.

Table 5-32 presents the largest extent of shoreline loading from a single spill simulation.

Table 5-33 presents the probability of exposure to shoreline segments from the MDO spill scenario.

Table 5-32: Largest extent of shoreline loading from a single spill simulation

Shoreline statistics		Results
Maximum probability of contact to any shoreline		16%
Absolute minimum time to shore		40 hours
Maximum volume of hydrocarbons ashore*		27.6 m^3
Average volume of hydrocarbons ashore^		9.6 m^3
10 g/m^2 loading	Maximum shoreline length	37.5 km
	Average shoreline length	8.9 km
100 g/m^2 loading	Maximum shoreline length	8.4 km
	Average shoreline length	2.5 km
1,000 g/m^2	Maximum shoreline length	–
	Average shoreline length	–

** Maximum volume ashore – the maximum peak volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory.*

^ Average volume ashore – the average volume to come ashore for defined receptors, or all shorelines, from a single simulation/trajectory. Only non-zero values are considered.

Table 5-33: Summary of shoreline contact threshold results for the MDO spill scenario

Receptor		Maximum probability (%)			Minimum time to contact (days)		
		Low (detectable) threshold	Moderate (impact) threshold	High threshold	Low (detectable) threshold	Moderate (impact) threshold	High threshold
Shoreline area	Anser Island	1	–	–	6.50	–	–
	Bass Coast	1	–	–	3.96	–	–
	Circular Head	1	–	–	10.67	–	–
	Colac Otway	3	–	–	1.67	2.00	–
	Corangamite	1	1	–	7.13	10.25	–

	Glennie Group	1	1	–	6.33	6.83	–
	Kanowna Island	1	–	–	6.50	–	–
	King Island	9	5	–	2.08	3.04	–
	Skull Rock	1	–	–	6.13	–	–
	South Gippsland	2	1	–	11.00	11.13	–
	Surf Coast	1	1	–	8.96	9.83	–
	Anglesea	1	1	–	8.96	9.83	–
	Apollo Bay	1	1	–	1.75	2.08	–
	Cape Liptrap (NW)	1	–	–	11.67	–	–
	Cape Otway West	2	2	–	1.67	2.00	–
	Cape Patton	1	1	–	1.92	2.21	–
	Moonlight Head	1	1	–	7.58	10.25	–
	Venus Bay	1	–	–	3.96	–	–
	Wilsons Promontory (West)	1	1	–	11.00	11.13	–

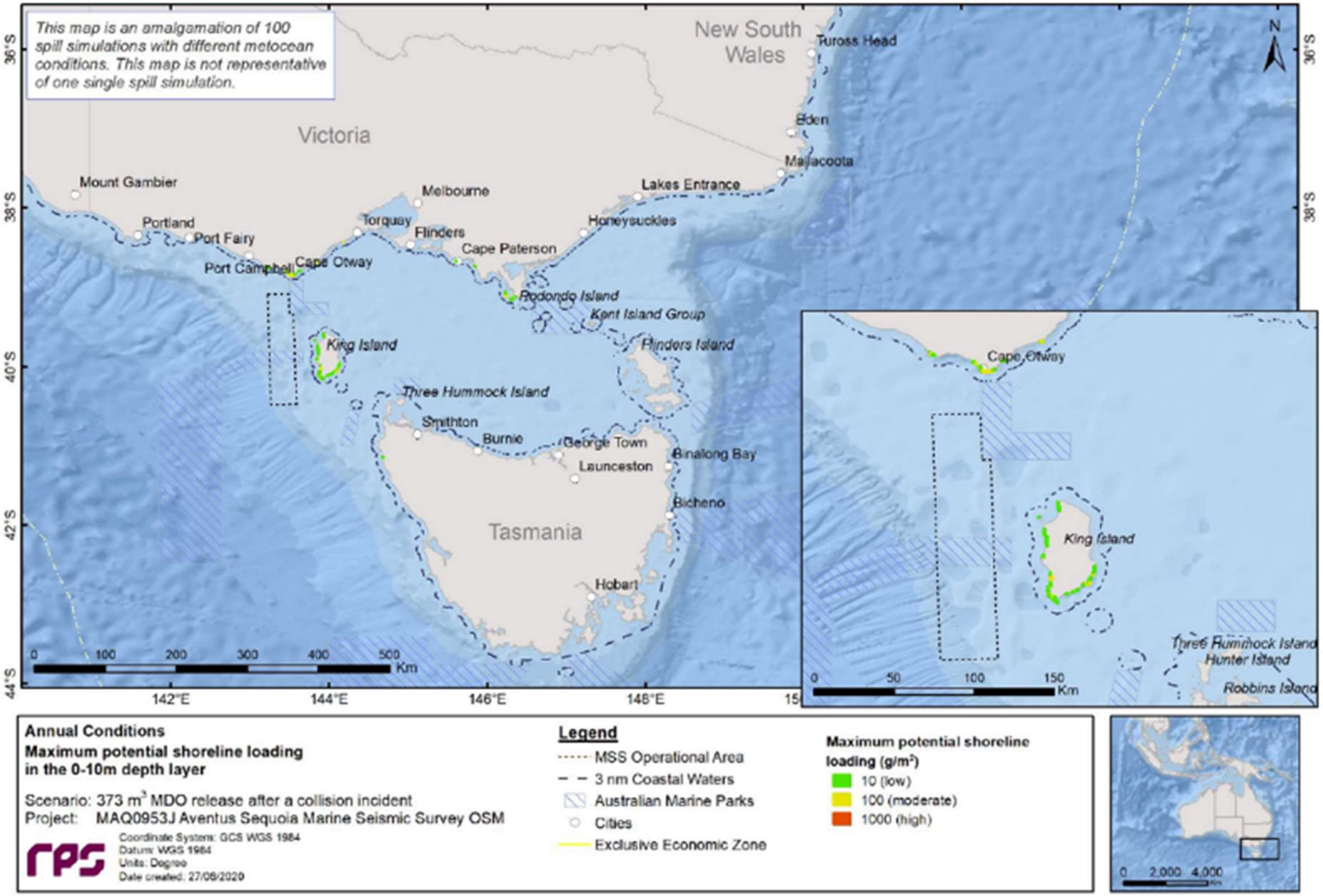


Figure 5-5: Predicted shoreline accumulation Spill EMBA resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

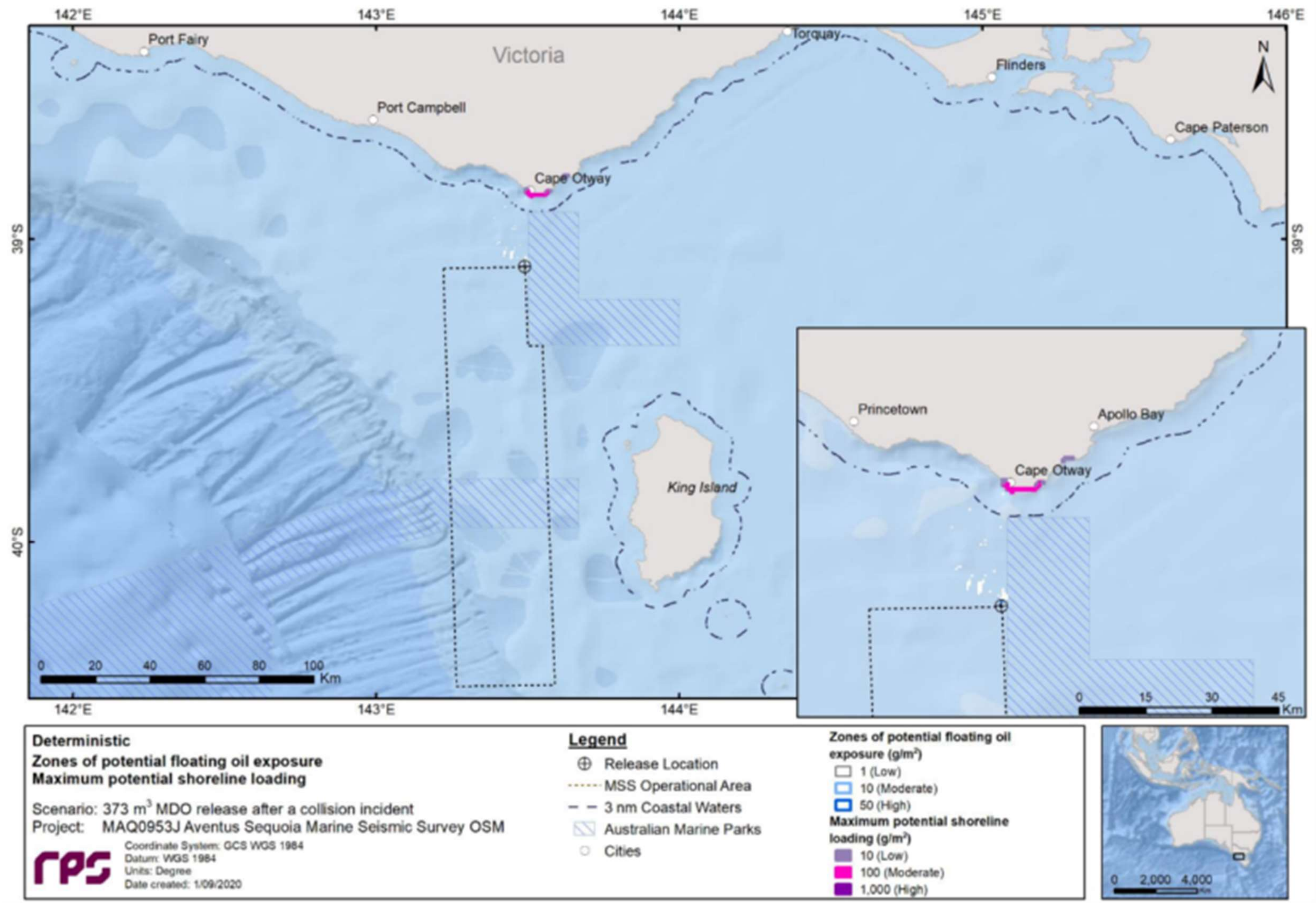


Figure 5-6: Predicted maximum potential shoreline loading resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

Dissolved Hydrocarbons Exposure Results

Table 5-34 summarises spill modelling results for dissolved hydrocarbons.

Figure 5-9 and Figure 5-11 illustrate the zones of potential moderate (impact) dissolved hydrocarbon exposure at 0-10 m, 10 – 20 m and 20-30m below the sea surface, respectively.

The results indicate that the maximum distance travelled from the release location is 251 km predominantly in an east-northeast direction for low exposure hydrocarbons and up to 211 km in the same direction for moderate exposure entrained hydrocarbons, with no contact with high exposure hydrocarbons.

In the surface layer (0-10m), dissolved hydrocarbon exposure at or above the moderate (impact) threshold was predicted for a range of receptors including two AMPs, one KEF, two nearshore local government areas and one sub area. Additionally, low dissolved exposure was shown to extend to nearshore waters between Port Campbell and Cape Paterson.

Table 5-34: Summary of dissolved oil spill modelling results for the MDO spill scenario at low (detectable) and moderate (impact) thresholds within 0-10 m depth layer

Receptor		Maximum probability (%)			Minimum time to contact (days)		
		Low (detectable) threshold	Moderate (impact) threshold	High threshold	Low (detectable) threshold	Moderate (impact) threshold	High threshold
AMP	Apollo	5	1	–	0.13	0.46	–
	Franklin	1	–	–	3.38	–	–
	Zeehan	6	1	–	0.04	0.04	–
KEF	West Tasmania Canyons	4	1	–	0.04	0.13	–
MNP	Bunurong	1	–	–	6.42	–	–
	Point Addis	1	–	–	3.33	–	–
LGA Nearshore	Colac Otway	1	1	–	1.38	1.63	–
	King Island	4	1	–	1.79	4.29	–
Sub-LGA Nearshore	Cape Otway West	1	1	–	1.38	1.63	–

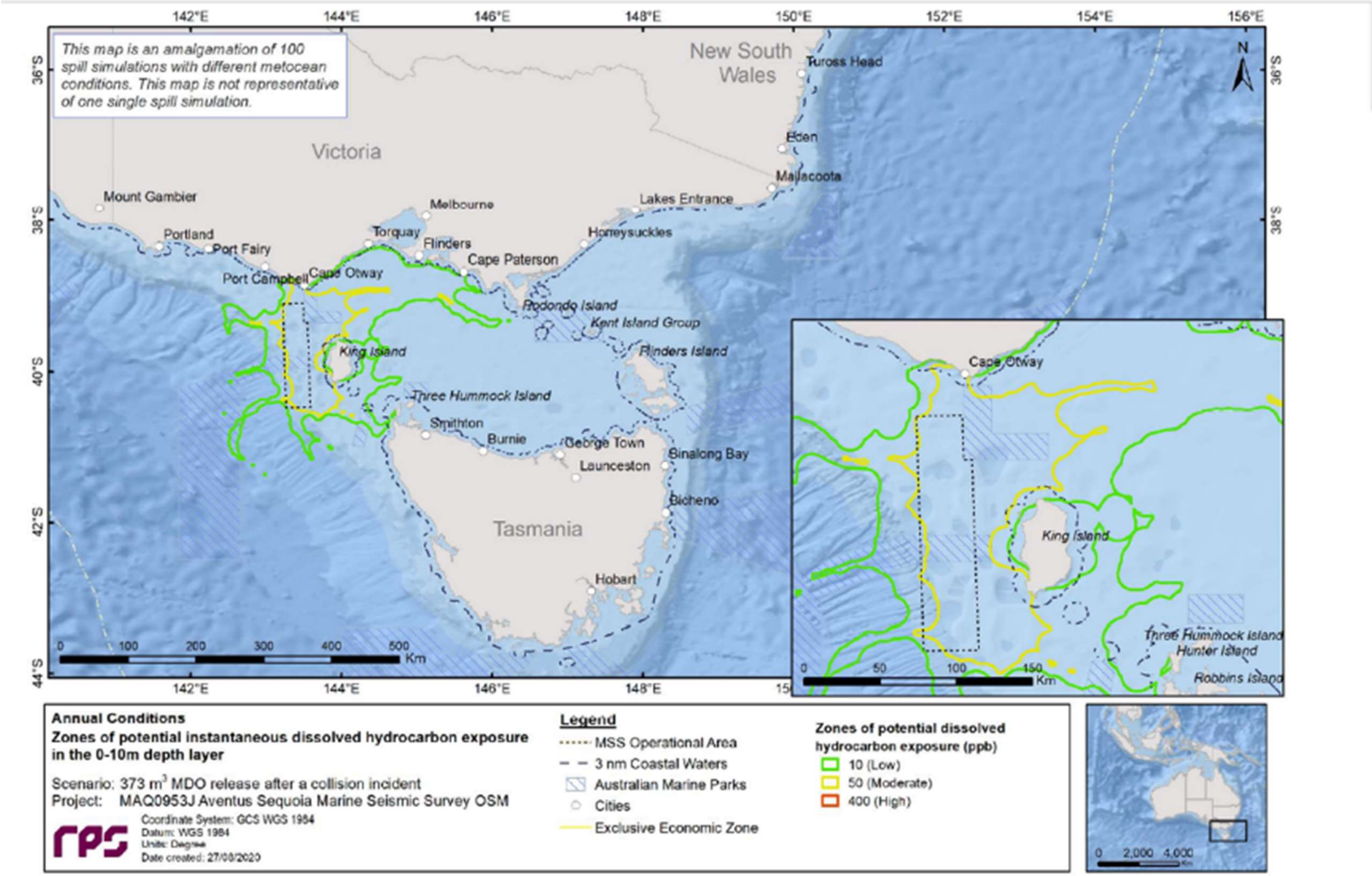


Figure 5-7: Predicted dissolved Spill EMBA for 0-10 m depth resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

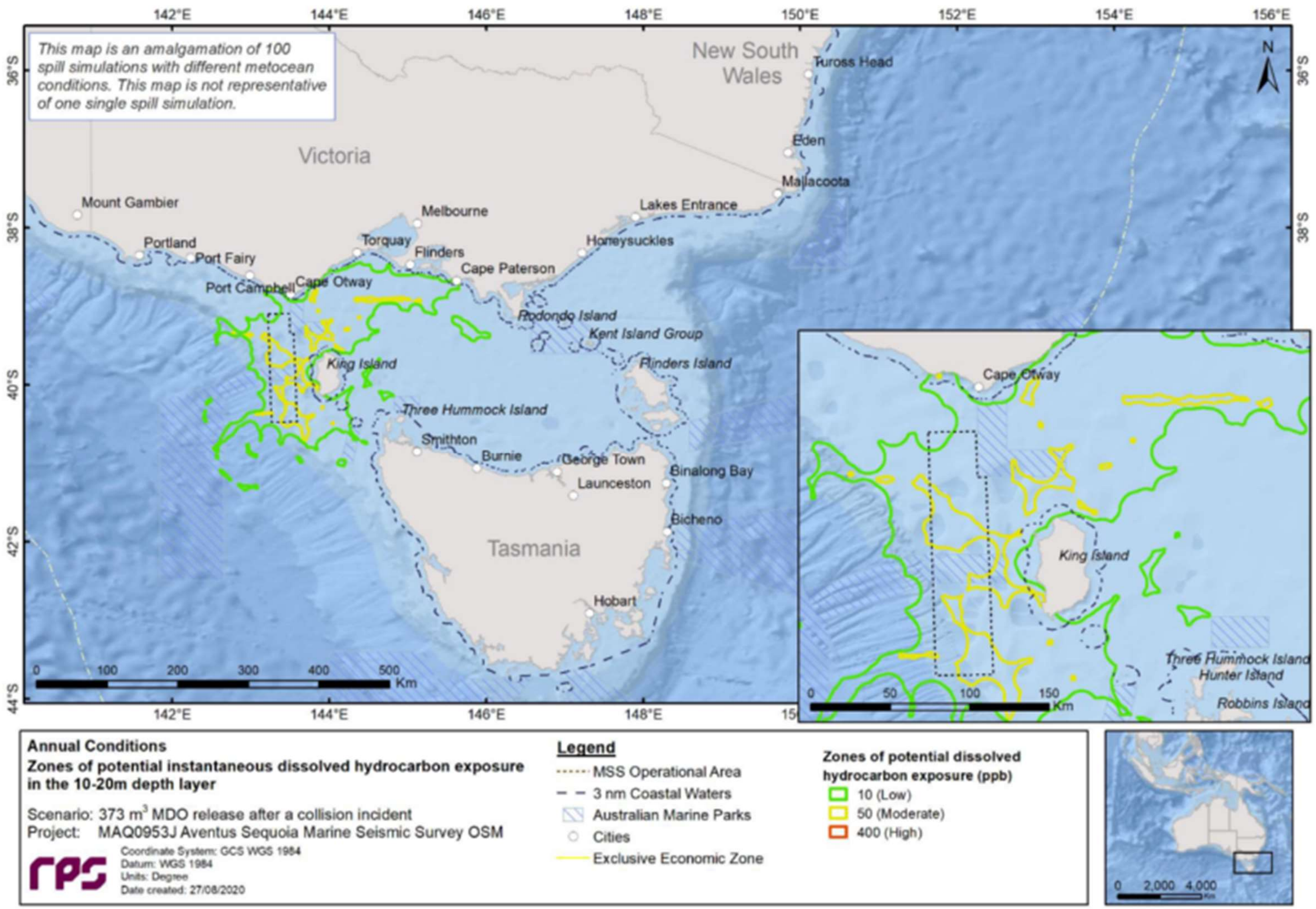


Figure 5-8: Predicted dissolved Spill EMBA for 10-20 m depth resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

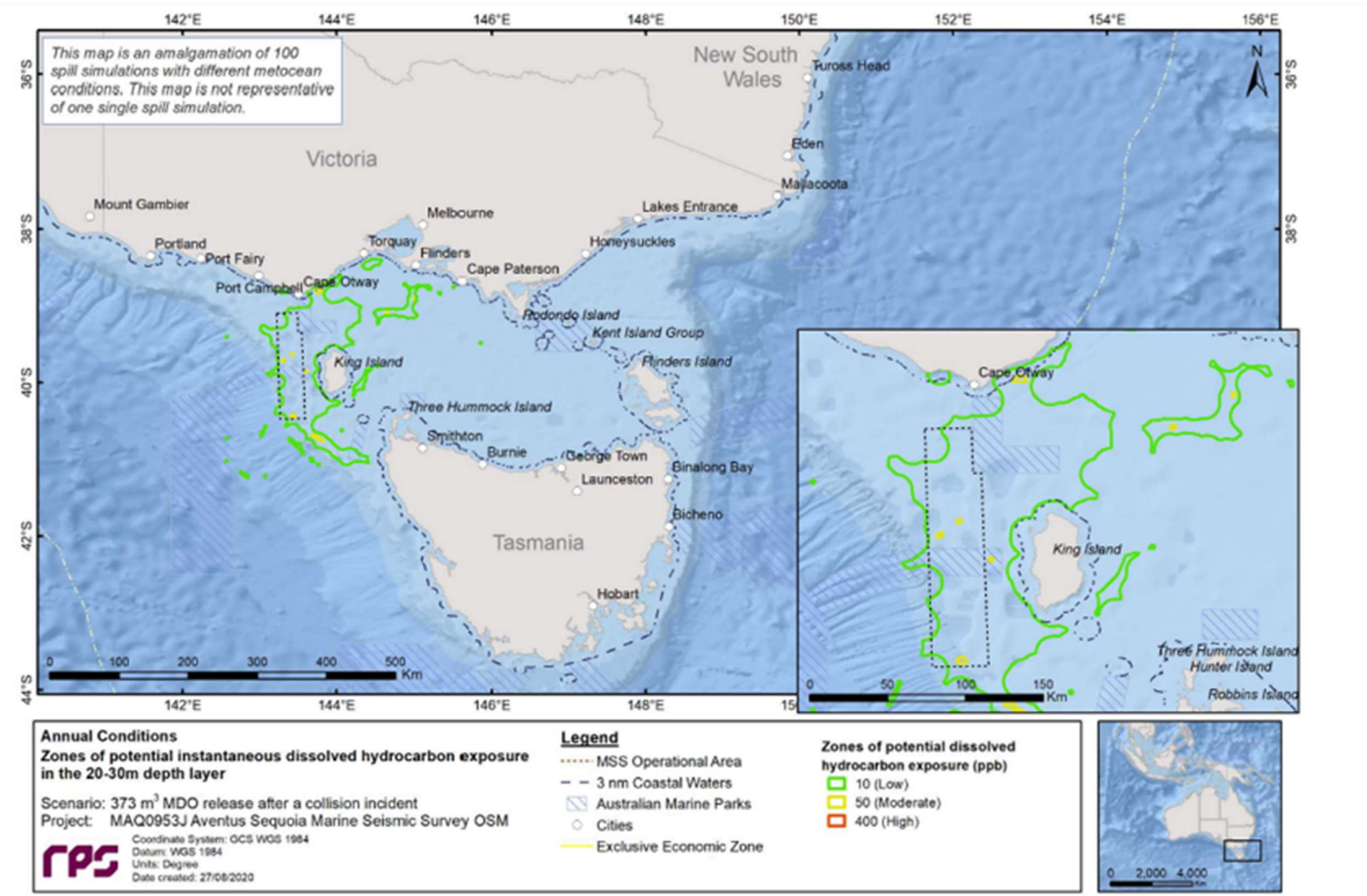


Figure 5-9: Predicted dissolved Spill EMBA for 20-30 m depth resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

Entrained Hydrocarbon Exposure Results

Table 5-35 summarises spill modelling results for entrained hydrocarbons. Noting that only those LGA and Sub-LGA nearshore receptors with moderate threshold exposure have been included in this summary.

Figure 5-10 and Figure 5-11 illustrate the zones of potential moderate (impact) entrained hydrocarbon exposure at 0-10 m and 10 – 20 m below the sea surface, respectively.

The results indicate that the maximum distance travelled from the release location is 742 km predominantly in an east-northeast direction for low (detectable) exposure hydrocarbons and up to 236 km in an east direction for moderate (impact) exposure entrained hydrocarbons.

In the surface layer (0-10m), entrained hydrocarbon exposure at or above the moderate threshold was predicted at three AMPs, two MNPs, one KEF, five nearshore local government areas and four sub areas.

Table 5-35: Summary of exposure to receptors from entrained MDO based on results for the MDO spill scenario thresholds within 0-10 m depth layer

Receptor		Maximum probability (%)		Minimum time to contact (days)	
		Low (detectable) threshold	Moderate (impact) threshold	Low (detectable) threshold	Moderate (impact) threshold
AMP	Apollo	22	10	0.04	0.04
	Beagle	6	–	7.46	-
	Boags	7	–	6.17	-
	Franklin	8	1	2.71	3.00
	Zeehan	24	13	0.04	0.04
Marine National Park (MNP)	Bunurong	2	1	3.13	3.33
	Cape Howe	3	–	17.79	-
	Point Addis	7	1	2.63	2.75
	Point Hicks	1	–	19.63	-
	Port Phillip Heads	1	–	13.71	-
	Twelve Apostles	2	–	6.38	-
	Wilsons Promontory	8	–	5.46	-
Marine Sanctuary (MS)	Barwon Bluff	1	–	24.83	-
	Marengo Reefs	5	–	1.71	-
	Mushroom Reef	1	–	7.17	-
	Point Danger	1	–	16.67	-
National Park (NP)	Kent Group	2	–	16.29	-
	Bunurong Marine Park	3	–	3.00	-
	Wilsons Promontory Marine Park	3	–	5.79	-

	Wilsons Promontory Marine Reserve	5	–	5.46	-
KEF	Bonney Coast Upwelling	1	–	25.58	-
	Canyons on the eastern continental slope	1	–	27.38	-
	Upwelling East of Eden	4	–	14.50	-
	West Tasmania Canyons	14	6	0.04	0.04
Ramsar Sites	Lavinia	2	–	5.29	-
	Port Phillip Bay (Western Shoreline) and Bellarine Peninsula	1	–	24.79	-
	Westernport	1	–	7.63	-
LGA Nearshore	Black Pyramid	8	1	3.17	3.71
	Colac Otway	9	1	1.08	1.17
	King Island	16	3	1.33	1.42
	Reid Rock	15	2	2.58	3.29
	Surf Coast	7	1	2.13	2.25
Sub-LGA Nearshore	Apollo Bay	9	1	1.17	1.21
	Cape Otway West	9	1	1.08	1.17
	Cape Patton	8	1	1.75	1.92
	Lorne	7	1	2.08	2.17

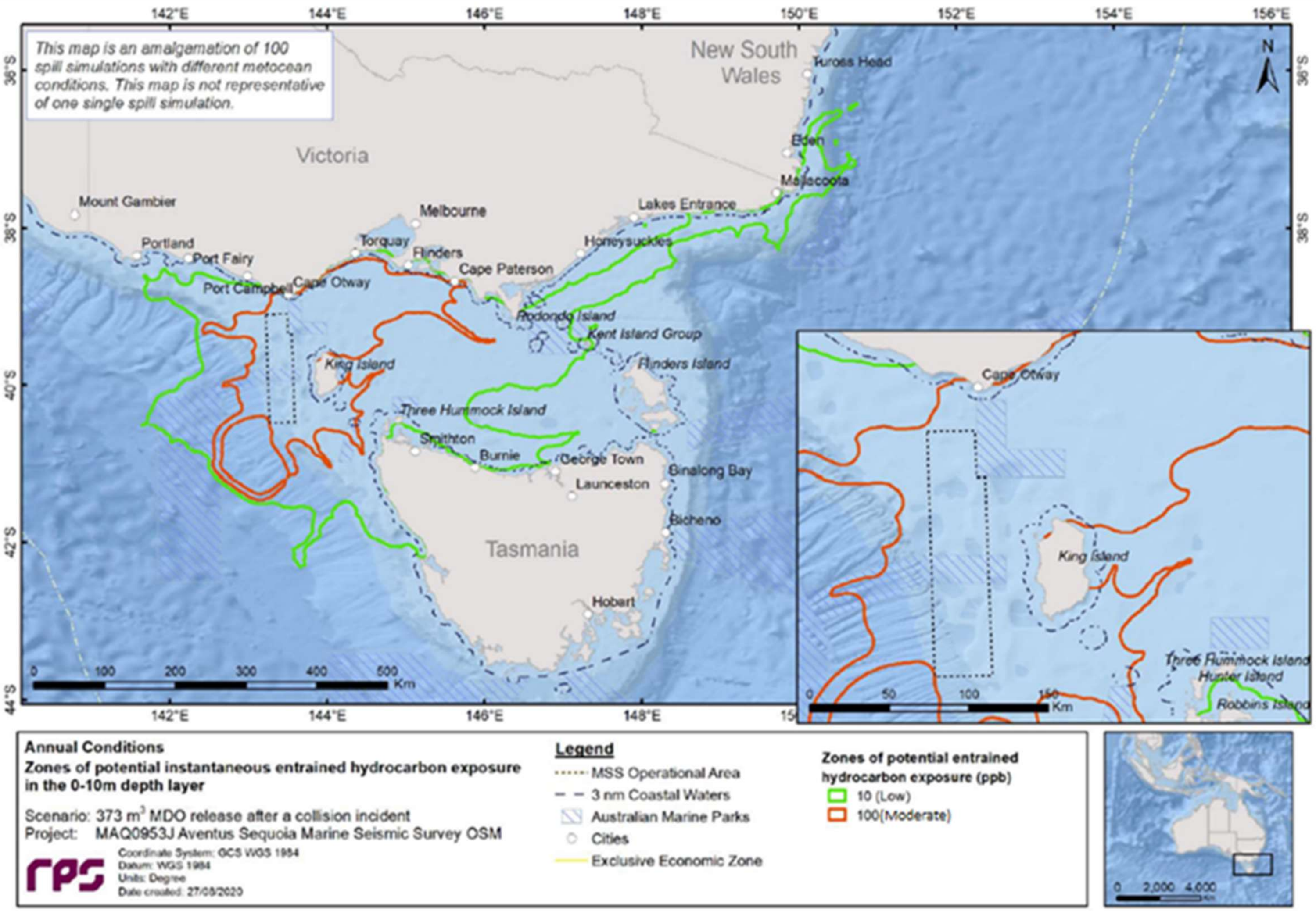


Figure 5-10: Predicted entrained Spill EMBA for 0-10 m depth resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

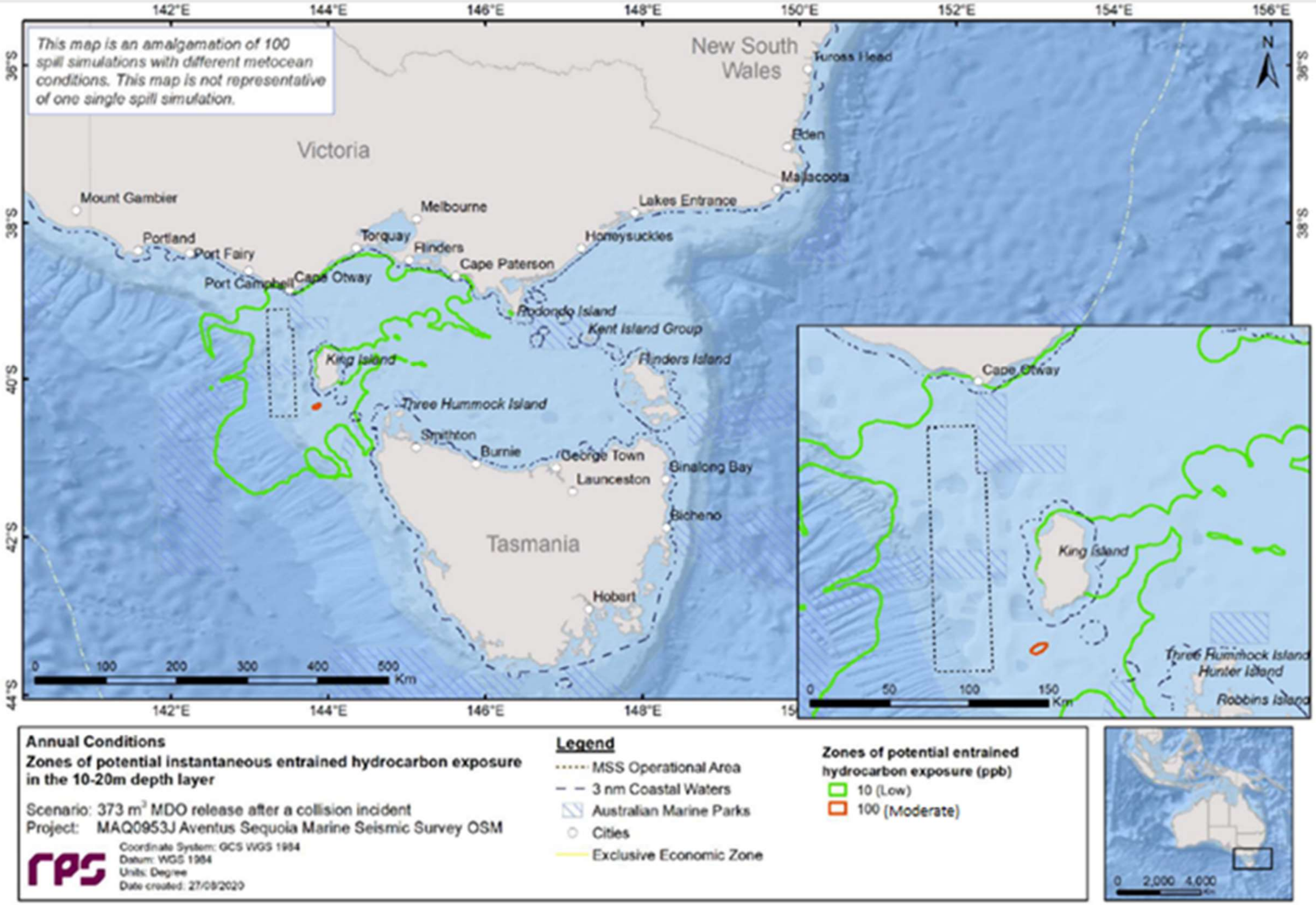


Figure 5-11: Predicted entrained Spill EMBA for 10-20 depth resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days

5.4.3. Existing Environment

The full description of the environment that may be affected by the Spill EMBA (i.e. worst-case low threshold exposure) is provided in Appendix G. The description of environment and impact assessment is undertaken at a level of detail relevant for the nature and scale of the values and sensitivities. The level of detail required for the receptors depends on whether the environment or receptor affected is formally managed, protected and/or threatened, has biologically important behaviour in relevant EMBA, is more vulnerable, and/or is considered a high priority by stakeholders/ ConocoPhillips Australia.

For those receptors that are also identified within the Operational Area and smaller EMBAs for planned aspects (i.e. Sound, Light); a detailed description of their values and sensitivities is provided in Section 4 (Receptors).

The key values and sensitivities of the receptors only found within the Spill EMBA are shown in Figure 5-12 to Figure 5-40 below. To support the risk assessment and be conservative, the low thresholds of spill modelling exposures are shown on these figures.

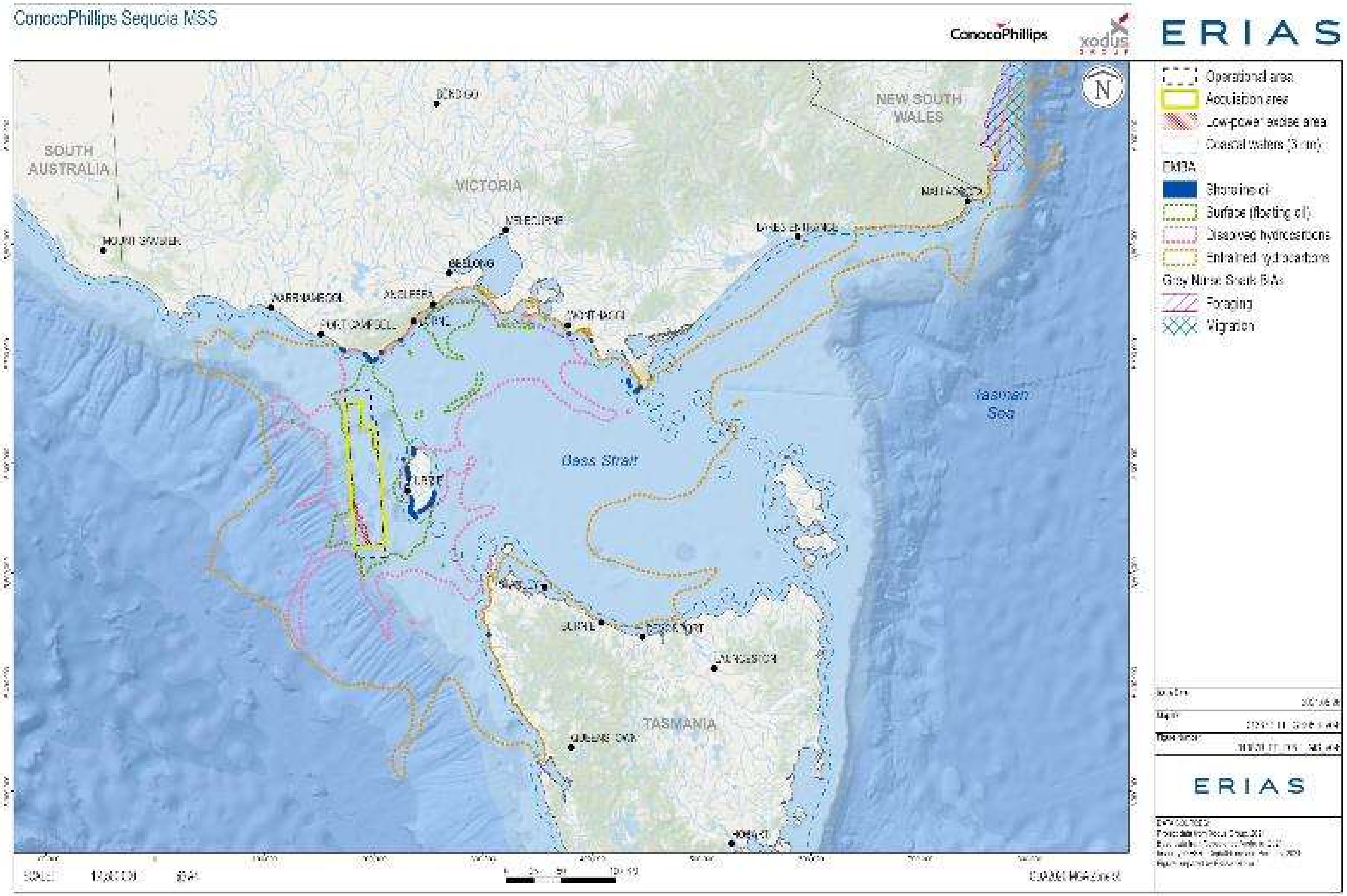


Figure 5-12: Grey Nurse Shark BIAs

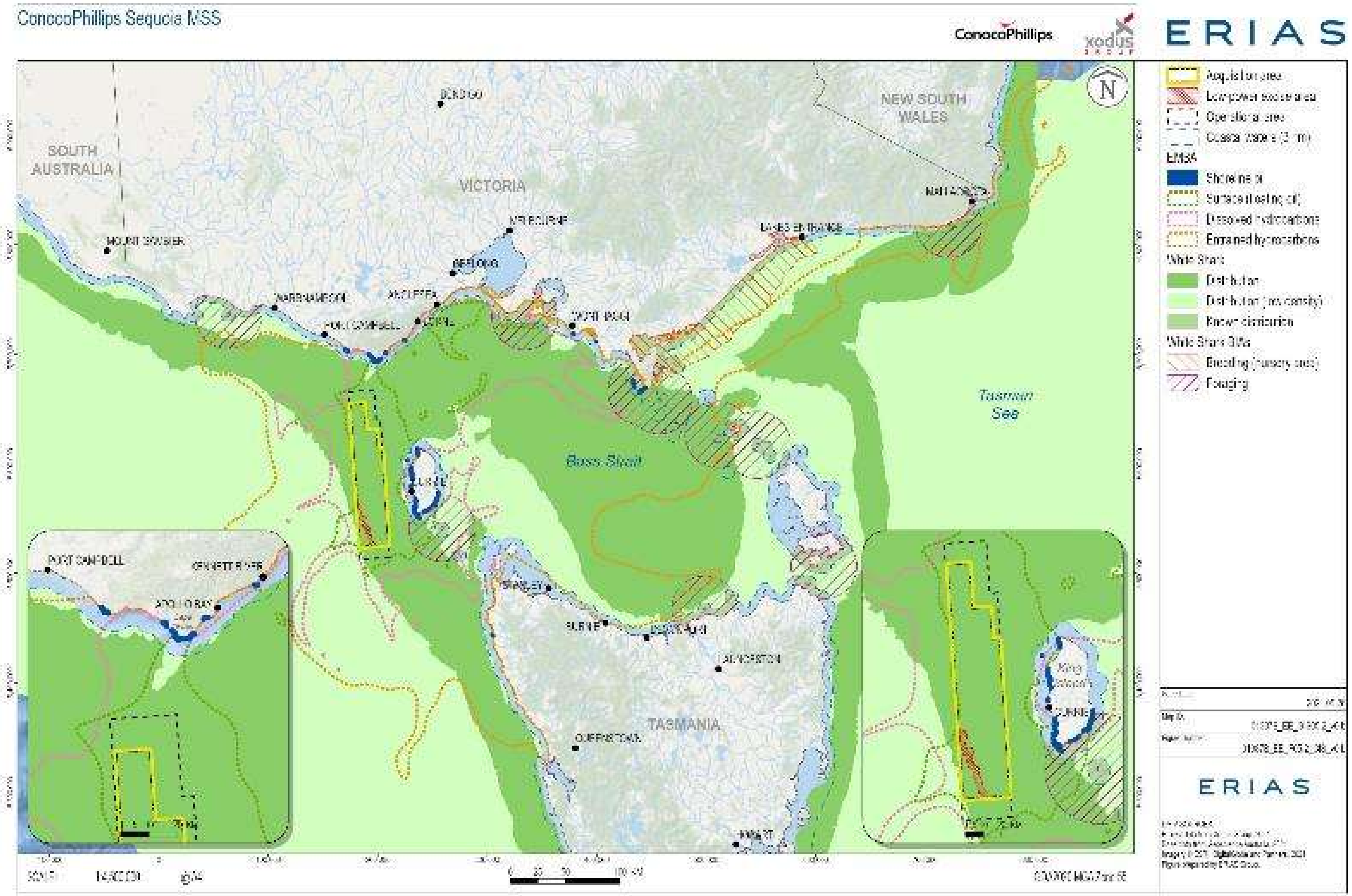


Figure 5-13: White Shark BIAs

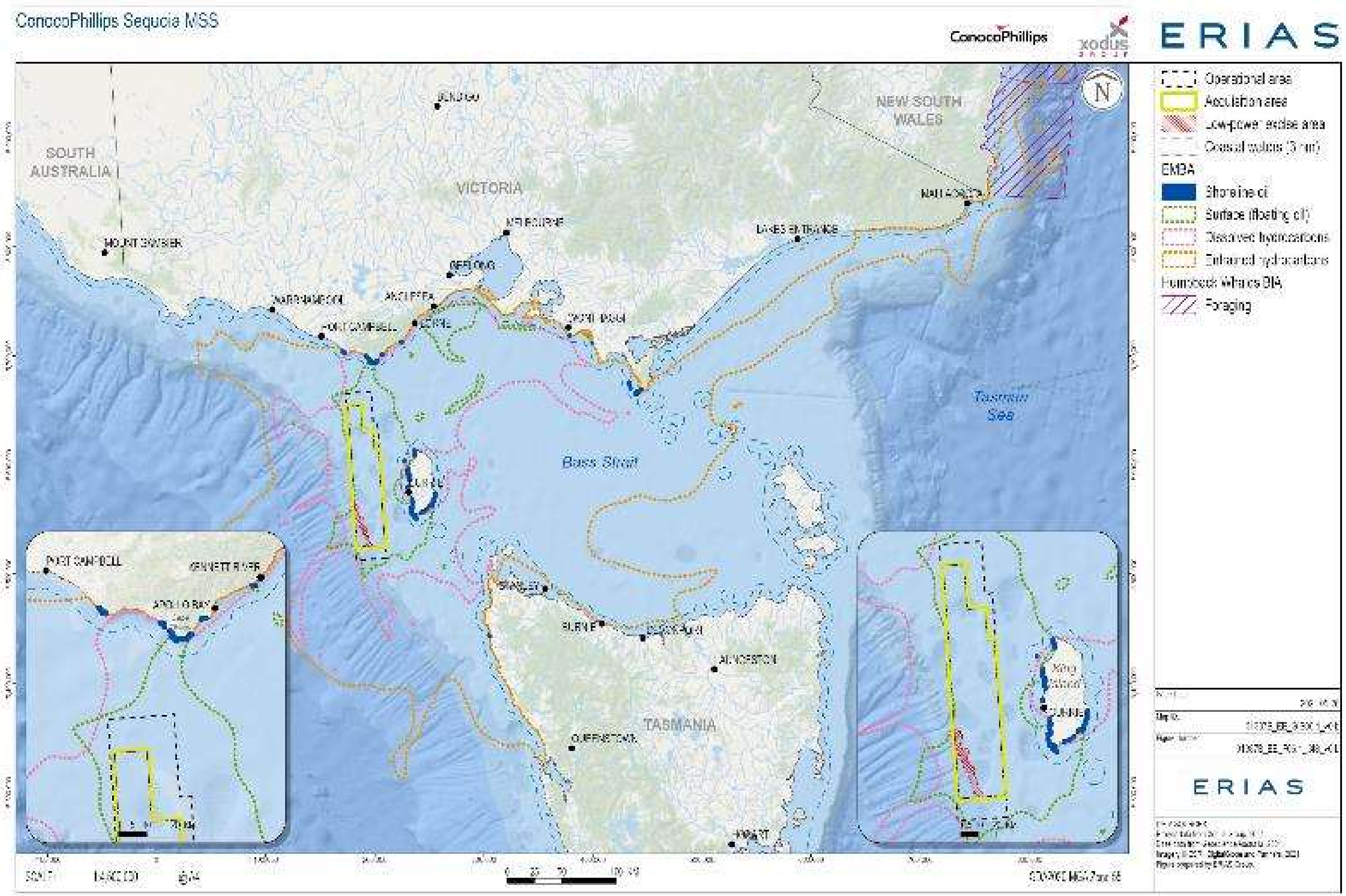


Figure 5-14: Humpback Whale BIA

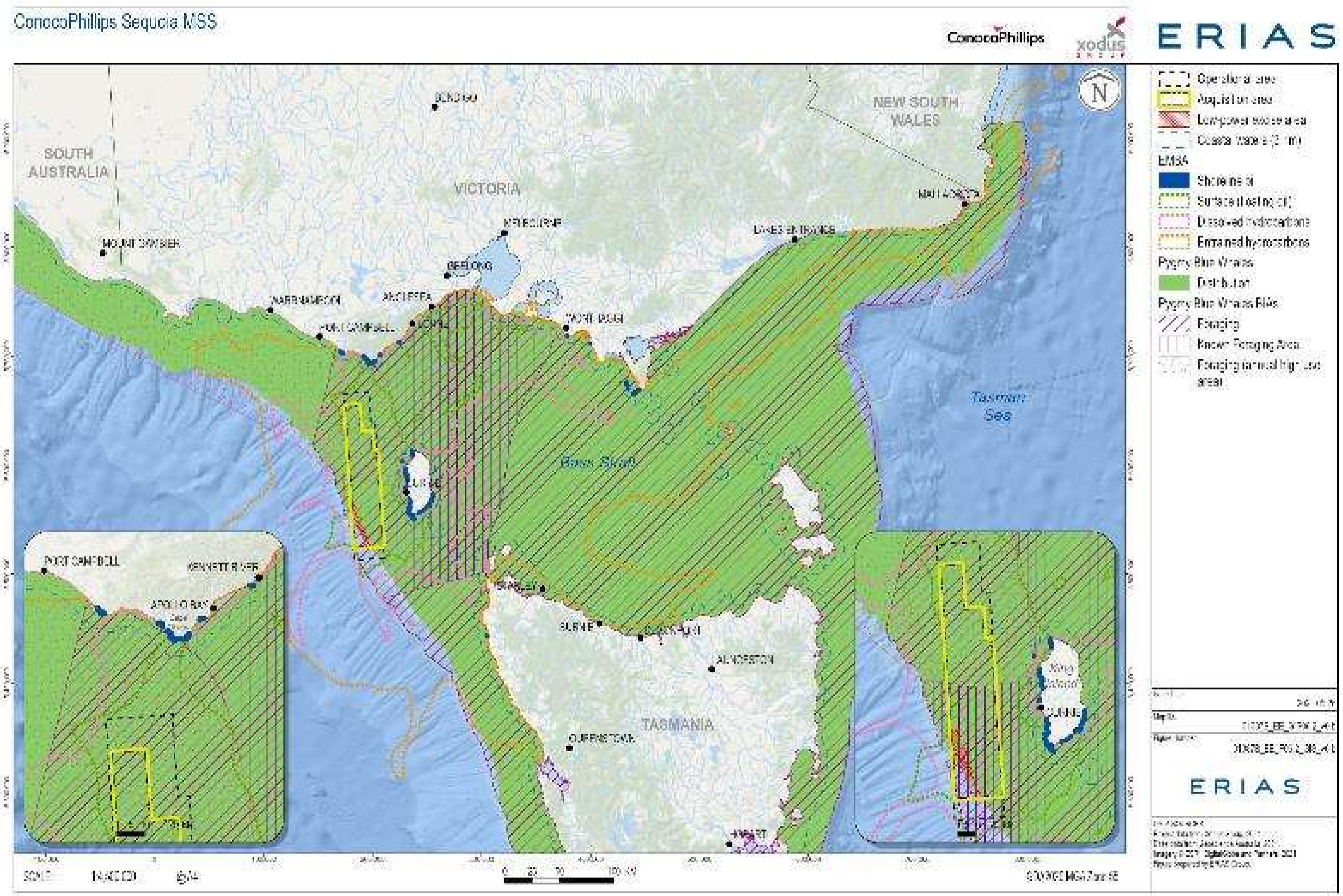


Figure 5-15: Pygmy Blue Whale BIAs

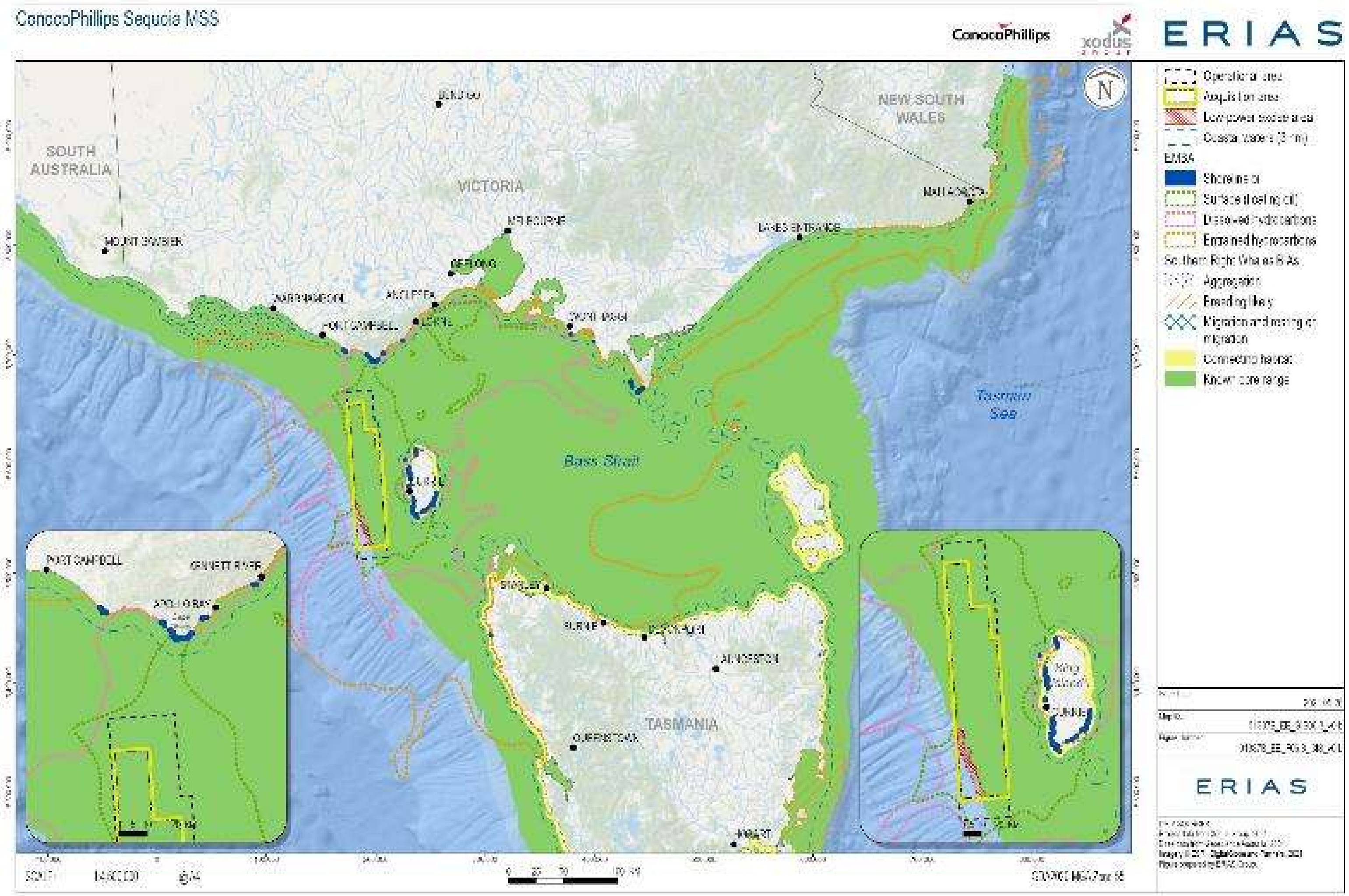


Figure 5-16: Southern Right Whale BIAs

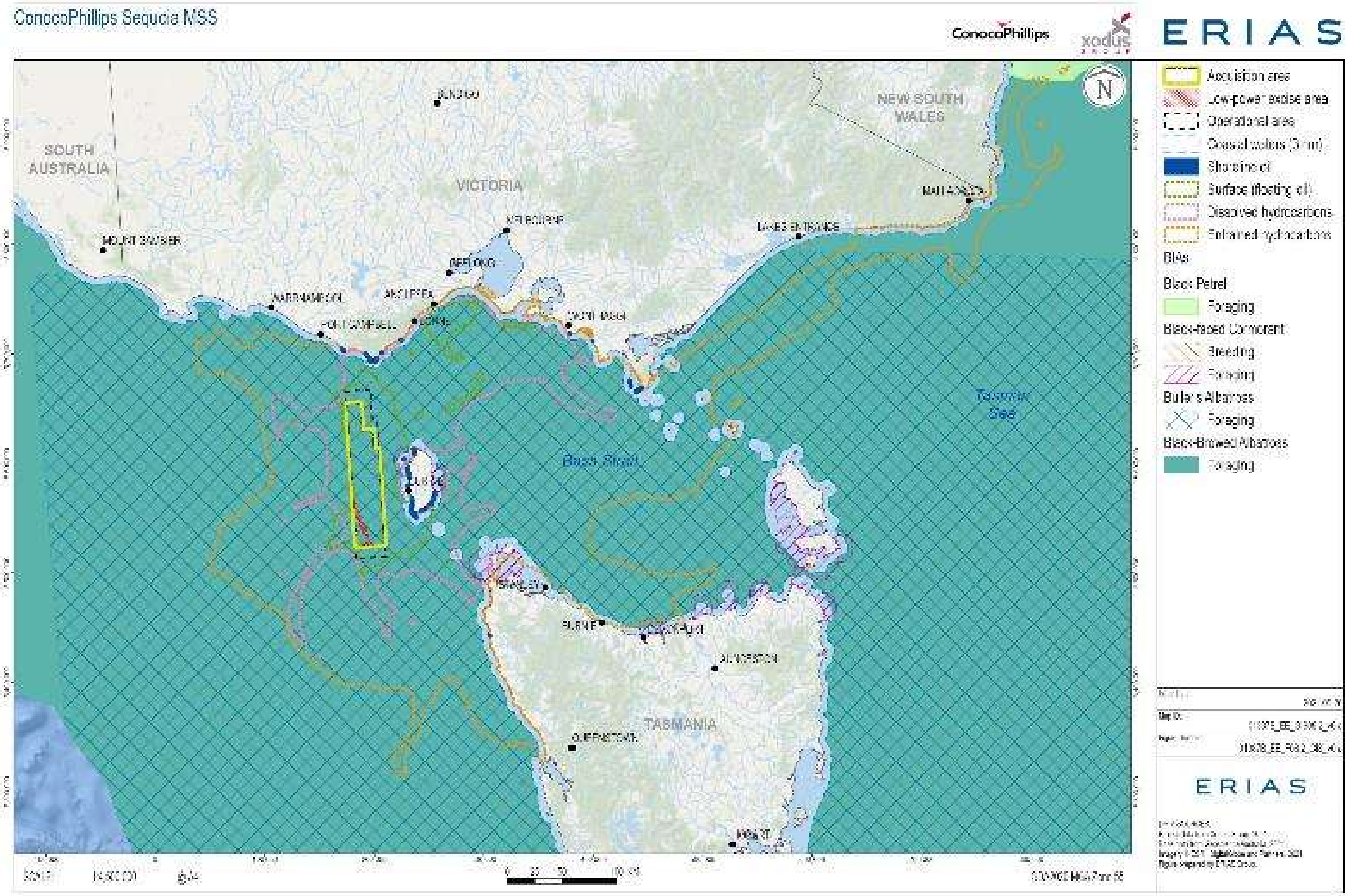


Figure 5-17: Black Petrel, Black-faced Cormorant, Buller's Albatross and Black-bowed Albatross BIAs

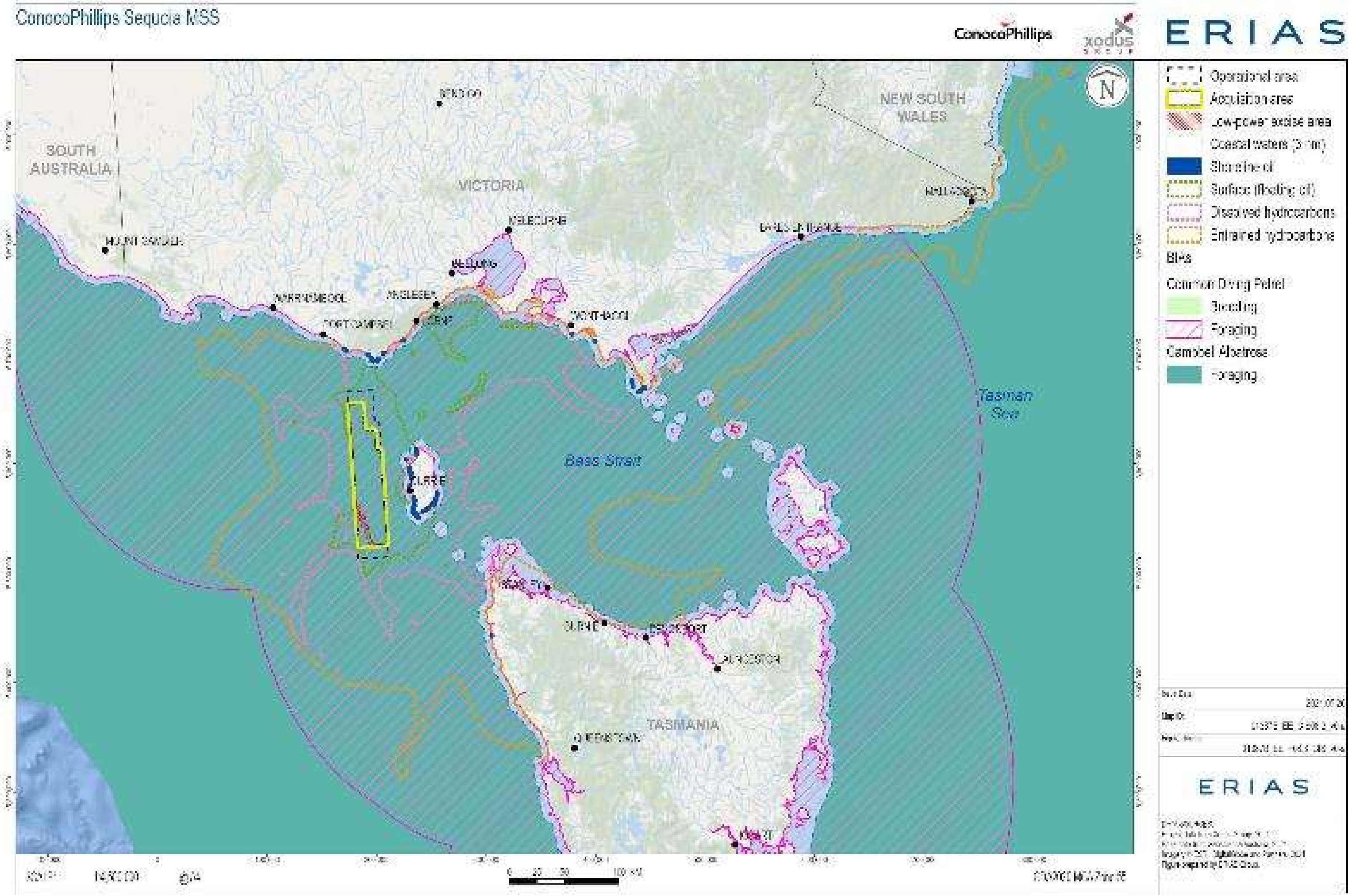


Figure 5-18: Common Diving Petrel and Campbell Albatross BIAs

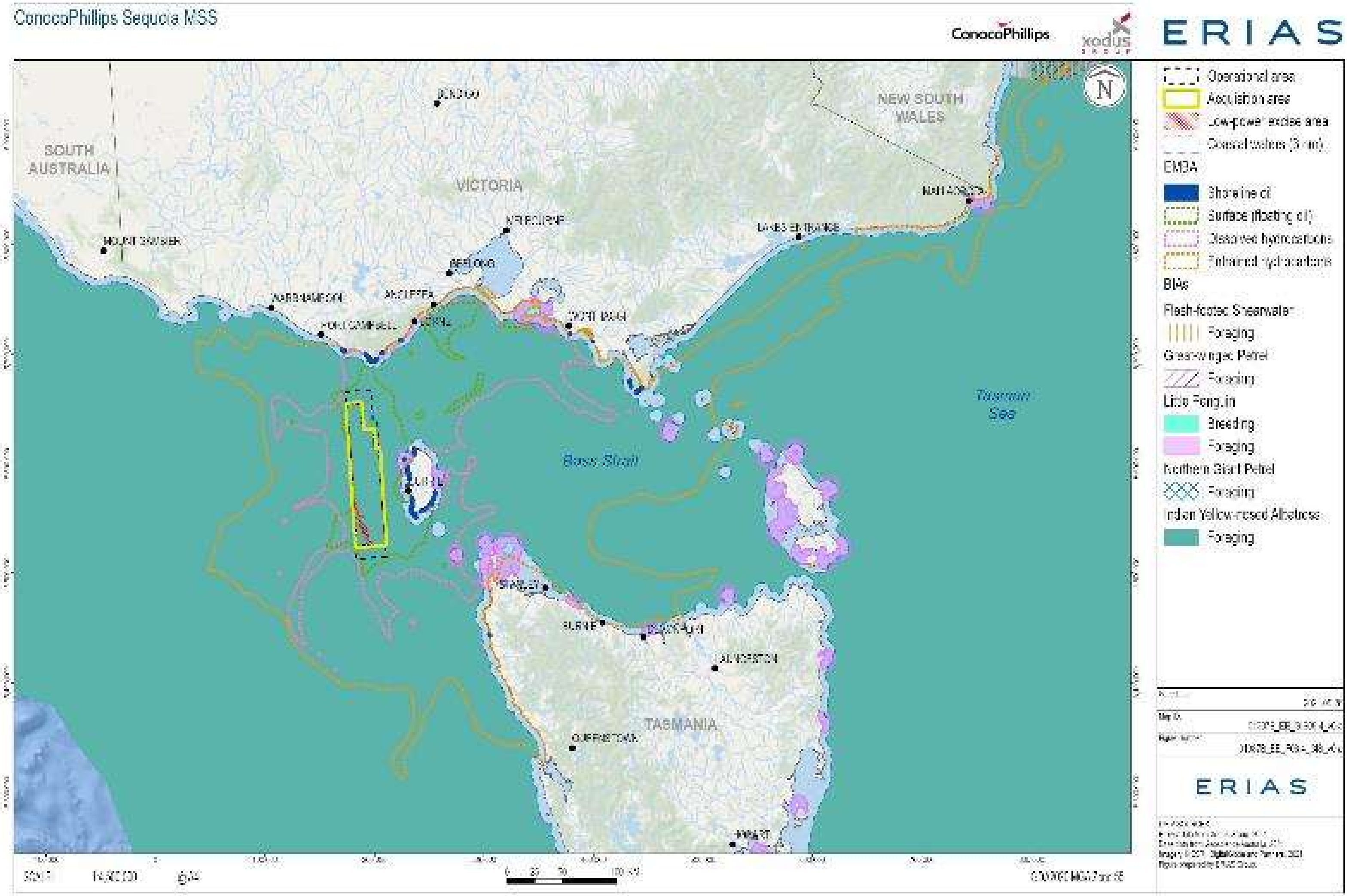


Figure 5-19: Flesh-footed Shearwater, Great-winged Petrel, Little Penguin, Northern Giant Petrel and Indian Yellow-nosed BIAs

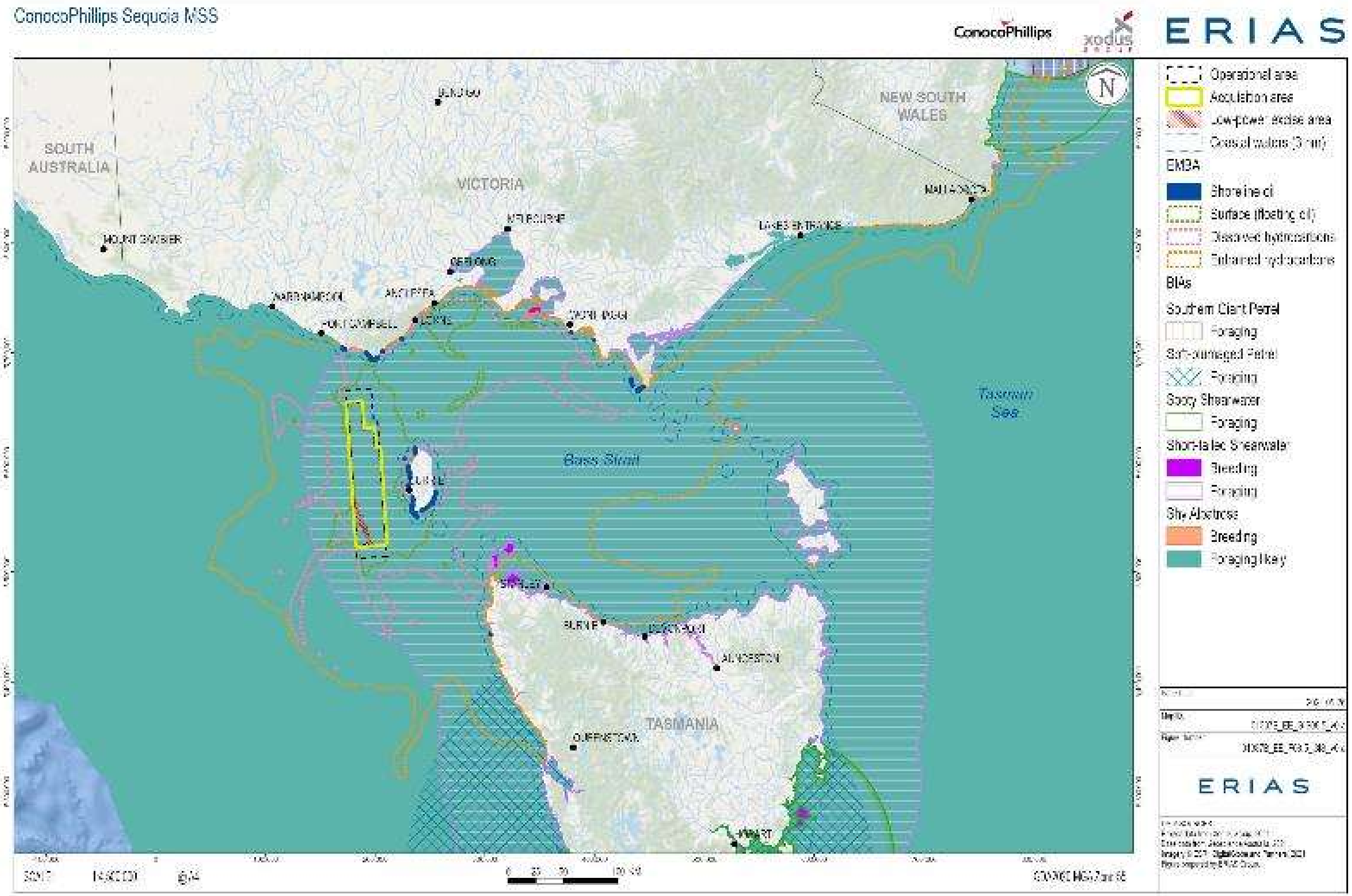


Figure 5-20: Southern Giant Petrel, Soft-plumaged Petrel, Sooty Shearwater, Short-tailed Shearwater and Shy Albatross BIAs

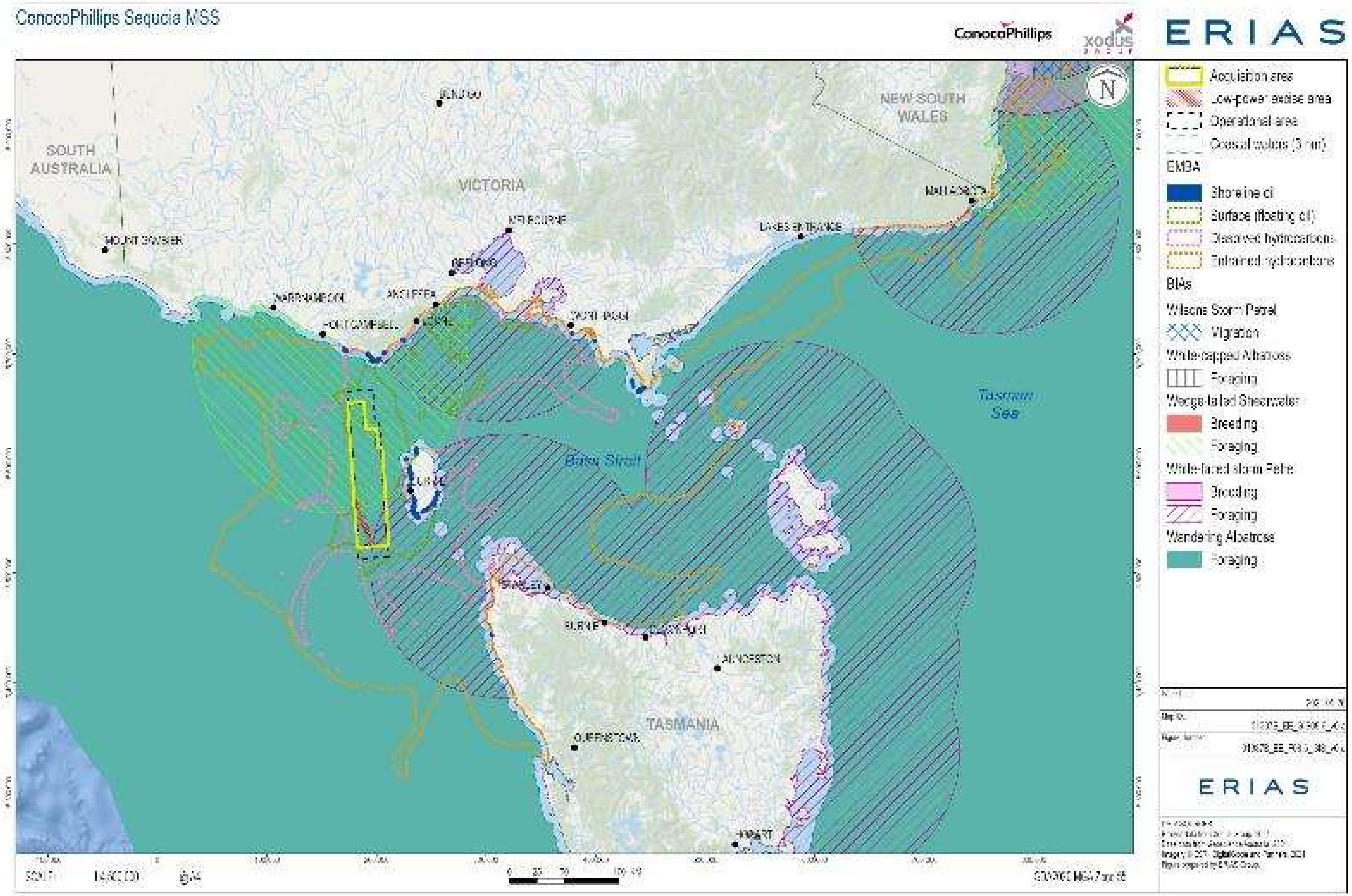


Figure 5-21: Wilsons Storm Petrel, White-capped Albatross, Wedge-tailed Shearwater and Wandering Albatross BIAS

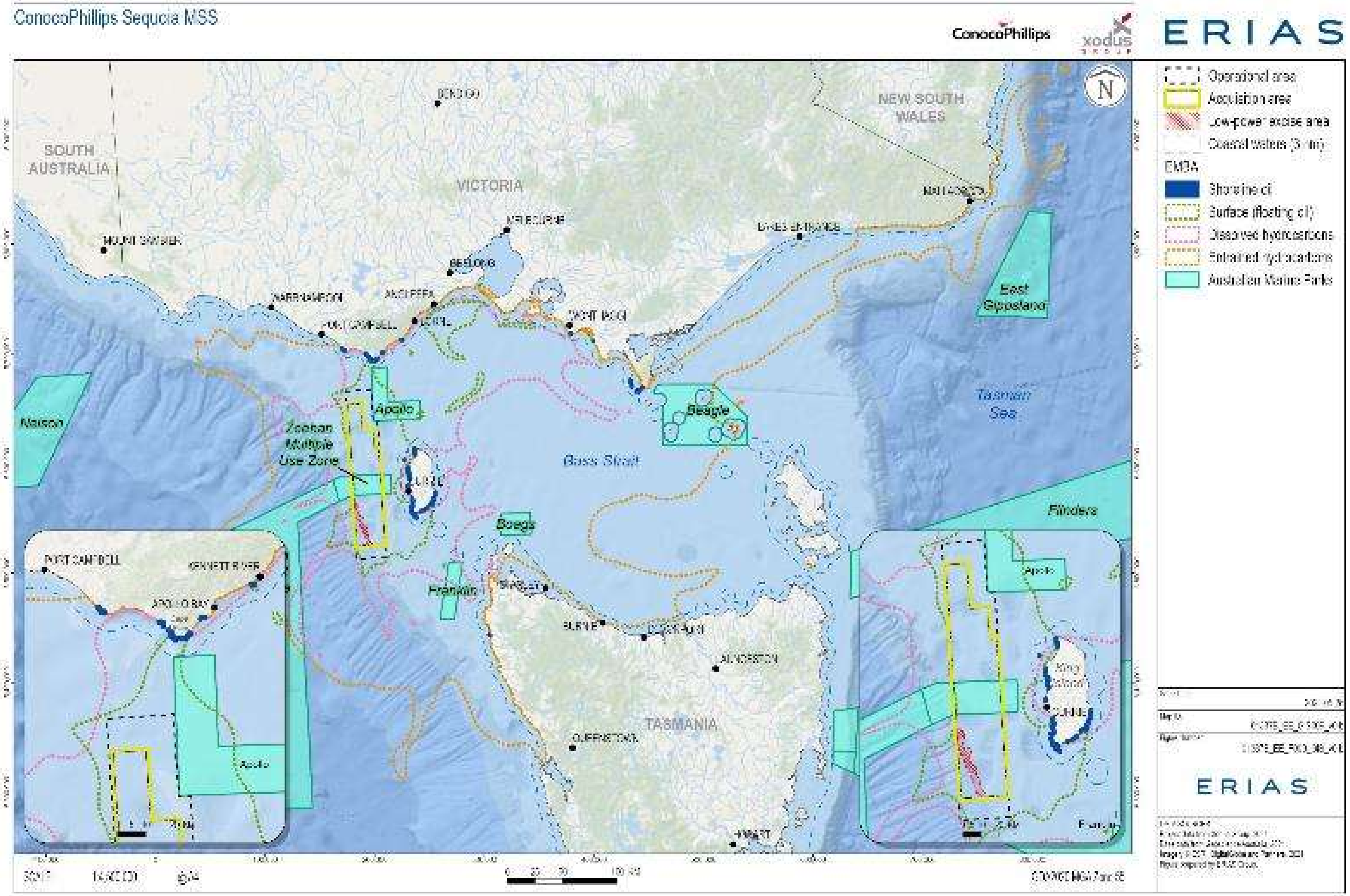


Figure 5-22: Australian Marine Parks

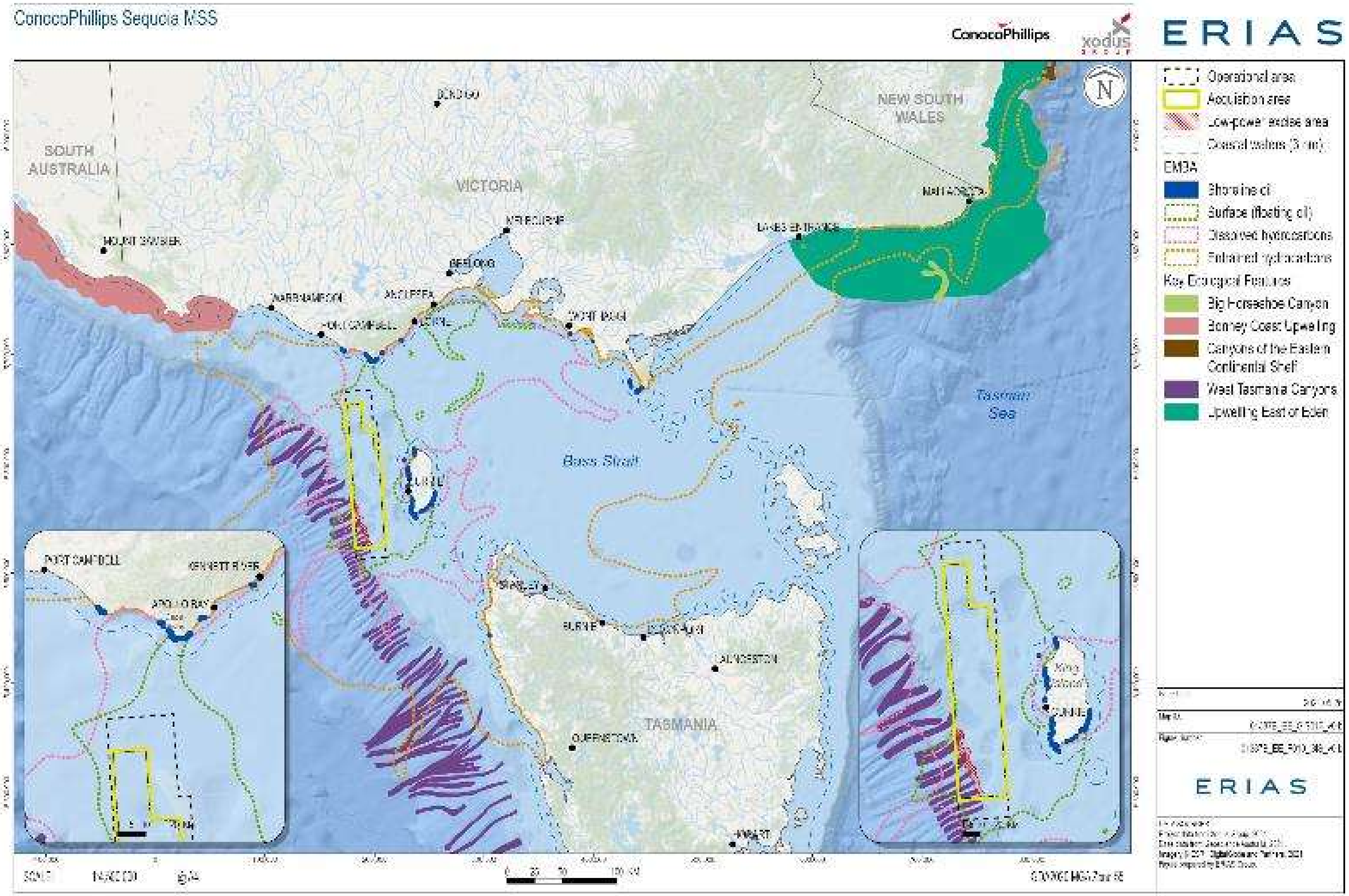


Figure 5-23: Key Ecological Features within the Spill EMBA

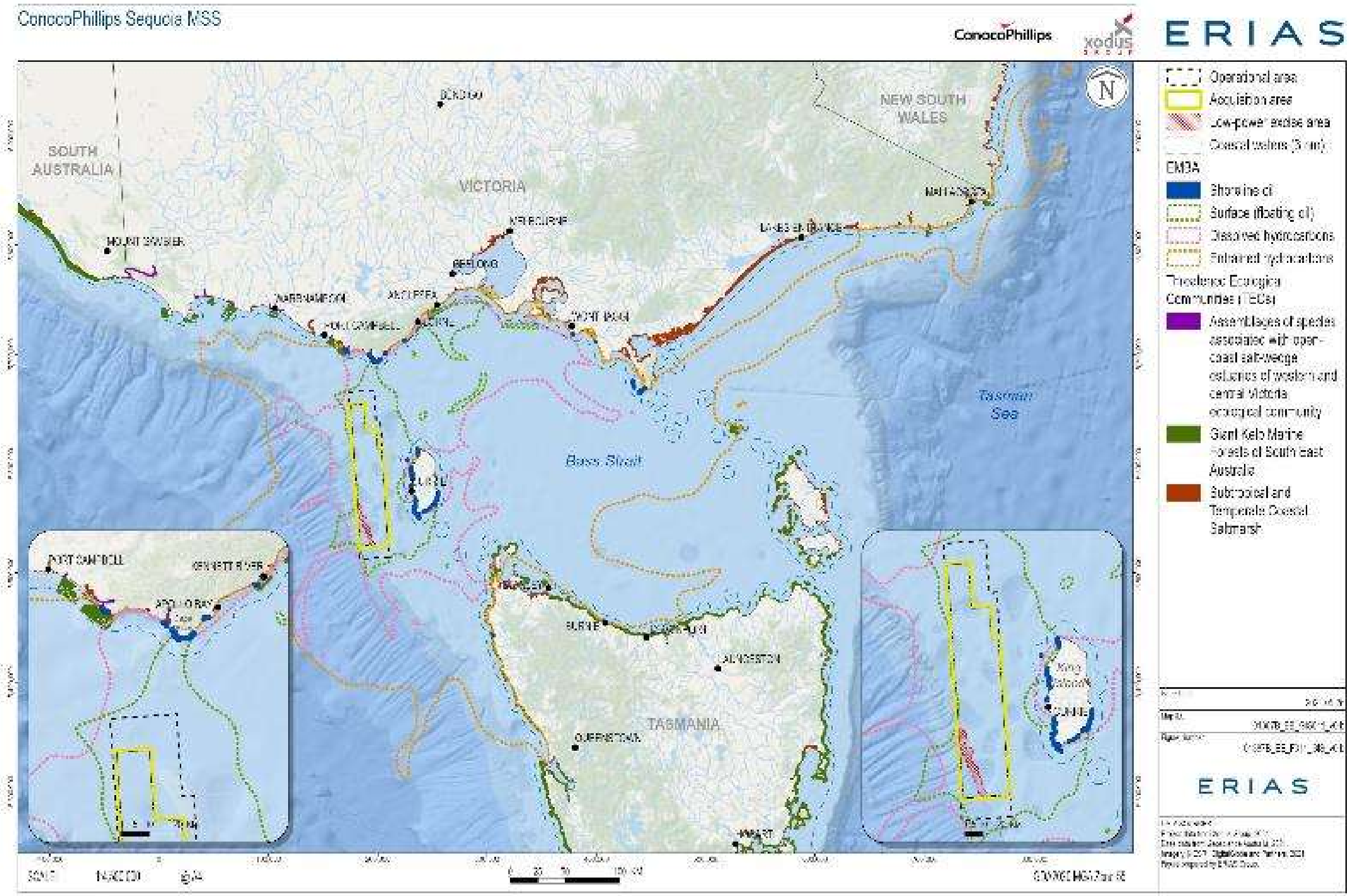


Figure 5-24: Threatened Ecological Communities within the Spill EMBA

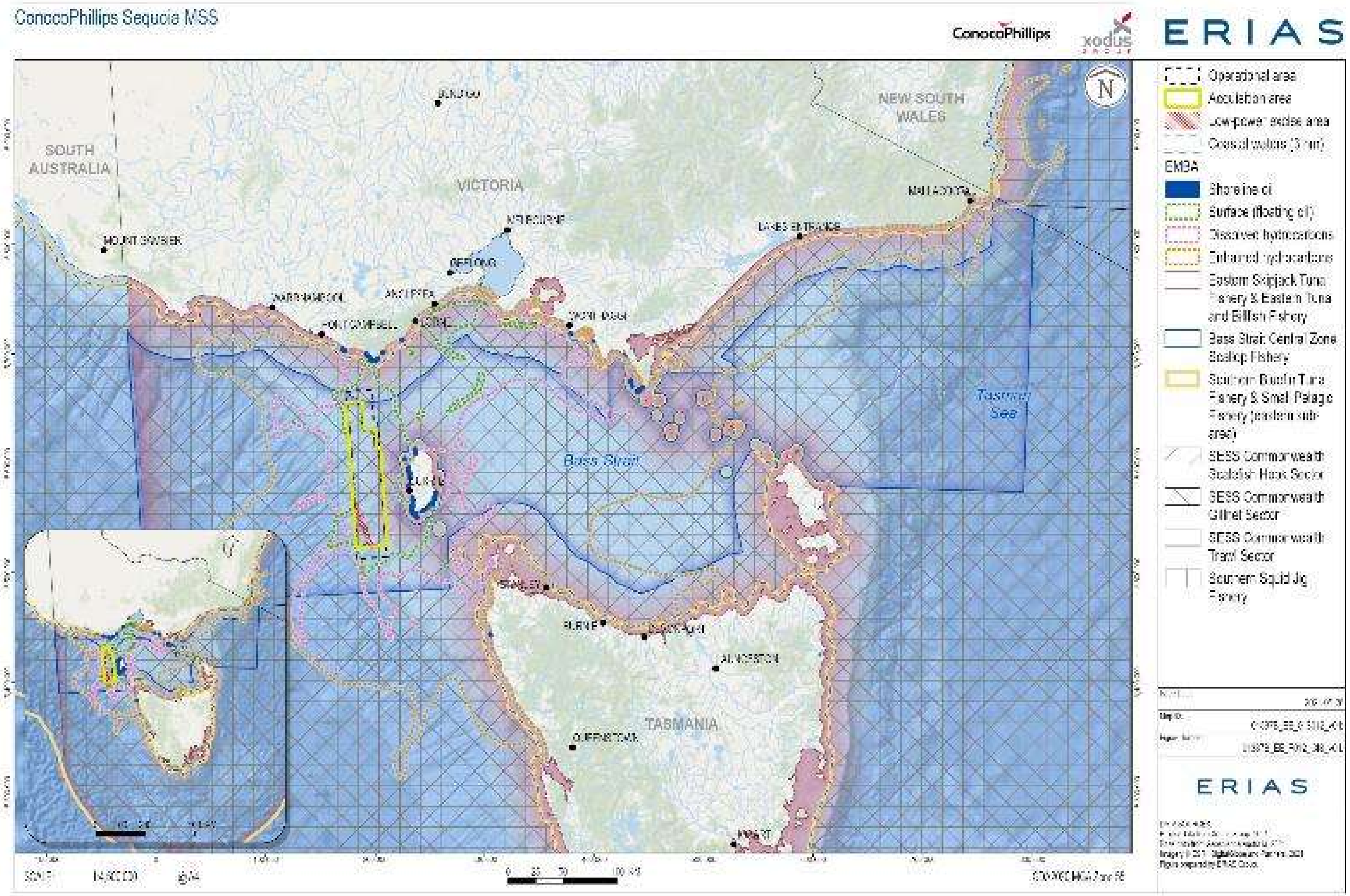


Figure 5-25: Commonwealth Fisheries

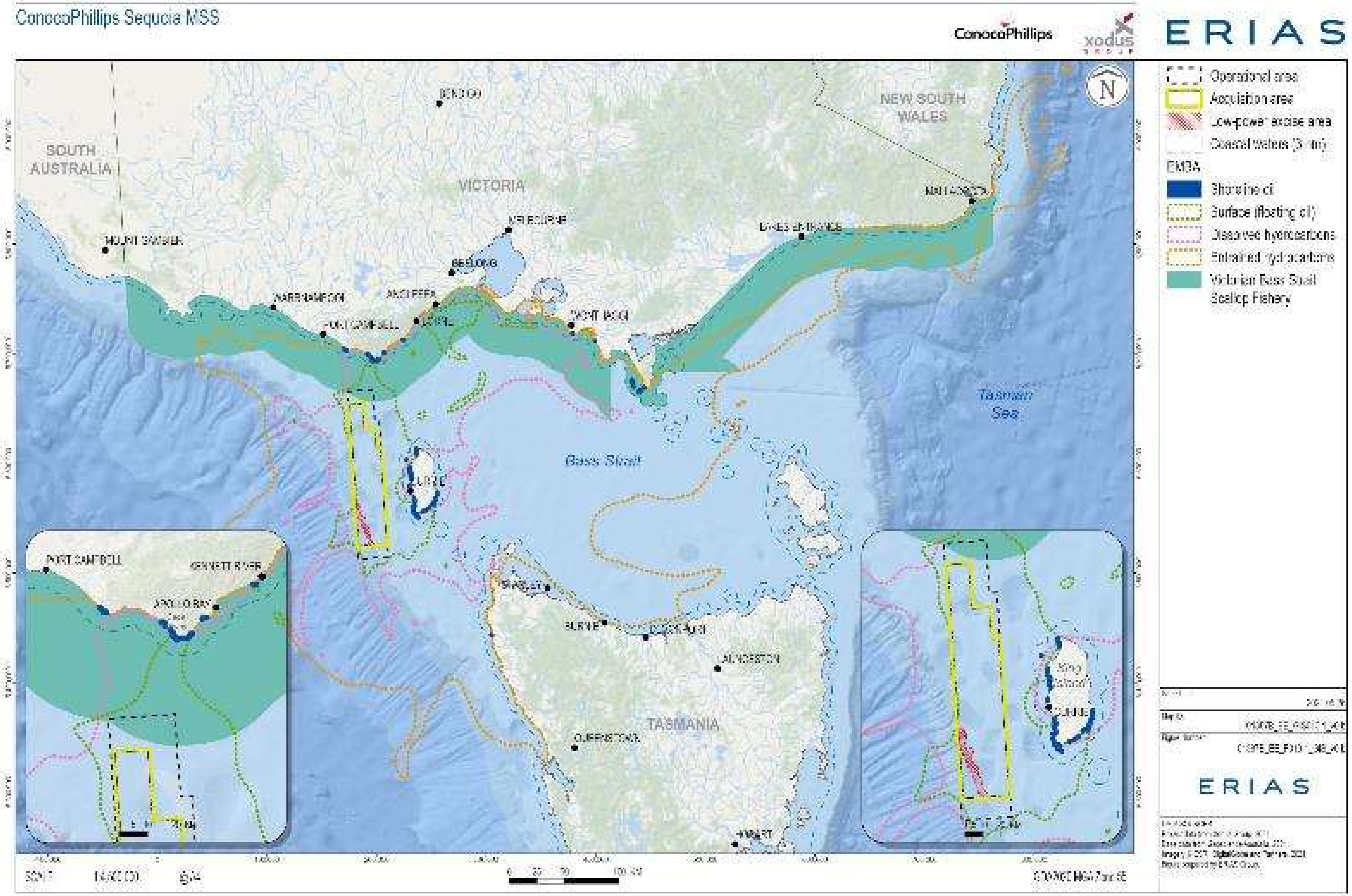


Figure 5-26: Victorian Bass Strait Scallop Fishery

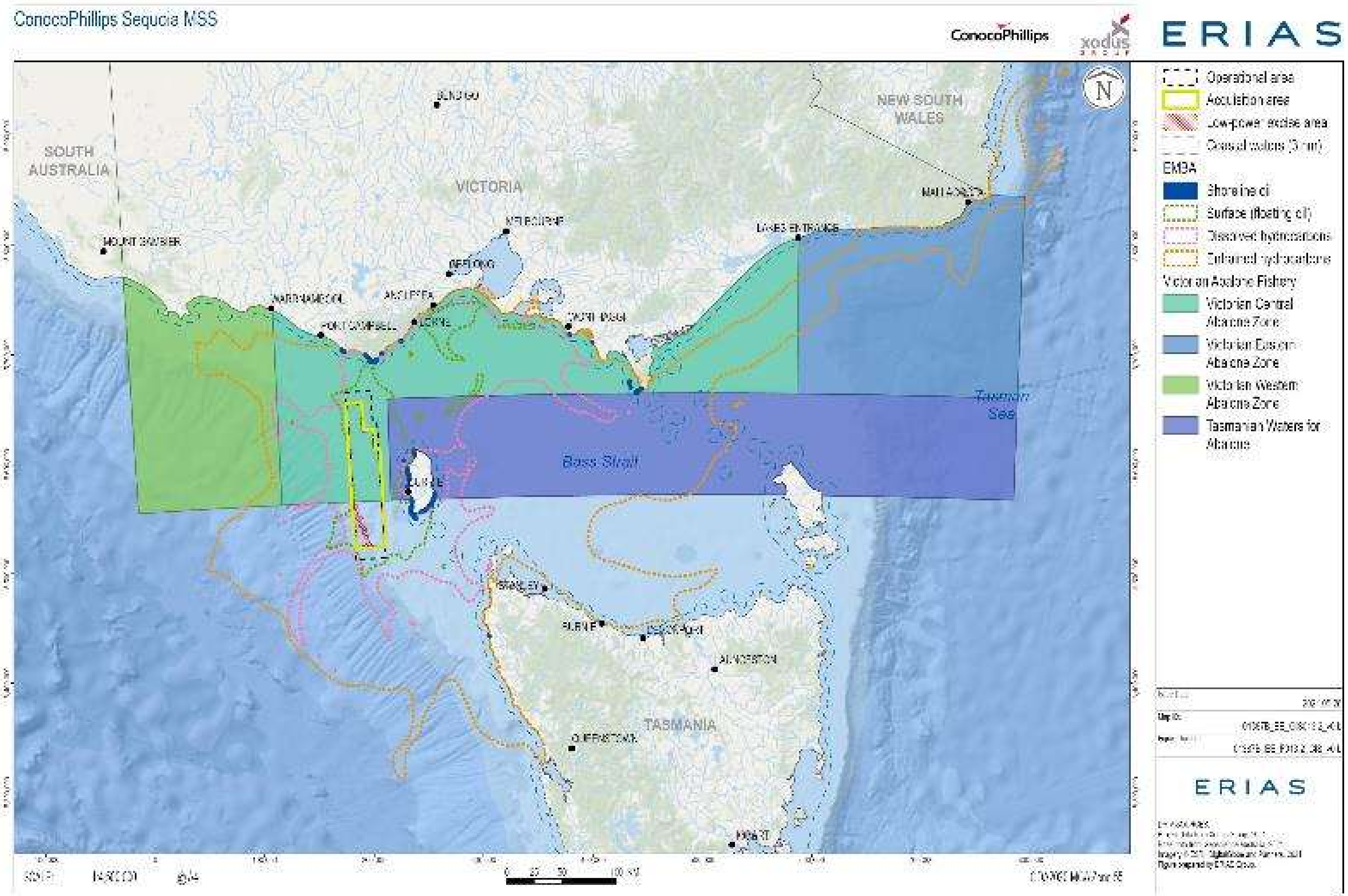


Figure 5-27: Victorian Abalone Fishery

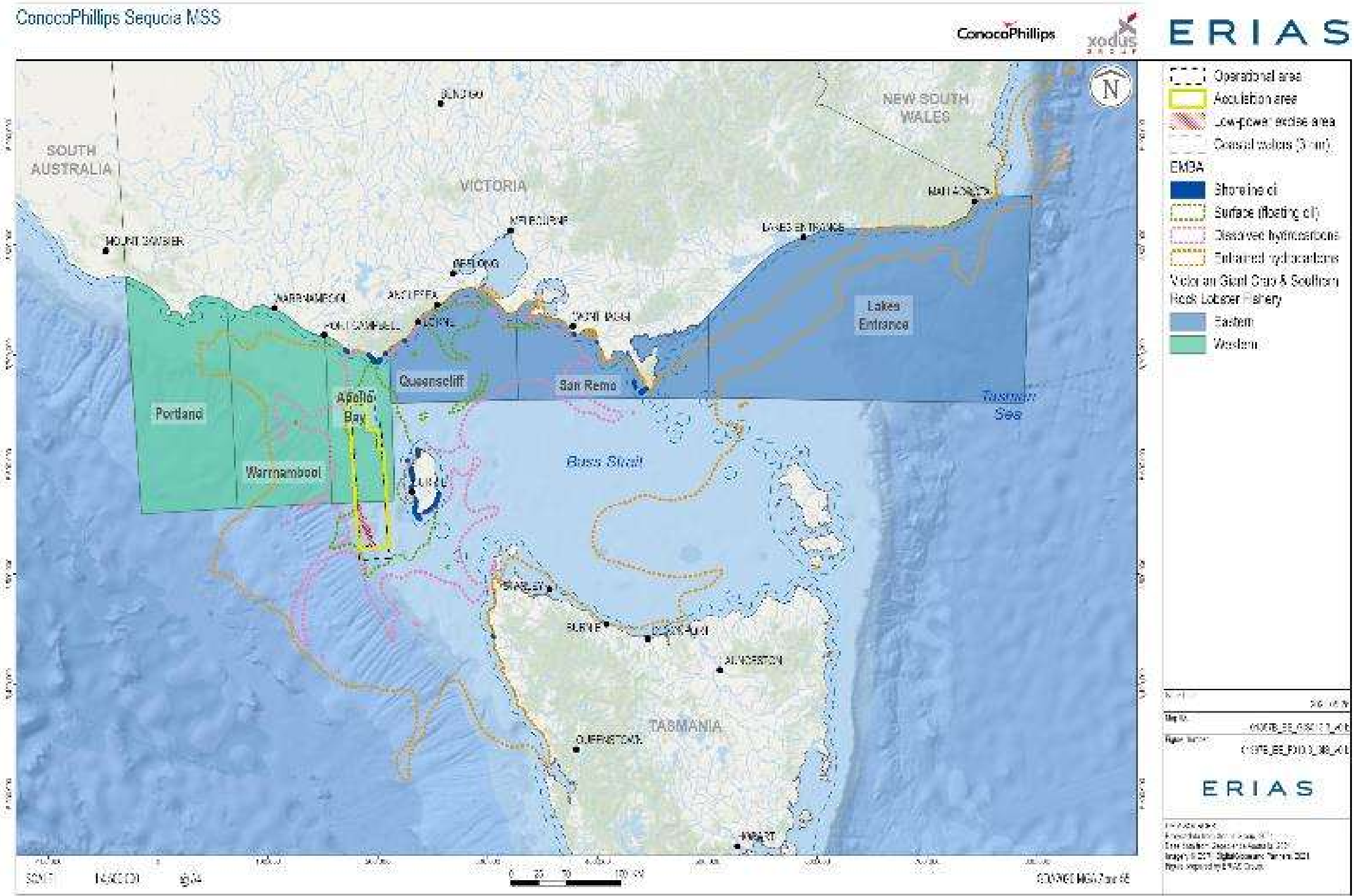


Figure 5-28: Victorian Giant Crab and Southern Rock Lobster Fishery

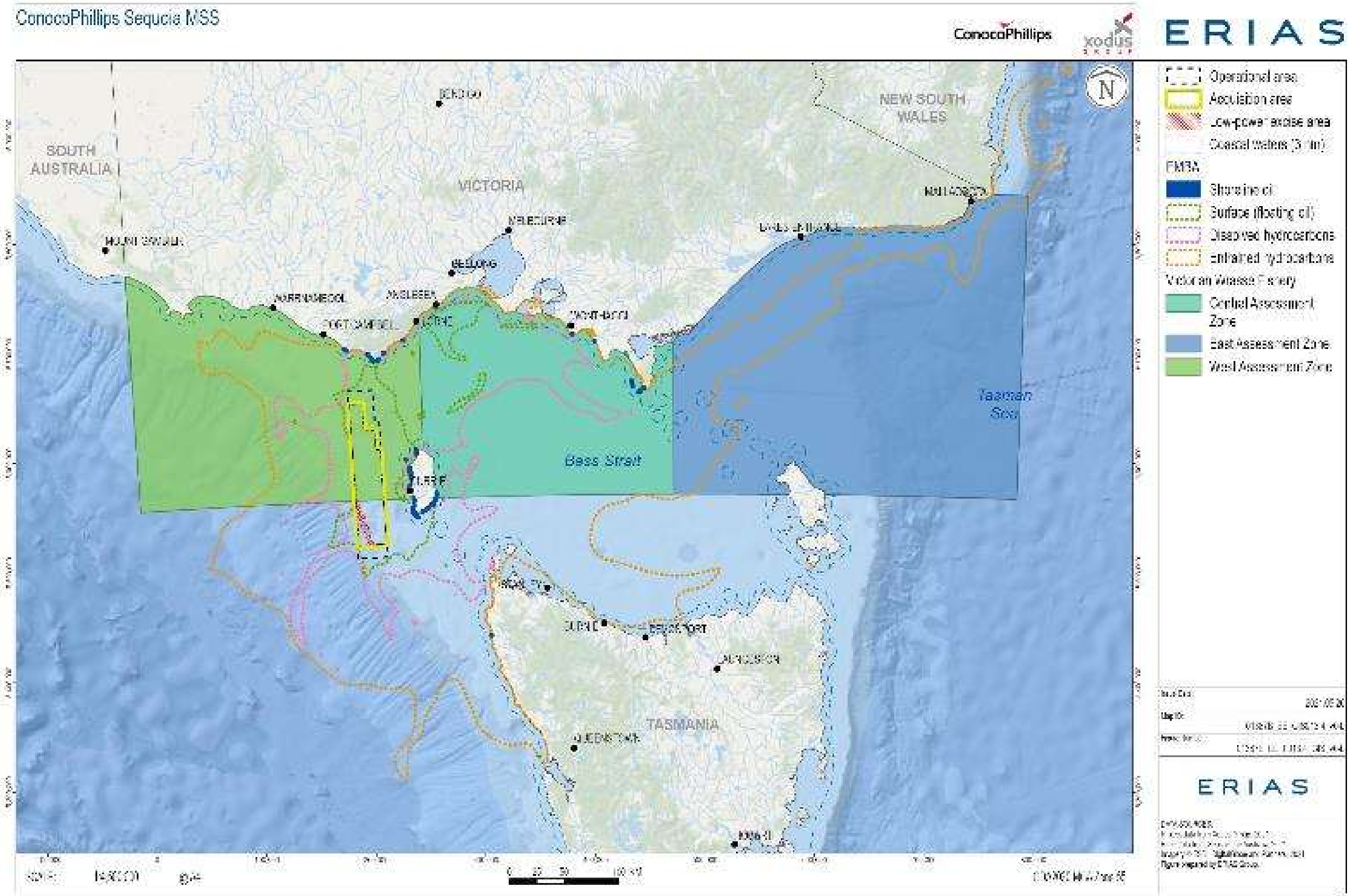


Figure 5-29: Victorian Wrasse Fishery

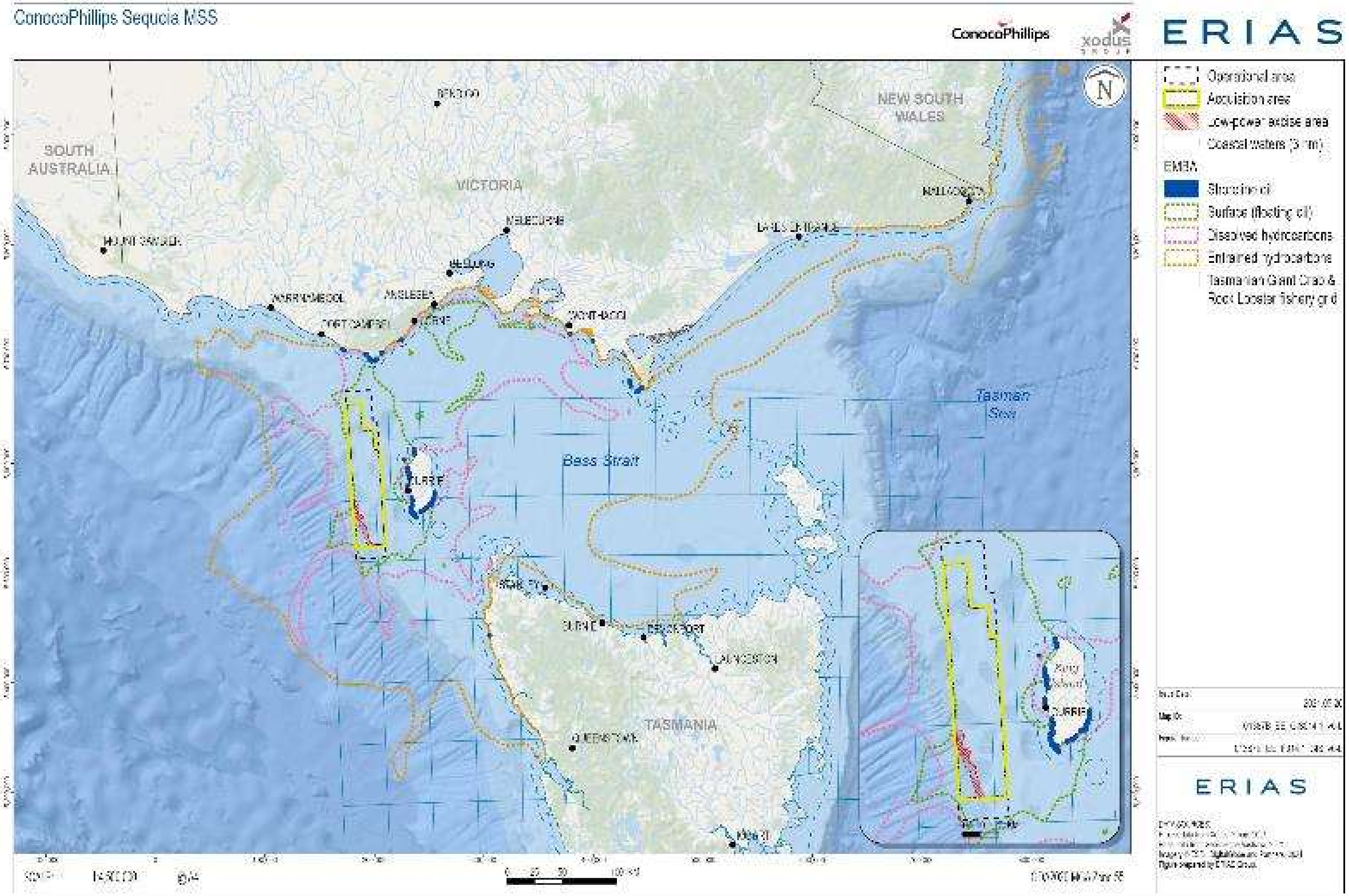


Figure 5-30: Tasmanian Giant Crab and Southern Rock Lobster Fishery

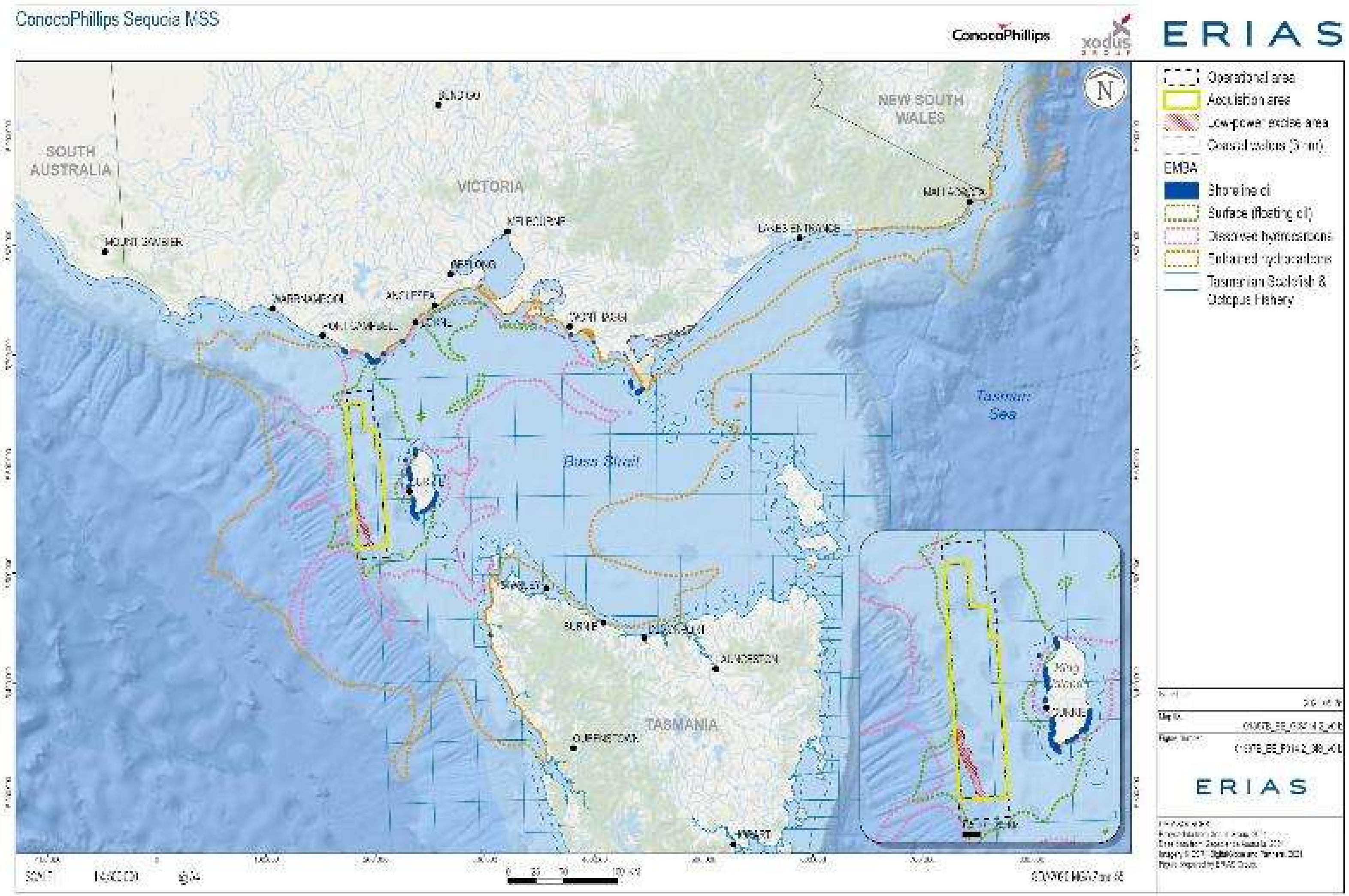


Figure 5-31: Tasmanian Scalefish and Octopus Fishery

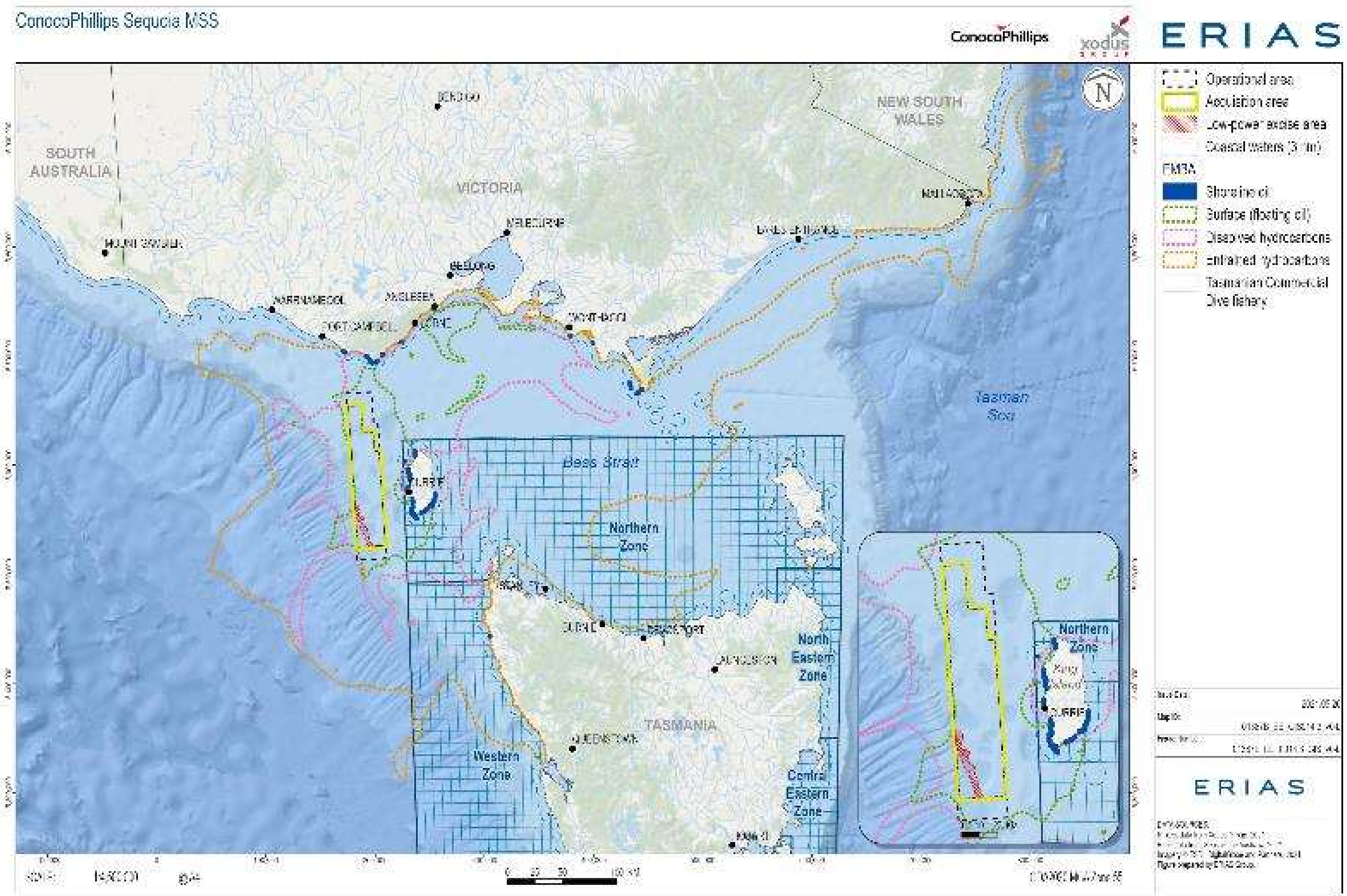


Figure 5-32: Tasmanian Commercial Dive Fishery

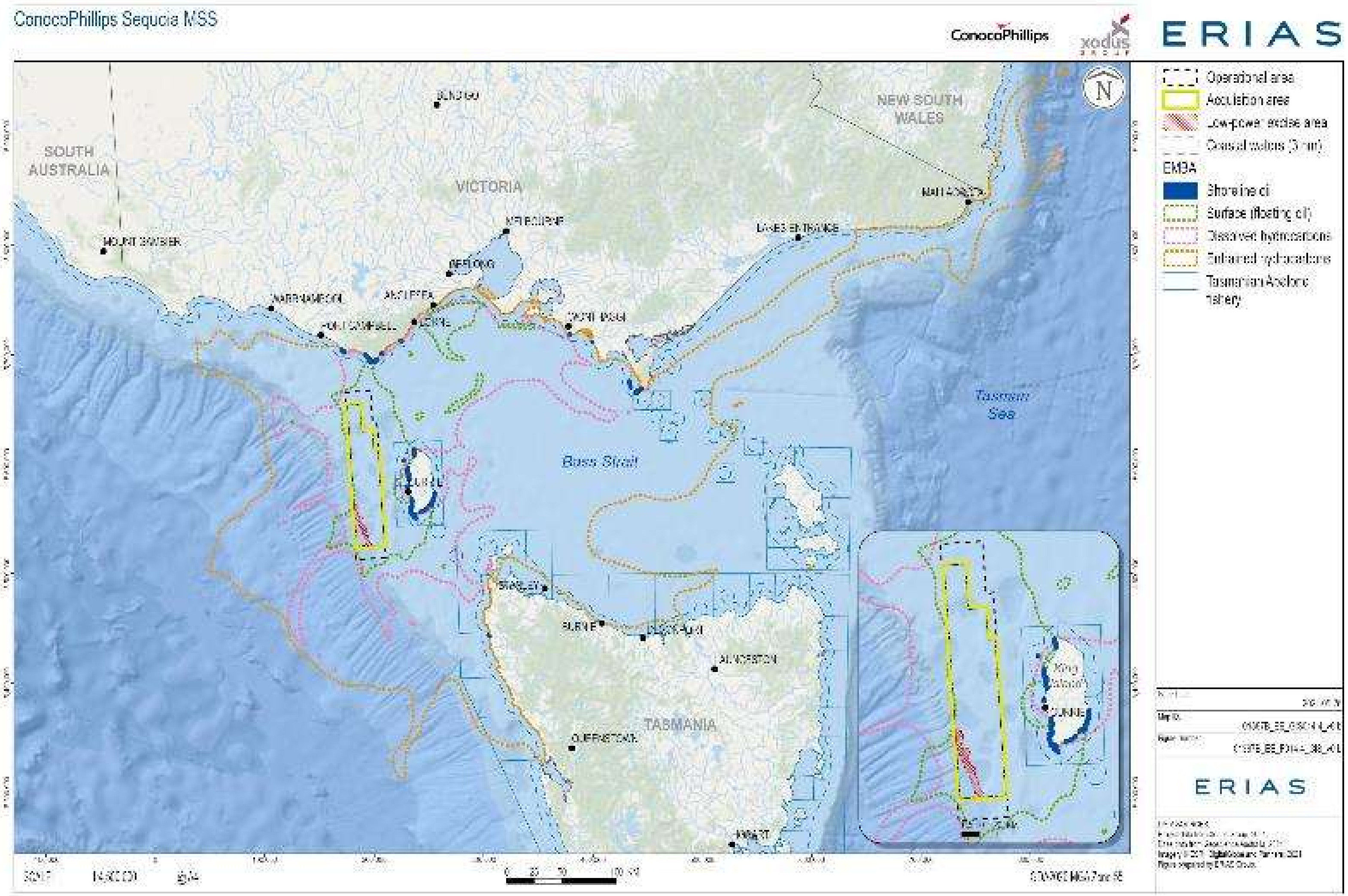


Figure 5-33: Tasmanian Abalone Fishery

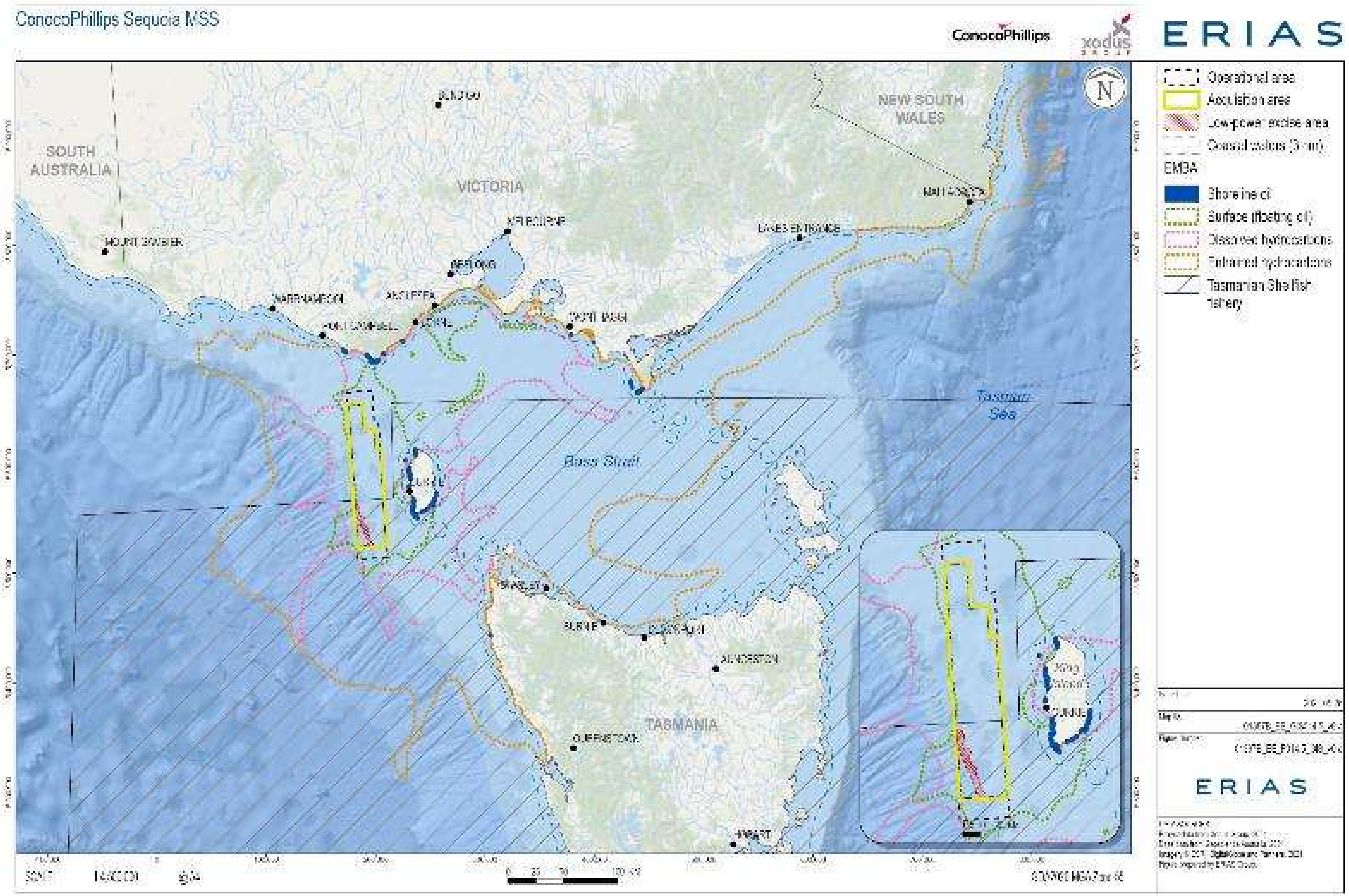


Figure 5-34: Tasmanian Shellfish Fishery

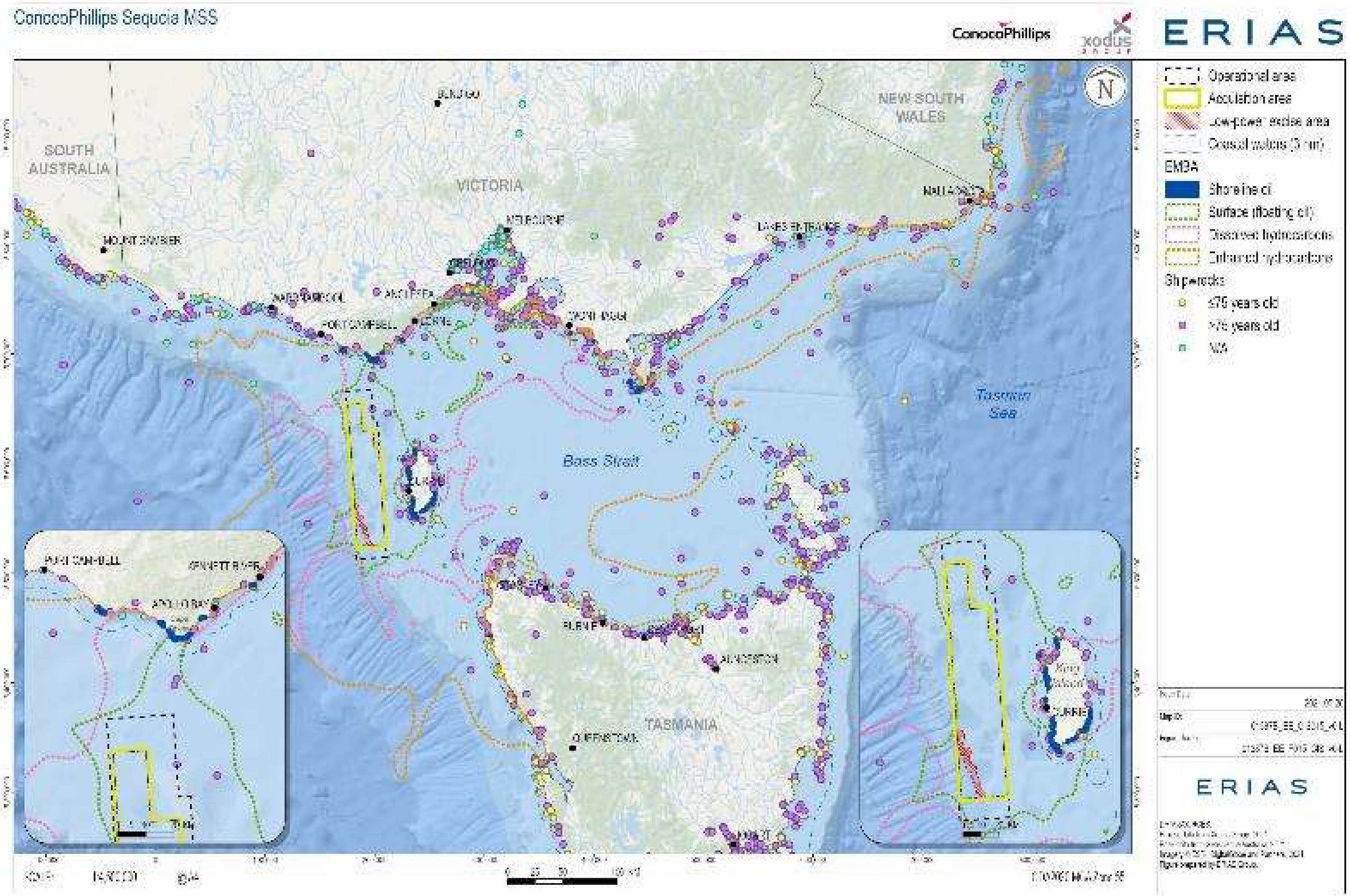


Figure 5-35: Shipwrecks within the vicinity of the Spill EMBA

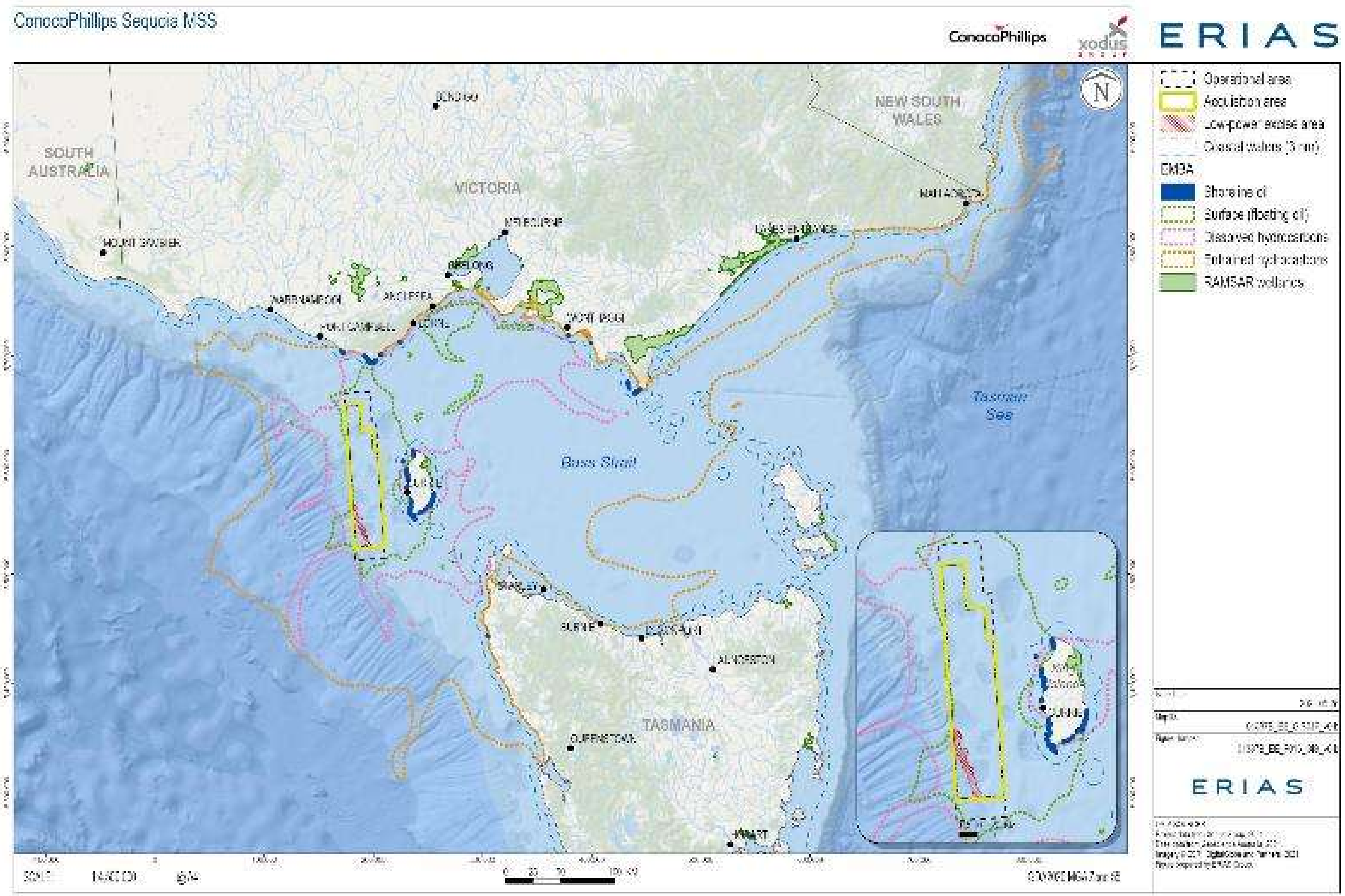


Figure 5-36: RAMSAR sites within the spill EMBA

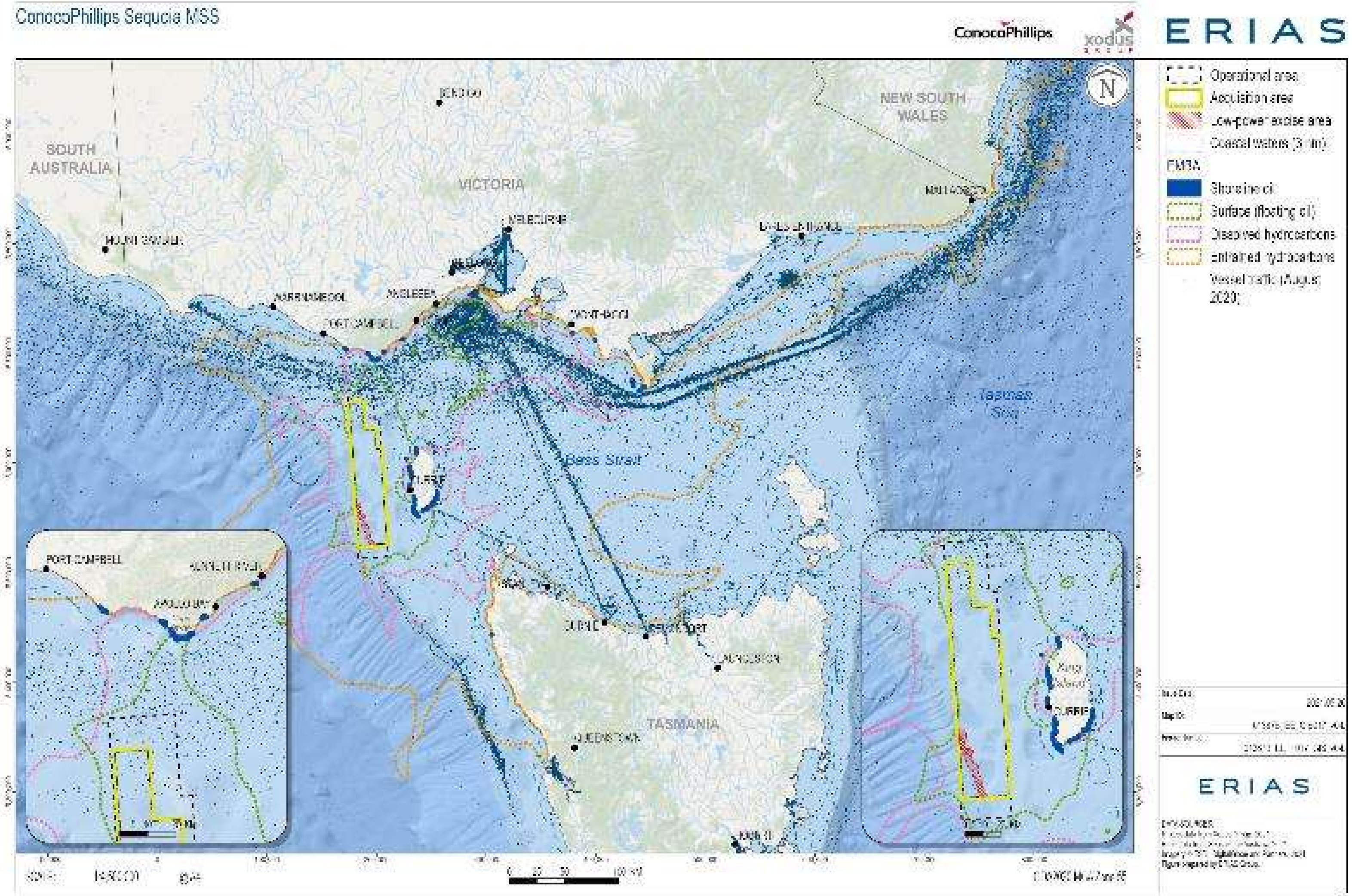


Figure 5-37: Vessel traffic within spill EMBA

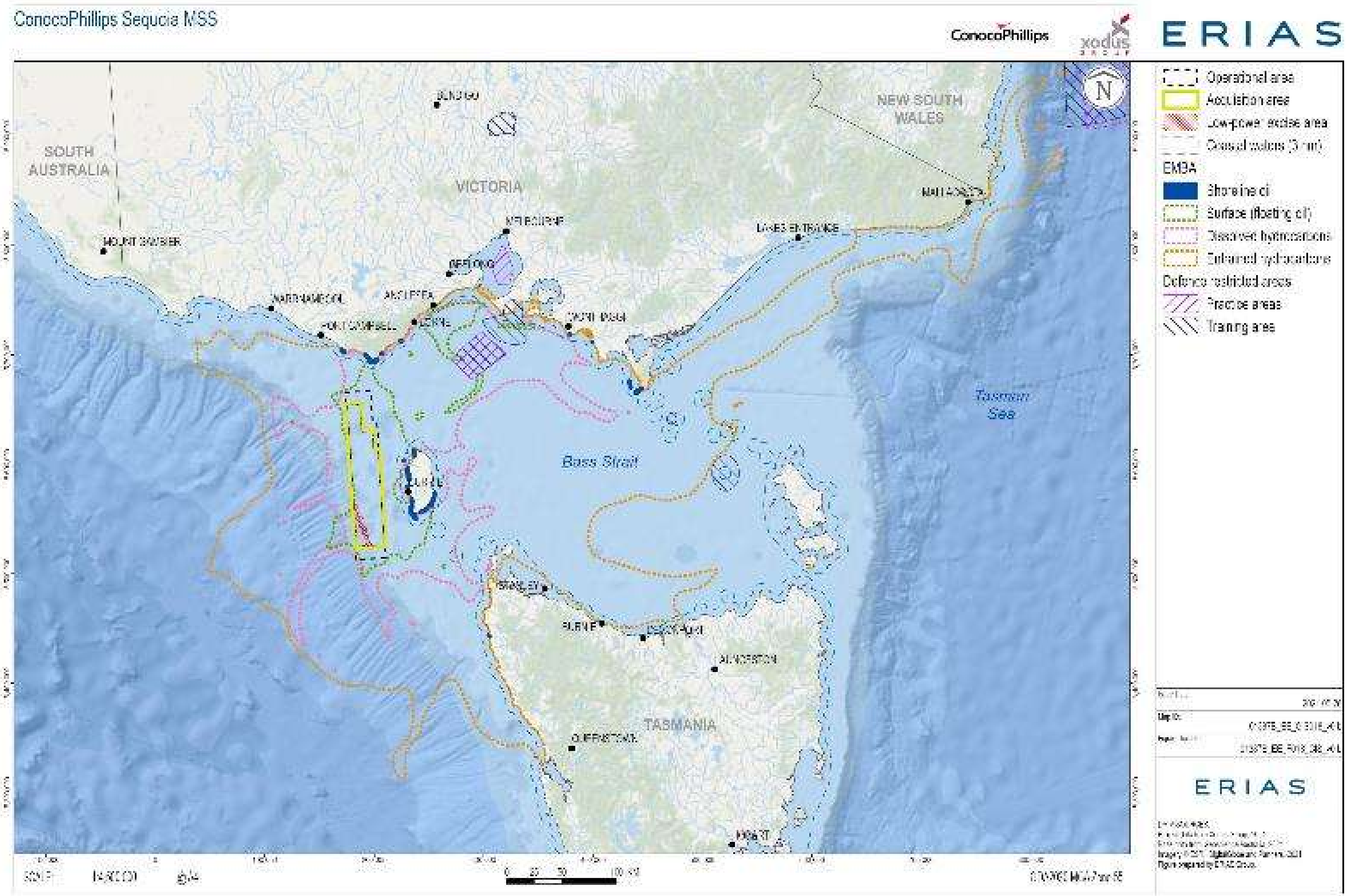


Figure 5-38: Defence activities within Spill EMBA

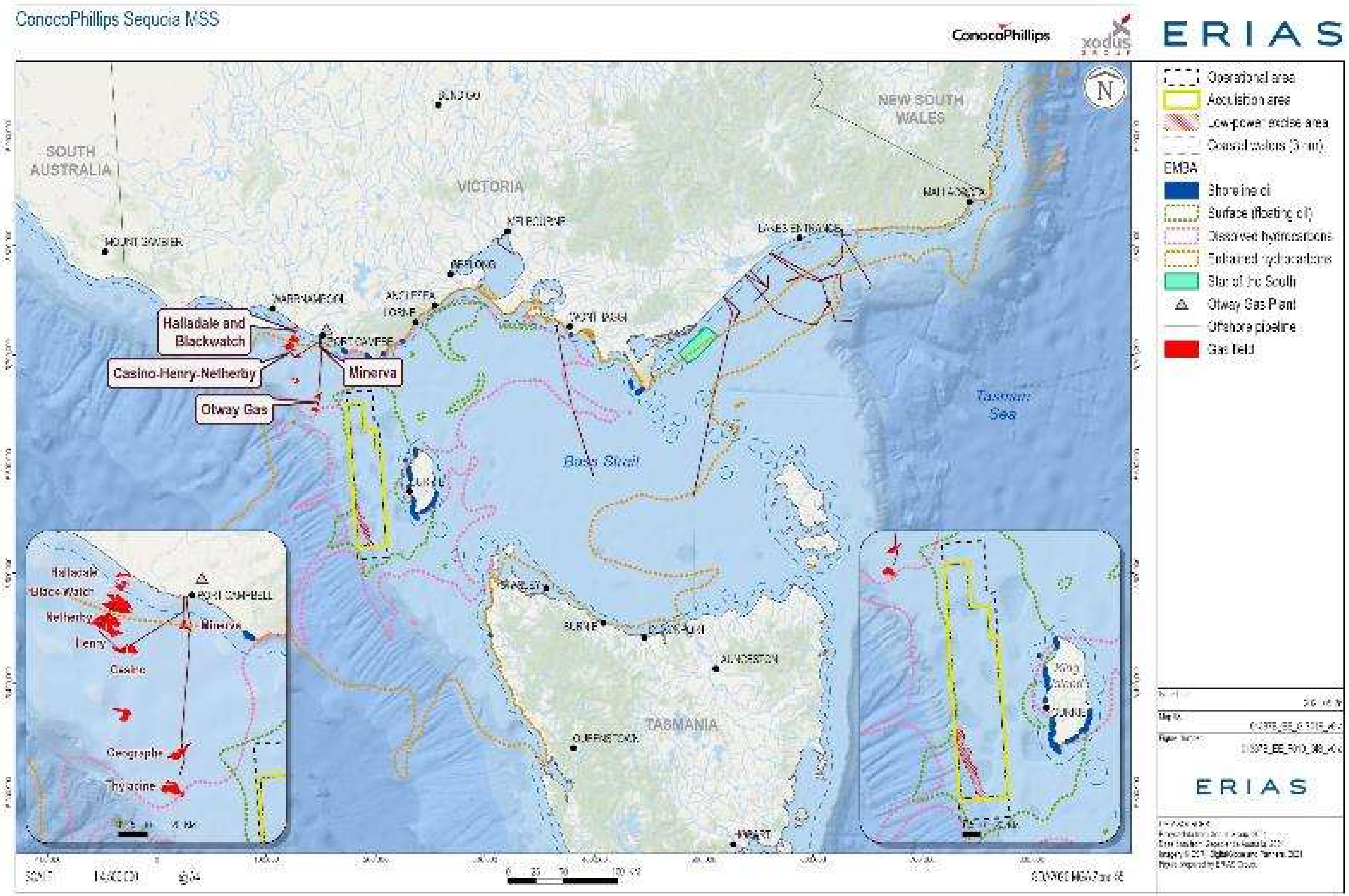


Figure 5-39: Offshore Energy Exploration and Production within Spill EMBA

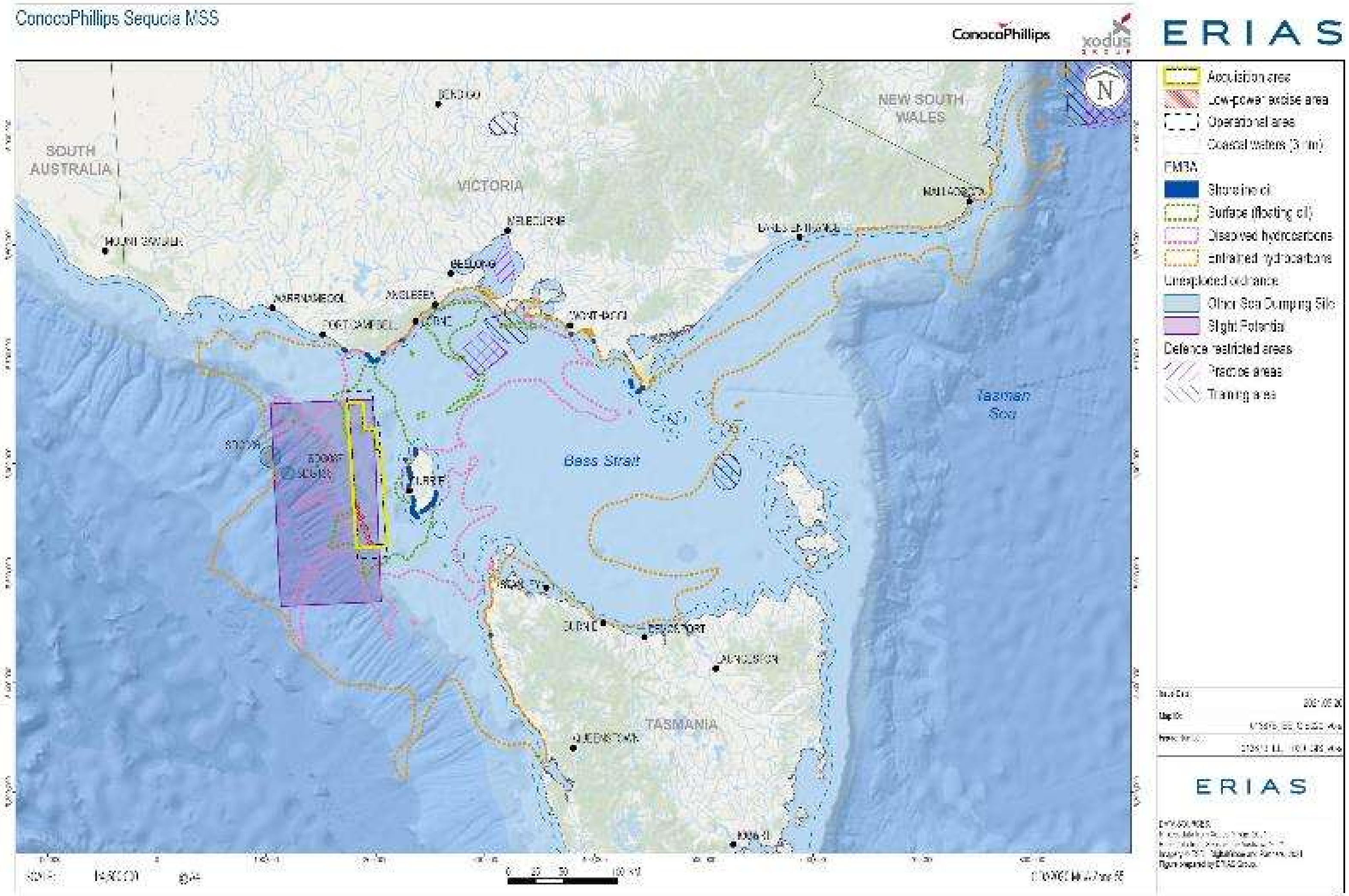


Figure 5-40: Defence Activities within the Spill EMBA

5.4.4. Legislative Requirements

Table 5-36 identifies the legislative and other requirements that are relevant to an unplanned MDO release. Legislative and other requirements specific to relevant receptors are described in receptor sections (Section 4.1 to 4.8). EPBC management plans that have oil spill or pollution identified as a key threat are included in Table 5-36.

The relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Table 5-36: Other Requirements – MDO Release

Type	Requirement	Relevant Item/Objective/Action
Legislation	Australian Maritime Safety Authority Act 1990 (AMSA Act)	Facilitates international cooperation and mutual assistance in preparing and responding to major oil spill incidents and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies. Requirements are implemented through the Australian Maritime Safety Authority (AMSA). AMSA is the lead agency for responding to oil spills in the Commonwealth marine environment and is responsible for implementing the Australian National Plan for Maritime Environmental Emergencies ('NatPlan').
Legislation	Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act)	This Act applies to actions that have, will have or are likely to have a significant impact on matters of national environmental or cultural significance. The Act protects Matters of National Environmental Significance (MNES) and provides for a Commonwealth environmental assessment and approval process for actions. There are eight MNES, these being: • World heritage properties • Ramsar wetlands • listed Threatened species and communities • listed Migratory species under international agreements • nuclear actions • Commonwealth marine environment • Great Barrier Reef Marine Park • water trigger for coal seam gas and coal mining developments. Three RAMSAR sites overlap with the visible EMBA- Lavinia, Lake Conneware and Western Point
Legislation	EPBC Act Part 13 Division 3 – Whales and other cetaceans	Under the EPBC Act, all cetaceans (whales, dolphins and porpoises) are protected within the Australian Whale Sanctuary, which includes all Commonwealth waters from the state waters limit out to the boundary of the Exclusive Economic Zone. Section 229 of the EPBC Act makes it an offence to kill, injure or interfere with a cetacean within the Australia Whale Sanctuary. All state and territories also protect whales and dolphins within their waters.
Legislation	*Fisheries Management Act 1991* (& Regulations 2009)	This Act aims to implement efficient and cost-effective fisheries management on behalf of the Commonwealth, ensure that the exploitation of fisheries resources and the carrying on of any related activities are conducted in a manner consistent with the principles of ESD, maximise the net economic returns to the Australian community from the management of Australian fisheries, ensure accountability to

		the fishing industry and to the Australian community in the Australian Fisheries Management Authority's (AFMA's) management of fisheries resources, and achieve government targets in relation to the recovery of the costs of AFMA.
Legislation	National Plan for Maritime Emergencies (AMSA 2000)	The National Plan for Maritime Environmental Emergencies (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.
Legislation	*Navigation Act* 2012 (& Regulations 2013) Chapter 4 prevention of Pollution	This Act regulates ship-related activities in Commonwealth waters and invokes certain requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) relating to equipment and construction of ships. Several Marine Orders (MO) are enacted under this Act relating to the environmental and social management of offshore petroleum activities, including: • MO 21 – Safety and emergency arrangements. • MO 30 – Prevention of collisions. • MO 50 – Special purpose vessels. • MO 70 – Seafarer certification.
Legislation	OPGGS Act 2006 (and Regulations 2009)	The Act provides the legislative framework for petroleum exploration and recovery, and the injection and storage of greenhouse gas substances, in offshore areas, and for other purposes. Section 572A-F (Polluter pays for escape of petroleum) and the OPGGS(E):Part 3 (Incidents, reports and records). OPGGS Regulations: Part 2.3 (Notifying reportable incidents). An Environmental Plan, including oil spill contingency and emergency response arrangements, must be place for any petroleum activity prior to activities commencing.
Legislation	*Protection of the Sea (Prevention of Pollution from Ships) Act 1983 (POSPOPS Act)* *Protection of the Sea (Prevention of Pollution from Ships) (Orders) Regulations 1994*	Regulates ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. It requires that ships >400 gross tonnes have pollution emergency plans. Several MO are enacted under this Act relating to offshore petroleum activities, including: • MO 91: Marine Pollution Prevention – Oil • MO 93: Marine Pollution Prevention – Noxious liquid substances • MO 94: Marine Pollution Prevention – Packaged harmful substances • MO 95: Marine Pollution Prevention – Garbage • MO 96: Marine Pollution Prevention – Sewage • MO 97: Marine Pollution Prevention – Air Pollution • MO 98: Marine Pollution Prevention – Anti- fouling Systems. The survey vessel (and support vessels if >400 gross tonnes) will adhere to the relevant MOs by having a SMPEP, Oil Record Book and Garbage Management Plan in place and implemented, along with international

		pollution prevention certificates verifying compliance with oil, air pollution and sewage measures.
Legislation	*Underwater Cultural Heritage Act 2018*	Protects the heritage values of shipwrecks, sunken aircraft and relics (older than 75 years) in Australian Territorial waters from the low water mark to the outer edge of the continental shelf (excluding the State's internal waterways). The Act allows for protection through the designation of protection zones. Activities / conduct prohibited within each zone will be specified.
Legislation (Vic)	POWBONS Act 1986 (Vic)	Section 10 (Duty to report certain incidents involving oil and oily mixtures).
Guideline (Cwlth)	Oil Spill: Risk Management Guidance Note (GN1488)	This guideline provides titleholders with clarification on the regulatory requirements for oil pollution risk assessment as well as the content and level of detail required in an oil pollution emergency plan (OPEP).
Guideline (Cwlth)	Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species	This guideline states that direct mortality of birds may result from a variety of activities including oils spills, and goes on to state that actions that introduce risk of mortality in important habitat may result in a significant impact to shorebirds. Three RAMSAR sites overlap with the visible EMBA- Lavinia, Lake Conneware and Western Point
EPBC Management Plans – Benthic Assemblages	Conservation Advice for Giant Kelp Marine Forests of South East Australia	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Fish	Conservation Advice for the Black rockcod (Epinephelus daemelii)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Fish	Conservation Advice for the Whale shark (Rhincodon typus)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Fish	National Recovery Plan for the Dwarf Galaxias (Galaxiella pusilla)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Fish	National Recovery Plan for the Australian Grayling (*Prototroctes maraena*)	Identifies poor water quality as a threatening process however does not explicitly identify pollution as a source of habitat degradation.
EPBC Management Plans - Fish	Recovery Plan for the Grey Nurse Shark (Carcharias Taurus)	Identifies habitat degradation (e.g. through coastal development, pollution) as a threat to species long-term survival. Management action identified to review and assess the potential threat of introduced species, pathogens and pollutants.
EPBC Management Plans - Fish	Recovery Plan for Three Handfish Species	Identified habitat degradation (from marine and coastal developments and pollution) as a principle threat to the species identified in the plan. No explicit relevant objectives or management actions.
EPBC Management Plans - Fish	Recovery Plan for the White Shark (Carcharodon carcharias)	Identifies habitat degradation (e.g. through pollution) as a threat. No explicit relevant objectives or management actions.

EPBC Management Plans – Marine Mammals	Conservation advice *Balaenoptera borealis* Sei Whale	Identifies habitat degradation including pollution as a threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation advice *Balaenoptera physalus* Fin Whale	Identifies pollution (persistent toxic pollutants) as a threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation Advice for *Megaptera novaeangliae* (Humpback Whale)	Identifies habitat degradation including coastal development and port expansion as a threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation Advice *Neophoca cinerea* Australian Sea Lion	Identified oil spill as a mechanism of habitat degradation and pollution impacting the Australian Sea Lion. Relevant conservation and management priorities identified being for all vessels to have oil spill mitigation measures in place and implement jurisdictional oil spill response strategies as required.
EPBC Management Plans – Marine Mammals	Conservation Advice for the Southern Elephant Seal (*Mirounga leonine*)	Identified exposure to chemical pollution as threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation Advice for the Subantarctic fur seal (*Arctocephalus tropicalis*)	Identified exposure to chemical pollution as threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation Management Plan for the Blue Whale: A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2015–2025	Identifies habitat modification as a threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Conservation Management Plan for the Southern Right Whale	Identifies habitat modification as a threat. No explicit relevant objectives or management actions.
EPBC Management Plans – Marine Mammals	Recovery Plan for the Australian Sea-lion (*Neophoca cinerea*)	Identified pollution and oil spill as one of the significant factors contributing to the lack of population recovery. Relevant management action identified implement jurisdictional oil spill response strategies as required.
EPBC Management Plans – Marine Reptiles	Recovery plan for Marine Turtles in Australia	This plan identifies acute chemical and terrestrial discharge (including spills from vessels) as a threat to marine turtles long term survival. However no marine turtle stock group is identified to overlap with the spill EMBA. Specific mention to risks of oil present on or near a beach can persist in sticky or toxic forms in the environment (sand and sediments) for many

		years. Marine turtle nesting behaviour can uncover this resulting in sticky oil adhering to adults, eggs or hatchlings causing both physical (smothering) and physiological (toxic) effects. Oil is highly toxic to turtle eggs, and the toxic components can penetrate the skin and carapace of hatched and older marine turtles affecting respiration, salt gland function and blood chemistry. Action Area A4 identifies minimising chemical and terrestrial discharge. With relevant management actions including: • 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. • Quantify the impacts of decreased water quality on stock viability. Quantify the accumulation and effects of anthropogenic toxins in marine turtles, their foraging habitats and subsequent stock viability.
EPBC Management Plans - Birds	Conservation Advice for the Australian painted-snipe (*Rostratula australis*)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	Conservation Advice for the Bar-tailed Godwit (northern Siberian) (Limosa lapponica menzbieri)	Identifies habitat loss and habitat degradation (through environmental pollution), pollution/contamination and direct death as a consequence of oil spill as a threat.
EPBC Management Plans - Birds	Conservation Advice for the Blue Petrel (*Halobaena caerulea*)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	Conservation advice *Calidris canutus* (Red Knot)	Environmental pollution is explicitly identified as a potential threat to Red Knot due to potential impacts on habitat loss and habitat degradation. Further oil spills are identified as a source of direct morality within this plan. With pollution/contamination identified as a having potential to adversely affected migratory shorebirds, both on passage and in non-breeding areas. No explicit relevant objectives or management actions provided.
EPBC Management Plans - Birds	Conservation Advice *Calidris ferruginea* (Curlew Sandpiper)	Environmental pollution is explicitly identified as a potential threat to due to potential impacts on habitat loss and habitat degradation. Environmental pollution identified to be of particular concern around settled areas may have reduced the availability of food and at migratory staging sites. Key staging site for Curlew Sandpiper includes the Yellow Sea, China and as such occurs outside of the EMBA. No explicit relevant objectives or management actions provided.
EPBC Management Plans - Birds	Conservation Advice for the Great Knot (*Calidris tenuirstris)*	Identifies environmental pollution / contaminants and habitat loss and degradation from pollution as a threat.
EPBC Management Plans - Birds	Conservation Advice for the Greater Sand Plover (*Charadrius leschenaultii*)	Identifies habitat loss and habitat degradation (through environmental pollution), pollution/contamination and direct death as a consequence of oil spill as a threat.
EPBC Management Plans - Birds	Conservation Advice for the Lesser Sand Plover (*Charadrius mongolus*)	Identifies habitat loss and habitat degradation (through environmental pollution), pollution/contamination and direct death as a consequence of oil spill as a threat.
EPBC Management Plans - Birds	Conservation Advice for *Numenius*	Environmental pollution is explicitly identified as a potential threat to due to potential impacts on habitat loss and habitat degradation. Environmental pollution identified to be of particular concern around

	madagascariensis (Eastern Curlew)	settled areas may have reduced the availability of food, along migratory routes. Conservation Advice suggest the Yellow Sea to Australia migration leg is usually undertaken in a single direct flight. It further suggests many birds arriving in eastern Australia appear to move down the coast until mid-February, arriving in southern Tasmania, mostly around late August to early October; later arrivals, probably of juveniles, occur until December. As such this migratory behaviour is likely to overlap with Sequoia MSS. No explicit relevant objectives or management actions provided.
EPBC Management Plans - Birds	Conservation Advice for *Pachyptila tutur subantarctica* (Fairy Prion Southern)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	Conservation Advice *Pterodroma Mollis* (Soft-plumaged Petrel)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	Conservation Advice *Sternula nereis nereis* (Fairy Tern)	Oil spills is explicitly identified as a potential threat the Fairy Tern, particularly in Victoria, where the close proximity of oil facilities poses a risk of oil spills that may affect the species' breeding habitat. Local recovery and threat abatement actions identified in this plan also identified 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 subspecies breeds in October to February in Australia and as such overlaps Sequoia MSS. Moderate exposure threshold for MDO spill scenario does not overlap with Fairy Tern breeding BIAs, however Conservation Advice identified the following location as having notable occurrence within Victoria Corangamite; East Gippsland; West Gippsland; and Port Phillip and Western Port.
EPBC Management Plans - Birds	Conservation Advice for the Swift Parrot (*Lathamus discolor*)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	Conservation Advice *Thinornis rubricollis rubricollis* (Hooded Plover Eastern)	Oil spill is explicitly identified as a potential threat to Hooded Plover eastern. Management action identified being to prepare oil spill response plans to ensure effective rehabilitation of oiled birds.
EPBC Management Plans - Birds	Draft Wildlife Conservation Plan for Seabirds	Acute pollution such as oil spill is explicitly identified as a direct and moderate threat to seabirds, given they spend much of their time on the sea surface, they are particularly vulnerable to the hazards of oil or fuel spills and are difficult to rehabilitate. No explicit relevant objectives or management actions.
EPBC Management Plans - Birds	Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan	The plan explicitly refers to oil spills, stating that oceanic oil spills may pose some risk give in oceanic feeding habits. No explicit relevant objectives or management actions.
EPBC Management Plans - Birds	National Recovery Plan for the Orange-bellied Parrot (*Neophema chrysogaster*)	No mention of environmental pollution or oil spill as threat to species long term survival.
EPBC Management Plans - Birds	National Recovery Plan for Threatened Albatross and Giant Petrels 2011-2016	Marine pollution is explicitly identified as a potential threat to long term survival in the wild of Albatross and Giant Petrels identified within this plan. With relevant management actions identified to include: • Where feasible, population monitoring programs also monitor, in a standardised manner, the incidence of:

		○ Oiled birds at the nest ○ Marine debris egestion/entanglement at the nests ○ Eggshell thinning.
EPBC Management Plans - Birds	Wildlife Conservation Plan for Migratory Shorebirds	Acute pollution such as oil spill is explicitly identified as a moderate threat to migratory shorebirds not due to direct contact but rather through impacting important habitat for many years through catastrophic loss of marine benthic food sources. Relevant objectives or management actions identified included: • Develop guidelines for wetland rehabilitation and the creation of artificial wetlands to support populations of migratory shorebirds. Three RAMSAR sites overlap with the visible EMBA- Lavinia, Lake Conneware and Western Point
EPBC Management Plans	South-east Commonwealth Marine Reserves Network Management Plan 2013-23	Identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure on conservation values of the South-east to the Commonwealth Marine Reserves Network.

5.4.5. Risk Assessment

5.4.5.1. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from the MDO spill scenario have been evaluated in the tables below for each receptor; having had regard to the legislative and other controls (Section 5.4.4).

Table 5-37 provides the criteria used to determine the sensitivity of receptors within the EMBA. The evaluation of environmental risks to these receptors (including fauna, marine parks and fisheries) resulting from the MDO release is presented in the tables below.

Table 5-37: Criteria used to determine receptor sensitivity in the EMBA

Sensitivity	Protected areas	Species status	BIA	Coastal habitat sensitivity	Receptors in the EMBA
Low	• No State marine protected areas. • No Commonwealth multiple use zones are the dominant component of the protected area.	• Species is EPBC Listed and impact expected to be limited to individuals with no population level impact. • Present in the EMBA only occasionally or as vagrants, with no biologically important behaviours occurring. • 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 sandy beaches 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.	• Benthic assemblages • Plankton • Invertebrates • Fish • Sandy beaches • Rocky shores
Medium	• No State marine protected areas. • Little to no Commonwealth special purpose zonation.	• Species may be EPBC Listed threatened or vulnerable and impact expected to be limited to individuals with no population level impact. • Species may or may not be present at time of activity, however not undertaking biologically important behaviours. • Some susceptibility to oiling. • Populations may take a moderate time to	• Intersection with one or more BIAs, generally for distribution or foraging 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.	• Marine reptiles • Seabirds • Coastal habitats and communities • Cetaceans • Commercial fisheries • Other marine users

		recover from oiling.			
High	• State marine protected area present. • Commonwealth special purposes zones are the dominant component of the protected area.	• Species are EPBC Listed Endangered or Critically Endangered • Species known to be present at time of activity, undertaking biologically important behaviours. • Known to be susceptible to oiling. • Populations may take a long time to recover from oiling.	• Significant intersection with one or more BIAs • Notable overlap with spatially restricted BIA (e.g. breeding, nesting, migration)	• 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.	• Pinnipeds • Shorebirds • Aquatic birds

Benthic Assemblages

Table 5-38: Predicted Impact Level of MDO Release for Benthic Assemblages

General sensitivity to MDO – Benthic Assemblages	
Sensitivity rating (environmental):	Low
A description of Benthic Assemblages within the EMBA is provided in:	Section 1.3.2 – Appendix H

Marine Flora

Given the nature of the MDO spill scenario being a surface spill, the following assessment has been restricted to assessment of benthic assemblages observed on shallow shelf areas to depth of 20 m. The shallow shelf of the temperate south east region is understood to have a high diversity of benthic plant species including seagrasses and macroalgae. As such, the focus of the following assessment is on macroalgae components of benthic assemblages.

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).

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 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.

Giant Kelp Forrest of SE Australia (EPBC Listed Endangered) are predicted to be exposed to low threshold for entrained (in-water) MDO based on stochastic modelling.

Other Benthic Assemblages

Other benthic assemblages expected to occur in shallow shelf areas include rocky reef patches, encrusting bryozoans and sponges. These benthic assemblages are typically low lying and not occurring within intertidal zone, which is regularly exposed. Further descriptions are provided in Section 1.2.2 of Appendix G.

Potential risks from MDO release

Surface (floating) MDO Exposure	In water (dissolved and entrained) MDO Exposure	Shoreline MDO Exposure
Marine Flora Floating life phase of vegetation in western Bass Strait may be exposed to limited areas of moderate hydrocarbons at the sea surface. Given the nature of the spill in this scenario (occurring in high energy, western Bass Strait waters >20 m deep) limited floating vegetation is expected to be present resulting in consequence to marine flora benthic assemblages to be **minor**. **Other Benthic Assemblages** Given these assemblages are benthic, exposure to surface (floating) MDO is not expected.	**Marine Flora** Only contact at the low and moderate threshold was predicted. There is no modelled exposure to the high threshold for in-water hydrocarbons. In nearshore waters, where there is greater risk of interaction with photosynthetic benthic assemblage communities, moderate threshold exposure is predicted at King Island and the Colac Otway coast. Low threshold exposure, which is unlikely to result in ecological impact, is predicted at the Hunter Island Group, Circular Head and Phillip Island. Due to the low concentrations and physical properties of the hydrocarbons and the well- mixed nature of the waters of the EMBA, coating of benthic assemblages and prolonged exposure to hydrocarbons is considered highly unlikely. Thus, the consequence to marine flora benthic assemblage communities from exposure to moderate threshold hydrocarbons is **minor**. **Other Benthic Assemblages** Within the shallow coastal shelf in-water MDO exposure at low and moderate thresholds is predicted. Low threshold exposure, which is unlikely to result in ecological impact, occurs at the Hunter Island Group, Circular Head and Phillip Island. While moderate threshold exposure may occur, it is expected at low threshold (3%). Thus, the consequence to other benthic assemblages' communities from exposure to moderate threshold hydrocarbons is **minor**.	**Marine Flora** Shoreline accumulation of hydrocarbons at the low threshold is unlikely to have an ecological impact. Areas of predicted moderate shoreline loading, which is likely to have an ecological impact, are limited to the Colac Otway coast, King Island and Wilsons Promontory. At this threshold, there may be ecological impacts to benthic assemblages stranded on the shoreline. However, wave- action at the shoreline will naturally disperse and weather the hydrocarbons quickly. Therefore, the consequence of exposure to moderate threshold shoreline loading to marine flora benthic assemblage communities is **minor**. **Other Benthic Assemblages** Given these assemblages are not associated with intertidal areas shoreline MDO exposure is not anticipated.

Summary of predicted impact level to Benthic assemblages	**Risk rating**

An MDO release has the potential to result in:
• change in ecosystem function
• injury/mortality to biota
The extent of the area of impact is limited to coastal waters less than 30 m deep, which represents the photic zone. The consequence of MDO release on ecosystem function and injury/ mortality to benthic assemblage biota has been assessed as **Minor (2)**, based on:
• Impacts on benthic assemblages (i.e. marine flora and other) associated with oil smothering, fouling and asphyxiation is expected to be limited based on the following:
  ○ Common feature of macroalgae is the presence of a mucous coating that prevents oil adherence.
  ○ Water soluble components of MDO are expected to be rapidly weathered and, as such, toxicity of water-soluble portion is reduced by the time it enters shallow coastal waters where interaction with benthic assemblages attached to seabed are more likely.
• Intertidal macroalgal beds are more prone to oil spills than subtidal beds, however given the exposed nature of these shorelines weathering of hydrocarbon is expected to be more rapid limiting duration of exposure.
• Macroalgae tend to exhibit rapid recovery from oil spill due to common growth habitat where new growth occurs near the base of the plant while the distal parts (which would be exposed to the oil contamination) are continually lost.
• The Conservation Advice for Giant Kelp Marine Forests of South East Australia does not identify oil spill or acute pollution key threat to survival.
• The magnitude of potential risk associated MDO release is considered to result in medium-term and localised impacts, representing a small portion of benthic habitat that is widely representative of the region, with no population level impact expected.
Controls are in place for all vessels engaged in Sequoia MSS to reduce risk of vessel collision and limit the total volume of MDO release. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, impacts would be restricted to localised coastal areas within the photic zone (up to 30 m depth) and would be unlikely to impede the recovery of a benthic assemblages, including those identified as a Threatened Ecological Communities.
	Low

Plankton

Table 5-39: Predicted Impact Level of MDO Release for PLankton

General sensitivity to MDO – Plankton	
Sensitivity rating (environmental):	Low
Sensitivity rating (socio-economic):	Section 4.7 – Commercial Fisheries
A description of Plankton communities in the EMBA is provided in:	Section 1.3.1 – Appendix H
Plankton is found in nearshore and open waters beneath the surface in the water column. These organisms migrate vertically through the water column to feed in surface waters at night. As they move close to the sea surface it is possible that they may be exposed to both surface hydrocarbons but to a greater extent, hydrocarbons dissolved or entrained in the water column (NRDA, 2012).	

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 again 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 exposure to light. In turn affect 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, 2011a), allowing for seasonal influences on the assemblage characteristics.

Potential risks from MDO release

Surface (floating) and in water (entrained and dissolved) MDO Exposure	**Shoreline MDO Exposure**
Plankton found in open water of the EMBA is expected to be widely represented in Bass Strait and the offshore Otway region. Plankton in the upper water column is likely to be directly (e.g., through smothering and ingestion) and indirectly (e.g., toxicity from decrease in water quality and bioaccumulation) affected by dissolved, entrained and floating hydrocarbons. Once background water quality conditions are rapidly re-established following the natural weathering and dispersion of the hydrocarbons, plankton populations are expected to recover rapidly due to recruitment of plankton from surrounding waters and reproduction by survivors. Thus, consequence on plankton populations from exposure to moderate threshold hydrocarbons is **minor**.	Plankton are found in the water column; not on the shoreline; therefore, there is no exposure pathway expected.

Summary of predicted impact level to Plankton	**Risk rating**
An MDO release has the potential to result in: • Fauna injury/mortality The extent of the area of impact is predicted to be limited to photic portions of the water column (i.e. up to 30 m depth) due to the expected higher concentration of plankton within this area and due to nature of the spill scenario being a surface release. The consequence of MDO release associated with fauna injury/mortality has been assessed as **Minor (2)**, based on:	Low

• Phytoplankton may be impacted by limiting photosynthetic (growth) capacity as a result of direct smothering or limited ability for light to penetrate the water column. While zooplankton may be impacted by toxicity through direct contact (ingestion, inhalation and dermal contact) resulting in injury or mortality. • Due to their small size and high surface area to volume ratio, plankton tend to rapidly accumulate the water-soluble portion of MDO, however due to the abundant nature of plankton within the upper water column, an MDO spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level. • Plankton exhibit rapid recovery due to mass spawning behaviours of many species with planktonic life phase, along with ocean current facilitating migration from unaffected areas. It is expected that plankton communities will recovery over weeks to months once background water quality conditions have re-returned. • Conservation values of the following protected areas are not expected to be affected in response to predicted impacts of MDO release on plankton - Apollo AMP, Beagle AMP, Boags AMP, Franklin AMP, Zeehan AMP, Bonney Coast Upwelling KEF, West Tasmanian KEF, Big Horseshoe Canyon KEF or Upwelling East of Eden KEF. • The magnitude of potential risk associated with an MDO release is considered to result in short-term and localised impacts, representing a small portion of the plankton population that is widely representative of the region, with no population level impact expected. Controls are in place for all vessels engaged in Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, it would be restricted to upper water column within the photic zone (up to 30 m depth) and would be unlikely to impede the recovery of a plankton and associated food chains within the South-East bioregion.	

Invertebrates

Table 5-40: Predicted Impact Level of MDO Release on Invertebrates

General sensitivity to MDO – Invertebrates	
Sensitivity rating (environmental):	Low
Sensitivity rating (socio-economic):	Section 4.7 – Commercial Fisheries
A description of Invertebrates in the EMBA is provided in:	Section 1.3.3 – Appendix H
The primary modes of exposure for benthic invertebrate communities in oil spills include: • Direct exposure to dispersed oil (e.g., physical smothering) where bottom discharges stay at the ocean bottom • Direct exposure to dispersed and non-dispersed oil (e.g., physical smothering) where oil sinks down from higher depths of the ocean • Direct exposure to dispersed and non-dispersed oil dissolved in sea water and/or partitioned onto sediment particles • Indirect exposure to dispersed and non-dispersed oil through the food web (e.g., 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 (C_2 and C_3) 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):

- 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 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).

Potential risks to benthic fauna from MDO release

Surface (floating) MDO Exposure	In-water (dissolved and entrained) MDO Exposure	Shorelines MDO Exposure
Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters, rarely reaching the water's surface in their life cycle, and are unlikely to be exposed except at locations where surface oil reaches shorelines. Refer to shoreline MDO exposure for further description of potential risks.	Adult marine invertebrates and larvae usually reside within benthic substrates and pelagic waters. Modelling predicts impact associated with moderate in-water (dissolved and entrained) MDO exposure is limited to shallow waters, and therefore invertebrate benthic habitats (< 30 m deep). There is no modelled exposure to the high threshold for dissolved hydrocarbons, however moderate exposure was identified at nearshore locations (Colac Otway, King Island, Cape Otway West) however only with low probability of 1%. Entrained exposure modelling identified moderated exposure at nearshore areas, however maximum probability of occurrence was 3% and 2% at King Island and Reid Rock respectively. In-water low threshold exposure is more likely in nearshore locations, with probability of contact at King Island and Reid Rock being 16% and 15% respectively. However, at low thresholds it is unlikely to result in ecological impact. Due to the low concentrations and physical properties of the hydrocarbons and the well- mixed nature of the waters of the EMBA, coating of invertebrates and prolonged exposure to	Invertebrates are expected to be most exposed to shoreline MDO exposure, where surface oil reaches shorelines. There is no modelled exposure to the high threshold for dissolved hydrocarbons, however moderate exposure was identified at nearshore locations, but only with low probability of occurrence. The highest probability of occurrence was observed at King Island and Cape Otway West, at 5% and 2% respectively. Shoreline MDO exposure at lthe ow threshold is more likely, with a 9% probability of contact at King Island. However, at low thresholds it is unlikely to result in ecological impact. Due to the low concentrations and physical properties of the weathered hydrocarbons expected to wash up on shorelines and exposed nature of these shoreline, coating of invertebrates and prolonged exposure to hydrocarbons is considered highly unlikely. Thus, the consequence to invertebrate communities from exposure to moderate threshold hydrocarbon sat the shoreline is **minor**.

	hydrocarbons is considered highly unlikely. Thus, the consequence to invertebrate communities from exposure to moderate threshold dissolved and entrained hydrocarbons is **minor**.	

Summary of predicted impact level to invertebrates	Risk rating
An MDO release has the potential to result in: • Change in fauna behaviour • Injury/mortality to fauna The extent of the area of impact is predicted to be limited to shallow benthic habitats and areas of shoreline exposure. The consequence of MDO release injury/mortality or change in behaviour of individual invertebrates has been assessed as **Minor (2)**, based on: • Limited exposure to large quantities of unweathered MDO, as such less opportunity for smothering or toxicity impacts due to distance from Operational Area to shallow habitat and shorelines. • Planktonic phase of invertebrates, although expected to be more vulnerable than adult phase to presence of in-water MDO exposure, are expected to exhibit rapid recovery rate due to mass spawning behaviours of many species, along with ocean current facilitating migration from unaffected areas. Whereby it is expected that plankton communities will establish over weeks to months once background water quality conditions have re-established. As such any impact on larval phased is expected to be localised and of short duration. • The magnitude of potential risk associated with an MDO release is considered to result in medium-term and localised impacts on a small portion of the invertebrate population (in shallow waters), with no population level impact expected. Controls are in place for all vessels engaged in the Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, it would be restricted to invertebrate habitats in shallower water and shoreline and would be unlikely to impede the recovery of invertebrates and associated food chains within the South-East bioregion.	Low

Fish

Table 5-41: Predicted Impact Level of MDO Release for Fish

General sensitivity to MDO – Fish	
Sensitivity rating (environmental):	Low
Sensitivity rating (socio-economic):	Section 4.7 – Commercial Fisheries
A description of fish in the EMBA is provided in:	Section 1.3.4 – Appendix H

Demersal species may be susceptible to oiled sediments, particularly species that are site-restricted. While pelagic species that occupy the water column are more susceptible to entrained and dissolved hydrocarbons. However, generally these species are highly mobile and as such are not likely to suffer extended exposure due to their patterns of movement. The exception would be in areas such as reefs and other seabed features where species are less likely to move away into open waters (i.e., site-attached species).

Fish are exposed to in-water hydrocarbon through a variety of pathways, including:

- Direct dermal contact (e.g. swimming through oil or waters with elevated dissolved hydrocarbon concentrations and other constituents, with diffusion across their gills (Hook *et al*., 2016));
- Ingestion (e.g. directly or via food base, fish that have recently ingested contaminated prey may themselves be a source of contamination for their predators); and
- Inhalation (e.g. elevated dissolved contaminant concentrations in water passing over the gills).

Exposure to hydrocarbons at the surface or 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).

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.

Fish are most vulnerable to hydrocarbon discharges during their embryonic, larval and juvenile life stages. Eggs and larvae of many fish species are highly sensitive to oil exposure, resulting in decreased spawning success and abnormal larval development (see ‘Plankton’ assessment).

Since fish and sharks do not generally break the sea surface, the impacts of surface hydrocarbons to fish and shark species are unlikely to occur. Near the sea surface, fish are able to detect and avoid contact with surface slicks meaning fish mortalities rarely occur in the event of a hydrocarbon spill in open waters (Volkman *et al*., 2004). As a result, wide-ranging pelagic fish of the open ocean generally are not highly susceptible to impacts from surface hydrocarbons. Adult fish kills reported after oil spills occur mainly to shallow water, near-shore benthic species (Volkman *et al*., 2004).

Hydrocarbon in the water column can physically affect fish with high site fidelity (or that cannot move out of harm’s way) exposed for an extended duration (weeks to months) by coating of gills, leading to lethal and sub-lethal effects from reduced oxygen exchange and coating of body surfaces that may lead to increased incidence of irritation and infection. Fish may also ingest hydrocarbon droplets or contaminated food, leading to reduced growth (Volkman *et al*., 2004).

The threshold value for species toxicity in the water column is based on global data from French et al. (1999) and French-McCay (2002, 2003), which showed that species sensitivity (fish and invertebrates) to dissolved aromatics exposure >4 days (96-hour LC50) under different environmental conditions varied from 6 to 400 µg/L (ppb), with an average of 50 ppb. This range covered 95% of aquatic organisms tested, which included species during sensitive life stages (eggs and larvae). Based on scientific literature, a minimum threshold of 6 ppb over 96 hours or equivalent was used to assess in-water low exposure zones, respectively (Engelhardt, 1983; Clark, 1984; Geraci and St Aubin, 1988; Jenssen, 1994; Tsvetnenko, 1998). French- McCay (2002) indicates that an average 96-hour LC50 of 50 ppb could serve as an acute lethal threshold to 50%.

Studies of oil impacts on bony fishes report that light, volatile oils are likely to be more toxic to fish. Many studies conclude that exposure to PAHs and soluble compounds are responsible for the majority of toxic impacts observed in fish (e.g., Carls *et al*., 2008; Ramachandran *et al*., 2004). A range of lethal and sub-lethal effects to fish in the larval stage has been reported at water-accommodated fraction (WAF) hydrocarbon concentrations (48-hour and 96-hour exposures) of 0.001 to 0.018 ppm during laboratory exposures (Carls *et al*., 2008; Gala, 2001). In contrast, wave tank exposures reported much higher lethal concentrations (14-day LC50) up to 1.9 ppm for herring embryos and up to 4.3 ppm for juvenile cod (Lee *et al*., 2011).

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 WAF of between 24 and 48 hours. Danion et al (2011) observed PAH uptake of 148 µg/kg-1 after 48-hour exposures to PAH from Arabian Crude at high concentrations of 770 ppm. 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 spills) 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) (see 'Commercial Fisheries' assessment).

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. It is not known how the data on the sensitivity of bony fishes would relate to toxicity in cartilaginous fishes.

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 MODU, 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.

Sampling from January 2010 to June 2011 by the University of South Alabama and Dauphin Island Sea Lab found no significant evidence of diseased fish in reef populations off Alabama or the western Florida Panhandle as a result of the Macondo well blowout in the Gulf of Mexico (BP, 2014).

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.

White Shark (EPBC Listed: Vulnerable, Migratory, Marine)

White Shark distribution BIA overlaps low, moderate and high surface (floating) and in-water thresholds.

Australian Grayling (EPBC Listed: Vulnerable, Migratory)

The Australian Graying 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. The National Recovery Plan for this species identifies several rivers in the following bioregions which overlap with the low in-water exposure thresholds as important habitats:

• South East Corner, Victoria • South East Coastal Plain, Victoria • Tasmanian West, Tasmania • King Island, Tasmania **Blue Warehou (EPBC Listed: Conservation Dependant)** Blue Warehou are a bentho-pelagic species that inhabits continental shelf and slope waters, usually aggregating close to the seabed.		
Potential risks to pelagic fish from MDO release		
Surface (floating) MDO Exposure	**In-water (dissolved and entrained) MDO Exposure**	**Shoreline MDO Exposure**
Moderate and high threshold exposure MDO is predicted at the sea surface. Fish species in the water column and syngnathid species associated with rafts of floating seaweed may come into contact with surface oil. The maximum distance of moderate exposure threshold from the release site (representing the point at which harmful effects may be encountered) represents a small area of the sea surface in comparison to the wider Bass Strait. However, the majority of fish species tend to remain in the mid-pelagic zone and are not likely to come into contact with floating hydrocarbons on the sea surface. Due to this reduced likelihood of exposure for the majority of fish species present in the EMBA, the consequence of MDO on the sea surface to fish is **minor**.	There is up to a 13% and 10% probability of moderate exposure to entrained hydrocarbons at Zeehan AMP and Apollo AMP, respectively. Noting, however, this exposure was limited to 10 m depth. This threshold of exposure represents the possibility of sublethal impacts to chronically exposed fish species. However, NOAA (2013) and ITOPF (2011a) state that hydrocarbon spills in open water are so rapidly diluted that fish kills are rarely observed. The moderate threshold associated with dissolved hydrocarbons had a maximum probability of 1% for identified receptors up to 20 m depth. Fish such as the White Shark, Shortfin Mako and Porbeagle Shark spend most of their time in the water column. As highly mobile species, they are unlikely to remain in one area for a long period of time, which minimises the risk that they would be exposed to toxic levels of hydrocarbons for the length of time necessary to impart a lethal impact. Given that that the release occurs at the surface into the waters of Bass Strait which generally well-mixed and, along with the high and rapid rate of MDO weathering, the consequence of an MDO spill to fish in the water column is **minor**.	Since fish and sharks do not generally break the sea surface, surface hydrocarbon impacts to fish and shark species are unlikely to occur.
Summary of predicted impact level to Fish		**Risk rating**

An MDO release the potential to result in:
• Change in fauna behaviour
• Injury/mortality to fauna
The extent of the area of impact is predicted to be limited to in-water exposure of fish in the upper water column (20 m depth). The consequence of an MDO release on injury/mortality or change in behaviour of individual fish has been assessed as **Minor (2)**, based on:
• Risk of direct contact, ingestion or inhalation amongst fish species is largely determined by behaviours and habitat preferences of fish species. With those at greatest risk of such impacts display limited mobility or high site fidelity. As such, given the nature of spill being a surface release and occurring in an offshore area, benthic species or those with high site fidelity occurring in the immediate vicinity of fresh MDO are not expected to be exposed to a high threshold given the Operational Area is approximately 125 m deep. Pelagic fish, who are more likely to interact with fresh MDO, are highly mobile and are unlikely to remain in the area of a spill for long enough to be exposed to sub-lethal doses of hydrocarbons.
• Fish are able to detect and avoid contact with surface slicks, reducing the likelihood of mass fish mortalities in the event of a hydrocarbon spill in open waters. Toxicity impacts associated with an MDO release are expected to be less severe in distant coastal waters, with no high threshold for surface hydrocarbons expected within State waters and the majority of MDO accumulated along shorelines is expected to be highly weathered.
• Fish species that are abundant, short-lived and highly fecund are expected to recover rapidly. However less abundant, long-lived species may take longer to recover.
• Planktonic life phases, though more susceptible to toxicity effect, tend to exhibit rapid recovery due to mass spawning behaviours of many species and ocean current facilitating migration from unaffected areas. It is expected that plankton communities will establish over weeks to months once background water quality conditions have re-established (see 'Plankton' assessment).
• The Recovery Plans for species identified as present in the EMBA do not explicitly identify 'oil spill', as a key threat. However, they do make relevant references including the following:
  o National Recovery Plan for the Australian Grayling (*Prototroctes maraena*) identifies poor water quality as a threatening process and a source of habitat degradation. Specific river systems have been identified as important habitat for long term survival within NSW, Victoria and Tasmania and several rivers overlap low in-water exposure thresholds.
  o Recovery Plan for the White Shark (*Carcharodon carcharias*), identifies habitat degradation (e.g. through pollution) as a threat.
• In addition, the white shark has a distribution BIA that overlaps the EMBA. However, its presence is expected to be largely transitory or short term in nature. This BIA represents low occurrence only and extends to all EEZ waters adjacent to their coastal distribution in Australia.
• Conservation values of the following protected areas not expected to be affected in response to predicted impacts of MDO release on fish; Apollo AMP, Beagle AMP, Boags AMP, Franklin AMP, Zeehan AMP, Bonney Coast Upwelling KEF, Wes Tasmanian KEF, Big Horseshoe Canyon KEF or Upwelling East of Eden KEF.
• The magnitude of potential risk associated MDO release is considered to result in short-term (7 to 12 months) and localized impacts, representing a small portion of fish population that is widely representative of the region and a small portion of the total BIA for species identified, with no population level impact expected.
Controls are in place for all vessels engaged in Sequoia MSS to reduce risk of vessel collision and limit the total volume of MDO release. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, it impacts would largely be restricted to upper water column and coastal areas. Impact expected to be restricted to individual fauna and unlikely to impede the recovery of a protected species or any associated food chains within the South-East bioregion.
	Low

Birds

Table 5-42: Predicted Impact Levels of MDO Release for Birds

General sensitivity to MDO – Birds	
Sensitivity rating (Seabirds):	Medium
Sensitivity rating (Shorebirds):	High
Sensitivity rating (Aquatic birds):	High
A description of birds in the EMBA is provided in:	Section 1.3.8 – Appendix H

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, 2011a).

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, 2011a). 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 theslick.

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 water-proofing (ITOPF, 2011a). A bird suffering from cold, exhaustion and a loss of buoyancy (resulting from fouling of plumage) may dehydrate, drown or starve (ITOPF, 2011a; DSEWPC, 2011; AMSA, 2013). 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).

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).

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).

A Little Penguin breeding BIA occurs at Christmas Island, Tasmania and represents part of the King Island Important Bird Area (IBA). 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 located at Three Hummock Island (Tasmania), Hunter Island (Tasmania), Albatross Island (Tasmania), Black Pyramid (Tasmania), Councillor Island (Tasmania), Sisters Island (Tasmania), Egg Island (Tasmania) and Phillip Island (Victoria).

Other Important Coastal Habitats

The following Listed RAMSAR wetlands are exposed to low threshold for entrained (in-water) MDO:

- Lake Connewarre, Victoria
- Western Port, Victoria
- Lavinia, Tasmania

King Island 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.

Potential risks to birds from MDO release

Surface (floating) MDO Exposure	In-water (dissolved and entrained) MDO Exposure	Shoreline MDO Exposure
Seabirds Most of the seabird species described in Section 4.4 that may occur in the spill EMBA 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 expected to result in the lethal impacts of feather matting and hypothermia. However, contact at the high threshold is expected to impart toxicity and ecological impacts. The extensive ocean foraging habitat available to species such as albatross and petrel and the small area and temporary nature of the hydrocarbon release on the sea surface (<3 days) makes it unlikely that a spill will limit their ability to forage for	**Seabirds** The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting 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 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, meaning there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. Therefore, the consequence to seabirds is **minor.** **Shorebirds** Due to the small area and temporary nature of the hydrocarbon release, shorebird feeding habits restricted to shorelines and largely transitory presence in offshore environment, they are	**Seabirds** Most of the seabird species described in Section 4.4that may occur in the spill EMBA forage over an extensive area and are distributed over a wide geographic range, with no identified breeding or nesting BIAs recognised. Seabird interactions with shorelines is expected to be largely during periods of rest and breeding activities. Species such as Albatrosses and Giant-petrels being among most oceanic of all seabirds, seldom come to land unless breeding. Resident seabirds are expected to spend greater periods of time on shorelines associated with burrows on sloping ground in coastal forest, scrubland, shrubland or grassland. There is no predicted exposure at the high threshold for shoreline loading and shoreline loading at the low exposure threshold is unlikely to result in ecological impacts to shorebird species. However, coastlines potentially exposed to moderate threshold shoreline loading are rocky and located on the Cape

unaffected prey, nor will the unlikely event of exposure at the sea surface result in permanent injury or mortality. Therefore, the consequence to seabirds is **minor**. **Shorebirds** Due to the small area and temporary nature of the hydrocarbon release, shorebird feeding habits and largely transitory presence in offshore environment, they are not expected to be exposed to surface (floating) MDO. Therefore, the consequence to shorebirds is **minor**. **Aquatic Birds** 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, the small area and temporary nature of the hydrocarbon release on the sea surface (<3 days) it is 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. Therefore, the consequence to seabirds is **minor**.	not expected to be exposed with in-water exposure. Therefore, the consequence to shorebirds is **minor**. **Aquatic Birds** The zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting 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 Aquatic birds would be feeding exclusively or predominantly on fish found in areas of higher hydrocarbon thresholds, meaning there is low probability of aquatic birds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The proximity of the BIA on Christmas Island and foraging behaviours involving extended periods of time at sea, means that the potential direct exposure of these birds to MDO is greater than for other species. Therefore, the consequence to aquatic birds is **moderate.**	Otway coast, the south west and south east coast of King Island and on islands off the west coast of Wilsons Promontory, where seabird roosting may occur. The Wedge-tailed shearwater breeding BIA at Muttonbird Island, Victoria (August to May) occurs near to Cape Otway coast moderate threshold shoreline loading. However, given the small area of accumulation and exposure nature of these shoreline the consequence to seabirds is **minor**. **Shorebirds** The shorebird species described in Section 4.4 are not likely to be exposed to the moderate concentrations of hydrocarbons due to the small average length of shoreline (2.5 km) predicted to be exposed at this concentration. There is no predicted exposure at the high threshold for shoreline loading and shoreline loading at the low exposure threshold is unlikely to result in ecological impacts to shorebird species. 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 are largely not contacted by the moderate threshold hydrocarbons. Rather, coastlines potentially exposed to moderate threshold shoreline loading are rocky and located on the Cape Otway coast, the south west and south east coast of King Island and on islands off the west coast of Wilsons Promontory. The King Island coastline is a recognised IBA which supports hooded plovers and includes Lavinia State Reserve (not intersected by shoreline loading), which supports orange-bellied parrots and endemic subspecies of bush birds. Due to the proximity of the IBA and habitat for the orange-bellied parrot, and isolated areas of potential moderate shoreline loading on the IBA, the consequence of an MDO spill to shorebird species is **moderate**. **Aquatic Birds** Little Penguin are largely sedentary, returning to the colony when not at sea, with multiple breeding BIAs identified throughout the Bass Strait. These habitats are largely not contacted by the moderate threshold hydrocarbons. Rather, coastlines potentially exposed to moderate threshold shoreline

		loading are rocky and located on the Cape Otway coast, the south west and south east coast of King Island and on islands off the west coast of Wilsons Promontory. The King Island coastline is a recognised IBA which include a breeding BIA at Christmas Island (not intersected by shoreline loading). Due to the proximity of the BIA on Christmas Island and isolated areas of potential moderate shoreline loading , the consequence of an MDO spill to aquatic bird species is **moderate**.

Summary of predicted impact level to Birds	Risk rating
An MDO release has the potential to result in: • Change in fauna behaviour • Injury/mortality to fauna The extent of the area of impact is predicted to be limited to moderate threshold of surface (floating) hydrocarbon and in-water exposure in the upper water column (30 m depth). The worst-case consequence of an MDO release on injury/mortality or change in behaviour for birds has been aassessed as **Moderate (3)** (for shorebirds and aquatic birds), based on: • Risk of direct contact, ingestion or inhalation amongst bird species is largely determined by behaviours and habitat preferences. With those at greatest risk displaying behaviours and characteristics causing greater opportunity for exposure including the following characteristics: o Proportion of the time spent at the sea surface, creating increase opportunity for direct exposure, inhalation or ingestion (i.e. Seabird species that raft together in large flocks on the sea surface, seabird plunge diving and aquatic birds which forage at sea for extended periods of time) o Occurrence of biologically important behaviours (i.e. breeding or feeding may override any tendency to avoid hydrocarbons) o Species feeding habits (i.e. seabird plunge diving, aquatic bird in water feeding, shorebird intertidal foraging) o Breeding locations (i.e. preference for nest location in low lying coastal area) • Flying birds are highly mobile and able to avoid noxious presence of hydrocarbons, as such general it is very unlikely to be constantly exposed to concentrations of hydrocarbons that would lead to chronic toxicity effects. Aquatic birds though also highly mobile are less able to avoid in-water exposures. • Areas of bird breeding colonies on low lying coastal areas (i.e. aquatic birds, shorebirds and seabirds) are likely to have greater exposure and sensitivity to hydrocarbon spills. For example, bird eggs may be damaged if a contaminated adult sits on the nest. However, given volatile nature of MDO expected to weather rapidly. • Lake Connewarre, Western Port and Lavinia Listed RAMSAR wetlands are exposed to hydrocarbon however only at low threshold for entrained (in-water) MDO, as such low exposure threshold is unlikely to result in ecological impacts to habitat function and in turn no ecological impacts to RAMSAR Listed Shorebirds. • The King Island (recognised IBA) has predicted shoreline accumulation of weathered MDO at moderate threshold however only predicted maximum length of 4 km with a 5% probability. • Preening behaviours of birds also presents increased risk of ingested by birds exposed MDO at sea (i.e. seabirds and aquatic birds). • A Listed Critical Habitat occurs within low threshold for low MDO exposure at Albatross Island (Tasmania), which represents one of four major breeding locations under Australian jurisdiction where these Shy Albatross, Wandering Albatross and Grey-headed Albatross species.	Medium

- The Recovery Plans for species identified as present in the EMBA identify marine pollution/oil spill, as a key threat including the following:
    - Conservation Advice *Sternula nereis nereis* (Fairy Tern), is explicitly identified as a potential threat, particularly in Victoria, where the close proximity of oil facilities poses a risk of oil spills that may affect the species' breeding habitat. Subspecies breeds in October to February in Australia and as such overlaps Sequoia MSS. Moderate exposure threshold for MDO spill scenario does not overlap with Fairy Tern breeding BIAs, however Conservation Advice identified the following location as having notable occurrence within Victoria Corangamite; East Gippsland; West Gippsland; and Port Phillip and Western Port.
    - Conservation advice *Calidris canutus* (Red Knot), environmental pollution is explicitly identified as a potential threat due to impact on habitat loss and habitat degradation. Oil spills are also identified as a source of direct morality within this plan. With pollution/contamination identified as a having potential to adversely affected migratory shorebirds, both on passage and in non-breeding areas.
    - Conservation Advice *Calidris ferruginea* (Curlew Sandpiper), Environmental pollution is explicitly identified as a potential threat to due to potential impacts on habitat loss and habitat degradation. Environmental pollution identified to be of particular concern around settled areas may have reduced the availability of food and at migratory staging sites. Key staging site for Curlew Sandpiper includes the Yellow Sea, China and as such occurs outside of the EMBA.
    - Conservation Advice for *Numenius madagascariensis* (Eastern Curlew), Environmental pollution is explicitly identified as a potential threat to due to potential impacts on habitat loss and habitat degradation. Environmental pollution identified to be of particular concern around settled areas may have reduced the availability of food, along migratory routes. Migratory arrivals are expected in southern Tasmania, mostly around late August to early October; later arrivals, probably of juveniles, occur until December.
    - Conservation Advice *Thinornis rubricollis rubricollis* (Hooded Plover Eastern), oil spill is explicitly identified as a potential threat.
    - Draft Wildlife Conservation Plan for Seabirds, acute pollution such as oil spill is explicitly identified as a direct and moderate threat to seabirds
    - Gould's Petrel (*Pterodroma leucoptera leucoptera*) Recovery Plan, explicitly refers to oil spills, stating that oceanic oil spills may pose some risk give in oceanic feeding habits.
    - National Recovery Plan for Threatened Albatross and Giant Petrels 2011-2016, explicitly identifies marine pollution as a potential threat to long term survival
    - Wildlife Conservation Plan for Migratory Shorebirds, explicitly identifies acute pollution such as oil spill is as a moderate threat due to potential impact on important habitat for many years through catastrophic loss of marine benthic food sources.
- In addition, species identified with BIA overlapping the EMBA are expected to be largely transitory or short term in nature. BIAs for the following intersect with the Operational Area:
    - Antipodean albatross Foraging BIA
    - Wandering albatross Foraging BIA, however Listed Critical Habitat occurs at Albatross Island, which represents a major breeding habitat for this species. However contacted at low threshold for entrained MDO exposure is expected. (with 1% probability of contact).
    - Buller's albatross Foraging BIA
    - Shy albatross Foraging BIA, however Listed Critical Habitat occurs at Albatross Island, which represents a major breeding habitat for this species globally, given this species is known to only breed in Australia. However, exposure is expected at low threshold for entrained MDO exposure only (with 1% probability of contact).
    - Campbell albatross Foraging BIA
    - Black-browed albatross Foraging BIA
    - Soft-plumaged petrel Foraging BIA
    - Sooty shearwater Foraging BIA

○ Short-tailed shearwater Foraging BIA • The magnitude of potential risk associated MDO release is considered to result in short-term and localized impacts, representing a small portion of bird population that is widely representative of the region, with no population level impact expected. Controls are in place for all vessels engaged in Sequoia MSS to reduce risk of vessel collision and limit the total volume of MDO release. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, its impacts would largely be restricted to upper water column and coastal areas. Impact expected to be restricted to individual fauna and unlikely to impede the recovery of a protected species or any associated food chains within the South-East bioregion.	

Marine Mammals

Table 5-43: Predicted Impact Levels of MDO Release for Marine Mammals

General sensitivity to MDO – Marine Mammals	
Sensitivity rating (Cetacean):	Medium
Sensitivity rating (Pinnipeds):	High
A description of Marine Mammals in the EMBA is provided in:	Section 1.3.5 – Appendix H
Cetaceans Cetaceans can 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; • 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; and
- Stress due to oil exposure and behavioural changes.

French-McCay (2009) identifies that a 10–25 µm oil thickness threshold has the potential to impart a lethal dose on marine species, however also estimates 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, southern right and humpback 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).

As highly mobile species, in general it is very unlikely that cetaceans 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.

Pygmy Blue Whale (EPBC Act: Endangered, Migratory)

Pygmy Blue Whale foraging (high use) BIA, foraging BIA and distribution BIA overlap low in-water thresholds and moderate in-water thresholds. Sightings of PBW in the Otway region between June-October are rare.

Southern Right Whale (EPBC Act: Endangered, Migratory)

SRW aggregation BIA, migration and resting on migration BIA, connecting habitat BIA overlap low surface water threshold. SRW migration and resting on migration BIA and connecting habitat BIA overlap moderate in-water threshold. The species are regularly present on the Australian coast between early-April to early November with isolated individuals seen outside these periods (DSEWPC, 2012c). Note the number of SRWs in SE Australia remains low, with no clear estimates of trend. Less than 10% of the Australian SRWs are distributed east of Adelaide (in eastern SA, TAS, Vic and NSW) and may represent a separate population.

Sei Whale (EPBC Act: Vulnerable, Migratory)

No BIAs overlap MDO release thresholds. This species is infrequently recorded off Tasmania and offshore of the continental shelf in the Bonney upwelling (Gill et al, 2015; TSSC, 2015e), with no known mating or calving areas in Australian waters (TSSC, 2015e). Based on available sighting and upwelling data, it is considered unlikely that this species occurs in the area during the Sequoia MSS period (August to October).

Fin Whale (EPBC Act: Vulnerable, Migratory)

No BIAs overlap MDO release thresholds. The species is known to feed in the Bonney Upwelling during summer/autumn (DAWE, 2020d). Areas of upwelling and interfaces with mixed and stratified waters may be an important feature of Fin Whale feeding habitat. It is unlikely, based on its habitat preferences, sightings and upwelling data, that this species will be encountered during the proposed survey period (August to October).

Humpback Whale (EPBC Act: Vulnerable, Migratory)

No BIAs overlap MDO release thresholds. The nearest area that Humpback Whales are known to congregate and potentially forage is approximately 550 km north-east of the Sequoia MSS Operational Area at Twofold Bay, Eden off the New South Wales south coast. However, Humpback whales are reported to migrate through Tasmanian waters. A study conducted by Andrews-Goff et al (2018) highlights the unlikeliness of the western coast of Tasmania and western Bass Strait to be frequently utilised for Humpback Whale migration.

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 and St. Aubins (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 (2011a) 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, hydrocarbons 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 mother-pup 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).

<table>
<tr><td colspan="3">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.</td></tr>
<tr><th colspan="3">Potential risks to marine mammals from MDO release</th></tr>
<tr><th>Surface (floating) MDO Exposure</th><th>In-water (dissolved and entrained) MDO Exposure</th><th>Shoreline MDO Exposure</th></tr>
<tr><td>Cetaceans
The OSTM predicts that low, moderate and high zones of exposure to sea surface hydrocarbon will overlap the foraging BIA for pygmy blue whales.
It is possible that pygmy blue whales may be present in the EMBAs. However, , the survey will be conducted at a time when they are unlikely to be present in the Bass strait and Otway regions (August to October). If present, these species (and other cetaceans) may be exposed to oil in the manner described in this table. If large quantities of zooplankton exposed to the spill were ingested, chronic toxicity impacts may occur.
Biological consequences of physical contact with localised areas of low concentrations of hydrocarbons at the sea surface 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(. However, given that southern right whales are expected to be present during the Survey period and given the particular sensitivities of baleen whales to oil spills, the consequence to cetacean populations from MDO at the sea surface while migrating or foraging in the EMBA at the time of the spill, is moderate.
Pinnipeds
The foraging range for New Zealand Fur-seals, Australian Sea-lions and Australian Fur-seals may be temporarily exposed to</td><td>Cetaceans
The OSTM shows (based on stochastic modelling, i.e. not a single event) the EMBA for dissolved and entrained phase hydrocarbons at the low threshold through Bass Strait and the Otway region. At the low threshold, water quality triggers may be exceeded, but there are no toxicity or ecological effects to cetaceans. The EMBA predicted to be affected by dissolved hydrocarbons at the moderate threshold is up to 211 km from the centre of the operational area and up to 236 km for entrained hydrocarbons at the high threshold.
It is unlikely that highly mobile and transient species such as cetaceans moving through deep water, through a geographically and temporally limited area of entrained or dissolved hydrocarbons at the moderate or high exposure, would experience any toxicity effects of the MDO and population level impacts would be unlikely.
As described by the oceanographic data presented in Appendix H, the well-mixed waters of central Bass Strait are likely to assist in weathering of the hydrocarbons. The OSTM predicts that 140 m^3 (37%) of the spilled MDO will evaporate after one day.
The oceanographic conditions, the light nature of the hydrocarbon and the low concentration of hydrocarbons in the</td><td>Cetaceans
Given cetaceans marine existence, shoreline hydrocarbons are not applicable.
Pinnipeds
Exposure to weathered hydrocarbons at the low threshold is unlikely to have a biological or ecological impact.
Moderate threshold hydrocarbons may contact shorelines used by fur-seals on the south coast of King Island and off the west coast of Wilsons Promontory. However, no contact is expected at known haul out and breeding locations in the region.
Given the brief time that MDO will remain at the moderate threshold and its limited extent, the consequence of an MDO spill to multiple individuals and populations present in Bass Strait is minor.</td></tr>
</table>

low, moderate and high concentration of hydrocarbons at the sea surface. As fur-seals forage for prey within the water column rather than at the sea surface, exposure to oil at the sea surface will only result when surfacing to breathe and resting at the surface. Moderate and high concentrations do not reach shorelines where seals are likely to be entering and exiting the water. Depending on the duration of time spent at the sea surface, exposure may result in irritation to mucous membranes that surround the eyes and line the oral cavity, respiratory surfaces, and anal and urogenital orifices. Given the very small area of MDO at moderate and high exposure levels on the sea surface predicted from a single spill, as well as the rapid evaporation from the sea surface (days), acute or chronic toxicity impacts are not likely for multiple individuals. The highly mobile nature of the pinniped means areas on the sea surface impacted by moderate and high hydrocarbon exposure can be avoided. Given that no breeding or haul out areas around adjacent to sea surface exposure areas and the rapid weathering of MDO, the consequence of an MDO spill to multiple individuals and populations present in Bass Strait is **minor**.	water column means the consequence to cetacean populations from an MDO spill is **minor**. **Pinnipeds** Given that fur-seals forage for prey within the water column, exposure to hydrocarbons (either via ingestion of contaminated prey or direct contact with oil droplets) may occur. However, the low concentrations modelled are below those likely to impart permanent injury or mortality to pinniped populations. The predicted zones of dissolved hydrocarbons meeting the moderate threshold and entrained hydrocarbons meeting the high threshold are small in comparison to the wider area available to pinnipeds for foraging. However, modelling indicates that a known Australian Fur-seal haul-out site where pups are occasionally born at Reid Rocks, Tasmania (Shaughnessy, 1999) overlaps with area of entrained moderate threshold. Note however, this site is not recognised within Conservation Atlas Tool BIA. The presence of a haul-out site means that it is likely that pinnipeds would be feeding on prey found in the areas of higher hydrocarbon thresholds for longer periods of time, particularly given Sequoia MSS overlaps with pup weaning months from June to October. The area potentially affected by hydrocarbons represents a relatively small area in which Fur- Seals are known to forage in Bass Strait and the Otway region. Because of this, the consequence to fur-seals from an MDO spill is **minor**.	

Summary of predicted impact level to Marine Mammals	Risk rating
An MDO release the potential to result in: • Change in fauna behaviour • Injury/mortality to fauna The extent of the area of impact is predicted to be limited to moderate thresholds of surface (floating) and in-water hydrocarbons in the upper water column (30 m depth). The worst-case consequence of MDO release on injury/mortality or change in behaviour has been aassessed as **Minor** (2) for pinnipeds and **Moderate** (3) for cetaceans, based on: • Risk of direct contact, ingestion or inhalation amongst marine mammal species is largely determined by behaviours and habitat preferences. With those at greatest risk displaying behaviours and characteristics causing greater opportunity for exposure including the following characteristics: ○ Availability of rough surface for oil to adhere to (i.e. pinnipeds more susceptible than cetaceans)	Medium

- Proportion of the time spent at the sea surface, creating increase opportunity for direct exposure, inhalation or ingestion (i.e. pinnipeds more susceptible than cetaceans due to inhalation requirements and resting (haul out) and breeding behaviours) - Occurrence of biologically important behaviours (i.e. breeding or feeding may override any tendency for marine mammals to avoid hydrocarbons) - Species feeding habits (i.e. Baleen whales are not particularly susceptible to ingestion of oil in the water column, but are more susceptible to oil at the sea surface as they feed by skimming the surface) - Marine mammals are highly mobile and able to avoid noxious presence of hydrocarbons, as such general it is very unlikely for marine mammals to be exposed to concentrations of hydrocarbons for a duration that would lead to chronic toxicity effects. - Pinniped breeding colonies are likely to have greater exposure and sensitivity to hydrocarbon spills. Hydrocarbon contaminated pups may not be recognisable to their mothers and present an increased risk that mothers may inject oil when cleaning oiled pups. - The Recovery Plans for species identified as present in the EMBA that identify marine pollution/oil spill as a key threat include the following: - Conservation Management Plan for the Blue Whale identifies habitat modification as a threat, with no explicit relevant objectives or management actions. - Conservation Management Plan for the Southern Right Whale identifies habitat modification as a threat, with no explicit relevant objectives or management actions. - Conservation advice for Balaenoptera borealis (Sei Whale) identifies habitat degradation including pollution as a threat, with no explicit relevant objectives or management actions. - Conservation advice for Balaenoptera physalus (Fin Whale) identifies pollution (persistent toxic pollutants) as a threat, with no explicit relevant objectives or management actions. - Approved Conservation Advice for Megaptera novaeangliae (Humpback Whale) identifies habitat degradation including coastal development and port expansion as a threat, with no explicit relevant objectives or management actions. - South-east Commonwealth Marine Reserves Network management plan 2013-23 identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure on conservation values of the South-east to the Commonwealth Marine Reserves Network, however provides no explicit relevant objectives or management actions. - In addition, the presence of species identified with BIAs overlapping the EMBA are expected to be largely transitory or short term in nature. BIAs for the following intersect with the moderate in-water threshold: - PBW distribution: - High use foraging BIA represents seasonally high usage occurring between Cape Otway and Robe, in conjunction with seasonal Bonney Upwelling in summer/autumn months. - Foraging BIA represents a known foraging area which occurs north-west part of Bass Strait, from Cape Otway to Port Phillip Heads and to the south of King Island and extends to the majority of Bass Strait and the coastal waters of Tasmania. - Distribution BIA represent seasonally high usage of a large area that extends from southern NSW to Indonesia along whale seasonal migratory route. - Southern Right Whale - Migration and resting on migration BIA represents shallow coastal waters occurring east of Warrnambool to Philip Island area between May to November.	

▪ Connecting habitat BIA represents shallow coastal waters of King Island and Tasmania, with likely SRW occurrence likely to occur between May to November. • The magnitude of potential risk associated MDO release is considered to result in short-term and localised impacts at an individual level, with no population level impact expected. Controls are in place for all vessels engaged in Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, it impacts would largely be restricted to upper water column and coastal areas. Impact is expected to be restricted to individual fauna and unlikely to impede the recovery of a protected species.	

Marine Reptiles

Table 5-44: Predicted Impact Level of MDO Release for Marine Reptiles

General sensitivity to MDO – Marine Reptiles	
Sensitivity rating (environmental):	Medium
A description of marine reptiles in the EMBA is provided in:	Section 1.3.7 – Marine Reptiles
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. 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, 2015). 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.	

<table>
<tr><td colspan="4">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.
Note sea snakes have not been describe here as they are not expected to occur (Section 4.6; Appendix H), as such sensitivity of MDO release has not been assessed.</td></tr>
<tr><td colspan="4">Potential risks to marine reptiles from MDO release</td></tr>
<tr><td>Surface (floating) MDO Exposure</td><td>In-water (dissolved and entrained) MDO Exposure</td><td colspan="2">Shoreline MDO Exposure</td></tr>
<tr><td>Some individual marine reptiles may come into contact with low, moderate and high hydrocarbon exposure on the sea surface during transitory behaviours in the Bass Strait. Turtle interaction with floating oil is expected 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 Bass Strait and the Otway region and the low number of turtles foraging or migrating through Bass Strait in general, the consequence of an MDO spill to threatened turtle individuals and populations is minor.</td><td>Some individual marine reptiles may come into contact with low, moderate and high hydrocarbon exposure in-water, while swimming or feeding. At the 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 Bass Strait and the Otway region and the low number of turtles foraging or migrating through Bass Strait in general, the consequence of an MDO spill to threatened turtle individuals and populations is minor.</td><td colspan="2">There are no turtle nesting sites on the southern Victorian coast, offshore islands or Tasmanian shorelines. Thus, the consequence of an MDO spill to threatened turtle individuals and populations is minor.</td></tr>
<tr><td colspan="3">Summary of predicted impact level to Marine Reptiles</td><td>Risk rating</td></tr>
<tr><td colspan="3">An MDO release has the potential to result in:
Change in fauna behaviour
Injury/mortality to fauna
The extent of the area of impact is predicted to be limited to moderate threshold of surface (floating) and in-water hydrocarbon exposure in the upper water column (30 m depth). The consequence of MDO release on injury/mortality or change in behaviour has been aassessed as Minor (2), based on:
Risk of direct contact, ingestion or inhalation amongst marine turtle species is largely determined by behaviours and habitat preferences. With those at greatest risk displaying behaviours and characteristics causing greater opportunity for exposure including the following characteristics:
Proportion of the time spent at the sea surface, creating increased opportunity for direct exposure, inhalation or ingestion
Occurrence of biologically important behaviours, particularly where nesting location occur within the EMBA (i.e. breeding or feeding may override any tendency for to avoid hydrocarbons)
Marine reptiles are highly mobile and able to avoid noxious presence of hydrocarbons, as such general it is very unlikely for marine turtles to be exposed to concentrations of hydrocarbons for durations that would lead to chronic toxicity effects.
There are no nesting or internesting areas identified as habitat critical to the survival of marine turtles in the waters of southern Australia, removing risk of impact to eggs and hatchlings which are most vulnerable to chronic toxicity effects in the event of a MDO release.</td><td>Low</td></tr>
</table>

- Recovery Plan for Marine Turtles in Australia, identifies acute chemical discharge (including spills from vessels) as a threat to the long term survival of marine turtles. However, no marine turtle stock group is identified to overlap with the low threshold EMBA, suggesting turtle occurrence in the south-east is transitory. Action Area A4 identifies minimising chemical and terrestrial discharge. With relevant management actions including: - 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. - Quantify the impacts of decreased water quality on stock viability. - Quantify the accumulation and effects of anthropogenic toxins in marine turtles, their foraging habitats and subsequent stock viability. - The presence of marine turtles identified via PMST overlapping the EMBA are expected to be largely transitory or short term in nature. No BIAs or habitat critical to the survival of the species were identified. - The magnitude of potential risk associated MDO release is considered to result in short-term and localised impacts at an individual level, with no population level impact expected. Controls are in place for all vessels engaged in the Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, the impacts would largely be restricted to the upper water column and restricted to an area of surface (floating) MDO at the moderate threshold, due to occurrence of water-soluble volatile MDO component. Impact is expected to be restricted to individual fauna and unlikely to impede the recovery of a protected species or any associated food chains within the South-East bioregion.	

Commercial Fisheries / Other Marine Users

Table 5-45: Predicted Impact Levels of MDO Release for Commercial Fisheries / Other Marine Users

General sensitivity to MDO – Commercial fishing	
Sensitivity rating (Commercial Fisheries):	Medium
Sensitivity rating (Other Marine Users):	Medium
A description of Marine Users operating in the EMBA is provided in:	Section 1.4 – Appendix H
Commercial Fisheries 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 from nearshore fisheries 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 WAF of between 24 and 48 hours. Danion et al (2011) observed PAH uptake of 148 µg/kg-1 after 48-hour exposures to PAH from Arabian Crude at high	

concentrations of 770 ppm. 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 spills) 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.
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 VFA (or voluntarily by the fishers themselves). Oil may foul the hulls of fishing vessels and associated equipment, such as gill nets. 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 ofincome derived from these fisheries are likely to have short-term but widespread socio-economic consequences, such as reduced employment (in fisheries service industries, such as tackle and bait supplies, fuel, marine mechanical services, accommodation and so forth). **Other Marine Users** Other marine users are expected to include commercial shipping, defence activities, other offshore energy industry and recreational users. Following an oil spill there marine users are expected to be impacted largely by implementation of exclusion zones. Exclusion zones may impede access to areas, for a short period of time. Marine users in the area may be impacted by oiled/ contamination of equipment and assets. Notably there are several offshore energy development projects and onshore processing plants within the Bass Strait which require water intake for system cooling and heating. In the event of a spill, it is anticipated that any oceanwater intakes will be closed off to prevent contamination and equipment damage. Such heating a cooling systems a central in safe functioning of processing facilities and activities and expected to result in project or production delays. Recreational marine users, include recreational fishing and other coastal recreation activities (beach access, surfing etc.) are expected to be the most affected by an MDO release. However, given offshore location and volatility of MDO these impacts are reduced to largely perception issues associated with visible hydrocarbons reaching coast lines. Following Macondo well blowout in the Gulf of Mexico in 2010, recreational fishing harvests in 2011, 2012 and 2013 were recorded to exceed landings from 2007-09, prior to the blowout (BP, 2014), suggesting recovery of fish stocks and confidence that public perception in fish quality.

Potential risks to Marine Users from MDO release		
Surface (floating) MDO Exposure	**In-water (dissolved and entrained) MDO Exposure**	**Shorelines MDO Exposure**
Commercial Fisheries	**Commercial Fisheries**	**Commercial Fisheries**

A short-term (days to weeks) fishing exclusion zone may be implemented by AFMA or the Victorian or Tasmanian fishing authorities. Given the temporary nature of any surface slick and the low fishing intensity in the EMBA, there are unlikely to be any significant impact on fisheries in terms of lost catches (and associated income). However, additional expense to individual fishers where contamination of fishing gear has occurred can be expected. Whereby oiled surfaces may themselves be a source of secondary contamination until they are cleaned. Therefore, the consequence to Commercial Fisheries overall function or its target catch species in the long-term is **minor**. **Other Marine Users** Marine users most at risk of surface (floating) hydrocarbons are largely restricted to shallower coastal waters and shorelines. Exposure of coastal waters and shoreline to surface (floating) oil is only expected at low thresholds. Therefore, the consequence to other marine users is **minor** **Energy exploration and production** Energy exploration and production occurring in the Bass Strait are not anticipated to be significantly impacted by surface (floating) oil given intakes are typically located below sea surface to avoid intake of floating objects. Therefore, the consequence to other marine users is **minor,** given offshore nature of the spill and anticipated rapid weathering of MDO.	Stochastic modelling identified the EMBA that may be affected by dissolved and entrained hydrocarbons at the relevant exposure thresholds. This represents the entire area affected by 100 spill simulations and cannot be used to determine the extend of impact from a single spill event. A single spill event may result in a short-term fishing exclusion zone (days to weeks) being implemented by AFMA or the Victorian or Tasmanian fishing authorities. 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 expected to accumulate among benthic sediments in the EMBA 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 beyond 20 m depth, which are likely slower to recover. For most fisheries described in Section 4.7, precautionary exclusion from fishing grounds can be expected until water quality monitoring verifies the absence of residual hydrocarbons, as such providing confidence to consumers in fisheries tainting. Therefore, the consequence to Commercial Fisheries operating the offshore environment where there are no expected impacts to overall function or target catch species in the long-term is **minor**. However, for fisheries operating inshore (>10 m depth) along coastal sections (depending on the actual spill trajectory) consequence is expected to be **moderate**. Stochastic modelling indicates the maximum extent of low to high exposure of the benthic layer to entrained hydrocarbons (in 0-10 m water depths) occurs in the nearshore environment along the Colac and Otway coast sections as well as King Island coast. Impacts to this fishery may eventuate in the form of a temporary and precautionary exclusion from fishing grounds until water quality monitoring verifies the absence of residual hydrocarbons. Extended exclusions zones maybe persist due to slower rate of degradation of entrained MDO components. Such fisheries may include Rock Lobster fishery (Vic), Giant Crab (Tas), Southern Rock Lobster (Tas), depending on actual spill trajectory.	Vessels use local ports, many of which are not included within the EMBA. Where the EMBA includes moored fishing vessels, some staining or coasting of vessel hulls may occur. Therefore, the consequence to Commercial Fisheries overall function or its target catch species in the long-term is **minor**. **Other Marine Users** Marine users most at affected by shoreline accumulation of weathered MDO are recreational fishers and those engaging in water sports (e.g. surfing, boating, diving). Modelling suggests that average length of shoreline contact is 8.9 km at low (visible) threshold and 2.5 km at moderate (impact) threshold, with at 16 % probability of contacting a shoreline above low threshold. Therefore, the consequence to other marine users is **minor,** given limited shoreline contact and anticipated rapid weathering of MDO. **Energy exploration and production** No impacts to energy exploration and production is expected as a result of shoreline accumulation of MDO.

	Other Marine Users Marine users most at risk of in-water hydrocarbons are largely restricted to shallower coastal waters and shorelines. Exposure of coastal waters and shoreline is expected at moderate thresholds, in nearshore environment along the Colac and Otway coast sections as well as King Island coast. Precautionary exclusion from these areas may be implemented by local governments until water quality monitoring verifies the absence of residual hydrocarbons. Therefore, the consequence to other marine users is **minor,** given offshore nature of the spill and anticipated rapid weathering of MDO. **Energy Exploration and Production** Energy exploration and production occurring in the Bass Strait may be impacted by in-water hydrocarbons given intakes are typically located below sea surface. Based on spill modelling, location of the spill (closest point to an operating facility is 25 km) and rapid weathering characteristic of MDO, any closure of water intakes is anticipated to be short term (days to weeks). However, given day rates of these operations consequence is **moderate**.	

Summary of predicted impact level to Commercial Fisheries	**Risk rating**
An MDO release has the potential to result in: • Changes to the functions, interests or activities of other users • Change in aesthetic value The extent of the area of impact is predicted to be limited to locations where there is potential for marine users equipment to come into contact with moderate threshold exposure or where activities are excluded from areas traditionally accessed. These are anticipated to be largely areas interacting with the upper water column (20 m depth) or where MDO is visible. The consequence of an MDO release on impacting individual marine users traditional behaviours has been assessed as **Moderate (3)**, based on: • Risk of marine users equipment being contaminated or traditional access to locations being excluded is largely determined by location and volume of MDO spill in relation to these activities and visual extent of the spill. • Exclusion zones from areas are expected to be short term (days to weeks) based on MDO weathering characteristics. • Precautionary exclusion from fishing grounds is expected to be based on water quality monitoring which verifies the absence of residual hydrocarbons, as such providing consumer confidence. • Impact to fish is expected to be short-term, given their ability to metabolise petroleum hydrocarbons. As such limited ill effects are expected in a small number of individual fish only, with tainting expected to return to reference levels within two months of exposure.	Medium

• The magnitude of potential risk associated MDO release is considered to result in short-term and localised impacts, representing individual marine users of a small area which is widely representative of the region, with no fishery level impacts expected resulting from MDO release. Controls are in place for all vessels engaged in the Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, its impacts would largely be restricted to the upper water column in the immediate vicinity of the spill, coastal areas and shoreline experiencing low (visible) threshold hydrocarbons exposure. Impact is expected to be restricted to individual marine users and unlikely to affect an entire fishery.	

Coastal Habitats and Communities

Table 5-46: Predicted Impact Levels of MDO Release for Coastal Habitats and Communities

General sensitivity to MDO – Coastal habitats and Communities	
Sensitivity rating (Rocky shores, Sandy beaches):	Low
Sensitivity rating (other Coastal habitats and communities):	Medium
A description of Coastal habitats and Communities in the EMBA is provided in:	Section 1.2.5 – Appendix H
Sandy beaches 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 into 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). For example, following the Sea Empress crude oil spill (in west Wales, 1996) many amphipods (sandhoppers), cockles and razor shells were killed. There were mass strandings on many beaches of both intertidal species (such as cockles) and shallow sub-tidal species. Similar mass strandings occurred after the Amoco Cadiz spill (in Brittany, France, 1978) (IPIECA, 1999). Following the Sea Empress spill, populations of mud snails recovered within a few months, but some amphipod populations had not returned to normal after one year. Opportunists such as some species of worm may	

actually show a dramatic short-term increase following an oil spill (IPIECA, 1999). Long-term depletion of sediment fauna could have an adverse effect on birds or fish that use tidal flats as feeding grounds (IPIECA, 1999).

In March 2014, small volumes of crude oil from an unidentified source (confirmed to not be offshore oil and gas production facilities) washed up along a 7-km section of sandy beach on the Victorian Gippsland coast as small (a few millimetres thick) granular balls (Gippsland Times, 2014; ABC News, 2014). AMSA (2014b) reported that no impacts were observed over the course of two months following the incident.

The Macondo well blowout resulted in crude oil washing up on sandy beaches of the Alabama coastline. The natural movement of sand and water through the beach system continually transformed and re-distributed oil within the beach system, and 18 months after the event, mobile remnant oil remained in various states of weathering buried at different depths in the beaches (Hayworth *et al*., 2011). Other results from beach sampling undertaken at Dauphin Island, Alabama, in May (pre-impact) and September 2011 (post-impact) found a large shift in the diversity and abundance of microbial species (e.g., nematodes, annelids, arthropods, polychaetes, protists, fungi, algae and bacteria). Post-spill, sampling indicated that species composition was almost exclusively dominated by a few species of fungi. DNA analyses revealed that the 'before' and 'after' communities at the same sites weren't closely related to each other (Bik et al., 2012). Similar studies found that oil deposited on the beaches caused a shift in the community structure toward a hydrocarbonoclastic consortium (petroleum hydrocarbon degrading microorganisms) (Lamendella *et al*., 2014).

Rocky shores

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. 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 shoreline, most of the oil is concentrated along the high tide mark while the lower parts are often untouched (IPIECA, 1995).

It is not long before the waves and tides that carried the hydrocarbons onto the shore gradually remove it again, but the rate of such weathering is dependent on many factors. The oil type, wave exposure, weather conditions and the shore characteristics are most important. For example, a patch of oil on a rock exposed to heavy wave action is not going to remain there for long. However, it could take many years for the limited water movement in a sheltered bay to remove oil trapped under boulders or in gullies and crevices. Gradual leaching of this oil could result in constant low-level pollution of, for example, a rock pool. Microbial breakdown of the oil is slower in cold or temperature environments than sub-tropical or tropical environments. The presence of silt and clay particles can assist with oil removal by the process of flocculation. Grazing animals such as marine snails may also remove significant amounts of oil.

As the oil is weathered it becomes more viscous and less toxic, often leaving little but a small residue of tar on upper shore rocks. This residue can remain as an unsightly stain for a long time but it is unlikely to cause any more ecological damage. Oil tends not to remain on wet rock or algae but is likely to stick firmly if the rock is dry (IPIECA, 1995).

Coastal TECs

The following listed TECs may be exposed to the low threshold for entrained (in-water) MDO:

- Subtropical and Temperate Coastal Salt Marsh (EPBC Listed Vulnerable)
- Giant Kelp Forrest of SE Australia (EPBC Listed Endangered)
- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community (EPBC Listed Endangered)

Other Important Coastal Habitats

The following Listed RAMSAR wetlands may be exposed to the low threshold for entrained (in-water) MDO:

<table>
<tr><td colspan="2">

- Lake Connewarre, Victoria
- Western Port, Victoria
- Lavinia, Tasmania

Listed RAMSAR wetlands are further assessed within the Bird MDO release assessment.

King Island IBA

The IBA includes the entire coastline of King Island, which supports significant numbers of Hooded Plovers; Lavinia State Reserve, which supports Orange-bellied Parrots 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.

The IBA is further assessed within the Bird MDO release assessment.
</td></tr>
<tr><td colspan="2">Potential risks from MDO release</td></tr>
<tr><td colspan="2">Shoreline MDO Exposure</td></tr>
<tr><td colspan="2">

The shorelines predicted to be exposed to moderate MDO loading are exposed, mostly rocky and are subject to strong wave action (Figure 5-5) assisting in natural degradation of MDO.

Areas of low exposure to shoreline loading are not expected to exhibit environmental harm. Due to the exposed nature of the shoreline 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. No MDO shoreline loading at the high threshold is predicted by OSTM. Potential impacts 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 of MDO at low threshold exposure.

MDO entrained in the water column (in the top 10 m) at the low threshold (10–100 ppb) has the potential to intersect sandy shorelines within the Mornington Peninsula, Cape Patterson, East Gippsland and the southern-most sandy beaches of NSW in the EMBA. Given the distances of these beaches from the spill location, the MDO will be highly weathered and unlikely to result in any toxicity impacts to shoreline invertebrate communities or shoreline bird species feeding on such invertebrates.

There is a 5% probability of moderate shoreline loading on the King Island coast. Much of this coastline is comprised of rocky shores with cliff- dominated coastline present adjacent the operational area.
</td></tr>
<tr><td>Summary of predicted impact level to Coastal habitats</td><td>Risk rating</td></tr>
<tr><td>

An MDO release has the potential to result in:

- Change in ecosystem dynamics
- Change in fauna behaviour
- Change in aesthetic value

The extent of the area of ecological impact is predicted to be within the limits of the shoreline moderate exposure threshold, and expected to be short-term, and recoverable by natural degradation of hydrocarbon. While socio-economic impacts is predicted to extend to the low (visible) threshold, it is similarly expected to persist short-term only as a result of natural degradation of hydrocarbon. The consequence of MDO release to coastal habitats and communities on ecological and socio-economic has been assessed as **Moderate (3)**, based on:
</td><td>Medium</td></tr>
</table>

• The action of reflected waves off rocky shores and exposed sandy beach, together with the predicted weathering of MDO, means it is unlikely that toxicity or smothering effects to exposed biota will occur in coastal habitats (further from spill location). In exposed areas MDO is likely to be continually washed off the substrate and into the water, leading to further weathering. • Exposure pathways of species to weathered oil (i.e. smothering and potential ingestion for some species) are less likely to result in adverse effects. • Moderate threshold for shoreline accumulation does not overlap with any listed critical habitats but may overlap Threatened Ecological Communities (TECs). • Lake Connewarre, Western Port and Lavinia Listed RAMSAR wetlands are exposed to hydrocarbon however only at low threshold for entrained (in-water) MDO, as such low exposure threshold is unlikely to result in ecological impacts to habitat function. • Visible EMBA overlaps with coastal areas utilised by tourism and recreation however given Sequoia MSS will be conducted over colder months from late winter to early spring, overall usage of these coastal areas is expected to be lower than summer season when weather is milder, as such allowing more time for weathered MDO to further degrade before these regions are more regularly accessed. • The magnitude of potential risk associated with MDO release is considered to result in medium-term and localised impacts, representing a small portion of coastal habitat that is widely representative of the region, with no population level impact is expected. Controls are in place for all vessels engaged in the Sequoia MSS to reduce the risk of vessel collision and limit the total volume of MDO released. These systems are well practiced and well understood. The likelihood is assessed as **Remote**, given the occurrence of unplanned vessel collision resulting in MDO release is very low. If an incident occurred, it would be restricted to localised coastal communities and unlikely to impede the recovery of coastal communities with Listed critical habitats.	

5.4.6. Comparison of Predicted Impact with Defined Acceptable Levels

Table 5-47 compares the predicted impact levels for MDO Release against the acceptable levels.

Table 5-47: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for MDO Release

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	**Level**		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Planned activities not expected to result in MDO release.	Yes
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction.	Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	Marine pollution is a threat identified for albatross and giant-petrels in the National recovery plan for threatened albatross and giant petrels 2011-2016 (DSEWPC, 2011a). Population monitoring is the suggested action to deal with marine pollution. The conservation advice and management plans for blue, humpback, sei and fin whales identify hydrocarbon spill as threats, though there are no specific aims to address this.	
Biological Ecological Economic	No spills of marine diesel oil to the marine environment.	No spills of marine diesel oil are predicted.	Yes
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM7 - the marine assurance system, ensures that project vessels comply with all maritime laws and is considered effective. CM10 - the vessel bunkering procedure, manages the highest part of the risk and is proven to be effective. CM8 - the OPEP, and OSMP, ensures that ConocoPhillips Australia is prepared and ready to	Yes

		respond in the unlikely event of a spill.		
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental risks will be at or below significant.	Likelihood	Rare	Yes
		Consequence	Minor	
		Risk	Low	
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to oil spills have been considered in Section 3.4. Only general public comments were made in relation to oil spills.		
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 5-36.		Yes
Acceptability Summary				
Following completion of the risk assessment process, the environmental risk arising from a release of MDO are acceptable because: • The impacts associated with an MDO release are well known • Inductions for vessel crew will be completed so the policies and procedures for the storage, use, handling and transfer of MDO are well understood • Regulatory guidelines controlling MDO handling are known • Good practice controls are well defined and well implemented • In the unlikely event of a release of MDO, ConocoPhillips Australia has an OPEP in place to facilitate a rapid and effective response, and OSMP to implement timely operational and scientific monitoring programs to support the response and monitor impact and recovery over time.				

5.4.7. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Risk	• There is no spill of diesel to the marine environment and ConocoPhillips are ready to respond it they do.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section in Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 5-48 which assesses whether the control measures for MDO release are effective to meet the EPO.

Table 5-48: Control Measure Effectiveness – MDO Release

Measures	CM 10 – Vessel bunkering procedure
Assessment of Effectiveness	This procedure is an industry standard for all fuel transfers at sea which are regularly completed throughout Australia without incident. The performance standards for this control measure include specific items of equipment that activate to limit the spread of any diesel spill. In addition, a commitment to carry out fuel transfers outside of the marine park is made to further reduce risks to higher value sensitivities.
Is the EPO achieved?	Partially

Measures	CM 10 – Vessel bunkering procedure
Residual impacts requiring additional management	The vessel bunkering procedure support prevention of spills and reducing the likelihood of their event. It does not contribute to reduction of consequence.
Next Measure	CM 7 – Marine assurance system
Assessment of Effectiveness	The pre-survey inspection will confirm that vessels have a SOPEP that covers the actions of the vessel owner and Master in the unlikely event of a diesel spill.
Is the EPO achieved?	Partially
Residual impacts requiring additional management	Whilst the measures implemented by following the SOPEP they are limited to what can occur on the vessel and do not specify response actions in the marine environment.
Next Measure	CM 8 – Oil Pollution Emergency Plan and CM 9 – Oil spill response equipment and personnel
Assessment of Effectiveness	These measures fill the gaps in the previous control measures such that a marine environmental response will be carried out in the unlikely event of a diesel spill.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

5.5. Oil Spill Response Activities

5.5.1. Spill Response Strategies

The Sequoia MSS OPEP (Appendix I) outlines specific emergency response options and tactics to respond effectively if a spill occurs during petroleum activities under this EP. This section represents the risk assessment for oil spill response options as required by the OPGGS(E)R Regulations and describes:

- The potential spill scenario
- The response strategy (as well as justifying those strategies not selected)
- Environmental risk assessment.

5.5.1.1. Response Option Selection / NEBA

Spill response implementation would be triggered in the event of a hydrocarbon spill. Whereby spill response activities would be dependent on advice from AMSA, as Control Agency. Not all hydrocarbon spill response options are appropriate for every spill scenario – responses options vary based on factors such as hydrocarbon type, volume, location, sea state and spill trajectory.

ConocoPhillips Australia have conducted a Strategic (pre-spill) Net Environmental Benefits Analysis (NEBA) to identify response strategies that will result in the lowest overall impact and maximum protection or recovery of environmental and social resources at risk within the Spill EMBA. This process acknowledges that some response and clean-up activities may in fact result in a negative impact, compared to natural weathering or other strategies. The process requires the identification of sensitive environmental and social receptors and the prioritisation of those receptors for protection so that the strategic objectives of the response can be established (OPEP; Appendix I). NEBA is undertaken at a strategic level (pre-spill) to identify pre-determined recommended response strategies, while an Operational NEBA is undertaken routinely throughout an emergency response, as per the process described within Section 4 of the OPEP. Only those response strategies that are determined to be feasible and effective are risk assessed in this section.

Stochastic oil spill trajectory modelling (OSTM) predicted potential hydrocarbon accumulation on the western, northern and south-eastern coastlines of King Island and isolated areas along the Port Campbell, Cape Otway and Wilson Promontory coasts, with only very limited and remote lengths of shoreline predicted above actionable exposure levels (100 g/m3). The maximum length of shoreline contact predicted at the actionable threshold was 8.4 km near Cape Otway. Predicted weathering and fates graph for MDO the single spill trajectory is provided in Figure 5-41.

Table 5-49 summarises the possible response strategies to a Level 2 or 3 MDO spill considered by ConocoPhillips Australia and provides outcomes of the OSR Strategic NEBA assessment as to their suitability for an MDO release. Note however in the event of a spill implementation of these strategies would be pending Operational NEBA. OSR response techniques considered potentially viable (feasible and effective), based on Strategic NEBA outcomes, that have been assessed in this Section include:

- Source Control
- Monitoring, Evaluation, and Surveillance (MES)
- Natural Recovery
- Assisted Natural Dispersion (AND)

- Shoreline Clean-up and Assessment
- Oiled Wildlife Response

Natural recovery is not discussed further in this Chapter (Section 5.5.1), as specific tasks are not required to be implemented. Should natural recovery be considered an appropriate response option, continual MES and NEBA will be undertaken, as per the overarching response implementation process.

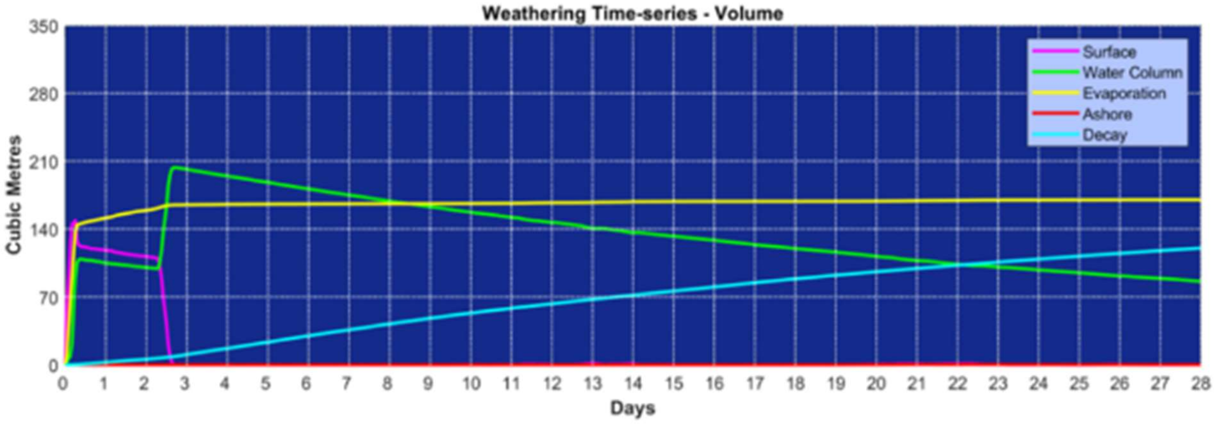


Figure 5-41: Predicted weathering and fates graph for the single spill trajectory. Results are based on a 373 m3 surface release of MDO over 6 hours, tracked for 28 days, starting 08:00 am 25th June 2009

Table 5-49: Suitability of Response Options for MDO

Response Option	Description	Suitability of response option	Feasibility / Effectiveness	Strategic NEBA outcome
Source Control	Limit flow of hydrocarbons to environment. Key method of source control is outlined in the vessel- specific SMPEP (or equivalent based on class). However, the key response measures typically involve: • Moving further out to sea (away from shoreline sensitivities) if the vessel is still able to navigate; and • Transferring MDO from the affected tank/s to non-affected tanks.	Primary response strategy. Minimises volume of hydrocarbon lost to environment. Achieved by vessel emergency management plan/SOPEP, as required by AMSA Marine Orders Part 21 and 91.	Feasible and effective	✓
Monitor and Evaluate	To maintain situational awareness. Ongoing monitoring and evaluation typically includes the following: • Aerial observation (primarily by helicopter); • Vessel-based observation; • Oil spill trajectory modelling (OSTM) [computer-based and/or manual vector analysis]; • Fate and Weathering Modelling (computer modelling and computational techniques); and • Remote sensing.	MDO spreads rapidly to thin layers, with typically <50% remaining on the surface after 24-48 hours. Initial surveillance could be undertaken by the vessel itself (depending on cause of failure/damage). Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance is limited in effectiveness in determining spread of oil. Noting where an additional vessel may be required to conduct observation the distance from Port to Operational Area and vessel mobilisation timeframe needs consideration in Operational NEBA. Manual calculation based upon weather conditions will be used at the time to provide guidance to aerial observations. Oil Spill trajectory modelling utilised to forecast impact areas.	Feasible and effective	✓
Natural Recovery	Leaving the oil in place to be broken down through natural processes. No actions required beyond ongoing monitor and evaluate.	Suitable, due to MDO characteristic. Particularly given rocky substrate and rough seas widely experienced in the region, suggesting spilt MDO would weather rapidly due to the action of waves against the rocks. Whereby along shorelines environmental impacts are likely to be higher when implementing shoreline clean up response techniques compared to the natural degradation Adoption will be subject to outcomes of Operational NEBA.	Feasible and effective	✓

Assisted Natural Dispersion	Use of motorised vessels to break up hydrocarbon slicks using propeller wash. This activity is generally only necessary if monitoring indicates the slick is moving to sensitive shorelines and anticipated to be conducted by the same VoO conducting monitor and evaluate.	Suitable, particularly where the spill is headed towards sensitive receptors. Potentially in conjunction with other response options	Feasible and partially effective	Subject to Operational NEBA
Dispersant Application	Breakdown surface spill and draw droplets into upper layers of water column. Increases biodegradation and weathering and provides benefit to sea-surface /air breathing animals.	MDO, while having a small persistent fraction, spreads rapidly to thin layers. Insufficient time to respond while suitable surface thicknesses are present. Dispersant application can result in punch-through where dispersant passes into the water column without breaking oil layer down if surface layers are too thin. Application can contribute to water quality degradation through chemical application without removing surface oil. Considered not to add sufficient benefits.	Feasible, but not effective	X
Containment and Recovery	Booms and skimmers to contain surface oil where there is a potential threat to environmental sensitivities.	Suitability is dependent on adequate (recoverable) floating MDO (>10 g/m^2), calm seas and significant areas of unbroken surface slicks. MDO spreads rapidly to less than 10 g/m^2 and is expected that areas of actionable MDO concentration would weather in less time than is required to deploy response equipment In general, this method only recovers approximately 10-15% of total spill residue, creates significant levels of waste, requires significant manpower and suitable weather conditions (calm) to be deployed.	Not feasible, not effective	X
Shoreline Protection and Deflection	Booms and/or skimmers, or mechanical equipment to block creeks, etc deployed to protect environmental sensitivities.	Effectiveness is dependent on suitability of environmental condition (swells and waves) for the use of booming materials. Modelling predicts shoreline contact on the western, northern and south-eastern coastline of King Island and isolated areas along the Port Campbell, Cape Otway and Wilson Promontory coasts. However only very limited and remote length of shoreline were predicted above actionable exposure levels (100 g/m^3), with maximum length of shoreline contact at the actionable threshold being 8.4 km Not required, given potentially affected shorelines are mostly ‘self- cleaning’ and open ocean areas limit the effectiveness of this response. Adoption will be subject to outcomes of Operational NEBA and consultation with by relevant Jurisdictional Authority. Would be considered in event of TEC or critical habitat risk.	Potentially feasible and partially effective	Subject to Operational NEBA

Shoreline Assessment and Clean-up	Shoreline assessment is appropriate where moderate shoreline loading is expected to confirm contact and support decisions around clean-up. Shoreline clean-up is a last response strategy due to the potential environmental impact. It would involve foot access along shorelines potentially at risk of contact (based on real-time OSTM).	Shoreline assessment would be considered in event of TEC or critical habitat risk where safe access is available, and/or observations can be made safely by boat. In regard to clean-up: • MDO spreads rapidly to thin layers, with typically <50% remaining on the surface after 24-48 hours. Minimum time to shoreline contact at the visual (not actionable) threshold is 40 hours. • Modelling predicts shoreline contact on the western, northern and south-eastern coastline of King Island and isolated areas along the Port Campbell, Cape Otway and Wilson Promontory coasts. However only very limited and remote length of shoreline were predicted above actionable exposure levels (100 g/m^3), with maximum length of shoreline contact at the actionable threshold being 8.4 km • Not required, given potentially affected shorelines are mostly 'self-cleaning' and open ocean areas limit the effectiveness of this response. • No suitable, given environmental impacts associated with accessing remote coastlines are likely to be higher when implementing this response technique compared to allowing for natural degradation. However, adoption will be subject to outcomes of Operational NEBA. Would be considered in event of TEC or critical habitat risk.	Potentially feasible and partially effective	Subject to Operational NEBA
Oiled wildlife Response (OWR)	Consists of capture, cleaning and rehabilitation of oiled wildlife. May include hazing or pre-spill captive management.	Given limited size and rapid spreading of the MDO spill, large scale wildlife response is not expected. However, there is the potential that individual birds could become oiled in the vicinity of the spill. MDO evaporates and disperses rapidly, most fauna is unlikely to be exposed to sub-lethal or lethal hydrocarbon concentrations that warrant wildlife capture and treatment, especially at the sea surface. The close proximity of the Phillip Island wildlife rescue centre to the affected shoreline makes an OWR response feasible. Hazing may be considered to disperse animals away from a slick (such as seabirds, shorebird, seals and dolphins) or any shoreline areas where MDO has not infiltrated beach sediments. Only DELWP, DPIPWE or AMSA officers (or those authorised by these agencies) are permitted to handle and treat oiled wildlife. This may limit the effectiveness	Potentially feasible and partially effective	Subject to Operational NEBA

		and feasibility of this response in terms of the number of responders and therefore the number of affected fauna that could be treated. The feasibility of collecting oiled fauna from the deck of a vessel is low; given deck heights, and that a calm sea state and low wind are required, meaning there is a potential risk of injuring fauna during field collection and handling. Not suitable, given like to result in more harm to wildlife could occur during the handling and treatment process than allowing for natural cleaning. However, reassessment will occur during operational NEBAs based on oiled wildlife observation from operational (Type I) monitoring and more detail on this response option have been included the OPEP, if required.		

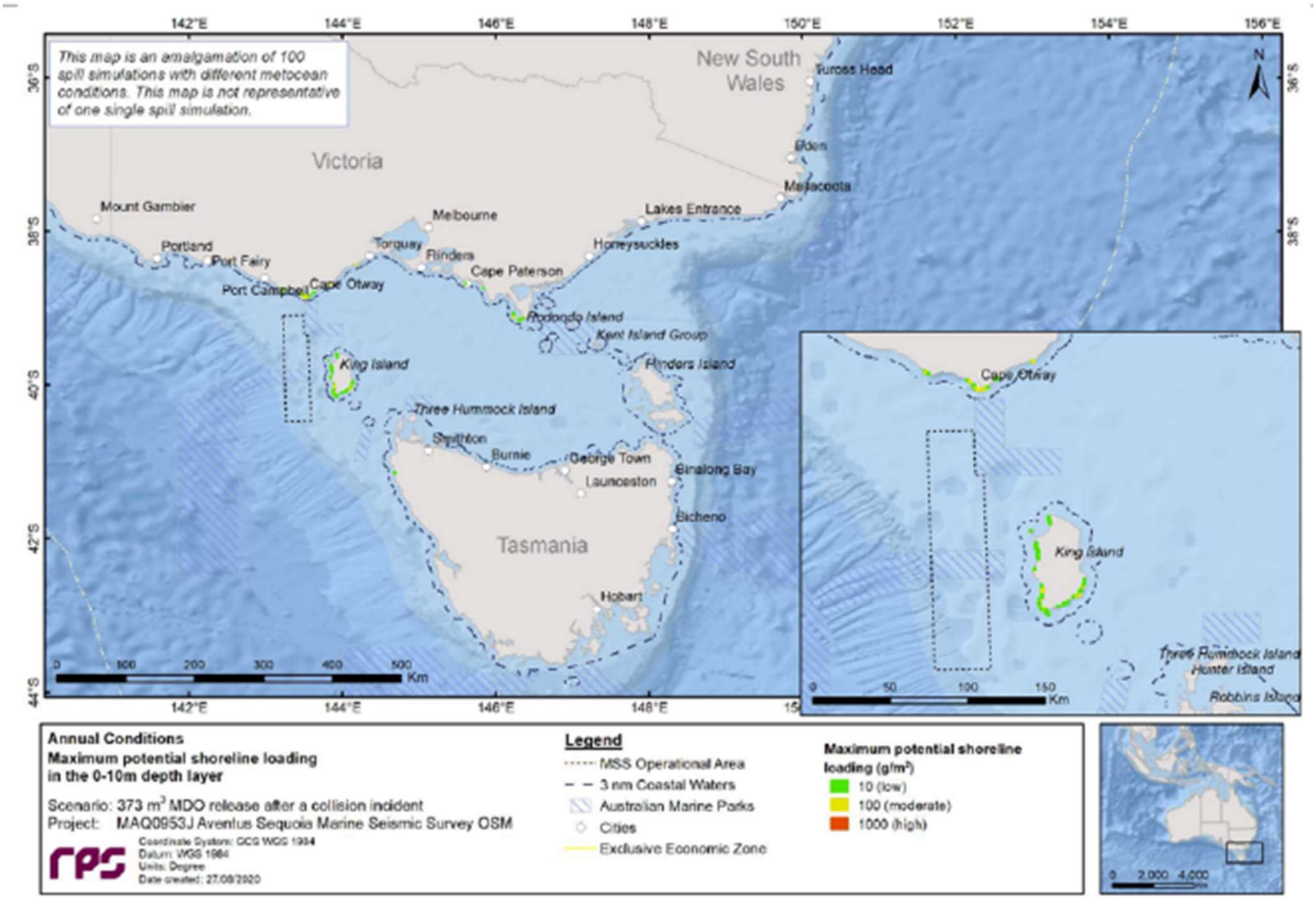


Figure 5-42: Maximum potential shoreline loading in the event of a 373 m3 surface release of MDO over 6 hours and tracked for 28 days

5.5.2. Scoping the Assessment

5.5.2.1. Cause and Effect Pathway

Oil spill response (OSR) activities may be required following a level 2 or 3 MDO release as a result of:

- Vessel activities.

In accordance with Regulation 13 (3A) of the OPGGS regulations, the significant impacts and risks arising indirectly from the activity (associated with the response strategies) have been identified and evaluated and summarised in this section.

The Spill Response Scoping Matrix summarises the aspects generated by implementing the spill response activities and identifies the activities and associated hazards for each of the recommended response strategy. Upon completion of the scoping matrix, activities considered as similar and having the same potential environmental impacts were grouped to minimise duplication and enable targeted controls to be implemented. These activities driving aspects experienced were identified to be:

- Vessel activities
- Aircraft activities

- Shoreline access.

Typically, unplanned environmental risks that arise from conducting emergency response activities in the offshore environment are similar to those already described in this EP, specifically, aspects associated with operating offshore vessels, and have therefore not been assessed in this section as they are considered to be appropriately identified in Section 5. Although not assessed again in this section unplanned events have been included in Table 5-50 for completeness.

Table 5-50: Spill Response Activities – Aspects Generator

Spill Response Strategy	Planned Activities					
	Emissions - Underwater Sound (Continuous)	Emissions - Light	Emissions – Atmospheric	Planned Discharges – Vessels	Interference with Other Marine Users	Onshore disturbance
Source Control						
Vessel Activities	✓	✓	✓	✓	✓	
Monitor and Evaluate						
Aircraft Activities	✓	✓	✓	✓	✓	
Vessel Activities	✓	✓	✓	✓	✓	
Shoreline access						✓
Assisted Natural Dispersion						
Vessel Activities	✓	✓	✓	✓	✓	
Protect and Deflect						
Vessel Activities	✓	✓	✓	✓	✓	
Shoreline access						✓
Shoreline Assessment and Clean-up						
Vessel Activities	✓	✓	✓	✓	✓	
Shoreline access					✓	✓
Oiled wildlife Response						
Vessel Activities	✓	✓	✓	✓	✓	
Shoreline access					✓	✓

5.5.2.2. Defining the Impacts

Table 5-51 identifies the impacts and receptors that have the potential to be impacted by spill response activities (identified in Table 5-50) in the event of a level 2 or 3 MDO spill during the Sequoia MSS.

Receptors and impacts marked 'X' are subject to risk that are predicted to have a consequence considered as less than Negligible (1); or where no cause/effect pathway has been identified.

Table 5-51: Activity, Aspects and Impacts Spill Response Activities

Activity	Aspect	Impacts	Plankton	Invertebrates	Birds	Fish	Marine mammals	Marine reptiles	Commercial Fisheries	Other Marine Users	Coastal habitats and communities
Aircraft Activities	Emissions - Underwater Sound (Continuous)	Change in fauna behaviour		X	X	✓	✓	✓			
Vessel Activities	Emissions - Underwater Sound (Continuous)	Change in fauna behaviour		X	X	✓	✓	✓			
	Emissions - Light	Change in fauna behaviour			X	✓	✓	✓			
	Interference with Other Marine Users	Changes to the functions, interests or activities of other users							✓	✓	
Shoreline Access	Onshore disturbance	Change in habitat									✓
		Change in fauna behaviour			✓		✓				
		Injury/mortality to fauna			✓		✓				
		Changes to the functions, interests or activities of other users								✓	

5.5.2.3. Defining the EMBA

Table 5-52 describes how the EMBA has been defined for the receptors and impacts that have the potential to be impacted by OSR activities (Table 5-51).

Table 5-52: EMBA for OSR Activities

Aspect	EMBA	Basis of EMBA	Source	Spatial extent
OSR Activities	Spill EMBA	The EMBA has been defined on the basis that spill response activities may occur anywhere in the Spill EMBA (Figure 5-43).	AMSA National Plan for Marine Pollution Emergencies.	Spatial extend of spill modelling outcome based on low (visible) threshold for surface, shoreline, dissolved and entrained MDO. Note low thresholds are precautionary and do not indicate areas of actionable oil response (moderate thresholds).

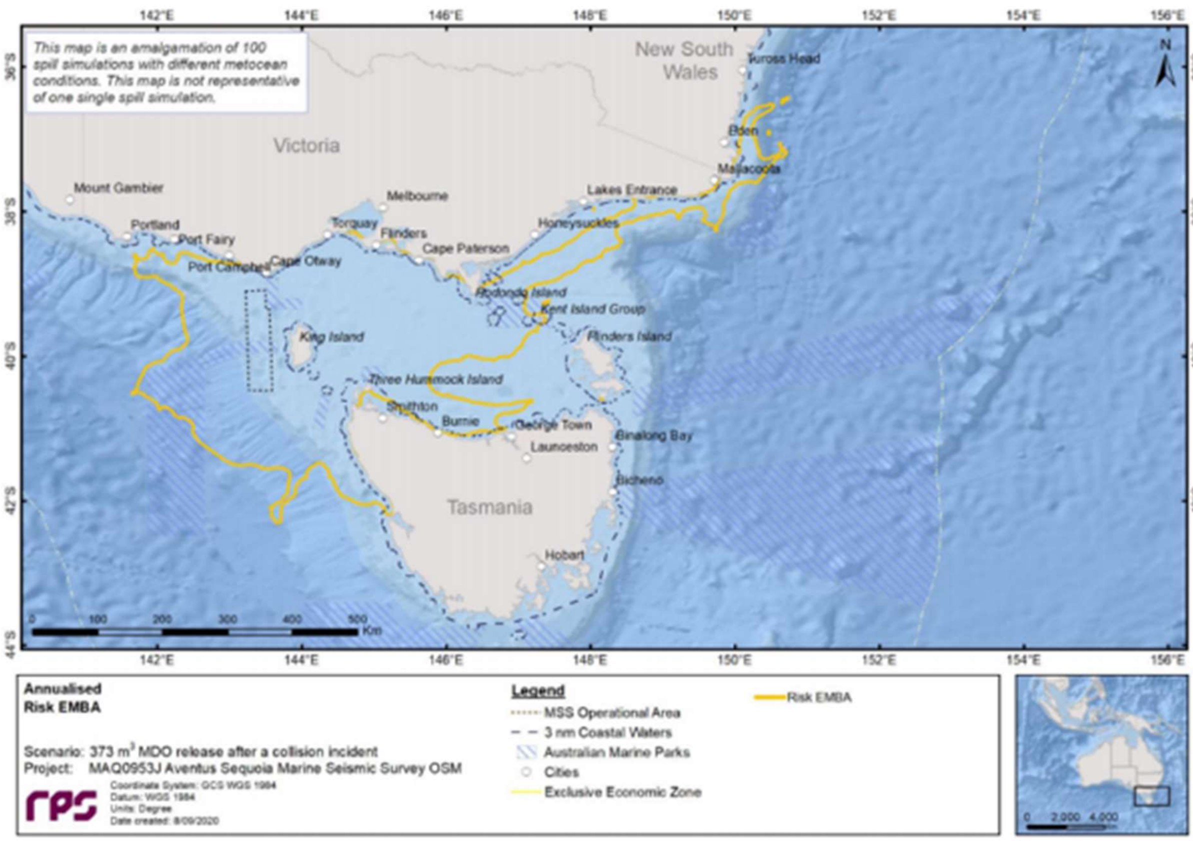


Figure 5-43: Predicted Spill EMBA resulting from 373 m3 MDO over 6 hours calculated from 100 spill trajectories and tracked for 28 days low (visible) threshold for surface, shoreline, dissolved and entrained MDO

5.5.2.4. Existing Environment

The values, sensitivities and existing pressures of the relevant receptors (receptor groups identified in Table 5-50) have been described in the following sections:

- Plankton (Section 4.1)
- Invertebrates (Section 4.2)
- Fish (Section 4.3)
- Birds (Section 4.4)
- Marine mammals (Section 4.5)
- Marine reptiles (Section 4.6)
- Commercial Fisheries (Section 4.7)
- Other Marine Users (Section 4.8).

Further description about the general environment and ecosystem function of the South-east Marine Region is provided in Appendix H – Existing Environment.

5.5.2.5. Legislative Requirements

A larger proportion of minimum legislative and other requirements relevant to OSR activities have been described in Section 5.4.4 MDO Release. As such Table 5-53 identifies only any additional minimum legislative and other requirements specific to OSR activities and describes relevant item, objective or action has been identified, and how this is addressed or managed by the Sequoia MSS.

Legislative and other requirements (such as EPBC management plans) specific to relevant receptors are described in receptor sections (Section 4.1 to 4.8), along with identified impact/risk associated with OSR as a key threat (as identified in Table 5-51).

Table 5-53: Other Requirements for OSR Activities

Type	Requirement	Relevant Item/Objective/Action	Addressed/Managed by Sequoia Survey
Guideline (Industry)	Aerial Observations of Marine Oil Spills Technical Information Paper (ITOPF, 2011b).	This Technical Information Paper presents advice and guidance on conducting effective aerial reconnaissance.	Refer to receptor and aspect sections described within MDO Release (Section 5.4.5.1) for further details.
Guideline (Industry)	Aerial Observations of Oil Spills at Sea Good Practice Guideline (IPIECA/OGP, 2015a).	This good practice guidelines summarises a consensus of industry and government viewpoints on Aerial Observations of Oil Spills at the time of writing.	
Guideline (Industry)	In-water Surveillance of Oil Spills at Sea Good Practice Guidelines (IPIECA/IOGP, 2016).	This good practice guidelines summarises current views on good practice for a range of oil spill preparedness and response topics.	
Guideline (Industry)	Contingency Planning for Oil Spills on Water Good Practice Guidelines (IPIECA/IOGP, 2015)	This document provides guidance on the contingency planning process for potential oil spills in or on water following an accidental release of oil to a marine or aquatic environment, whether that be during the handling, transport, production or storage of oil products	
EPBC Management Plans (Cwlth)	Recovery Plans for other listed threatened and/or migratory MNES species	Recovery plans set out the research and management actions necessary to stop the decline of, and support the recovery of, listed threatened species or threatened ecological communities. The aim of a recovery plan is to maximise the long-term survival in the wild of a threatened species or ecological community.	
EPBC Management Plans (Cwlth)	Conservation Advices for other listed threatened and/or migratory MNES species	Conservation advice provides guidance on immediate recovery and threat abatement activities that can be undertaken to ensure the conservation of a newly listed species or ecological community.	

5.5.3. Risk Assessment

5.5.3.1. Predicted Impact Levels

Based upon an understanding of the cause/effect pathway, predicted impact levels from oil spill response activities and subsequent aspects (Table 5-50) on identified receptors have been evaluated in the tables below; with regard to the legislative and other controls (Table 5-53).

Table 5-54: Predicted Impact Levels for Marine Fauna

Oil Spill Response Activities	Consequence
Change in fauna behaviour Increase in vessel and aircraft operating within the spill EMBA is expected during oil spill response activities and is expected to result in change in fauna behaviour within the immediate vicinity of these	Minor (2)

activities. Similarly behavioural responses are anticipated where an increase in activity along shorelines and coastal areas occurred where shoreline assessment and clean-up and /or OWR response options are implemented.

It is expected that multiple VoO may be operational at any one time, while up to two aircraft may be conducting aerial observation within the spatial extent of the Spill EMBA. Duration of spill response and increased vessel and aircraft activity is anticipated to persist for a short period of a few days to a week. Similarly, increased shoreline access is anticipated to occur for a short period (weeks).

Based on Spill EMBA fauna anticipated to have behavioural response to increased vessel and aircraft activities include fish, marine mammals and reptiles. These faunae are expected to exhibit an initial curiosity response, but avoidance response is largely anticipated, resulting in hazing effect in area of hydrocarbon (vessel and aircraft activity).

Injury/mortality to fauna

In the event that Operational NEBA determine shoreline assessment and clean-up and /or OWR response options are appropriate, risk of causing injury/mortality to individual fauna exists largely associated with potential use of untrained resources capturing and handling native fauna which may cause distress, injury and death of the fauna.

The highest priorities for OWR are threatened bird species, Little Penguins and pinnipeds (fur seals) (OPEP). Fauna handling activities are only expected for a short duration during the emergency response. Only a small proportion of the local population would be exposed to fauna interactions, therefore any OWR resulting in fauna injuries/mortalities is expected to be limited to individuals within the localised area. OWR would only be undertaken by trained and competent personnel under the direction of the relevant Control Agency (Section 5.3.4 of the OPEP).

The extent of the area of impact is predicted to restricted to the immediate vicinity of the spill response for a short duration (weeks), during the Sequoia MSS (August to October 2021). The severity is assessed as **Minor (2)** based on:

- Impacts associated with vessel and aircraft activity and disturbance to fauna due to light and sound emissions is well understood, and controls are documented in legislation as already described in detail in Section 4.
- Potential impacts from OSR activities are very similar to those assessed for planned activities in Section 4; except there may be more vessels and aircraft used to conduct MES and other response strategies if selected. The duration of active response is likely a matter of days. If longer-term monitoring is required under the OSMP, this would likely require occasional short-term use of a vessel.
- Vessel and aircraft activities associated with OSR are well defined and well understood, and compliant with industry best practice and Australian legislation and requirements (Section 5.4.4).
- Given limited size and rapid spreading of the MDO spill, large scale shoreline assessment and clean-up and/or OWR response is not expected. However, individual birds and pinnipeds occurring along shorelines could become oiled in the vicinity of the spill. These spill response activities would only occur where Operational NEBA determines positive net outcome and as directed by the relevant Control Agency.
- Fauna handling activities are only expected for a short duration during the emergency response. Only a small proportion of the local population would be exposed to fauna interactions, therefore any OWR resulting in fauna injuries/mortalities is expected to be limited to individuals within the localised area.
- In the event of a spill, monitoring used to inform both response planning and monitoring requirements. Whereby pre-emptive desk-based surveillance (OM04) will be implemented to review of fate and weathering predictions and spill trajectory predictions, combined with the location of key environmental and socio- economic sensitive receptors. Combination of pre-emptive and operational oiled wildlife surveillance (OM04 and OM05, respectively) enable pre-planning and maximise effectiveness and reducing potential for injury/mortality to individual fauna.
- NatPlan will be used to guide the spill response activities. The use of trained AMSA, AMOSC and ConocoPhillips Australia personnel to monitor and respond to the spill reduces the likelihood and consequence of a poor response being implemented and creating more environmental damage than it prevents.

• Consideration of net environmental benefit to fauna at population level has determined that that temporary short-term fauna avoidance is likely less harmful compared to fauna becoming oil contaminated.	

Table 5-55: Predicted Impact Levels for Socio-economic Receptors

Oil Spill Response Activities	Consequence
Changes to the functions, interests or activities of other users Increase in vessel and aircraft operating within the spill EMBA is expected during oil spill response activities and is expected to result in changes to the functions, interests or activities of socio-economic receptors in the region. It is expected that multiple VoO may be operational at any one time, while up to two aircraft may be conducting aerial observation within the spatial extent of the Spill EMBA. Duration of spill response and increased vessel and aircraft activity is anticipated to persist for a short period of a few days to a week. However socio-economic receptors are expected to avoid the area of impact or be affected over a larger area and duration due to stakeholder perceptions rather than directly from OSR interference activities. In the event of a spill, public access to marine environment and potentially affected shoreline will likely occur for HSE and shoreline contact preparedness, as such in changes to the functions, interests or activities of other users is expected for a short period of time (weeks). The severity is assessed as **Minor (2)** based on: • Vessel and aircraft activities associated with OSR are well defined and well understood, and compliant with industry best practice and Australian legislation and requirements (Section 1.2.4). • Given limited size and rapid spreading of the MDO spill, large scale shoreline assessment and clean-up and/or OWR response is not expected. However, access restriction may be implemented pre-emptively for a shore period (weeks). These spill response activities would only occur where Operational NEBA determines positive net outcome. Marine user impacts associated with access restriction are expected to be shore term and impact restricted areas where shoreline contact is predicted only. • Potential impacts from OSR activities are very similar to those assessed for planned activities in Section 4; except there may be more vessels and aircraft used to conduct MES. The duration of active response is likely a matter of days. If longer-term monitoring is required under the OSMP, this would likely require occasional short-term use of a vessel. • NatPlan will be used to guide the spill response activities. The use of trained AMSA, AMOSC and ConocoPhillips Australia personnel to monitor and respond to the spill reduces the likelihood and consequence of a poor response being implemented and creating more environmental damage than it prevents. • Although socio-economic receptor impacts may persist beyond spill response, it is expected that these impacts are influenced by visual extent of spill and community perception (i.e. media, social media) rather than actual ecological impact associated with a spill. Ecological impacts will be monitored and informed by OSMP scientific monitoring.	Minor (2)

Table 5-56: Predicted Impact Levels for Coastal Habitats and Communities

Oil Spill Response Activities	Risk Level
Change in habitat If shoreline access is required to implement MES (or OSMP), Shoreline Assessment and Clean-up, Shoreline Protection and Deflection or OWR (pending Operational NEBA), this may cause a change in habitat. Potential impact to marine fauna is assessed in Table 5-54. Shoreline access may be by personnel on foot, vehicles or small mobile equipment (e.g. bobcats). Hand tools may be used (e.g. shovel, rake).	Negligible (1)

Spill response requiring shoreline access would only be undertaken if the Operational NEBA process identifies that there will be a net environmental benefit i.e. response activities does not cause more environmental harm than allowing the spill to naturally recover. OSR that requires heavy machinery on a beach or any disturbance to vegetation or sensitive habitats such as bird nesting areas would not achieve net environmental benefit, and therefore would not be implemented. The extent of the area of impact is predicted to restricted to the immediate vicinity of the spill response for a short duration (weeks), during the Sequoia MSS (August to October 2021). The severity is assessed as **Minor (2)** based on: • Given limited size and rapid spreading of the MDO spill, large scale shoreline access is not expected. • OSR that require shoreline access would only be undertaken if the Operational NEBA determines there will be a positive net outcome. OSR would not be implemented if there was any potential to further impact shoreline values and sensitivities. • Shoreline access to conduct OSR would only be implemented in consultation with the Control Agency and in consultation with relevant agencies. • NatPlan will be used to guide the spill response activities. The use of trained AMSA, AMOSC and ConocoPhillips Australia personnel to monitor and respond to the spill reduces the consequence of a poor response being implemented and creating more environmental damage than it prevents.	

5.5.4. Comparison of Predicted Impact with Defined Acceptable Levels

Table 5-57 compares the predicted impact levels for oil spill response activities against the acceptable levels.

Table 5-57: Demonstration of Acceptability / Comparison or Defined Acceptable Levels with Predicted Impact Levels for Oil Spill Response Activities

Defined Acceptable Levels		Predicted Risk Level	Is the predicted impact below the defined acceptable level?
Source	Level		
Principles of ESD	Activities that result in temporary / reversible, small scale, and/or low intensity environmental damage. Environmental impacts and risks have a worst-case consequence ranking less than Major (4).	Planned activities not expected to result in OSR activities.	Yes
Principles of ESD	Enough appropriate information to understand impact/risk of serious/irreversible environmental damage. Application of the precautionary principle in the presence of scientific uncertainty.	There is high confidence in the prediction.	Yes
Principles of ESD	EPBC Program Requirements: The EP must not be inconsistent with EPBC Management Plans and Recovery Plans.	No relevance to oil spill response (See Appendix A).	Yes
Biological		The OPEP facilitates a rapid response to minimise resultant biological, ecological	Yes

Defined Acceptable Levels		Predicted Risk Level		Is the predicted impact below the defined acceptable level?
Source	Level			
Ecological Economic	Any spill is monitored and responded to in accordance with the OPEP and OSMP.	and economic impact. The OSMP ensures timely implementation of operational and scientific monitoring programs to support the response and monitor impact and recovery over time.		
ConocoPhillips Australia Policies	All reasonably practicable control measures have been adopted to reduce environmental impacts and risks.	CM7 - the marine assurance system, ensures that project vessels comply with all maritime laws and is considered effective. CM8 - the OPEP and OSMP, ensures that ConocoPhillips Australia is prepared and ready to respond in the unlikely event of a spill.		Yes
ConocoPhillips Australia Policies	Environmental impacts and risks are consistent with environmental policies such that residual environmental risks will be at or below significant.	Likelihood	Rare	
		Consequence	Minor	
		Risk	Low	Yes
Relevant Persons	Measures have been adopted because of the consultations to address reasonable objections and claims of relevant persons. The views of public have been considered in the preparation of the EP.	Claims and objections relevant to oil spills have been considered in Section 3.4 No public comments were made in relation to oil spill response.		Yes
International Standards	Relevant international, national, and industry standards have been considered and where relevant applied in the EP.	Yes, see Table 5-53.		Yes
Acceptability Summary				
Following completion of the risk assessment process, the environmental risk arising from the introduction of OSR Activities are acceptable because: • The impacts and risks associated with OSR activities are well known - the impacts associated with vessel discharges and noise disturbance to fauna from responding vessels and helicopters are well understood, and controls are documented in legislation. • Inductions for vessel crew will be completed so the policies and procedures for handling OSR activities are well understood • Regulatory guidelines controlling OSR activities are known (i.e. contacting AMSA) • The good practice controls are well defined and well implemented. • Legislative requirements are understood and implemented in the adopted OSR activities				

5.5.5. Environmental Performance

Environmental Performance Outcome (EPO)	
Aspect	Carry out the Sequoia MSS within the boundaries of the EP so that:
Risk	• Oil spill response activities introduce no greater environmental impacts and risks than are necessary for the clean-up of an oil spill.

Control measures are adopted to ensure that environmental impacts will be of an acceptable level throughout the Sequoia MSS. The full suite of control measures and environmental performance standards are available in the Environmental Performance section of Appendix A. Relevant details about the effectiveness of the control measures is provided in Table 5-58 which assesses whether the control measures for oil spill response activities are effective to meet the EPO.

Table 5-58: Control Measure Effectiveness – Oil Spill Response Activities

Measures	CM 8 – Oil Pollution Emergency Plan
Assessment of Effectiveness	The OPEP discusses the spill response strategies to respond to a diesel spill. These have been considered in the planning process for the net benefit that the response strategies have on the range of environmental values and sensitivities at threat from the spill. Relevant experts and the response organisation that is established contribute to ensuring the EPO can be met.
Is the EPO achieved?	Partially
Residual impacts requiring additional management	The OPEP is written as a plan and should be tested prior to the activity commencing.
Next Measure	Implementation Strategy – Testing of the emergency response arrangements
Assessment of Effectiveness	A test of the response arrangements will be carried out prior to the activity commencing such that the tools in the OPEP function effectively to ensure that the EPO can be met.
Is the EPO achieved?	Yes
Residual impacts requiring additional management	None

6. Implementation Strategy

This section details the implementation strategy for the activity, as required under Regulation 14 of the OPGGS(E). The implementation strategy describes the arrangements for monitoring, review and reporting of environmental performance and the strategy to confirm that the Environmental Performance Standards (EPS) are implemented, maintained and effective for the in-force period of the Environment Plan (EP). This will allow environmental impacts and risks to be continually managed to a level that is ALARP and acceptable.

The implementation strategy includes roles, responsibilities, training and competency requirements for all personnel involved in the survey with relation to:

- Implementing controls
- Managing non-conformance
- Emergency response
- Meeting monitoring, auditing, and government reporting requirements.

The Sequoia MSS will be conducted under the framework of the ConocoPhillips Australia Health, Safety and Environment (HSE) Policy and the HSE Management System Standard.

The contractor will be required to have systems and procedures that align with the ConocoPhillips Australia HSE Policy and the HSE Management System (HSEMS) Standard to ensure the survey's EPS are achieved. This shall be managed through a bridging document, to address any gaps between the ConocoPhillips Australia and survey contractor procedures, for the operation of the survey and support vessels.

6.1. ConocoPhillips Australia Health, Safety and Environmental Management System Standard

The ConocoPhillips Australia HSEMS Standard and supporting procedures provide a systematic process to identify, assess and manage the operational risks to the business, employees, contractors, stakeholders and environment. The routine application of a HSEMS provides on-going identification, prioritisation and control of these risks.

The ConocoPhillips Australia HSEMS Standard and supporting procedures establishes a risk-based, risk-appropriate, continuous improvement process for the implementation of the HSE Policy, leadership expectations and ConocoPhillips Australia values (Safety, People, Integrity, Responsibility, Innovation and Teamwork, also known as 'SPIRIT').

The HSEMS is implemented through a hierarchy of policies and procedures that cascade from the corporate level through to the individual operating assets. The system has four distinct phases and 15 interrelated elements, as shown in Figure 6-1and Table 6-1: ConocoPhillips Australia HSEMS Elements, with each phase of the process building on the previous phases:

- **PLAN:** identifies the hazards, risks, regulatory requirements and risk mitigation necessary for HSE effectiveness. The elements in this step also establish strategic plans, goals, and objectives.
- **DO:** describes the specific implementation tools needed to manage the risks and requirements identified in the PLAN phase.
- **ASSESS:** describes detailed monitoring and auditing to ensure that risks and requirements are being identified, assessed, and managed.

- **ADJUST:** requires review of the HSEMS, its implementation, and effectiveness to identify strengths, gaps, and opportunities for continuous improvement.

The 15 individual elements and their how they are implemented activity are described in Section 6.2 to Section 6.16.

Figure 6-1: Overview of ConocoPhillips Australia HSEMS Phases and Elements

Table 6-1: ConocoPhillips Australia HSEMS Elements

Element			
1	Policy and Leadership	**9**	Awareness, Training and Competency
2	Risk Assessment	**10**	Non-Conformance, Incident, Near Miss Investigation and Corrective Action
3	Legal Requirements and Standards of Operation	**11**	Communication
4	Strategic Planning, Goals and Objectives	**12**	Document Control and Records Management
5	Structure and Responsibility	**13**	Measuring and Monitoring
6	Programs and Procedures	**14**	Audits
7	Asset and Operating Integrity	**15**	Review
8	Emergency Preparedness		

6.2. Element 1: Policy and Leadership

This element defines expectations for the ConocoPhillips Australia HSE policy and leadership requirements for supporting a strong HSE culture, ensuring compliance with HSE requirements and driving HSE excellence.

In accordance with Regulation 16(a) of the OPGGS(E), ConocoPhillips Australia HSE Policy is provided in Figure 6-2.

The policy provides a public statement of the company's commitment to minimise adverse effects on the environment and to improve environmental performance. It establishes the expectations, principles of operation and desired outcomes for the company and its subsidiaries. The policy is distributed to all company facilities and contracted parties and is displayed prominently at work sites.

ConocoPhillips

HEALTH, SAFETY AND ENVIRONMENT POLICY

Our Commitment

ConocoPhillips is committed to protecting the health and safety of everybody who plays a part in our operations, lives in the communities in which we operate or uses our products. Wherever we operate, we will conduct our business with respect and care for both the local and global environment and systematically manage risks to drive sustainable business growth. We will not be satisfied until we succeed in eliminating all injuries, occupational illnesses, unsafe practices and incidents of environmental harm from our activities.

Our Plan

To meet our commitment, ConocoPhillips will:

- Demonstrate visible and active leadership that engages employees and services providers, and manage health, safety and environmental (HSE) performance as a line responsibility with clear authorities and accountabilities.
- Ensure that all employees and contractors understand that working safely is a condition of employment, and that they are each responsible for their own safety and the safety of those around them.
- Maintain "stop work" policies that establish the responsibility and authority for all employees and contractors to stop work they believe to be unsafe.
- Manage all projects, products and processes through their life cycles in a way that protects safety and health and minimizes impacts on the environment.
- Provide employees with the capabilities, knowledge and resources necessary to instill personal ownership and motivation to achieve HSE excellence.
- Provide relevant safety and health information to contractors and require them to provide proper training for the safe, environmentally sound performance of their work.
- Measure, audit and publicly report HSE performance and maintain open dialogue with stakeholder groups and with communities where we operate.
- Comply with applicable regulations and laws.
- Work with both governments and stakeholders where we operate to develop regulations and standards that improve the safety and health of people and the environment.
- Maintain a secure work environment to protect ourselves, our contractors and the Company's assets from risks of injury, property loss or damage resulting from hostile acts.
- Communicate our commitment to this policy to our subsidiaries, affiliates, contractors and governments worldwide and seek their support.

Our Expectations

Through implementation of this policy, ConocoPhillips seeks to earn the public's trust and to be recognized as the leader in HSE performance.

Ryan Lance
Chairman and Chief Executive Officer
ConocoPhillips

Figure 6-2 ConocoPhillips HSE Policy

6.2.1. ConocoPhillips Australia Sustainable Development Position

ConocoPhillips Australia's approach is to conduct business in a way that promotes economic growth, a healthy environment, and vibrant communities, now and into the future. ConocoPhillips Australia's focus is to develop the following company-wide competencies to successfully promote sustainable development:

- Integration — Clearly and completely integrate economic, social and environmental considerations into strategic planning, decision-making and operating processes.
- Stakeholder Engagement — Engage our stakeholders to understand their diverse and evolving expectations and incorporate that understanding into our strategies.
- Life-Cycle Management — Manage the full life cycle impacts of our operations, assets, and products.
- Knowledge Management — Share our successes and failures to learn from our experiences.
- Innovation — Create a culture that brings new, innovative thinking to the challenges of our evolving business environment.

Further information can be found at: https://www.conocophillips.com/sustainability/integrating-sustainability/sustainable-development-governance/policies-positions/sustainable-development-position/

6.2.2. ConocoPhillips Australia Biodiversity Position

ConocoPhillips Australia's biodiversity approach is designed to manage risks and mitigate impacts to biodiversity, with a focus on:

- Applying a science-based approach and considering cumulative effects to develop leading best practices.
- Collecting data and information on local biological diversity through site assessments and baseline studies.
- Developing indicators and metrics to track biodiversity impacts and risk management performance.
- Applying technological innovation and practical, sustainable solutions for biodiversity conservation.
- Implementing stewardship and habitat conservation practices on company owned lands.
- Leveraging our SPIRIT of Conservation Program, migratory bird joint ventures and other partnership programs to support the conservation and restoration of habitats.
- Collaborating with conservation organisations, governments, and policy bodies.
- Engaging with local communities on biodiversity-related impacts associated with our operations, mitigation actions and proactive initiatives to support biodiversity conservation.

Further information can be found at: https://www.conocophillips.com/sustainability/integrating-sustainability/sustainable-development-governance/policies-positions/biodiversity-position/

6.3. Element 2: Impact and Risk Assessment

This element defines the HSE risk management requirements for ConocoPhillips Australia and the activity.

ConocoPhillips Australia seeks to maintain the health and safety of its employees and minimise environmental impact through the active and progressive elimination of hazards and the reduction of risk in the workplace. This objective is achieved for the Sequoia 3DMSS through a systematic and integrated approach to risk management to reduce risks to a level that is ALARP and acceptable. Section 4 and 5 provides the environmental impact and risk assessments that were undertaken for this EP.

The ConocoPhillips Australia Global Marine Risk Management Standard (GM-STD-MA-003) requires marine assurance approval for all vessels prior to the commencement of the charter and for the duration of activities performed for ConocoPhillips Australia. The marine vetting and audit process for offshore vessels, details the requirements and procedures that are used to ensure that risks involved in marine activities are effectively managed, consistent with ConocoPhillips Australia's vision for safety, health, environment, reliability and efficiency. These establish the expectations and processes by which ConocoPhillips Australia can ensure that vessels are fit for purpose, suitable for the nominated scope of works, and comply with and are operated in accordance with applicable local, national and international regulations, industry guidelines, standards and/or contractual arrangements.

Additional risk assessments will be undertaken on an ongoing basis when triggered by any of the following circumstances:

- When there is a proposed change to the activity, as identified by a ConocoPhillips Australia management of change (MoC) request
- When new hazards or risks are identified, or as necessary following the investigation of an event or in relation to inspection and audit findings
- When additional information about environmental impacts or risks becomes available (e.g. through better knowledge of the receptors present within the spill EMBA, new scientific information/papers, results of monitoring, other industry events or studies, new guidelines)
- If there is a change in regulations, as necessary.

6.3.1. Risk Analysis

For this activity, ConocoPhillips Australia has determined that impacts and risks are defined as:

- Impacts – occur from planned events. There will be consequences associated with the event occurring. Impacts are an inherent part of the activity. For example, acoustic discharges will be generated during the MSS and this will have consequences for marine life. For impacts, only a consequence is assigned (likelihood is irrelevant given that the event does occur).
- Risks – results from unplanned events. There may be consequences if an unplanned event occurs. Risks are not an inherent part of the activity. For example, a hydrocarbon spill may occur if the survey vessel collides with another vessel, but neither the collision nor the spill is certain to occur. The risk of this event is determined by multiplying the consequence of the impact (using factors such as the type and volume of hydrocarbons and the nature of the receiving environment) by the likelihood of this event happening (which may be determined objectively or subjectively, qualitatively or quantitatively). For risks, the consequence and likelihood are combined to determine the risk rating.

ConocoPhillips Australia assesses risks in two key stages:

- Unmitigated risk analysis – The level of risk (with existing control measures in place) before application of additional risk control measures arising from risk assessment processes.
- Residual risk analysis – The risk remaining after all proposed control measures have been implemented. Two key factors underpin the ERA:

    1. The severity of the consequences if impact does occur; and
    2. The likelihood of receptors at risk being impacted.

The ERA frames the assessment of controls that could be applied during execution of activities that pose a potential hazard to receptors. It also provides a framework to identify the measures to mitigate the severity of the impact arising from either planned or unplanned events. The process provides essential input into the assessment of control measures to ensure that the level of risk posed by an activity to a sensitive receptor is reduced to ALARP and is acceptable.

6.3.2. Assessing Consequence

In assessing the level of consequence of a hazard, the following factors have been considered:

- Extent of hazard – whether it affects the local or wider regional environment;
- Duration of the impact – how long it will interact with the receiving environment; and
- Sensitivity of the receiving environment (including seasonal sensitivities) – nature, importance (local, national or international significance) and the sensitivity or resilience to change of the receptor that could be affected. This also considers any relevant laws, regulations or standards aimed at protecting the receiving environment.

Table 6.2 provides the consequence descriptions in accordance with the ConocoPhillips Risk Matrix Standard, which have been used in the impact assessment and have been applied to the risk assessment utilised in this EP (Table 6.3).

For impact assessment in this EP, a consequence rating below Major (4) (i.e. moderate (3) or below) is deemed to correspond to an acceptable level of impact as per ConocoPhillips' own internal context. It should be noted that there are other criteria (see section 1.4) that need to be considered in demonstrating whether an environmental impact is of an acceptable level. This

For the risk assessment, the level of risk is determined by establishing the potential consequence of a hazard on an environmental, socio-economic or cultural receptor resulting from an aspect of the activities associated with the MSS. Following the determination of the level of consequence, the likelihood of the consequence occurring is then assigned for risks. The assigned consequence and likelihood are mapped on the risk matrix to determine the level of risk, as seen in Table 6.3.

Table 6.2: Risk assessment consequence definitions

Rating	Biodiversity	Socio-cultural and economic
5 High	• High environmental impact, very severe such as resulting in catastrophic release. • Long term impacts to sensitive habitats and multiple ecosystems. • Impacts causing to drinking water supply or fishing areas. • Significant offshore release with potential to impact shoreline.	• Extended permanent loss of access (greater than 2 years) and loss of operations or planned activities. • Severe impact to/from key stakeholders requiring executive level involvement. • Damage is permanent.

Rating	Biodiversity	Socio-cultural and economic
4 Major	• Major environmental impact, requires significant mitigation measures that address ecological systems or sensitive habitats • Off-site impacts realised from one to several kilometres or more. • Release affecting public infrastructure or roads that results in public evacuation or closure of transportation routes such as roads or waterway • Widespread surface water or groundwater contamination.	• Permanent partial restriction on access (3 months to 2 years) and major impact to operations or planned activities. • Major impact to/from key stakeholders. Mitigation requires senior level management involvement. • Issue will take a significant amount of time to resolve.
3 Moderate	• Moderate environmental impact most likely requires emergency response but not always. • Uncontained release with off-site environmental impacts realised greater than the surrounding area of the facility with observable off-site impacts to flora/fauna. • Release affects surrounding area and impacts flora/fauna. • Multiple exceedances of regulatory limit during a prolonged incident or operational condition – regulatory enforcement likely (all media). • Off-site localised groundwater contamination.	• Temporary restriction on access (1 to 3 months) and moderate impact to operations or planned activities. • Moderate impact to/from key stakeholders. • Mitigation requires focused efforts with various business unit groups. • Issue resolved in a moderate amount of time.
2 Minor	• Minor environmental impact, but with impacts being readily remediated or addressed by natural attenuation processes. • Onshore release impact limited to facility and adjacent surrounding area. • Offshore release mitigated through natural attenuation. • Single to multiple exceedances of a permit or regulatory limit – regulatory enforcement likely (all media).	• Brief restriction on access (1 day to 1 month) and minor impact to operations or planned activities. • Minor impact to/from key stakeholders. Likely addressed by prompt mitigation by stakeholder engagement professionals. • Issue resolved in a minimum amount of time.

Rating	Biodiversity	Socio-cultural and economic
1 Negligible	• Negligible environmental impact. • Immediate or instantaneous duration, no remediation required. • Small, contained release that stays on site. • No exceedance or single exceedance of a permit or regulatory limit – regulatory enforcement unlikely (all media).	• No restriction on access and no impact to operations. • Negligible impact to/from key stakeholders Issue resolved quickly.

Table 6.3: ConocoPhillips risk assessment matrix

Risk Matrix					
Likelihood	**Consequence severity**				
	Level 1 (Negligible)	**Level 2 (Minor)**	**Level 3 (Moderate)**	**Level 4 (Major)**	**Level 5 (High)**
Frequent (5)	RRII	RRII	RRIII	RRIV	RRIV
Probable (4)	RRI	RRII	RRIII	RRIII	RRIV
Rare (3)	RRI	RRII	RRII	RRIII	RRIII
Remote (2)	RRI	RRI	RRII	RRII	RRII
Improbable (1)	RRI	RRI	RRI	RRI	RRII

Risk rating		
Risk score	**Risk rating**	**Description of risk level**
RRIV	High	• Manage risk using additional or improved risk-reducing measures with priority. • Inform appropriate management level with risk assessment detail and obtain appropriate approvals per the business unit's requirements. • Cessation until the residual risk is reduced to 'significant' or below unless exposure is authorised as indicated.
RRIII	Significant	• Manage risk using additional or improved risk-reducing measures with priority. • Inform appropriate management level with risk assessment detail and obtain appropriate approvals per the business unit's requirements. • Ensure action to deal with this risk is incorporated into business plan. • Ensure ALARP Principle is demonstrated.
RRII	Medium	• No additional risk-reducing measures required where controls can be verified as functional. • Improvements based on lessons learned are encouraged. • Tolerable if cost of risk reduction exceeds improvement.
RRI	Low	• No additional risk-reducing measures required. • Improvements based on lessons learned are encouraged.

6.3.3. Assessing Likelihood

Table 6.4 provides the likelihood descriptions that have been used for the risk assessment, which are based on the ConocoPhillips Risk Matrix Standard.

The likelihood of a consequence occurring due to a planned or unplanned activity considers the effective implementation of industry standard safeguards.

Table 6.4: Risk assessment likelihood definitions

Level	Descriptor	Enhanced description
1	Improbable	Virtually unrealistic, never heard of in the oil and gas industry
2	Remote	Occurred or has been heard of within the oil and gas industry
3	Rare	Has occurred within ConocoPhillips or more than once per year within the oil and gas industry
4	Probable	Occurred within the ConocoPhillips business unit or more than once per year within ConocoPhillips
5	Frequent	Occurs multiple times per year in the ConocoPhillips business unit

6.4. Element 3: Legal Requirements and Standards of Operation

This element establishes requirements for ConocoPhillips Australia to maintain a process to monitor changing laws and regulations, to monitor changing site activities, and to assign responsibilities to help ensure compliance with legal requirements (e.g., laws, regulations, permits or project approvals and commitments made in permit applications) and standards of operation (e.g., relevant industry standards and/or design codes) applicable to the activity.

The key environmental legislation applicable to the activity is described in the Legislation and Other Requirements table in each relevant receptor or aspect section (Section to 4 and 5).

The full list and screening for legislative and other requirements relevant to the Sequoia MSS are identified in the Other Requirements section in Appendix A.

6.5. Element 4: Strategic Planning, Goals and Objectives

This element establishes the requirements associated with HSE planning and goal setting. Planning at ConocoPhillips Australia cascades from the Corporate level to individual functions, including HSE, Governance and Capital Projects.

The Sequoia MSS HSE planning process will include the development and implementation of plans that are resourced, communicated and measured to contribute to continuous HSE improvement and the reduction of HSE risk. These plans will be developed through consultation with both ConocoPhillips Australia and the survey contractor.

6.6. Element 5: Structure and Responsibility

This element establishes requirements to define and manage roles, responsibilities, accountabilities, employee engagement and interrelationships.

ConocoPhillips Australia maintains a structured organisation to manage all HSE issues that impact on, or have the potential to impact on the Sequoia 3DMSS, including:

- Maintaining a specialist HSE team
- Communicating organisation charts outlining the resourcing and management structure for ConocoPhillips Australia
- HSE Committees that function at multiple levels to review and manage HSE related issues
- Conducting management reviews of the ConocoPhillips HSEMS to assess resource needs
- Implementing specific processes that identify and effectively communicate roles, responsibilities and accountabilities associated with critical equipment and systems including via inductions, on-boarding processes and competency training programs
- Documenting roles, responsibilities and accountabilities, as they relate to the HSEMS and the HSE Policy.

6.6.1. Organisational Structure

The organisation structure for the activity is illustrated in Figure 6-3.

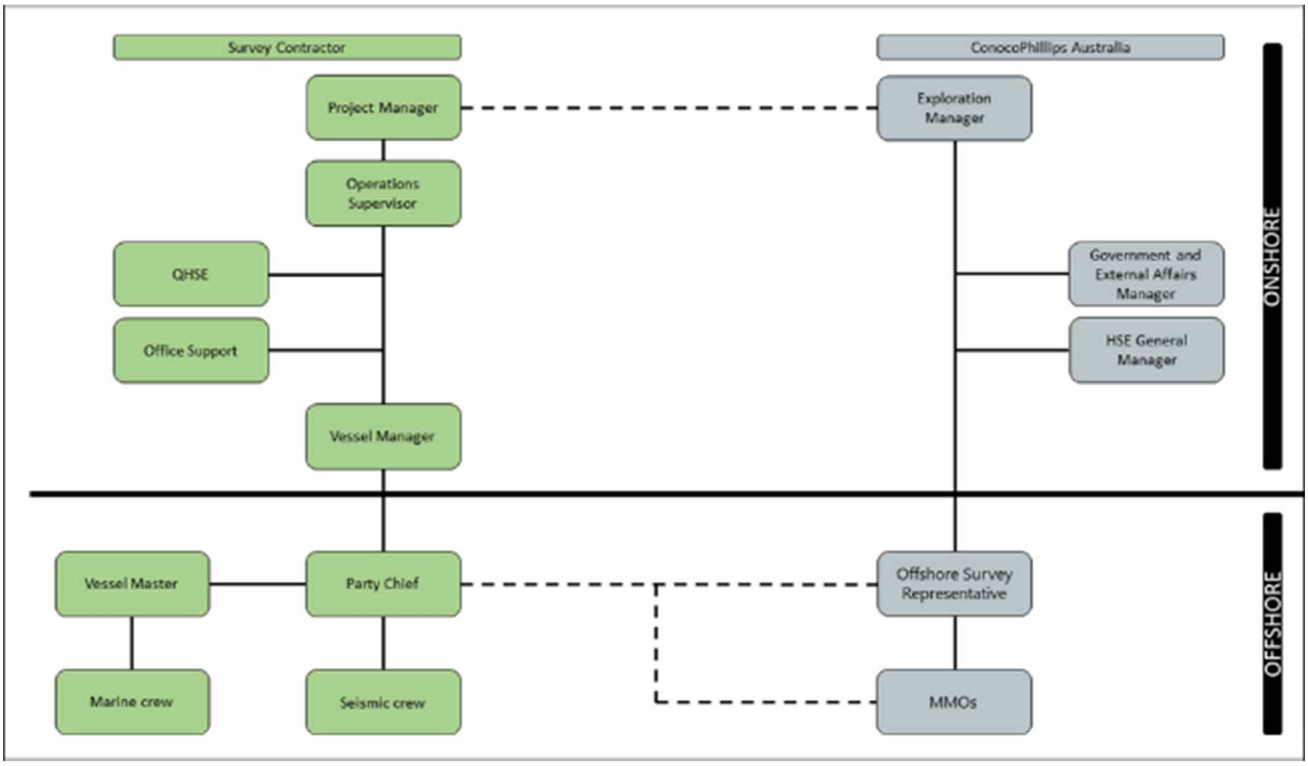


Figure 6-3: Sequoia MSS Organisation Structure

6.6.2. Roles and Responsibilities

The roles and responsibilities of key team members are summarised in Table 6-2.

Table 6-2: Sequoia MSS Roles and Key Environmental Responsibilities

Role	Key Environmental Responsibilities
Onshore	
ConocoPhillips Australia President	Ensures: • ConocoPhillips Australia has the appropriate organisation in place to be compliant with regulatory and other requirements and this EP. • Policies and systems are in place to guide the company's environmental performance. • Adequate resources are in place for the safe operation of all activities.

Role	Key Environmental Responsibilities
	• The HSEMS continues to meet the evolving needs of the organisation.
ConocoPhillips Australia Exploration Manager	Ensures: • The activity is undertaken as per the Environmental Performance Objectives (EPO) of the EP. • Sufficient resources are allocated to implement management measures to achieve the EPS. • Stakeholder consultation is undertaken as per the requirements of the EP. • Change requests for the activity are managed and notifies the Client Site Representative, HSE General Manager and Marine Mammal Observers (MMOs) of any scope changes in a timely manner. • Liaison with regulatory authorities is undertaken as required. • The EP is reviewed as necessary and change requests are managed. • Environmental incident reporting meets regulatory requirements. • Corrective actions raised from environmental inspections/audits or incidents are monitored and closed out. • Necessary resources are provided to facilitate an emergency response strategy in the event of an incident. • The ConocoPhillips emergency response strategy is implemented in the event of an incident. • Results of the compliance audit during the survey are reviewed and makes recommendations for improvement where required. • That all reportable and recordable incidents are reported to NOPSEMA. • That a full induction to all activity personnel is provided, including details of the environmental sensitivities of the survey area and EPS detailed in this EP. • That an Environmental Performance Report (EPR) is prepared and submitted to NOPSEMA.
ConocoPhillips HSE General Manager	Ensures: • Compliance with HSE regulatory requirements. • An EP is prepared for the activity. • Records associated with the activity are maintained as per Section 6.13. • Personnel who have specific responsibilities pertaining to the implementation of this EP know their responsibilities and are competent to fulfil their designated role. • Environmental impacts and risks associated with the activity have been identified and any new or increased impacts or risks are managed via the Management of Change (MoC) process detailed in Section 6.13.1. • Incidents are managed and reported as per Section 6.11. • Any changes to equipment, systems and documentation where there may be a new, or change to, an environmental impact or risk or a change that may impact the EP are assessed in accordance with the MoC process detailed in Section 6.13.1 • Oil spill response arrangements for the activity are tested as per Section 6.9. • Audits and inspections are undertaken in accordance with Section 6.15. • Environmental and regulatory requirements are communicated to those who have specific responsibilities pertaining to the implementation of this EP. • The environmental component of the activity induction is prepared and presented. • Environmental incidents are reported and managed as per Section 6.11. • The monthly incident reports and end-of-activity EP environmental performance report are prepared and submitted to NOPSEMA. • Any new or changed environmental impact or risk or a change that may impact the EP is reviewed and documented as per Section 6.13.1. • Audits and inspections are undertaken as detailed in Section 6.15 and any actions from non-conformances or improvement suggestions tracked. • Reviews and revisions to the EP are made as per the requirements in Section 6.16. • Submits the Marine Mammal Observer (MMO) report to the DAWE.

Role	Key Environmental Responsibilities
ConocoPhillips Government and External Affairs Manager	Ensures: • A stakeholder engagement plan for the activity is prepared, implemented and maintained. • Stakeholder concerns and issues are promptly handled. • Ongoing engagement with relevant stakeholders for the duration of the activity is undertaken, as required.
Offshore	
ConocoPhillips Australia Offshore Representative	Ensures: • The activity is carried out in accordance with regulatory requirements and this EP. • Vessel personnel partake in the activity induction. • Vessel personnel are competent to fulfil their designated role. • HSE issues are communicated via mechanisms such as the daily report and daily pre-start meetings. • New or increased environmental impacts or risks are managed via the Management of Change (MoC) process detailed in Section 6.13.1. • HSE incidents are reported and investigated as per Section 6.11. • Emissions and discharges identified in Section 6.14 are recorded. • The ConocoPhillips HSE General Manager is informed of any changes to equipment, systems and documentation where there may be a new or change to an environmental impact or risk or a change that may impact the EP as per Section 6.13. • Weekly HSE vessel inspections as detailed in Section 6.16 are undertaken to ensure ongoing compliance with the EP and all environmentally critical plant and equipment are in good working order.
Vessel Master	Ensures: • Vessel operations are carried out in accordance with regulatory requirements and this EP. • Vessel personnel are competent to fulfil their designated role. • Personnel new to the vessel receive a vessel-specific induction. • Environmental incidents are reported to the ConocoPhillips Australia Offshore Representative within required timeframes as per Section 6.11. • Emissions and discharges identified in Section 6.14.2 are recorded and provided to the ConocoPhillips Australia Offshore Representative. • The ConocoPhillips Australia Offshore Representative is informed of any changes to equipment, systems and documentation where there may be a new or change to an environmental impact or risk or a change that may impact the EP as per Section 6.13.1. • Oil spill response arrangements are in place and tested as per the vessel's Shipboard Marine Pollution Emergency Plan (SMPEP). • General and hazardous wastes are backloaded to port for disposal to a licenced waste facility. • Weekly HSE meetings are conducted.
Contractor Party Chief (offshore)	Ensures: • Ensures the vessel management systems and procedures are implemented. • Ensures personnel starting work on the survey vessel and support vessels receive an induction that meets the requirements specified in this EP. • Ensures personnel are competent to undertake the work they have been assigned. • Ensures emergency drills are conducted as per the vessel schedules. • Ensures the vessels' emergency response team has been given sufficient training to implement SOPEP/SMPEP. • Ensures any environmental incidents or breaches of performance outcomes, standards or criteria, are reported immediately to the Offshore Representative. • That seismic crew are briefed about their role in supporting the MMOs to fulfil their duties.

Role	Key Environmental Responsibilities
Vessel personnel	All vessel crew are responsible for: • Completing the ConocoPhillips HSE induction. • Reporting fauna sightings and interactions to the MMOs. • Reporting hazards and/or incidents via company reporting processes. • Adhering to vessel's HSEMS and this EP. • Undertaking tasks safely and without harm to themselves, others, equipment or the environment and in accordance with their training, operating procedures and work instructions. • Stopping any task that they believe to be unsafe or will impact on the environment.

6.7. Element 6: Programs and Procedures

This element establishes requirements to develop and implement programs and documented procedures to ensure compliance with legal requirements and standards of operation and to manage HSE risk. All ConocoPhillips HSE procedures are maintained on the ConocoPhillips HSEMS intranet site and accessible to the business.

Documented ConocoPhillips programs and procedures, relevant to the activity, are established and maintained to manage significant risks and ensure compliance with legal requirements and standards of operation. These programs, processes and procedures are made easily accessible to relevant employees and contractors and are reviewed in accordance with a defined review schedule.

6.7.1. Contractors and Suppliers

ConocoPhillips employs competent people capable of identifying and implementing programs and procedures to facilitate HSE compliance and continuous improvement.

Contractors working for, or performing work on behalf of, ConocoPhillips Australia may use their own procedures provided they are aligned with ConocoPhillips HSEMS Standard and agreed HSE Bridging arrangements. Selection and management processes are in place to ensure that the minimum business expectations of ConocoPhillips are met, including those related to HSE and risk management, including:

- Contractors undergo an HSE assessment before receipt of an invitation to tender. As part of this process, ConocoPhillips carries out an assessment of the suitability of each contractor's management system.
- During the tender evaluation process, each contractor's management system is reviewed, assessed and ranked according to its robustness and ability to meet ConocoPhillips minimum requirements as relevant to the tender work scope.
- All contractors and their subcontractors are required to meet ConocoPhillips HSEQ minimum requirements. These requirements are communicated to the contractors as part of the Contract HSEQ Exhibits, Specifications and Terms and Conditions documents.
- Key contractor and subcontractor personnel must be approved by ConocoPhillips under the Contract HSEQ Exhibits, Specifications and Terms and Conditions documents.
- ConocoPhillips maintains contract-specific management teams which are responsible for the day–to-day supervision and review of contractor compliance with the EP.
- Contract compliance audits, and quality control and assurance checks, are conducted throughout the life of the contract as appropriate to the scope of work and risks involved. Contractors are required to provide regular reports to communicate their HSEQ performance and compliance status.

- HSEQ performance of contractors is monitored through regular engagement between ConocoPhillips and contractor personnel, and through regular audits of compliance against the contractor HSE management plans.
- Periodic checks and reviews are conducted by ConocoPhillips representatives.
- Contract specific HSE requirements will be developed by the contractor and reviewed and approved by ConocoPhillips prior to commencement of work. A project specific Bridging Document will also be developed to define how both HSE Management Systems interact during execution. An HSE engagement and alignment workshop will be conducted to ensure HSE requirements have been met.

6.8. Element 7: Asset and Operating Integrity

This element establishes standards for the development, implementation and maintenance of its Asset and Operating Integrity (A&OI) programs to:

- Properly manage risks associated with the activity including equipment failure or uncontrolled loss of primary containment
- Establish within ConocoPhillips Australia a clear understanding of its assets, failure mechanisms and their consequences/associated risks.

Equipment that has been identified as a control measure for the purpose of managing potential environmental impacts and risks from the activity have an associated EPS that details the performance required of the equipment as detailed in the Environmental Performance section of Appendix A.

During the contractor selection process and through ongoing inspections during the activity, ConocoPhillips Australia will ensure that the contractor maintains all environmentally critical equipment in good working order.

6.9. Element 8: Emergency Preparedness

Regulation 14(8) of the OPGGS (E) Regulations 2009 requires the implementation strategy to contain an OPEP and the provision for the OPEP to be updated. The OPEP is designed to be an operational document. As such, some of the content requirements of the regulations are included in this EP. A summary of the regulatory requirements and a reference to where the obligations are met is provided below. The OPEP (including the OSMP) is provided in Appendix H. In accordance with Regulation 14 (8AA), the OPEP must include arrangements to respond to and monitor oil pollution, including:

- The control measures necessary for a timely response to an oil pollution emergency
- The arrangements and response capability to implement a timely implementation of those controls, including ongoing maintenance of that capability
- The arrangements and capability for monitoring the effectiveness of the controls and ensuring that performance standards for those controls are met
- The arrangements and capability for monitoring oil pollution to inform response activities refer to OPEP (Appendix I).
- The provision for the OPEP to be updated (Note as the survey duration is short and is a once-off; there won't be a need to revise the OPEP within five years).

The Vessel-specific Emergency Response Plan defines the initial actions, reporting requirements and management processes to be applied in the event of an emergency or crisis occurring during the

Sequoia MSS. This plan will integrate (and be bridged) with ConocoPhillips Australia Crisis and Incident Management Plan (ABUE-450-HS-N05-C-00119). Crisis and emergency response are managed by a hierarchy of teams within ConocoPhillips Australia (refer to Section 6.9.2).

6.9.1. Arrangements and Capability

During the response to an incident, ConocoPhillips has adopted the P.E.A.R.L principle to guide prioritisation of the response:

P – People (health and safety of responders, employees and the public).

E – Environment.

A – Assets.

R – Reputation of the company.

L – Livelihood.

Preparedness also includes ensuring that there are competent personnel available to respond to and manage emergency events and that their competence is maintained through regular training. ConocoPhillips achieves this through its adoption of competency-based training and annual 'crisis and emergency' exercise plans.

All reasonably foreseeable crisis and emergency situations are identified via appropriate systematic review and analysis processes, with results documented in crisis and emergency management processes and systems.

6.9.2. Emergency Response Framework

The ConocoPhillips Australia crisis and emergency management arrangements uses a graduated tiered response framework which classifies incidents based on the significance of the consequences, the risks involved and potential for escalation. There are three integrated elements in this structure framework, which combine to effectively manage crisis events and emergencies at ConocoPhillips facilities and business operations.

ConocoPhillips maintains a trained and ready incident management team (IMT) and crisis management team (CMT) to execute the emergency response plans (ERPs) and crisis management plans. The IMT provides operational management support, and the CMT provides strategic direction with respect to management of reputational damage and impacts to business continuity.

ConocoPhillips utilises he Incident Command System (ICS), one of the leading response systems employed worldwide. ICS can be readily applied to a range of response situations and organisational emergency management structures.

The IMT and CMT will utilise the ConocoPhillips Crisis and Incident Management Plan to guide response to an event. The IMT and CMT are structured so that, during an emergency event, rotations are managed to avoid fatigue and maintain staff health and well-being.

For the Sequoia MSS, the ERT responsibilities and initial response processes will be managed via the contractor vessel ER; which feed information through to the ConocoPhillips IMT, via the Vessel Master and ConocoPhillips vessel representative. The contractor would stand up its own IMT also.

There are ERPs for all contractor vessels that are carried out by an emergency response team (ERT). The ERT will be coordinated by the relevant person in charge (Party Chief or Vessel Master) to ensure that there is adequate emergency service cover on board at all times. The Party Chief or Vessel Master will be the point of contact between assets within the permit area and the ConocoPhillips IMT. The ConocoPhillips IMT leader is the point of contact between the ConocoPhillips IMT and the CMT. Contractors are required to notify the ConocoPhillips Offshore representative of any emergency. The emergency response structure is presented the figure below.

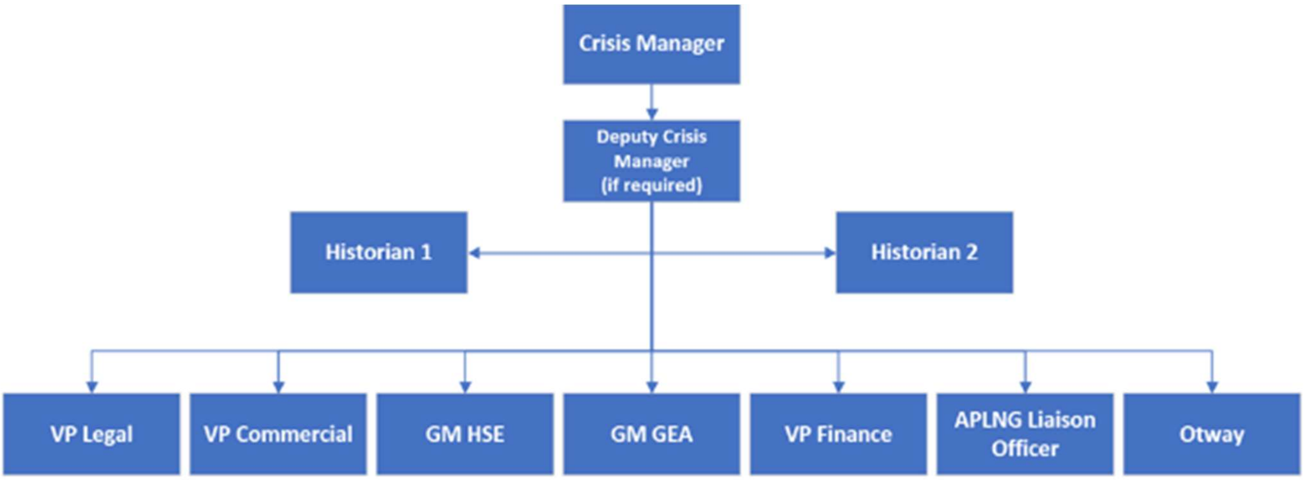


Figure 6-4: ConocoPhillips CMT Structure

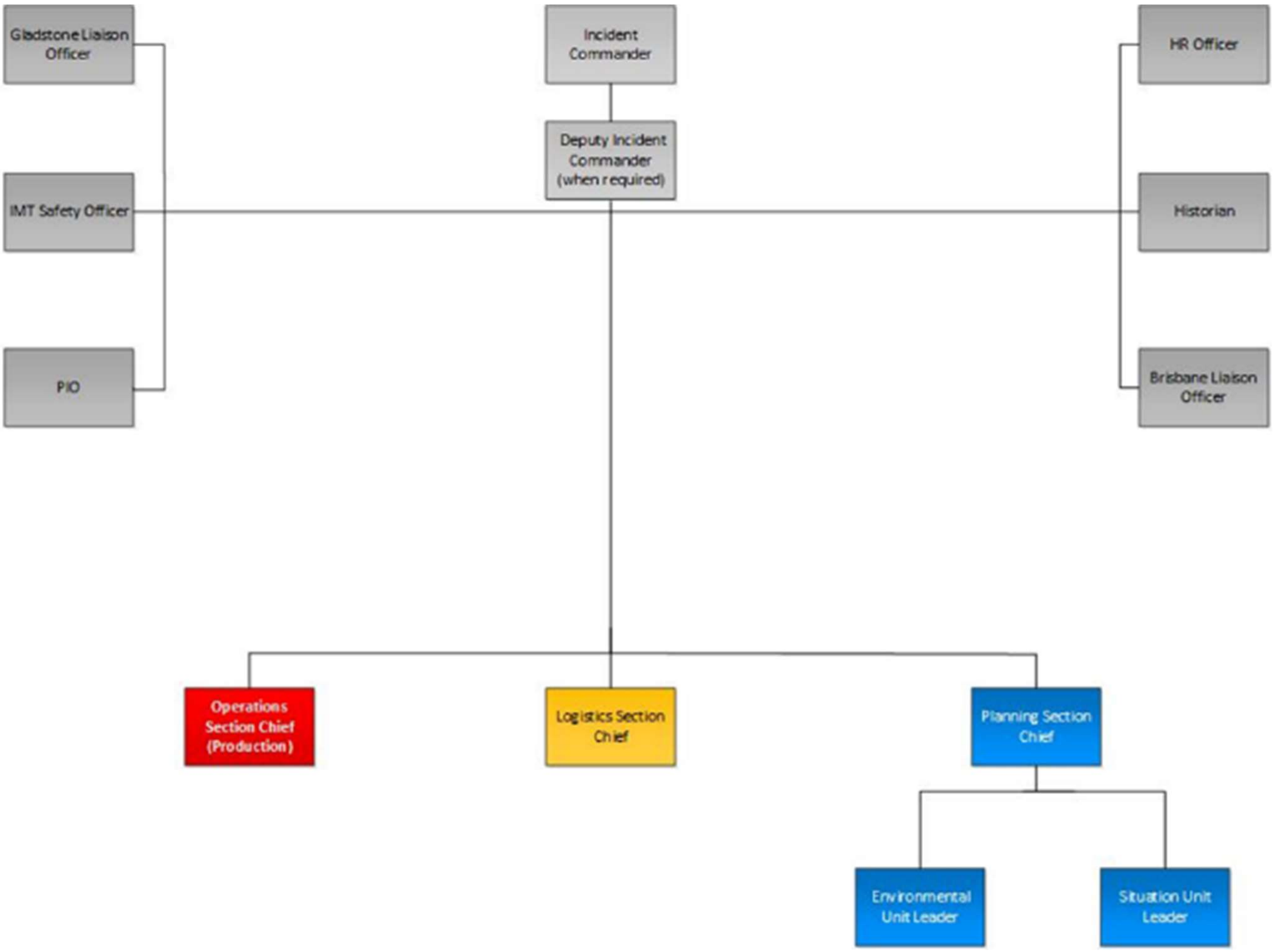


Figure 6-5: ConocoPhillips IMT Structure

6.9.3. Vessel Spill Response Training

Quarterly training of vessel crew in SOPEP (SOPEP) is a MARPOL requirement for vessels >400 gross tonnes (Annex 1, Regulation 37). During its contractor selection process, ConocoPhillips will ensure that the chosen contractor has been implementing this requirement.

Vessel SOPEPs typically include vessel-specific procedures for managing pollution emergencies (MDO spill) resulting from incidents such as hull damage from a collision or grounding. The SOPEP includes information about initial response, reporting requirements and arrangements for the involvement of third parties having the appropriate skills and facilities to effectively respond to oil spill issues.

The SOPEP will be the principal working document for the vessel and crew in the event of an MDO spill. The SOPEP describes specific emergency procedures including steps to control discharges for bunkering spills, hull damage, grounding and stranding, fire and explosion, collisions, vessel list, tank failure, sinking and vapour releases. The SOPEP also includes requirements for regular emergency response drills of the plan and revisions following drills or incidents.

6.9.4. Testing of Spill Response Arrangements

In accordance with Regulation 14(8A)(8C) of the OPGGS(E), emergency response arrangements for the Sequoia MSS are tested:

- When they are introduced
- When they are significantly amended
- Not later than 12 months after the most recent test.

Prior to commencing the survey, vessel contractor and ConocoPhillips' spill response arrangements will be tested and have been incorporated into the 2020/21 drill schedules (culminating in a multi-agency drill exercise in mid-2021 to confirm preparedness for this activity).

Actions and lessons arising from testing the OPEP will be tracked to completion within a timeframe relevant to the activity to ensure spill response preparedness.

To test and continually improve preparedness, an emergency response drill/exercise schedule in accordance with ConocoPhillips Australia Crisis and Incident Management Plan has been scheduled to support the Sequoia MSS.

6.9.5. Adverse Weather Protocols

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 onboard and environment.

- During adverse weather, the Vessel Master is responsible for the following:
- Ensuring the safety of all personnel onboard
- Monitor all available weather forecasts and predictions
- Initiating the vessel safety management system, vessel HSE procedures and/or vessel ERP
- Keeping the Party Chief and ConocoPhillips Australia Offshore 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, the survey contractor will obtain daily weather forecasting from the Bureau of Meteorology (and/or other services) to monitor weather within the Operational Area in the lead up to and for the duration of the survey.

6.9.6. Operational and Scientific Monitoring

Operational and scientific monitoring arrangements are in place in the event of a hydrocarbon spill during this activity and are summarised in Section 2 of the OPEP (Appendix I).

6.10. Element 9: Awareness, Training and Competency

This element establishes the requirement that all employees, contractors and visitors have the necessary awareness, training and competency to perform their activities consistent with the ConocoPhillips HSE Policy, standards, and procedures.

ConocoPhillips Australia will adopt a process to confirm that employees and contractors have the required training and competency to fulfil their duties in a safe, environmentally and socially responsible manner. The system addresses:

- Employee selection and identification of training, competence and development needs
- Contractor evaluation and management
- Employee orientation

- Operator or mechanical skills training and qualification
- Development and maintenance of training resources and records
- Demonstration of competency.

6.10.1. Survey-specific Awareness and Training Inductions

To ensure that personnel are aware of the EP requirements for the survey, all vessel personnel will complete a project-specific HSE induction. Records of completion of the induction will be recorded. The induction will cover (but is not limited to):

- The ecological and socioeconomic values of Operational Area and the surrounding areas
- Controls to be implemented to ensure impacts and risks are ALARP and of an acceptable level, including an overview of EPBC Policy Statement 2.1 procedures and controls associated with managing acoustic impacts
- Requirement to follow procedures and use risk assessments/job hazard assessments to identify environmental impacts and risks and appropriate controls
- Requirements for interactions with fishers and/or fishing equipment
- Oil spill management, including prevention, response and clean-up, location of SOPEP equipment and reporting requirements
- Requirement for responding to and reporting safety and environmental hazards or incidents
- Overview of emergency response and spill management plans and vessel interaction procedures
- Reporting of incidents.

In addition to the project-specific induction, each person with specific responsibilities pertaining to the implementation of this EP will be made aware of their responsibilities, and the specific control measures required to maintain environmental performance and legislative compliance.

The vessel contractor will conduct its own company and vessel-specific inductions independently of the project-specific HSE induction.

As trained and competent MMOs are a key mitigation for the Sequoia MSS, MMO training and competency is captured as a control measure in described in Section 4.5.

6.11. Element 10: Non-conformance, Incident and Near Miss Investigation and Corrective Action

The purpose of this element is to ensure non-conformances, incidents and near misses are properly reported and investigated commensurate with associated risk, and to ensure that preventative and corrective actions are identified and tracked to closure.

Incident investigations will be documented using the survey contractor's incident management database to track actions and enable sharing of learnings. ConocoPhillips will be informed of all incidents and maintain its own database.

Non-conformances may be identified through audits, observations or incident reports. Actions to address non-conformances are developed following the same process applied to address root causes of incidents.

6.11.1. Recordable Incident Management

Regulation 4 of the OPGGS(E) regulations defines a 'recordable' incident as:

A breach of an EPO or EPS in the EP that applies to the activity that is not a reportable incident.

Routine monthly recordable incident reports, including ‘nil’ incident reports, will be prepared by ConocoPhillips Australia’s HSE General Manager and submitted to NOPSEMA by the 15th of each month. These are reported using the NOPSEMA template Monthly environmental incident reports (N-03000- FM0928). Table 6-3 summarises the recordable incident reporting requirements.

Table 6-3: Sequoia MSS recordable incident reporting requirements

Timing	Reporting requirements	Contact
By the 15th of each month	All recordable incidents that occurred during the previous calendar month. The date of the incident. All material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out. The EPO and/or EPS breached. Actions taken to avoid or mitigate any adverse environmental impacts of the incident. Corrective actions taken, or proposed to be taken, to stop, control or remedy the incident. Actions taken, or proposed to be taken, to prevent a similar incident occurring in the future. Actions taken, or proposed, to prevent a similar incident occurring in the future.	NOPSEMA – submissions@ nopsema.gov.au

6.11.2. Reportable Incident Management

Regulation 4 of the OPGGS(E) defines a ‘reportable’ incident as:

An incident that has caused, or has the potential to cause, moderate to significant environmental damage.

In the context of the Risk Matrix Standard, ConocoPhillips ‘moderate to significant’ environmental damage to be those hazards identified through the EIA and ERA process as having an unmitigated or residual impact consequence of ‘Moderate (3)’ or greater. Impacts and risks with these ratings (as outlined throughout Section 4 and 5) are:

- Injury or death of individual megafauna from vessel strike/entanglement;
- Introduction of Invasive Marine Species (IMS); and
- MDO release (impacts to shorebirds, fisheries, public amenity and the desalination plant). Table 6-4 presents the reportable incident reporting requirements.

Table 6-4: Reportable Incident Reporting Requirements

Timing	Requirements	Contact
Verbal notification		
Within 2 hours of becoming aware of incident	The verbal incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out;	NOPSEMA – 1300 674 472

Timing	Requirements	Contact
	• Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; and • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident.	
	Specifically, for a Level 1, 2 or 3 MDO spill, as above.	As above, plus: AMSA – 1800 641 792 (24 hrs) DJPR – 0409 858 715 DPIPWE – 03 6165 4599 Transport for NSW – 0419 484 446
	Oiled wildlife	DELWP – 1300 134 444 (24 hrs) DPIPWE – 03 6165 4599
	Suspected or confirmed IMS introduction	DAWE – 1800 803 772 (general enquiries)
	Injury or death of EPBC Act-listed fauna (e.g., vessel collision)	DAWE – 1800 803 772 Whale and dolphin emergency hotline – 1300 136 017 AGL marine response unit – 1300 245 678
Written notification		
Not later than 3 days after the first occurrence of the incident	A written incident report must include: • All material facts and circumstances concerning the incident that the titleholder knows, or is able, by reasonable search or enquiry, to find out; • Any actions taken to avoid or mitigate any adverse environmental impacts of the reportable incident; • The corrective action that have been taken, or is proposed to be taken, to stop, control or remedy the reportable incident; and • The action that has been taken, or is proposed to be taken, to prevent similar recordable incidents occurring in the future.	NOPSEMA – submissions@nopsema.gov.au
Within 72 hours of the incident	As above, with regard to details of a vessel strike incident with a cetacean	Upload information to DAWE online National Ship Strike Database (https://data.marinemammals.gov.au/report/shipstrike) DELWP (Whale and Dolphin Emergency Hotline) – 1300 136 017 Seals, Penguins or Marine Turtles – 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678.
Within 7 days of the incident	As above, with regard to impacts to MNES, specifically injury to or death of EPBC Act-listed species	EPBC.Permits@environment.gov.au DAWE 1800 803 772
Within three days of becoming aware of the event	Significant impact to MNES (as classified using the ConocoPhillips Risk Matrix)	Written notification to DAWE. EPBC.Permits@environment.gov.au DAWE 1800 803 772 Director of National Parks

Timing	Requirements	Contact
Within 7 days of providing written report to NOPSEMA	As above.	NOPTA – reporting@nopta.gov.au

Following submission of the above, NOPSEMA may, by notice in writing, request ConocoPhillips Australia to submit an additional report(s) of the incident. Where this is the case, NOPSEMA will identify the information to be contained in the report(s) or the matters to be addressed and will specify the submission date for the report(s). ConocoPhillips Australia will prepare and submit the report(s) in accordance with the notice given.

6.11.3. Incident Investigation

Any non-compliance with the EPS' outlined in this EP will be investigated and follow-up action will be assigned as appropriate.

The findings and recommendations of inspections, audits and investigations will be documented and distributed to relevant vessel and project personnel for review. Tracking the close-out actions arising from investigations is managed via the ConocoPhillips Australia and survey contractor's incident management systems.

Investigation outcomes will be communicated to the project team via daily operations meetings and to the vessel crew during daily toolbox meetings and at weekly HSE meetings.

Lessons learned in the investigation report will be incorporated into shared across ConocoPhillips Australia to reduce the likelihood of reoccurrences.

6.12. Element 11: Communication

This element sets the requirements for the internal communication of information within ConocoPhillips Australia and engagement with stakeholders and the survey contractor.

The ConocoPhillips Australia HSE General Manager has responsibility for ensuring that systems are in place to facilitate the communication of HSE issues to the survey and vessel crew. This is typically via the daily operations meeting and weekly HSE meetings.

6.12.1. Toolbox Talks and HSE Meetings

Environmental matters will be included in daily toolbox talks as required by the specific task being risk assessed (e.g., waste management).

Environmental issues will also be addressed in daily operations meetings and weekly HSE meetings, where each shift will participate with the ConocoPhillips Australia Offshore Representative, Party Chief and Vessel Master in discussing HSE matters that have arisen in the previous week, and issues to consider for the following week.

Records associated with project-specific training, environmental training, inductions and attendance at toolbox meetings will be recorded and maintained on board the vessel.

6.12.2. Internal Communications

The Vessel Master, Party Chief and ConocoPhillips Australia Offshore Representative are jointly responsible for keeping the marine and survey crews informed about HSE issues, acting as a focal point for personnel to raise issues and concerns and consulting and involving all personnel in the following:

- Issues associated with implementation of the EP
- Any proposed changes to equipment, systems or methods of operation of equipment, where these may have HSE implications
- Any proposals for the continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.

Table 6-5 outlines the key meetings that will take place onshore and offshore during survey acquisition.

Table 6-5: Project Communications

Meeting	Frequency	Attendees
Onshore		
ConocoPhillips project team	Daily	All team members
Offshore		
Operations (inclusive of daily cetacean strategy meeting)	Daily	ConocoPhillips onshore project team, department heads, ConocoPhillips Australia Offshore Representative, Party Chief, MMOs
Pre-start safety meeting	Daily – prior to each shift	All personnel
Toolbox	Before each task	All personnel involved in task
HSE	Weekly	All personnel

6.12.3. Ongoing Consultation

Ongoing consultation activities will build upon the engagement undertaken by ConocoPhillips Australia to date in relation to the activity. The ConocoPhillips document Stakeholder Engagement Process for Regulatory Approvals outlines a standard approach to interacting with relevant persons during the life of the activity and the process for dealing with feedback and updating records in a standardised fashion.

All relevant persons will be engaged with, irrespective of category as part of ongoing consultation. ConocoPhillips will undertake activities as shown in the table below.

The dedicated project hotline number and email detailed in (Section 3) will continue to operate and be monitored until three months after the completion of the activity as a minimum.

Table 6-6: Ongoing Engagement

Activity	Frequency and method

Provisions of updates on seismic activity progress	• Refer to EPS 1.1 for notification of commencement of survey. • Refer to EPS 1.14 for notification of key activity stages. • Refer to EPS 1.13 for notification of conclusion of activity. • Refer to EPS 1.8 and 1.9 for ongoing engagement with commercial fishers.
External routine reporting obligations	• Refer to Table 6-10 Includes: • Pre-survey • Survey completion • Performance reporting • Other notifications
Reportable Incident Notifications	• Refer to Table 6-4 Includes: • Injury or death of individual megafauna from vessel strike/entanglement; • Introduction of Invasive Marine Species (IMS); and • MDO release
NOPSEMA	• Ongoing as required and in accordance with Table 6-3
Emergency Response organisations	• Provide with a copy of the OPEP • Engage as per OPEP
Review of relevant persons list	• Annually unless triggered earlier
Provision of broader information relating to ConocoPhillips Australia policy	• Website updates as required on review of any policy.

In addition to the commitments outlined in Table 6-6, the ongoing engagement strategy for the activity will be tailored to fit key stakeholder and company needs as the project progresses. ConocoPhillips is committed to continuing engagement in accordance with the objectives outlined in Table 6-7.

Table 6-7: Ongoing Engagement Objectives

Stakeholder Group	Objectives	Preferred methods
Key commercial fishing representative bodies (TSIC, SIV, SETFIA)	• Ensure adjustment protocol is in place prior to activity commencing. • Present updated noise modelling outputs. • Continue to build relationship and channel feedback from fishers and provide a conduit to fishers during and after activity.	• Face to face meeting and/or workshop • Phone calls
Commercial fishers operating in the survey area during acquisition period	• To ensure users are aware of start and end dates • To ensure that safety requirements and logistics of a survey are clear • To ensure that fishers have a clear path to apply for the adjustment package if required.	• Posters at key ports • Phone hotline and email • Notice to mariners • Port visits and information sessions post-acceptance/pre-survey and mid-survey.

DPIPWE/UTAS	• Gain support for the survey acquisition boundary and agreement of acceptable risk to Giant Crab fishery. • Outline the research committed to as part of the activity.	• Face to face meeting • Phone calls
Dive based activities (including Tasmanian Abalone commercial fishers)	• Communicate noise modelling outputs • To ensure users are aware of start and end dates • To ensure that safety requirements and logistics of a survey are clear • Close out commitments made during engagement	• Information sheet for dive-based activities and requirements • Notices at key dive shops and launch points
Recreational marine users	• To ensure users are aware of start and end dates • To ensure that safety requirements and logistics of a survey are clear	• Posters at key ports • Information provided to representative bodies for newsletters • Phone hotline and email • Notice to mariners
King Island residents and representative bodies	• Close out commitments made during engagement • Keep community engaged and up to date on activity	• Pending COVD-19 travel restrictions, return to King Island post EP acceptance but prior to activity commencement (noting potential time sensitivities) to run an information session on what was committed/ accepted in the EP and how the acquisition will be managed. • Continue to provide updates on EP development as milestones are reached. • Share re-formatted relevant chapters with the KISC when available. • Share information on emerging research per MOC process (Section 6.13.1)

In addition, ConocoPhillips will undertake additional consultation in the event of an unplanned activity as outlined in Table 6-8. Ongoing measures will also be employed to ensure new relevant persons are captured and any changes to legislation or regulations results in an update to the engagement process.

Table 6-8: Engagement activities that will be triggered should an unplanned event occur or to ensure continuous improvement

Trigger	Action	Responsibility
Feedback received from relevant person	• Follow standard process outlined the ConocoPhillips Stakeholder Engagement Strategy	COP Government and External

		Affairs Manager
Change to risk profile or acquisition area	• Website update • Notification to all relevant persons • Re-engage for consultation if quantum of risk changes significant	COP Government and External Affairs Manager
Change to Offshore Petroleum Greenhouse Gas Storage (Environment) Regulations 2009 consultative requirements	• Review of Stakeholder Engagement Process	COP Government and External Affairs Manager
Change to legislative instruments which stipulate new or additional consultative requirements	• Review of Stakeholder Engagement Process	COP Government and External Affairs Manager
An element of ConocoPhillips's continuous improvement process identifies the procedure needs to be amended	• Review of Stakeholder Engagement Process	COP Government and External Affairs Manager
Level 2/3 Spill incident	• Notification of all relevant persons	IMT
AMP access in event of spill incident	• Notify AMP Director General of SMP (or other response activities) within AMP 10 days prior to entering (where possible) and at the cessation of activities in AMPs.	IMT
OSMP activation and termination	• Notify relevant persons of OSMP commencement 10 days prior to and at the cessation of activities.	IMT

6.13. Element 12: Document Control and Records Management

This element establishes the requirements for management and control of HSEMS documents and records.

The ConocoPhillips Document Control Procedure (ABUE-000-DC-N05-C-00001) is implemented to efficiently manage key documentation, including confirming that it remains accurate, current and available to required personnel. Documents and records, including procedures, work instructions and other information necessary to carry out work activities, are retained to corporate and legislative requirements. Documents are also periodically reviewed and revised as necessary, with current versions made available and obsolete documents removed or identified and retained (where necessary) for legal use.

In accordance with Regulations 27 and 28 of the OPGGS(E), documents and records relevant to the implementation of this EP are stored and maintained in the ConocoPhillips Australia Operations Document Management System for a minimum of five years. These records will be made available to NOPSEMA in electronic or printed form upon request.

Records to demonstrate implementation of the HSEMS and compliance with legislative requirements and other obligations are identified and maintained for at least five years. These records will include:

- Written reports – including risk assessment reports and registers, monitoring reports, audit and review reports – about environmental performance or implementation strategies
- Records relating to environmental performance or the implementation strategies
- Records of environmental emissions and discharge
- Modification and changes authorised by ConocoPhillips and/or contractor
- Incident and/or near miss investigation reports
- Improvement plans (corrective actions, key performance indicators)
- Records relating to training and competency in accordance with this EP.

6.13.1. Management of Change

The intent of Management of Change (MoC) is that all temporary and permanent changes to the organisation, personnel, systems, procedures, equipment, products, materials, and critical assumptions (including science) are identified and managed to ensure HSE risks arising from these changes remain ALARP and at an acceptable level.

The Management of Change Overview Procedure (ABUE-000-SF-N05-C-00002) is applied to ensure that all proposed changes are adequately defined, implemented, reviewed and documented by suitably competent persons. This process is managed using an electronic tracking database, which provides assurance that all engineering and regulatory requirements have both been considered and met before any change is operationalised. The MoC process includes not just plant and equipment changes, but also documented procedures where there is an HSE impact, regulatory or scientific documents and organisational changes that impact personnel in safety critical roles or environmental outcomes.

Not all changes require a MoC review. Each change is assessed on a case-by-case basis. Potential environmental impacts and/or risks are reviewed by a suitably competent member of ConocoPhillips Australia to determine whether the MoC review process is triggered.

As part of the MoC Overview Procedure, an activity specific addendum will be used to ensure environmental impacts and risks relevant to this activity will remain at levels that are ALARP and acceptable. This addendum is considered effective because it requires:

- Periodic monitoring of relevant publications for relevant literature.
- Consideration of the inherent and residual environmental impacts and risks
- Validation of the context and scope of the impact or risk assessment
- Validation of the predicted impact levels and the define acceptable levels
- Reassessment of the effectiveness of control measures against the specified performance standards
- Adoption of additional, alternative, or improved control measures that are identified to be reasonably practicable
- Reassessment of any environmental trade-offs or unintended consequence of the change
- Engagement with external experts for environmental matters where there is low levels of confidence in the prediction of impacts/risks.
- Will be completed as soon as possible after the release of literature.

In accordance with Regulation 17 of the OPGGS (E) Regulations 2009, ConocoPhillips Australia will undertake a review of this EP to ensure changes in legislation, science (and potential changes to impact assessment), stakeholder requirements or other management requirements are accounted for and assessed on a regular basis to maintain an acceptable level/ALARP, and at least one month prior to commencement of the survey. If an identified change triggers a MOC, the standard process will involve:

- Initiation
- Review or Assessment (as applicable)
- Approval
- Implementation
- Close-out
- Communication

The MoC request process will be periodically checked against NOPSEMA guidance to ensure ongoing compliance and will be undertaken as part of the review process described in Section 6.16.

Following a management of change process where new research is considered for the Sequoia EP all relevant persons who may be affected by the change will be provided with summaries of the research and changes to the activity or control measures.

ConocoPhillips is aware of the unpublished FRDC paper relevant to the consideration of effects of seismic sound on SRL. After engagement with the study lead the impact assessment has considered the increased buffers suggested as preliminary and precautionary actions. This study will be fully considered by the MoC process as soon as possible after the release of the study results.

6.14. Element 13: Measuring and Monitoring

This element defines the requirements for measuring and monitoring ConocoPhillips Australia's HSE performance, providing assurance of compliance, assessing the effectiveness in meeting its goals and legal obligations, and identifying opportunities for improvement.

ConocoPhillips Australia will monitor implementation and compliance of EPOs, control measures and EPSs throughout the Sequoia MSS, ensure control measures remain effective for the duration of the survey and non-compliances or opportunities for improvement are appropriately identified and addressed.

6.14.1. Emissions and Discharges Records

ConocoPhillips will maintain a quantitative record of emissions and discharges for the survey as required under Regulation 14(7) of the OPGGS(E). This includes emissions and discharges to air and water (from both planned and unplanned activities). Results are reported in the end-of-activity EP performance report submitted to NOPSEMA.

General and hazardous waste streams generated during the survey are backloaded to port for disposal to a licenced waste facility, and are not within the scope of the EP.

A summary of the environmental monitoring to be undertaken for the survey is presented in Table 6-9. Incident reporting is described in Section 6.11.

Table 6-9: Summary of Environmental Monitoring

Aspect	Monitoring parameter	Frequency	Record

Underwater sound (Impulsive)	MMO megafauna visual observations: Species, number, behaviour and any actions taken by vessel	Continuous during acquisition and pre-starts	MMO daily reports End-of-survey report Incident report (if required)
	Acoustic source volume implemented, and area source is discharged	Throughout survey	Seismic observer logs
Atmospheric emissions	Fuel consumption	Tallied at end of survey	Daily reports and/or bunker receipts
Vessel discharges	Volume of bilge water discharged	Each discharge (infrequent)	Oil record book
	Volume and quality of sewage and greywater discharge	As per ISPP certificate	Maintenance records of sewage treatment system
Waste disposal	Weight/volume of wastes sent ashore (including oil sludge, solid/hazardous wastes)	Tallied at end of survey	Waste manifest
Displacement of or interaction with third-party vessels	Ongoing patrol for, and communications with, third-party vessels by the support vessels. Radar surveillance from source vessel.	Continuous during survey	Bridge communications book
Introduction of IMS	Volume and location of ballast water discharges noted	Each discharge	Ballast water log

6.14.2. Routine Reporting and Notifications

Sub-regulation 11A(3) of the Environment Regulations provides that:

The Implementation strategy of the environment plan must provide for appropriate consultation with:

a) Relevant authorities of the Commonwealth, a State or Territory; and

b) Other relevant interested persons or organisations

Ongoing reporting and notification activities build upon ConocoPhillips Australia's engagement for the activity (Section 3 and Section 3.6). Section 3 outlines the processes that will be followed to ensure a standard approach to interacting with relevant persons during the life of the activity, including revision of relevant persons' list and process for dealing with feedback during this period. Table 6-10 outlines the routine reporting obligations that ConocoPhillips Australia will undertake with external organisations.

Table 6-10: External Routine Reporting Obligations

Requirement	Timing	Contact details	OPGGS(E) regulation
Pre-survey			
Notify DNP if the EP is approved by NOPSEMA	On approval	marineparks@awe.gov.au	11A
Notify DNP of any activities within the marine park (excluding transiting)	At least 14 days prior to all activities occuring	marineparks@awe.gov.au	11A
Notify the AHO of the survey commencement date and	Three weeks prior to survey starting.	datacentre@hydro.gov.au	11A

duration to enable Notices to Mariners to be issued.		02 4223 6500	
Australian Maritime Safety Authority (AMSA; Cwlth) Joint Rescue Coordination Centre (JRCC)	ConocoPhillips Australia to notify AMSA JRCC for promulgation of radio-navigation warnings 24-48 hours before operations commence and upon completion of the survey	(Email: rccaus@amsa.gov.au; Phone: 1800 641 792 or +61 2 6230 6811).	N/A
Survey completion			
Notify DNP of completion	At the conclusion of that activity	marineparks@awe.gov.au	11A
Bathymetry data collected during the survey is contributed to AusSeabed	Within 2 months of survey completion	http://www.ausseabed.gov.au/	11A
Notify AMSA in order to cease daily AusCoast warnings.	Within 24 hours of survey completion.	rccaus@amsa.gov.au	11A
Notify all stakeholders in the stakeholder register.	Within 2 days of survey completion.	Via email addresses managed by the External Affairs Advisor	11A
Notify the AHO in order to cease the issuing of Notices to Mariners.	Within 2 days of survey completion.	datacentre@hydro.gov.au 02 4223 6590	11A
Notify NOPSEMA of the survey end date.	Within 10 days of survey completion.	submissions@nopsema.gov.au	29
Notify NOPSEMA of the end of the operation of the EP.	After acceptance of the end-of-activity EP performance report.	submissions@nopsema.gov.au	25A
Performance reporting			
Submit an end-of-survey EP Performance Report.	Within 3 months of survey completion.	submissions@nopsema.gov.au	26C
Provide marine fauna observation data to the DAWE.	Within 3 months of survey completion.	Upload via the online Cetacean Sightings Application at: https://data.marinemammals.gov.au/nmmdb	N/A – EPBC Act
Other Notifications			
Department of Agriculture and Water Resources (Cwlth)	ConocoPhillips Australia will report any unusual vessel activity within the area to the Australian Border Force.		As required
Department of Agriculture and Water Resources (Cwlth)	ConocoPhillips Australia will keep the Department informed of any concerns raised by AFMA or other relevant Commonwealth fishing stakeholders	Environment (61 2) 6274 1111	N/A
Commercial fishers via Tasmanian Seafood Industry Council (TSIC)	TSIC and relevant commercial fisheries stakeholders will be notified of the activity commencement and cessation. 2 weeks prior to start of survey	tsic@tsic.org.au Phone: 03 6224 2332	N/A

EPA Tasmania	Two weeks prior to survey starting.	Enquiries@epa.tas.gov.au	
Notify all other stakeholders in the stakeholder register with the survey commencement date.	Two weeks prior to survey starting.	Via email addresses managed by the Government and External Affairs Manager	11A

6.14.3. Annual Performance Reporting

In accordance with Regulation 14(2) of the OPGGS (E) Regulations 2009, Conoco Phillips will undertake a review of its compliance with the environmental performance outcomes and standards set out in this EP and will provide a written report of its findings for the reporting period to NOPSEMA on an annual basis, as agreed with NOPSEMA. The annual submission date for the environmental performance report will not be less than 12 months after the acceptance of the EP by NOPSEMA.

6.15. Element 14: Audits

An audit and inspection program will be developed and implemented in accordance with the ConocoPhillips Corporate Audit Standard and ABU HSEMS.

Environmental performance will be reviewed in several ways to ensure:

- EPSs and CMs to achieve the EPOs are being implemented and reviewed
- Potential non-compliances and opportunities for continuous improvement are identified.
- Environmental monitoring and reporting requirements have been met
- Self-assessment HSE audits against the HSEMS

Unscheduled audits may also be initiated by ConocoPhillips in the event of an incident, non-compliance or for other valid reasons.

Table 6-11 describes the levels of inspections and audits that will be undertaken for the Sequoia MSS.

The Environmental Performance section of Appendix A captures all of the commitments for the Sequoia MSS. A summary of the EP commitments for the survey will be distributed aboard the vessels (including role- specific checklists), and implementation of the EPS will be continuously monitored by the ConocoPhillips Offshore Representative and verified by the ConocoPhillips HSE General Manager (or delegate) through review of the completed weekly checklists and attendance at relevant meetings.

Any non-compliances or opportunities for improvement identified at the time of an inspection or audit will be communicated to the relevant ConocoPhillips and contractor personnel at the time of the inspection and summarised in a report. These are tracked in the incident management system IntelexTM, which includes assigning responsibilities to personnel to manage the issue and verify that it is closed out.

Non-compliances and/or opportunities for improvement will be communicated to survey personnel in writing and at appropriate meetings (as listed in Table 6-5).

Table 6-11: Summary of Environmental Inspections and Audits

Type	When	Frequency	Vessel	Method	Details

HSE due diligence inspection	Post-award, pre-survey	Once	Survey vessel and support vessels	Desktop or in port/during mobilisation	Inspections will be undertaken to ensure that the environmental performance outcomes and standards documented in this EP can be achieved. The inspections will be conducted prior to mobilisation.
Ongoing inspections	During survey	Weekly	Survey vessel and support vessels	In person on board	Checklists provided by ConocoPhillips to be completed by: • Survey vessel – ConocoPhillips Australia Sequoia Offshore Representative • Support vessels – Vessel master. Inspection will include, but not be limited to: • spill preparedness • waste management • validation all EPOs and EPSs are maintained as per Appendix A Environmental Performance section • compliance with procedural controls relevant to environmental management of the Sequoia MSS such as: sail line plan, marine mammal's adaptive management procedure, monitoring programs.

6.15.1. Regulatory Inspections

Under Part 5 of the OPGGS Act, NOPSEMA inspectors have the authority to enter ConocoPhillips Australia premises, including the survey vessel, to undertake monitoring or investigation against this EP.

ConocoPhillips Australia will cooperate fully with the regulator if such investigations take place.

6.16. Element 15: Review

Through a process of adaptive management, lessons from management outcomes will be used for continual improvement. Formal reviews of the effectiveness and appropriateness of the management system are performed by senior management on a periodic basis. The things learned from this process and iterative decision-making will then be used as feedback to improve future management.

6.16.1. EP Review

ConocoPhillips may determine that an internal review of the EP (including the OPEP and OSMP) may be necessary based on any one or all of the following factors:

- Changes to hazards and/or controls identified in the review of the EP, which is supported by:
    - Reviewing changes to Australian Marine Park (AMP) management arrangements (through subscription to the AMP email update service at https://parksaustralia.gov.au/marine/about/).

    - Environment and industry legislative updates (through subscriptions to NOPSEMA, APPEA and legal firms).
    - Running a new EPBC Act Protected Matters Search Tool (PMST) search for the Spill EMBA immediately prior to the survey to determine whether there are newly-listed threatened species or ecological communities in the Spill EMBA.
    - Remaining up to date with new scientific research that may impact on the EIA/ERA in the EP (for example, through professional networking, APPEA membership and engagement with stakeholders).
    - Remaining in regular contact with stakeholders.
- Implementation of corrective actions to address internal or external inspection or audit findings
- An environmental incident and subsequent investigation identify issues in the EP that require review and/or updating
- A modification of the activity is proposed that is not significant but needs to be documented in the EP
- Changes identified through the MoC process, such as hazards or controls, organisational changes affecting personnel in safety critical roles or HSE management systems
- Changes to any of the relevant legislation.

The HSE team provides advice to the ConocoPhillips Australia Exploration Manager on the material impact of the items listed previously and whether or not a review of the EP should be undertaken. The scope of a review is determined by the factors that trigger the review and an appropriate team will be assembled by the HSE General Manager to conduct the review. The team may consist of representatives from the Government and External Affairs, Engineering, HSE, Operations or Supply Chain teams as required by the scope.

If a review of the EP relates to a topic that had previously been raised by a stakeholder, an updated response to affected stakeholders will be prepared and provided to affected stakeholders in a process managed by the Government and External Affairs Manager.

The MoC process described in (Section 6.13.1) will apply.

6.16.2. Revisions Triggering EP Re-submission

ConocoPhillips Australia will revise and re-submit the EP for assessment as required by the OPGGS(E) regulations listed in Table 6-12.

Table 6-12: EP Revision Requirements

Regulations	OPGGS(E) regulation
Submission of a revised EP before the commencement of a new activity.	17(1)
Submission of a revised EP when any significant modification or new stage of the activity that is not provided for in the EP is proposed.	17(5)
Submission of a revised EP before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk not provided for in the EP.	17(6)
Submission of a revised EP if a change in titleholder will result in a change in the manner in which the environmental impacts and risks of an activity are managed.	17(7)

Revisions and re-submission of the EP generally centre around ‘new’ activities, impacts or risks and ‘increased’ or ‘significant’ impacts and risks. ConocoPhillips Australia defines these terms in the following manner:

- **New** impact or risk – one that has not been assessed in section 4 or 5.
- **Increased** impact or risk – one with greater extent, severity, duration or uncertainty than is detailed in section 4 or 5.
- **Significant** change –
  - The change to the survey design deviates from the EP to the degree that it results in new activities that are not intrinsic to the existing Activity Description in Section 2.
  - The change affects the ability to achieve ALARP or acceptability for the existing impacts and risks described in section 4 or 5.
  - The change affects the ability to achieve the EPO and EPS contained in section 4 or 5.
  - A change in the activities, knowledge, or requirements applicable to the activity are considered to result in a ‘significant new’ or ‘significant increased’ impact or risk if any of the following criteria apply:
  - The change results in the identification of a new impact or risk and the assessed level of risk is not
  - ‘Low’, acceptable and ALARP;
  - The change results in an increase to the assessed impact consequence or risk rating for an existing impact or risk described in section 4 or 5; and
  - There is both scientific uncertainty and the potential for significant or irreversible environmental damage associated with the change.

While an EP revision is being assessed by NOPSEMA, any activities addressed under the existing accepted EP are authorised to continue. Additional guidance is provided in NOPSEMA’s Guideline *When to submit a proposed revision of an EP* (N04750-GL1705, Rev 1, January 2017).

6.16.3. Minor EP Revisions

Minor revisions to this EP that do not require resubmission to NOPSEMA will be made where:

- Minor administrative changes are identified that do not impact on the environment (e.g. document references, contact details, etc.).
- A review of the activity and the environmental impacts and risks of the activity do not trigger a requirement for a revision, as outlined in Table 6-12.

Minor revisions to the EP will not be submitted to the regulators for formal assessment. Minor revision6. 15.1	An Annual EP Performance Report is submitted to the regulators.	The Annual EP Performance Report is issued each year to NOPSEMA.	Annual EP Performance Reports and associated email correspondence is available to verify their issue to NOPSEMA.
6.16		This EP is reviewed and updated based on the triggers presented	A record of EP reviews and updates is available in OpenText.

	This EP is reviewed and updated on an as-required basis.	in Section 8.16 on an as- required basis.	The review and/or update details are recorded in the document control page of this EP.
		If the review identifies that significant changes to the EP are required, the EP (and OPEP, if required) is updated and re- issued to the regulators.	A record of EP revision is included in the document control page of this EP.
			Associated correspondence is available to verify the re-issue of the EP to NOPSEMA.

7. Acronyms

ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ACAP	Agreement on the Conservation of Albatrosses and Petrels
AFMA	Australian Fisheries Management Authority
AFZ	Australian Fishing Zone
AMP	Australian Marine Park
APPEA	Australian Petroleum Production and Exploration Association
AusCPR	Australian Continuous Plankton Recorder
AODN	Australian Ocean Data Network
AMP	Australian Marine Park
BIA	Biologically Important Area
BRS	Bureau of Rural Sciences
BSCZSF	Bass Strait Central Zone Scallop Fishery
CoA	Commonwealth of Australia
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cwlth	Commonwealth
DAWE	Department of Agriculture, Water and the Environment
DAWR	Department of Agriculture and Water Resources
dB	decibel
DNP	Director of National Parks
DoE	Department of the Environment
DoEE	Department of the Environment and Energy
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EAC	East Australian Current
EEAF	East Asian - Australasian Flyway
EIA	Environmental Impact Assessment
EMBA	environment that may be affected
EPBC Act	Environmental Protection, Biodiversity and Conservation Act
EP	Environment Plan
ESF	Eastern Skipjack Fishery
ETBF	Eastern Tuna and Billfish Fishery
GAB	Great Australian Bight
GABTS	Great Australian Bight Trawl Sector
GVP	Gross Value Product
GZ	Southern and Eastern Scalefish and Shark Fishery SESSF – Gemfish Eastern Zone
Ha	Hectare
HOB	Head of Bight
IAGC	International Association of Geophysical Contractors

IMCRA	Interim Marine and Coastal Regionalisation for Australia
IMO	International Maritime Organization
IMS	Invasive Marine Species
IUCN	International Union for Conservation of Nature
JASCO	JASCO Applied Sciences
KEF	Key Ecological Feature
Kg	Kilogram
Km	Kilometre
KO	Species or species habitat known to occur within area
L	Litre
LO	Species or species habitat likely to occur within area
m	metre
MO	Species of species habitat may occur within area
MSS	Marine Seismic Survey
nm	Nautical Mile
OPGGS	Offshore Petroleum and Greenhouse Gas Storage (Act 2006)
PBW	Pygmy Blue Whale
PK	Peak pressure
PMST	EPBC Act Protected Matters Search Tool
PPE	Personal Protective Equipment
PTS	Permanent Threshold Shift
ROV	Remote observation vehicle
SA	South Australia
SBTF	Southern Bluefin Tuna Fishery
SEL24h	maximum 24 h received sound exposure level
SESSF	Southern and Eastern Scalefish and Shark Fishery
SESSF – CTS	Southern and Eastern Scalefish and Shark Fishery – Commonwealth Trawl Sector
(SESSF- GSHSF)	Southern and Eastern Scalefish and Shark Fishery – Gillnet and Shark Hook Sector Fishery
SESSF – SHS	Southern and Eastern Scalefish and Shark Fishery SESSF – Scalefish Hook Sector
SETFIA	South East Trawl Fishing Industry Association
SOLAS	Safety of Life at Sea
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SRL	Southern Rock Lobster
SSJF	Southern Squid Jig Fishery
STLM	sound transmission loss modelling
SRW	Southern Right Whale
t	tonnes

TTS	Temporary Threshold Shift
VFA	Victorian Fisheries Authority

8. References

3D Oil, 2019. Dorrigo 3D Marine Seismic Survey Environment Plan. 3D Oil.

ABARES. 2018. – Fishery Status Reports – Southern Squid Jig Fishery. Australian Bureau of Agricultural and Resource Economics and Sciences. Accessed May 2021 at www.abares.gov.au.

ABARES. 2019. Fishery Status Report 2019. Australian Bureau of Agricultural and Resource Economics and Sciences. Commonwealth of Australia. Accessed May 2021 at https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status.

ABARES. 2020a. Fishery Status Reports 2020: Southern Bluefin Tuna Fishery. Department of Agriculture,Water and the Environment. Accessed May 2021 at:

ABARES. 2020b. Fishery Status Reports 2020: Small Pelagic Fishery. Department of Agriculture, Water and the Environment. Accessed May 2021 at: https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status/small-pelagic

Abbott, C.A., Double, M.C., Baker, G.B., Gales, R., Lashko, A., Robertson, C.J.R. and Ryan, P.G. 2006. Molecular provenance analysis of shy and white-capped albatrosses killed by fisheries interactions in Australia, New Zealand and South Africa. Conservation Genetics 7: pp531–542.

ACAP. 2011. ACAP Species assessment. Agreement on the Conservation of Albatrosses and Petrels, Accessed April 2021 at www.acap.aq.

ACAP. 2018. Agreement on the Conservation of Albatrosses and Petrels. Amended by the Sixth Session of the Meeting of the Parties. Skukuza, South Africa, 7- 11 May 2018.

Adam, P. 1990. Saltmarsh Ecology. Cambridge University Press, Cambridge.

AFMA. 2014. Blue Warehou (Seriolella brama) Stock Rebuilding Strategy 2014. Australian Fisheries and Management Authority. https://www.afma.gov.au/sites/default/files/uploads/2014/12/Blue-Warehou-Rebuilding-Strategy-2014.pdf.

AFMA. 2014a. Orange Roughy (Hoplostethus atlanticus) Stock Rebuilding Strategy 2014. Australian Fisheries and Management Authority. Accessed May 2021 at https://www.afma.gov.au/sites/default/files/orange_roughy_rebuilding_strategy_2014_final.pdf.

AFMA. 2015. School Shark (Galeorhinus galeus) Stock Rebuilding Strategy 2015. Australian Fisheries Management Authority. Canberra.

AFMA. 2020. Harvest Strategy Framework for the Southern and Eastern Scalefish and Shark Fishery 2009 (Amended 2020). Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/sites/default/files/sessf_harvest_strategy_amended_2020.pdf

AFMA. 2020a. Southern and Eastern Scalefish and Shark Fishery Management Arrangements Booklet 2020. Commonwealth of Australia, Canberra. Accessed May 2021 at: https://www.afma.gov.au/sites/default/files/2020_southern_and_eastern_scalefish_and_shark_fishery_management_arrangements_booklet.pdf

AFMA. 2021. Gummy Shark. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/gummy-shark.

AFMA. 2021. Southern and Eastern Scalefish and Shark Fishery. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries/southern-eastern-scalefish-shark-fishery.

AFMA. 2021a. Eastern school whiting. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/eastern-school-whiting.

AFMA. 2021b. Tiger flathead. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/tiger-flathead.

AFMA. 2021c. Elephantfish. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/elephant-fish.

AFMA. 2021d. Pink Ling. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/pink-ling.

AFMA. 2021e. Blue grenadier. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/blue-grenadier.

AFMA. 2021f. Orange Roughy. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/orange-roughy.

AFMA. 2021g. Saw Shark. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/sawsharks.

AFMA. 2021h. Ocean Perch. Australian Fisheries Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/ocean-perch.

AFMA. 2021i. Blue Warehou, Australian Fisheries and Management Authority. Accessed May 2021 at https://www.afma.gov.au/fisheries-management/species/blue-warehou.

Alderman, R., Gales, R., Hobda,y A.J. and Candy, S. 2010. Post-fledging survival and dispersal of shy albatrosses from three breeding colonies in Tasmania. Marine Ecology Progress Series 405: pp271–285.

AMSA. 1998. The Effects of Maritime Oil Spills on Wildlife Including Non-Avian Marine Life. Australian Maritime Safety Authority. Canberra.

Andrew, N. 1999. Under Southern Seas: The Ecology of Australia's Rocky Reefs. University of New South Wales Press, Sydney.

ANZECC and ARMCANZ. 2000. Australian guidelines for water quality monitoring and reporting. National Water Quality Management Strategy Paper No 7, Australian and New Zealand Environment and Conservation Council & Agriculture and Resource Management Council of Australia and New Zealand, Canberra.

APASA. 2012. Marine diesel fuel oil spills and weathering. Memorandum from Trevor Gilbert, Director Maritime, Environment and Chemical Services at APASA, to Phil Harrick, HSEQ Manager, AGR Petroleum Services. 24th June 2012.

Arnould, J., Berlincourt, M. 2013. At-sea movements of little penguins (Eudyptula minor) in the Otway Basin. Report prepared for Origin Energy.

Atlas of Living Australia. Accessed May 2021 at https://spatial.ala.org.au/#.

Backhouse, G., O'Connor, J. 2008. National Recovery Plan for the Australian Grayling (Prototroctes maraena), Department of Sustainability and Environment, Accessed May 2021 at https://environment.gov.au/system/files/resources/184f9f43-1f10-441d-a918-5df406b2cd2c/files/australian-grayling.pdf.

Baines, P. and Fandry, C. 1983. Annual cycle of the density field in Bass Strait. Marine and Freshwater Research 34, 143-153.

Baker, A. 1985. Pygmy right whale Caperea marginate. In: Handbook of Marine Mammals. Eds., Ridgway, S.H., R. Harrison. Vol. 3: The Sirenians and Baleen Whales. pp345-354. Academic Press, London.

Baker, B., and 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.

Baker, G.B., Gales, R., Hamilton, S. and Wilkinson, V. 2002. Albatrosses and petrels in Australia: a review of their conservation and management. Emu 102: pp71–97.

Bamford, M., D., Watkins, W., Bancroft, G., Tischler, Wahl, J. 2008. Migratory Shorebirds of the East Asian - Australasian Flyway: Population estimates and internationally important sites. Department of the Environment, Water, Heritage and the Arts, Wetlands International-Oceania. Canberra, ACT. Accessed April 2021 at http://www.environment.gov.au/biodiversity/migratory/publications/shorebirds-east-asia.html.

Bannister, J.L., Kemper, C.M., Warneke, R.M. 1996. The Action Plan for Australian Cetaceans. Australian Nature Conservation Agency, Canberra. Accessed May 2021 at http://www.environment.gov.au/resource/action-plan-australian-cetaceans.

Barrett, N., Buxton, C., Edgar, G. 2009. Changes in invertebrate and macroalgal populations in Tasmanian marine reserves in the decade following protection. Journal of Experimental Marine Biology and Ecology 370: pp104-119. DOI: 10.1016/j.jembe.2008.12.005.

Barter, M., Fawen, Q., Sixian, T., Xiao, Y., and Tonkinson, D. 1997. Hunting of migratory waders on Chongming Dao: a declining occupation? Stilt 31: pp19-22.

Barter, M.A. 2002. Shorebirds of the Yellow Sea: Importance, Threats and Conservation Status. Wetlands International Global Series No. 8, International Wader Studies 12. Canberra, ACT.

Bell, B., Spotila, J.R. and Congdon, J. 2006. High Incidence of Deformity in Aquatic Turtles in the John Heinz National Wildlife Refuge. Env Poll. 142(3): 457– 465.

Berra, T.M. 1982. Life history of the Australian grayling Prototroctes maraena (Salmoniformes: Prototroctidae) in the Tambo River, Victoria. Copeia. 1982(4): pp795-805.

Bett BJ and Rice AL. 1992. The influence of hexactinellid sponge (Pheronema carpenteri) spicules on the patchy distribution of macrobenthos in the Porcupine Seabight (Bathyal NE Atlantic). Ophelia 36:217–226

Bik, H.M, Halanych, K.H., Sharma, J. and Thomas, W.K. 2012. Dramatic shifts in benthic microbial eukaryote communities following the Deepwater Horizon oil spill. PLOS One 7(6): e38550.

Birdlife Australia. 2020. Species fact sheets. Accessed April 2021 at http://birdlife.org.au/.

Birdlife Australia. 2021. Species Profile. Accessed April 2021 at https://birdlife.org.au/bird-profile/.

BirdLife International. 2004. Tracking ocean wanderers: the global distribution of albatrosses and petrels. Results from the Global Procellariiform Tracking Workshop, 1–5 September, 2003, Gordon's Bay, South Africa. Birdlife International, Cambridge, UK.

BirdLife International. 2009. Antipodean albatross [Diomedea antipodensis]. Accessed April 2021 at http://www.birdlife.org.

BirdLife International. 2013. Sooty shearwater [Puffinus griseus]. Accessed April 2021 at http://www.birdlife.org.

Bishop, K.A.,Bell J.D.. 1978b. Aspects of the biology of the Australian grayling Prototroctes maraena Gunther (Pisces: Prototroctidae). Australian Journal of Marine and Freshwater Research. 29(6): pp743-761.

Blumer, M. 1971. Scientific aspects of the oil spill problem. Environmental Affairs 1: pp54–73.

Boeger, W.A., Pie, M.R., Ostrensky, A. and Cardoso, M.F. 2006. The effect of exposure to seismic prospecting on coral reef fishes. Brazilian Journal of Oceanography 54: pp235-239.

Bolle L.J., de Jong C.A.F., Bierman S.M., van Beek P.J.G., van Keeken O.A., Wessels P.W., van Damme C.J.G., Winter H.V., de Haan D., Dekeling R.P.A. 2012. Common Sole Larvae Survive High Levels of Pile-Driving Sound in Controlled Exposure Experiments. PLoS ONE 7(3): e33052. DOI: 10.1371/journal.pone.0033052.

Bolton, D., Mayer-Pinto, M., Clark, G.F., Dafforn, K.A., Brassil, W.A., Becker A., Johnston, E.L. (2017) Coastal urban lighting has ecological consequences for multiple trophic levels under the sea. Science of the Total Environment 576: pp1-9.

BOM. 2018. Climate Statistics for King Island Airport. Bureau of Meteorology, Accessed May 2021 at

Bonham P., Doblin M., Richardson A., Rochester W., Rousseaux C., Thompson P., Thomson P., Waite A. 2015. Climate variability drives plankton community composition changes: the 2010–2011 El Niño to La Niña transition around Australia, Journal of Plankton Research, 37(5): pp966-984. Accessed at https://doi-org.ezproxy.library.uwa.edu.au/10.1093/plankt/fbv069.

Booman, C., Dalen, J., Leivestad, H., Levsen, A., van der Meeren, T. and Toklum, K. 1996. Effects of airgun shooting on eggs, larvae and personnel. Havet (3): pp1-83.

Booth, J. D. and Stewart, R. A. 1991. Distribution of phyllosoma larvae of the red rock lobster Jasus edwardsii off the east coast of New Zealand in relation to the oceanography. In 'Proceedings of the Australian Society for Fish Biology workshop on larval biology', Hobart, pp. 138-148.

Boreen, T., James, N., Wilson, C., Heggie, D. 1993. Surficial cool-water carbonate sediments on the Otway continental margin, southeastern Australia. Marine Geology 112: pp35-56

Boyle, P., Rodhurst, P. 2005. Cephalopods, Ecology and Fisheries, Blackwell Publishing. Carlton, Victoria.

Braccini, M., Green, C., Lyle, J., Peddemors, V., Rogers, P., Woodhams, J. 2018c. Gummy Shark, Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/181-Gummy-Shark-2018.

Braccini, M., Ingram, B., Lyle, J., Peddemors, V., Rogers, P., Woodhams, J. 2018. School Shark. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/182-School-Shark-2018.

Braccini, M., Moore, B., Peddemors, V., Rogers, P., Woodhams, J. 2018a. SAWSHARKS. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/157-SAWSHARKS-2018.

Brooke, M. 2004. Albatrosses and Petrels Across The World. Oxford University Press, Oxford, UK.

Brothers, N., Gales, R., Hedd, A., Robertson, G. 1998. Foraging movements of the shy albatross Diomedea cauta breeding in Australia — implications for interactions with longline fisheries. Ibis 140: pp446–457.

Brown, D., Root, F. 2010. Western Port Ramsar Wetland Ecological Character Description. Report for Department of Sustainability, Environment, Water, Population and Communities, Canberra.

Brown, P.B., Wilson, R.I. 1980. A Survey of the Orange-bellied Parrot Neophema chrysogaster in Tasmania, Victoria and South Australia. Tasmanian National Parks and Wildlife Service. Hobart.

BRS. 2007. Designated Exchange Areas Project – Providing Informed Decision on the Discharge of Ballast Water in Australia (Phase II). Eds., Knight, E., Barry, S., Summerson, R., Cameron S., Darbyshire R. Report for the Bureau of Rural sciences.

Bruce, B., Bradford, R., Foster, S., Lee, K., Lansdell, M., Cooper S. 2018. Quantifying fish behaviour and commercial catch rates in relation to a marine seismic survey, Marine Environmental Research (2018).

Bruce, B., Griffin, D., Bradford, R. 2007. Laval Transport and Recruitment Processes of Southern Rock Lobster. FRDC 2002/007, Final Report, CSIRO Marine and Atmospheric Research.

Bruce, B., Griffin, D., Bradford, R. 2007. Laval Transport and Recruitment Processes of Southern Rock Lobster, FRDC 2002/007, Final Report. CSIRO Marine and Atmospheric Research.

Bruce, B.D., Bradford, R. Daley, Green, M., Phillips, K. 2002. Targeted Review of Biological and Ecological Information from Fisheries Research in the South East Marine Region. Final Report to the National Oceans Office. CSIRO Marine Research, Hobart. Accessed May 2021 at http://www.environment.gov.au/coasts/mbp/publications/south-east/pubs/se-fisheries.pdf.

Bruce, G.D., J.D. Stevens, Malcolm, H. 2006. Movements and swimming behaviour of white sharks (Carcharodon carcharias) in Australian waters. Marine Biology 150: pp161-172. Accessed May 2021 at http://web.ebscohost.com/ehost/pdfviewer/pdfviewer?vid=5&hid=15&sid=e92b4861-0c33-4972-81be- 796819288dd2%40sessionmgr4.

Brusati, E.D., Grosholz, E.D. 2006. Native and introduced eco-system engineers produce contrasting effects on estuarine infaunal communities. Biological Invasions 8: pp683—695.

Brusati, E.D., Grosholz, E.D. 2007. Effect of native and invasive cordgrass on Macoma petalum density, growth and isotopic signatures. Estuarine Coastal and Shelf Science 71: 517–522.

Burger, A.E. 1993. Estimating the mortality of seabirds following oil spills: effects of spill volume. Mar. Poll. Bull 26:140–143.

Burnell, S. R. (2001). Aspects of the reproductive biology, movements and site fidelity of right whales off Australia, Journal of Cetacean Research and Management (Special Issue) 2: 89–102

Butler, A., Althaus, F., Furlani, D., Ridgway, K. 2002. Assessment of the Conservation Values of the Bass Strait Sponge Beds Area: A component of the Commonwealth Marine Conservation Assessment Program 2002-2004. Report to Environment Australia. CSIRO Marine Research. Hobart

Butler, C., Lucieer, V., Walsh, P., Flukes., E and Johnson, C .2017. Seamap Australia [Version 1.0] the development of a national benthic marine classification scheme for the Australian continental shelf. Institute for Marine and Antarctic Studies, University of Tasmania. Accessed on May 2021 at: https://seamapaustralia.org. Canberra.

CarbonNet. 2018. Geotechnical and Geophysical Investigations Environment Plan Summary. Department of Jobs, Precincts and Regions, Melbourne. Accessed April 2021 at https://info.nopsema.gov.au/home/underway_offshore.

Carls, M.G., Holland. L., Larsen, M., Collier, T.K., Scholz, N.L. and Incardona, J.P. 2008. Fish embryos are damaged by dissolved PAHs, not oil particles. Aquatic Toxicology 88:121– 127.

Carroll, A.G., Przeslawski, R., Duncan, A., Gunning, M., Bruce, B. 2017. A critical review of the potential impacts of marine seismic surveys on fish & invertebrates. Marine Pollution Bulletin 114: pp9-24.

Casper, B.M., Halvorsen, M.B., Matthews, F., Carlson, T.J.,Popper, A.N. 2012. Recovery of barotrauma injuries resulting from exposure to pile driving sound in two sizes of hybrid striped bass. PLoS ONE 8(9): e73844.

Casper, B.M., Halvorsen, M.B., Popper, A.N. 2010. Anthropogenic Noise: Is this an issue for elasmobranch fish? The Journal of the Acoustical Society of America.

Challenger, G. and Mauseth, G. 2011. Chapter 32 – Seafood safety and oil spills. In: Oil Spill Science and Technology. M. Fingas (ed) 1083-1100.

Chapman, C., Hawkins, A. 1969. The importance of sound in fish behaviour in relation to capture by trawls. FAO Fisheries and Aquaculture Report (FAO) 62(3): pp717–729.

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. 171 pp.

Charlton, C., Ward, R., McCauley, R. D., Brownell Jr., R. L., Salgado Kent, S., & Burnell, S. (2019). Southern right whale (Eubalaena australis), seasonal abundance and distribution at Head of Bight, South Australia. Aquatic Conservation: Marine and Freshwater Ecosystems 29, 576–588.

Chick, R., Green, C., Hartmann, K., Mazloumi, N., Moore, B., Rogers P. 2018. Blue Warehou. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/146-Blue-Warehou-2018.

Chittleborough, R.G. 1965. Dynamics of two populations of the Humpback Whale, Megaptera novaeangliae (Borowski). Australian Journal of Marine and Freshwater Research. 16: pp33-128.

Christian, J.R., Mathieu, A., Thomson, D.H., White, D., Buchanan, R.A. 2003. Effect of seismic energy on snow crab (Chionoecetes opilio). Environmental Research Funds Report No 144, Calgary: pp106.

Christian, J.R., Mathieu, A.,, Buchanan, R.A. 2004. Chronic effect of seismic energy on Snow Crab (Chionoecetesopilio) Environmental Research Funds Project No. 158, Calgary.

Christiansen, F. and Lusseau, D. (2014) Understanding the ecological effects of whalewatching on cetaceans. In Whale-watching, sustainable tourism and ecological management (Higham, J. et al., eds), pp. 177–192, Cambridge University Press

Christiansen, F. et al. (2014) Inferring energy expenditure from respiration rates in minke whales to measure the effects of whale watching boat interactions. J. Exp. Mar. Bio. Ecol. 459, 96–104

Christiansen, F. et al. (2018) Maternal body size and condition determine calf growth rates in Southern right whales. Mar. Ecol. Prog. Ser. 592, 267–282

Cintron, G., Lugo, A.E., Marinez, R., Cintron, B.B., Encarnacion, L. 1981. Impact of oil in the tropical marine environment. Prepared by Division of Marine Research, Department of Natural Resources. Puerto Rico.

Clark, R.B. 1984. Impact of oil pollution on seabirds. Environmental Pollution (Series A) 33:1–22.

Clarke, R.H. 2010. The Status of Seabirds and Shorebirds at Ashmore Reef and Cartier and Browse Islands: Monitoring program for the Montara Well release - Pre-impact Assessment and First Post-impact Field Survey. Prepared on behalf of PTTEP Australasia and the Department of the Environment, Water, Heritage and the Arts, Australia.

Clay, T.A. Small, C., Tuck, G.N., Pardo, D., Carneiro, A.P.B., Wood, A.G., Croxall, J.P., Crossin, G.T., Phillips, R.A. 2019. A comprehensive large-scale assessment of fisheries bycatch risk to threatened seabird populations. Journal of Applied Ecology 56: pp1882 – 1893.

Close, D.H., Newman, O.M.G. 1984. The decline of the Eastern Curlew in south-eastern Australia. Emu 84: pp38-40.

CoA. 2006. A Guide to the Integrated Marine and Coastal Regionalisation of Australia Version 4.0. Commonwealth of Australia. Department of the Environment and Heritage, Canberra, Australia.

Committee on Oil in the Sea. 2003. Oil in the Sea III: Inputs, Fates and Effects. Washington, D.C. The National Academies Press.

Connell, D. W., Miller, G.J. and Farrington, J.W. 1981. Petroleum hydrocarbons in aquatic ecosystems— behaviour and effects of sublethal concentrations: Part 2. Critical Reviews in Environmental Science and Technology. 11(2): 105-162.

Conron, S., Emery, T., Liggins, G., Moore, B. 2018a Tiger flathead. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/199-Tiger-Flathead-2018.

Conron, S., Hall, K., Helidoniotis, F., Lyle, J., Moore., B. 2018c. Eastern school whiting. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/214-Eastern-School-Whiting-2018.

Conron, S., Moore, B., Peddemors, V. Woodhams, J. 2018b. Elephant fish. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/185-Elephantfish-2018.

Cooper Energy. 2020. Offshore Victoria Operations. Cooper Energy, Adelaide. Accessed May 2021 at https://www.cooperenergy.com.au/our-operations/australia/otway-basin/offshore-vic.

Courtenay, S.C., Boudreau, M., Lee K. 2009. Potential Impacts of Seismic Energy on Snow Crab: an Update to the September 2004 Peer Review. Environmental Studies Research Funds Report No 178, Moncton

Cox, B.S, Quist, M.C., Dux A.M., Guy C.S. 2011. Use of Seismic Airguns to reduce survival of salmonid eggs and embryos: A pilot study: completion report. Idaho Cooperative USFWS Research Unit, Department of Fish and Game, Montana Cooperative Fishery Research Unit.

CSIRO. 2015. State of Australia's Oceans. Linking science and policy: an assessment of our oceans using plankton indicators of ecological change. CSIRO Oceans and Atmosphere.

CSIRO. 2018. Australian fisheries stocks under climate change. Accessed May 2021 at www.csiro.au.

Curtin University. 2009. Report on Biopsy Collections from Specimens Collected from the Surrounds of the West Atlas Oil Leak – Sea Snake Specimen. Curtin University, Perth.

D'Costa, D.M., Grindrod, J. and Ogden, R. 1993. Preliminary environmental reconstructions from late Quaternary pollen and mollusc assemblages at Egg Lagoon, King Island, Bass Strait. Australian Journal of Ecology: 18:3.

Dalen, J., Knutsen, G.M. 1987. Scaring Effects in Fish and Harmful Effects of Eggs, larvae and Fry by Offshore Seismic Explorations. Institute of Marine Research, Bergin, Norway in Progress in Underwater Acoustics, Plenum Press, New York.

Danion, M. Le Floch, S. Kanan, R., Lamour, F. and Quentel, C. 2011. Effects of in vivo chronic hydrocarbons pollution on sanitary status and immune system in sea bass (Dicentrarchus labrax L.). Aquatic toxicology. 105. 300-11. 10.1016/j.aquatox.2011.06.022.

Davies, J.L. 1949. Observations on the gray seal (Halichoerus grypus) at Ramsey Island, Pembrokeshire. Proc. Zool. Soc. London. 119: 673-692.

Davis, H.K., Moffat, C.F. and Shepherd, N.J. 2002. Experimental Tainting of Marine Fish by Three Chemically Dispersed Petroleum Products, with Comparisons to the Braer Oil Spill. Spill Science & Technology Bulletin. 7(5–6): 257– 278.

Davis, J.E. and Anderson, S.S. 1976. Effects of oil pollution on breeding gray seals. Mar. Pollut. Bull. 7:115- 118.

Dawbin, W.H. 1997. Temporal segregation of humpback whales during migration in Southern Hemisphere waters. Memoirs of the Queensland Museum 42: pp105-138.

DAWE. 2015. Bonney Coast Upwelling. Species Profile and threats Database. Department of Agriculture, Water and the Environment. Accessed May 2021 at https://www.environment.gov.au/sprat-public/action/kef/view/89;jsessionid=01AD87551D0DE1B0248C8722BE137004#:~:text=The%20Bonney%20coast%20upwelling%20is,and%20mostly%20of%20smaller%20scale.

DAWE. 2019. Map of marine pests in Australia. Department of Agriculture, Water and Environment, commonwealth of Australia. Accessed April 2021 at https://www.marinepests.gov.au/pests/map.

DAWE. 2020. Ballast Water. Department of Agriculture and Water Resources. Canberra. Accessed May 2021 at https://www.agriculture.gov.au/biosecurity/avm/vessels/marine-pest-biosecurity/ballast/australian-ballast-water-management-requirements.

DAWE. 2020a. National Conservation Values Atlas. Department of Agriculture, Water and the Environment. Accessed May 2021 at http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf.

DAWE. 2020b. West Tasmanian Canyons. Department of Agriculture, Water and the Environment. Species Profile and Threats Database (SPRAT). Accessed May 2021 at https://environment.gov.au/sprat-public/action/kef/view/57.

DAWE. 2020c. Hoplostethus atlanticus — Orange Roughy, Deep-sea Perch, Red Roughy- SPRAT Profile. Department of Agriculture, Water and the Environment. Species Profile and Threats Database (SPRAT). Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68455, accessed 16/05/2021.

DAWE. 2020d. Species Profile and Threats (SPRAT) Database. Department of the Environment and Energy.

DAWE. 2020e. Australia's National Heritage List. Department of the Environment and Energy. Canberra. Accessed May 2021 at //www.environment.gov.au/heritage/places/national-heritage-list.

DAWE. 2020f Galeorhinus galeus- School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark- SPRAT Profile. Department of Agriculture, Water and the Environment. Species Profile and Threats Database (SPRAT). Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=68453, accessed 13/05/2021.

DAWE. 2021. Ardenna pacifica in Species Profile and Threats Database. Department of Agriculture and Water Resources, Canberra. Accessed April 2021 at https://www.environment.gov.au/sprat.

DAWE. 2021a. Australian fisheries and aquaculture outlook 2021. Department of Water Agriculture and the Environment. Accessed May 2021 at https://www.agriculture.gov.au/abares/research-topics/fisheries/fisheries-economics/fisheries-forecasts.

DAWE. 2021b. SPRAT Profile: Humpback Whale. Department of Agriculture, Water and the Environment. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=38.

DAWE. 2021c. Prototroctes maraena — Australian Grayling- SPRAT Profile. Department of Agriculture, Water and the Environment. Species Profile and Threats Database (SPRAT). Accessed May 2021 at https://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=26179.

DAWE. 2021c. West Tasmania Canyons. Species Profile and Threats Database, Department of Agriculture and Water Resources. Canberra. Accessed May 2021 at https://www.environment.gov.au/sprat-public/action/kef/view/57;jsessionid=4021BE6E3AE64C86A1BFBBC601757949#:~:text=The%20West%20Tasmania%20canyons%20are,far%20south%20as%20Macquarie%20Harbour.

DAWE. 2021d. Arctocephalus pusillus — Australian Fur-seal, Australo-African Fur-seal- SPRAT Profile. Species Profile and Threats Database. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=21, accessed 20/05/21.

DAWE. 2021d. SPRAT Profile: Pygmy Right Whale. Department of Agriculture, Water and the Environment. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=39.

DAWE. 2021e. Arctocephalus forsteri — Long-nosed Fur-seal, New Zealand Fur-seal- SPRAT Profile. Species Profile and Threats Database. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=20, accessed 20/05/21.

DAWE. 2021f. SPRAT Profile: Sperm Whale. Department of Agriculture, Water and the Environment. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=59.

DAWE. 2021g. Australasian Underwater Cultural Heritage Database. Department of Agriculture, Water and the Environment, accessed May 2021 at https://www.environment.gov.au/heritage/underwater-heritage/auchd.

DAWR. 2017. Australian Ballast Water Management Requirements. Version 7. Department of Agriculture and Water Resources. Canberra.

DAWR. 2018. Marine Pest Plan 2018-2023. National Strategic Plan for Marine Pest Biosecurity. Department of Agriculture and Water Resources. Canberra. Accessed May 2021 at https://www.marinepests.gov.au/what-we-do/publications/marine-pest-plan.

Day, R. D., McCauley, R., Fitzgibbon, Q.P., Semmens, J.M. 2016. Assessing the Impact of Marine Seismic Surveys on Southeast Australian Scallop and Lobster Fisheries. Fisheries Research and Development Corporation Report 2012/008. University of Tasmania, Hobart.

Day, R., Fitzgibbon, Q., McCauley, R., Hartmann, K., Semmens, J. 2020. Lobsters with pre-existing damage to their mechanosensory statocyst organs do not incur further damage from exposure to seismic air gun signals. Environmental Pollution. 267. DOI: 10.1016/j.envpol.2020.115478.

Day, R.D., R.D. McCauley, Q.P. Fitzgibbon, K. Hartmann, Semmens, J.M. 2019. Seismic air guns damage rock lobster mechanosensory organs and impair righting reflex. Proc. R. Soc. B. 286(1907): pp10.

Day, R.D., Fitzgibbon, Q.P., McCauley, R.D and Semmens, J.M. 2021. The Institute for Marine and Antarctic Studies, University of Tasmania, Hobart, Tasmania. *Examining the potential impacts of seismic surveys on Octopus and larval stages of Southern Rock Lobster - PART A: Southern Rock Lobster*. FRDC project 2019-051. 2021.

DEH. 2009. Draft significant impact guidelines for 36 migratory shorebirds. Draft EPBC Act Policy Statement 3.21. Department of the Environment and Heritage, Commonwealth of Australia, Canberra, ACT.

DEHWA. 2010. Approved Conservation Advice for *Ceyx azureus diemenensis* (Tasmanian Azure Kingfisher). Canberra, ACT: Department of the Environment, Water, Heritage and the Arts. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/25977-conservation-advice.pdf. In effect under the EPBC Act from 19-Aug-2010.

DEHWA. 2010a. Approved Conservation Advice for Tyto novaehollandiae castanops (Tasmanian Masked Owl). Canberra, ACT: Department of the Environment, Water, Heritage and the Arts. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/67051-conservation-advice.pdf. In effect under the EPBC Act from 19-Aug-2010.

Delord, K., Weimerskirch, H. 2011. Conserving pelagic habitats: seascape modelling of an oceanic top predator. Journal of Applied Ecology 48: pp121–132.

DELWP. 2015. Australian Grayling Action Statement. A WWW document accessed at https://www.environment.vic.gov.au/ data/assets/pdf_file/0012/33024/Australian-Grayling_actionstatement.pdf. Department of Environment, Land, Water and Planning. Melbourne.

DELWP. 2016. National Recovery Plan for the Orange-bellied Parrot, Neophema chrysogaster. Department of Environment, Land, Water and Planning, Australian Government, Canberra. Accessed April 2021: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/orange-bellied-parrot-201.

Department of Environment, Land, Water and Planning. 2017. Western Port Ramsar Site Management Plan. Department of Environment, Land, Water and Planning, East Melbourne

Department of Environment, Land, Water and Planning. 2018. Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan. Department of Environment, Land, Water and Planning, East Melbourne.

DEWHA. 2007. Western Rock Lobster in ecosystem processes of south-western Australia. Final Report to Department of Environment, Water, Heritage and the Arts. Accessed May 2021 at https://parksaustralia.gov.au/marine/pub/scientific-publications/archive/sw-rock-lobster.pdf.

DEWHA. 2008. Approved Conservation Advice for Raja sp. L (Maugean Skate). Department of the Environment, Water, Heritage and the Arts, Canberra. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/68451-conservation-advice.pdf. In effect under the EPBC Act from 03-Jul-2008.

DEWHA. 2008a. The South-West Marine Bioregional Plan: Bioregional Profile: A Description of the Ecosystems, Conservation Values and Uses of the South-West Marine Region. Department of the Environment, Water, Heritage and the Arts, Canberra. Accessed May 2021 at http://www.environment.gov.au/resource/south-west-marine-bioregional-plan-bioregional-profile-description-ecosystems-conservation.

DEWHA. 2008b. EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guideline. Department of the Environment, Water, heritage and the Arts.

DEWR. 2007. Draft East Marine Bioregional Plan: Bioregional Profile: A Description of the Ecosystems, Conservation Values and Uses of the East Marine Region. Department of the Environment and Water Resources.

DFO. 2004. Potential impacts of seismic energy on snow crab. DFO Canadian Science Advisory Secretariat. Habitat Status Report 2004/003.ort Number 2008/060.

DFO. 2004a. Potential Impacts of Seismic Energy on Snow crabs, Habitat Status Report 2004. Fisheries and Oceans Canada. Available at https://waves-vagues.dfo-mpo.gc.ca/Library/283728.pdf.

DFO. 2004b. Review of Scientific Information on Impacts of Seismic Sound on Fish, Invertebrates, Marine Turtles and Marine Mammals. DFO Canadian Science Advisory Secretariat. Habitat Status Report 2004/002.

DNP. 2013. South-east Commonwealth Marine Reserves Network Management Plan 2013-23. Director of National Parks, Canberra.

DoA. 2019. Marine Pests. Department of Agriculture, Canberra. Accessed May 2021 at: http://www.agriculture.gov.au/pests-diseases-weeds/marine-pests.

DoA. 2021. Map of marine pests in Australia. Department of Agriculture. Accessed May 2021 at: http://www.marinepests.gov.au/pests/map.

DoE 2014. Conservation Advice Thinornis rubricollis rubricollis hooded plover (eastern). Department of the Environment, Canberra. Accessed April 2021: http://www.environment.gov.au/biodiversity/threatened/species/pubs/66726-conservation-advice.pdf.

DoE. 2013. EPBC Act Policy Statement 1.1 – Significant Impact Guidelines – Matters of National Environmental Significance. Department of Environment, Commonwealth of Australia, Canberra.

DoE. 2014a. Assessment of the Tasmanian Giant Crab Fishery. Department of the Environment. Canberra. Accessed May 2021 at https://www.environment.gov.au/system/files/pages/605d8e41-3d23-4901-a5db-060e58a0d73b/files/tas-giant-crab-assessment-report-2014.pdf.

DoE. 2014b. Recovery Plan for the Grey Nurse Shark (Carcharias taurus). Canberra, ACT: Department of the Environment. Accessed May 2021 at http://www.environment.gov.au/resource/recovery-plan-grey-nurse-shark-carcharias-taurus. In effect under the EPBC Act from 14-Aug-2014.

DoE. 2015. Conservation Advice Numenius madagascariensis eastern curlew. Department of Environment. Accessed April 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/847-conservation-advice.pdf.

DoE. 2015. South-east marine region profile: A description of the ecosystems, conservation values and uses of the South-east Marine Region. Department of the Environment, Commonwealth of Australia.

DoE. 2015a. Conservation Management Plan for the Blue Whale, Department of the Environment, Commonwealth of Australia. Accessed May 2021 at http://www.environment.gov.au/system/files/resources/9c058c02-afd1-4e5d-abff-11cac2ebc486/files/blue-whale-conservation-management-plan.pdf.

DoE. 2015b. South-east Marine Region Profile. Department of the Environment, Canberra. Accessed May 2021 at http://www.environment.gov.au/marine/publications/south-east-marine-region-profile.

DoE. 2015c. Conservation Advice Grantiella picta painted honeyeater. Canberra: Department of the Environment. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/470-conservation-advice.pdf. In effect under the EPBC Act from 08-Jul-2015.

DoE. 2015d. Conservation Advice Calidris ferruginea curlew sandpiper. Department of the Environment, Canberra. Accessed April 2021: http://www.environment.gov.au/biodiversity/threatened/species/pubs/856-conservation-advice.pdf.

DoE. 2015e. Conservation Management Plan for the Blue Whale—A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999. Department of Environment, Canberra. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/publications/recovery/blue-whale-conservation-management-plan.

DoE. 2015f. Conservation Advice Balaenoptera borealis Sei Whale. Department of Environment, Canberra. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/34-conservation-advice-01102015.pdf.

DoE. 2015g. Wildlife Conservation Plan for Migratory Shorebirds. Department of Environment, Commonwealth of Australia, Canberra.

DoE. 2015h Conservation Advice Balaenoptera physalus Fin Whale. Department of Environment, Canberra. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/37-conservation-advice-01102015.pdf.

DoE. 2015i. Conservation Advice Megaptera novaeangliae Humpback Whale. Department of Environment, Canberra. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf.

DoE. 2016. National Recovery Plan for the Regent Honeyeater (Anthochaera phrygia). Department of the Environment. Canberra, ACT: Commonwealth of Australia. Accessed May 2021 at: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-regent-honeyeater-anthochaera-phrygia-2016. In effect under the EPBC Act from 04-May-2016 as Anthochaera phrygia.

DoE. 2019. Threatened Species Strategy Year 3 Scorecard – Eastern Curlew. National Environmental Science Program Threatened Species Research Hub. Department of Environment, Australian Government, Canberra. Accessed April 2021 at http://www.environment.gov.au/biodiversity/threatened/species/20-birds-by-2020/easterncurlew.

DoEE. 2013. Recovery Plan for the White Shark (Carcharodon carcharias). Department of the Environment and Energy, Commonwealth of Australia.

DoEE. 2017. EPBC Act Policy Statement 3.21 - Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species. Department of the Environment and Energy, Commonwealth of Australia, Canberra.

DoEE. 2017a. Recovery Plan for Marine Turtles in Australia. Department of the Environment and Energy. Accessed April 2021: http://www.environment.gov.au/system/files/resources/46eedcfc-204b-43de-99c5-4d6f6e72704f/files/recovery-plan-marine-turtles-2017.pdf.

DoEE. 2017b. – National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna, Commonwealth of Australia, 2017.

DoEE. 2018. Threat Abatement Plan for the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans 2018. Department of the Environment and Energy, Canberra.

DoEE. 2019. Assessment of the Tasmanian Giant Crab Fishery. Department of Environment and Energy. Accessed on May 2021 at: https://www.environment.gov.au/system/files/pages/605d8e41-3d23-4901-a5db-060e58a0d73b/files/assessment-tas-giant-crab-2019.pdf.

DoEE. 2019a. DRAFT National Recovery Plan for the Australian Fairy Tern (Sternula nereis nereis). Department of the Environment and Energy, Commonwealth of Australia 2019. Accessed April 2021 at https://www.environment.gov.au/system/files/consultations/16a0c908-32d4-4210-b07f-1018e34b5a13/files/draft-recovery-plan-australian-fairy-tern.pdf.

DoEE. 2019b. Draft Wildlife Conservation Plan for Seabirds. Department of Environment and Energy, Commonwealth of Australia, Canberra. Accessed April 2021 at https://www.environment.gov.au/system/files/consultations/73458222-6905-4100-ac94-d2f90656c05d/files/draft-wildlife-conservation-plan-seabirds.pdf.

DoEE. 2020. National Light Pollution Guidelines for Wildlife including marine turtles, seabirds and migratory shorebirds. Department of the Environment and Energy, Commonwealth of Australia.

DoEE. 2021. EPBC Act Protected Matters Search Tool. Department of the Environment and Energy, Canberra. Accessed April 2021 at http://www.environment.gov.au/epbc/pmst/.

DPI. 2009. Victorian Rock Lobster Fishery Management Plan. Fisheries Victoria Management Report Series No. 70. Department of Primary Industries, Victoria.

DPIPWE. 2019. Application to the Department of Environment on the Tasmanian Giant Crab Fishery. Against the Guidelines for the Ecologically Sustainable Management of Fisheries (2007). June 2019.

DPIPWE. 2020. Giant Crab Catch Updates, Sea Fishing and Aquaculture. Tasmanian Department of Primary Industries, Parks, water and Environment. Accessed May 2021 at https://dpipwe.tas.gov.au/sea-fishing-aquaculture/commercial-fishing/giant-crab-fishery/giant-crab-catch.

DPIPWE. 2020a. Marine Life and Their Habitats. Department of Primary Industries, Parks, Water and Environment. Hobart. Accessed May 2021 at: https://dpipwe.tas.gov.au/conservation/the-marine-environment/fisheries-habitats.

DPIPWE. 2021. Commercial Fishing. Tasmanian Government. Accessed on May 2021 at https://dpipwe.tas.gov.au/sea-fishing-aquaculture/commercial-fishing.

DPIPWE. 2021a. Threatened Species- Vertebrates: Conservation Orange-bellied Parrot. Department of Primary Industries, Parks, Water and Environment. Accessed April 2021 at https://dpipwe.tas.gov.au/conservation/threatened-species-and-communities/lists-of-threatened-species/threatened-species-vertebrates/orange-bellied-parrot/latest-updates

DPIPWE. 2021b. Scalefish Fishery: Commercial Scalefish Fishery. Accessed May 2021 at:https://dpipwe.tas.gov.au/sea-fishing-aquaculture/commercial-fishing/scalefish-fishery/commercial-scalefish#CommercialLicences

DSEWPaC. 2011. National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016. Department of Sustainability, Environment, Water, Population and Communities, Australian Antarctic Division, Canberra.

DSEWPaC. 2011a. Background Paper: Population Status and Threats to Albatrosses and Giant Petrels Listed as Threatened under the Environment Protection and Biodiversity Conservation Act 1999. Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia, Hobart.

DSEWPaC. 2011b. National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016. Department of Sustainability, Environment, Water, Population and Communities, Commonwealth of Australia, Canberra.

DSEWPaC. 2012. Conservation Management Plan for the Southern Right Whale. A Recovery Plan under the Environment Protection and Biodiversity Conservation Act 1999 2011-2021. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT. Accessed April 2021: http://www.environment.gov.au/resource/conservation-management-plan-southern-right-whale-recoveryplan-under-environment.

DSEWPC. 2011c. Approved Conservation Advice for Sternula nereis nereis (Fairy Tern). Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT.

DSEWPC. 2012a. Approved Conservation Advice for Epinephelus daemelii (black cod). Canberra, ACT: Department of Sustainability, Environment, Water, Population and Communities. Accessed May 2021 at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/68449-conservation-advice.pdf. In effect under the EPBC Act from 04-Apr-2012.

DSEWPC. 2012b. Approved Conservation Advice for Brachionichthys hirsutus (spotted handfish). Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT. Accessed May 2021 at http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=64418.

DSEWPC. 2012c. Approved Conservation Advice for Giant Kelp Marine Forests of South East Australia. Department of Sustainability, Environment, Water, Population and Communities, Canberra, ACT. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/communities/pubs/107- conservation-advice.pdf.

DSEWPC. 2013. Approved Conservation Advice for Rostratula australis (Australian painted snipe). Canberra: Department of Sustainability, Environment, Water, Population and Communities. Accessed May 2021 at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/77037-conservation-advice.pdf. In effect under the EPBC Act from 15-May-2013.

DSEWPC. 2013a. Issues Paper for the White Shark (Carcharodon carcharias). Department of Sustainability, Environment, Water, Population and Communities. Commonwealth of Australia.

DSEWPC. 2013a. Recovery Plan for the White Shark (Carcharodon carcharias). Department of Sustainability, Environment, Water, Population and Communities. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/recovery-plans/recovery-plan-white-shark-carcharodon-carcharias.

Duncan, F. 1986. Vegetation of Lavinia Nature Reserve and Sea Elephant Wildlife Sanctuary, King Island

Earthlife. 2014. The Phylum Ectoprocta (Bryzoa). Accessed April 2021 at http://www.earthlife.net/inverts/bryozoa.html.

Easton, A.K. 1970. The tides of the continent of Australia. Flinders University of Australia.

Ellison, W.T., Frankel, A.S. 2012. A common sense approach to source metrics. In: The Effects of Noise on Aquatic Life. Eds., Popper, A.N., Hawkins, A. Springer. pp433-438.

Emery, TJ, Noriega, R, Williams, AJ & Larcombe, J. 2019. Changes in logbook reporting by commercial fishers following the implementation of electronic monitoring in Australian Commonwealth fisheries. Marine Policy 104: pp135–45.

Engås, A., Løkkeborg, S. 2002. Effects of seismic shooting and vessel-generated noise on fish behaviour and catch rates. Bioacoustics 12: pp313–316.

Engas, A., Lokkeborg, S., Ona, E., Soidal, A.D. 1996. Effects of seismic shooting on local abundance and catch rates of cod (Gadus morhua) and haddock (Melanoprammus aeglefinus). Canadian Journal of Fisheries and Aquatic Sciences 53(10): pp2238-2249, DOI 10.1139/f39-177.

Engelhardt, F.R. 1983. Petroleum Effects on Marine Mammals. Aquatic Toxicology 4:199– 217.

EPBC Act Policy Statement 2.1 – Interactions between Offshore Seismic Exploration and Whales: Industry Guideline

Erbe, C., Marley, S.A., Schoeman, R.P. Smith, J.N., Trigg, L.E., Embling, C.B. 2019. The effects of ship noise on marine mammals – a review. Frontiers in Marine Science. DOI: 10.3389/fmars.2019.11606.

Eriksen, R.S., Davies C.H., Bonham, P., Coman, F.E., Edgar, S., McEnnulty, F.R., McLeod, D., Miller, M.J., Rochester, W., Slotwinski, A., Tonks, M.L., Uribe-Palomino, J., Richardson, A.J. 2019. Australia's Long-Term Plankton Observations: The Integrated Marine Observing System National Reference Station Network. Frontiers in Marine Science 6(161) DOI:10.3389/ fmars.2019.00161.

Falconer, R., Linforth, D. 1972. Winds and waves in Bass Strait. Bureau of Meteorology. Department of the Interior. Canberra.

Felder, D.L., Thoma, B.P., Schmidt, W.E., Sauvage, T., Self-Krayesky, S.L., Christoserdov, A., Bracken-Grissom, H.D. and Fredericq, S. 2014. Seaweeds and Decapod Crustaceans on Gulf Deep Banks after the Macondo Oil Spill. Bioscience 64: 808– 819.

Fenton, G.E. 2001. Radiometric Aging of Sharks. Final Report to the Fisheries Research and Development Corporation, 94/021 2001.

Ferns, L. and Hough, D. 2000. Environmental Inventory of Victoria's Marine Ecosystems Stage 3 (Second Edition): Understanding Biodiversity Representativeness of Victoria's Rocky Reefs.

Fewtrell, J.L., McCauley, R.D. 2012. Impact of air gun noise on the behaviour of marine fish and squid. Marine Pollution Bulletin 64(5): pp984–993.

Fields, D., Handegard, N O., Dalen, J., Eichner, C., Malde, K., Karlsen, Ø., Browman, H.I. 2019. Airgun blasts used in marine seismic surveys have a minor effect on survival at distances less than 10 m and no sublethal effects on behaviour or gene expression in the copepod Calanus finmarchicus. ICES Journal of Marine Science 76(7). DOI: 10.1093/icesjms/fsz126.

Finneran, J.J., Henderson, D.S., Houser, K., Jenkins, S., Kotecki, and J. Mulsow, J. 2017. Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis (Phase III). Technical report by Space and Naval Warfare Systems Center Pacific (SSC Pacific). 183 p.

Flegg, J. 2002. Photographic Field Guide Birds of Australia. Second Edition. Reed New Holland. Sydney. Fogden, S.C.L. 1971. Mother-young behaviour at gray seal breeding beaches. J. Zoo. 164: pp61-92.

FRDC 2018k. Tiger Flathead. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/199-Tiger-Flathead-2018.

FRDC. 2017 – Giant Crab. Fisheries Research and Development Corporation. Accessed May 2021 at http://fish.gov.au/report/29-Giant-Crab-2016..

FRDC. 2018a. Gummy Shark. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/181-Gummy-Shark-2018.

FRDC. 2018b. Eastern School Whiting. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/214-Eastern-School-Whiting-2018.

FRDC. 2018d. Elephantfish. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/185-Elephantfish-2018.

FRDC. 2018e. Sawsharks. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/157-SAWSHARKS-2018.

FRDC. 2018f. Giant Crab. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/180-Giant-Crab-2018?jurisdictionId=6.

FRDC. 2018g. Southern Rock Lobster. Fisheries Research and Development Corporation. Accessed May 2021 at https://www.fish.gov.au/report/174-Southern-Rock-Lobster-2018?jurisdictionId=6.

FRDC. 2018h. Gould's Squid. Tasmania. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/2014-Reports/Gould's_Squid.

FRDC. 2018j. Fisheries Research and Development Corporation. Accessed May 2021 at http://fish.gov.au/.

FRDC. 2018l Scallop. Fisheries Research and Development Corporation. Accessed May 2021 at http://www fish.gov.au/report/17-Commercial-Scallop-2016.

French McCay, D. P. 2004. Oil spill impact modeling: development and validation. Environ. Toxicol. Chem. 23, 2441–2456. doi: 10.1897/03-382.

French McCay, D. P., Li, Z., Horn, M., Crowley, D., Spaulding, M., Mendelsohn, D., et al. 2016. Modeling oil fate and subsurface exposure concentrations from the Deepwater Horizon oil spill," in Proceedings of the 39th AMOP Technical Seminar on Environmental Contamination and Response, Vol. 39, (Ottawa, ON: Environment Canada), 115–150.

French, D. Schuttenberg, H. and Isaji, T. 1999. Probabilities of oil exceeding thresholds of concern: examples from an evaluation for Florida Power and Light In: Proceedings of the 22nd Artic and Marine Oil Spill Program (AMOP), Technical Seminar, June 1999. Alberta, Canada.

French-McCay, Crowley, Rowe, Bock, Robinson, Wenning, Walker, Joeckel, Nedwed and Parkerton. 2018. Comparative Risk Assessment of spill response options for a deepwater oil well blowout: Part 1. Oil spill modeling. Marine Pollution Bulletin. 133. 10.1016/j.marpolbul.2018.05.042.

French-McCay, D.P. 2003. Development and application of damage assessment modelling: example assessment for the North Cape oil spill. Mar. Poll. Bull. 47 (9):9-12.

French-McCay, D.P. 2009. State-of-the-art and research needs for oil spill impact assessment modelling. Proceedings of the 32nd Arctic and Marine Oil Spill Program Technical Seminar. Environment Canada, Ottawa.

French-McCay, D.P., 2002. Development and application of an oil toxicity and exposure model, OilToxEx. Environmental Toxicology and Chemistry 21:2080-2094.

Gagnon, M.M. and Rawson, C. 2011. Montara Well Release, Monitoring Study S4A – Assessment of Effects on Timor Sea Fish. Curtin University, Perth, Australia.

Gala, W.R. 2001. Predicting the Aquatic Toxicity of Crude Oils. International Oil Spill Conference Proceedings (2):935–940.

Gales, R. 1998. Albatross populations: status and threats. In: The Albatross: Biology and Conservation. Eds., Robertson G. and Gales R. pp20–45. Surrey Beatty and Sons Chipping Norton, NSW.

Gardner C, Mills DJ. 2013. Determination of moulting events in rock lobsters from pleopod clipping. PLoS One. 2013;8(8) e74146.

Gardner C, Musgrove R. 2006. Quantifying Shell Hardness in the Southern Rock Lobster (Jasus edwardsii), Journal of Aquatic Food Product Technology, 15, (2) pp. 17-35.

Gardner, C., Jenkinson, A. and Heijnis, H. 2002. Estimating intermoult duration in giant crabs (Pseudocarcinus gigas). In 'Crabs in Cold Water Regions: Biology, Management and Economics'. Alaska Sea Grant College Program, Anchorage, Alaska.

Garnett S., Szabo J. and Dutson G. 2011. The Action Plan for Australian Birds 2010. CSIRO Publishing, Melbourne

Gausland, I. 2000. Impact of seismic surveys on marine life. SPE International Conference on Health, Safety and the Environment in Oil and Gas Exploration and Production. 26-28 June, 2000.

Georgeson, L. 2018. Blue Grenadier. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/189-Blue-Grenadier-2018.

Georgeson, L., Helidoniotis, F. 2018. Orange Roughy. Fisheries Research and Development Corporation. Accessed 2021 at https://fish.gov.au/report/193-Orange-Roughy-2018.

Georgeson, L., Rowan C. 2018. Pink ling. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/190-Pink-Ling-2018.

Geraci, J.R. and St. Aubin, D.J. 1988. Synthesis of Effects of Oil on Marine Mammals. Report to US Department of the Interior, Minerals Management Service, Atlantic OCS Region, OCS Study. Ventura, California.

Gibbs, C. 1992. Oceanography of Bass Strait: Implications for the food supply of little penguins Eudyptula minor. EMU 91, pp395-401.

Gibbs, C., Tomczak, Jr., Longmore, A. 1986. The Nutrient Regime of Bass Strait. Australian Journal of Marine and Freshwater Resources 36.

Gill, P.C. 2020. Blue Whale Literature Review - Offshore Victoria (Otway basin/Bass Strait). Report to Beach Energy Limited. Blue Whale Study Inc.

Gill, P.C., McCauley, R.D., Gavrilov, A.N., Golliffe, C.D., Ward, R. (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: pp154-168. Available at https://doi.org/10.1016/j.dsr2.2018.09.006.

Gill, P.C., Morrice, M.G., Page, B., Pirzl, R., Levings, A.H., Coyne, M. 2011. Blue whale habitat selection and within-season distribution in a regional upwelling system off southern Australia. Marine Ecology Progress Series 421: pp243–263.

GLaWAC. 2020. Gunaikurnai Land and Waters Aboriginal Corporation. Accessed May 2021 at https://gunaikurnai.org/.

Gohlke, J.M. 2011. A Review of Seafood Safety after the Deepwater Horizon Blowout. Environmental Health Perspectives. 119(8):1062– 1069.

Gomez, C., Lawson, J.W., Wright, A.J., Buren, A.D., Tollit, D., Lesage, V. 2016. A systematic review on the behavioural responses of wild marine mammals to noise: the disparity between science and policy. Canadian Journal of Zoology 94(12): pp801–819.

Gormley, A., Dann, P. 2009. Examination of Little Penguin Winter Movements from Satellite Tracking Data. Report for the Department of Sustainability and Environment Victoria accessed May 2021 at http://www.oem.vic.gov.au/Assets/668/1/AnalysisofLittlePenguinWinterMovements.pdf.

Gosbell, K., Collins, P., Christie, M. 2002. Wader Surveys in the Coorong and S.E. Coastal Lakes February 2002. Australasian Wader Studies Group.

Gotz, T., Hastie, G., Hatch, L., Raustein, O, Southall, B., Tasker, M, Thomsen, F. 2009. Overview of the impacts of anthropogenic underwater sound in the marine environment. OSPAR Commission. London.

Green, R.H. 1969. The birds of Flinders Island. Records of the Queen Victoria Museum. 34:1-32.

Hale, J. 2016. Ecological Character Description Addendum - Western Port Ramsar Site. Department of Environment, Land, Water and Planning. East Melbourne.

Harris, P., Heap, A., Passlow, V., Sbaffi, L. Fellows, M., Porter-Smith, R., Buchanan, C., & Daniell, J. 2005. Geomorphic Features of the Continental Margin of Australia. Geoscience Australia, Record 2003/30, 142pp.

Harris, P.T., Heap, A. 2009. Geomorphology and Holocene sedimentology of the Tasmanian continental margin. J. Geo. Soc. Aus.

Hartmann, K., Gardner, C., Hobday, D. 2013. Fishery Assessment Report. Tasmanian Rock Lobster Fishery 2011/12. May 2013. Institute for Marine and Antarctic Studies, University of Tasmania.

Hartmann, K., Reilly, D., How, J., McLeay, L. 2018. Giant Crab, Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/180-Giant-Crab-2018.

Hawkins, A.D., Popper, A.N. 2016. A sound approach to assessing the impact of underwater noise on marine fishes and invertebrates. ICES Journal of Marine Science: 17.

Hayes. 2021. Designing a Targeted Monitoring Program to Support Evidence Based Management of Australian Marine Parks: A Pilot on the South-East Marine Parks Network. Report to Parks Australia and the National Environmental Science Program, Marine Biodiversity Hub. Parks Australia, University of Tasmanian and CSIRO, Hobart, Australia. Hayes, K. R., Dunstan, P., Woolley, S., Barrett, N., Howe, S. A., Samson, C. R., Bowling, R., Ryan, M. P., Foster, S., Monk, J., Peel, D., Hosack, G. R., Francis, S. O. (2021).

Hayworth, Clement, Valentine. 2011. Deepwater Horizon oil spill impacts on Alabama beaches. Hydrology and Earth System Sciences Discussions. 8. 10.5194/hessd-8-6721-2011.

Hazel, J., Lawler, I.R., Marsh, H. and Robson S. 2007. Vessel speed increases collision risk for the Green Turtle Chelonia mydas. Endangered Species Research 3, pp105–113.

Hedd, A., Gales R. 2001. The diet of shy albatrosses (Thalasarche cauta) at Albatross Island, Tasmania. Journal of Zoology 253: pp69-90.

Higgins, P.J. (ed.). 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Oxford University Press, Melbourne.

Higgins, P.J., Davies, S.J.J.F. 1996. Handbook of Australian, New Zealand and Antarctic Birds. Volume 3: Snipe to Pigeons. Oxford University Press, Melbourne.

Hills, N., Krueck, N. and Hartmann, K. 2020. Tasmanian Octopus Fishery Assessment 2018/19. Institute for Marine and Antarctic Studies (IMAS), Hobart, Australia. Accessed May 2021 at: https://www.imas.utas.edu.au/__data/assets/pdf_file/0005/1296050/octopus_assessment2019.pdf.

Hinojosa, I. A., Green, B. S., Gardner, C., Hesse, J., Stanley, J. A., and Jeffs, A. G. 2016. Reef sound as an orientation cue for shoreward migration by pueruli of the rock lobster, Jasus edwardsii. PLoS One, 11, 1–15.

Hobday, A.J., Lough, J.M. 2011. Projected climate change in Australian marine and freshwater environments. Marine and Freshwater Research, 62: 1000–1014

Hobday, A.J., Poloczanska, E.S., Matear, R.J. 2007. Climate impacts on Australian fisheries and aquaculture: implications for the effects of climate change. Report to the Department of Climate Change, Canberra.

Holdsworth, M. C. 2006. Reproductive success and demography of the Orange-bellied Parrot Neophema chrysogaster. Masters Thesis, University of Tasmania.

Holdway, D.A. 2002. The acute and chronic effects of wastes associated with offshore oil and gas production on temperate and tropical marine ecological processes. Mar. Poll. Bull. 44:185– 203.

Hook, S., Batley, G., Holloway, M., Irving, P. and Ross, A. 2016. Oil Spill Monitoring Handbook. CSIRO Publishing. Melbourne.

Houde, E., Zastrow C. 1993. Ecosystem and taxon-specific dynamic and energetics properties of larval fish assemblages. Bulletin of Marine Science 53(2): pp290-335.

http://www.bom.gov.au/climate/data/.

Huang, Z., Wang, X. 2019. Mapping the spatial and temporal variability of the upwelling systems of the Australian south-eastern coast. Remote Sensing of Environment. 227: pp90-109.

Huntley, M., Lopez, M. 1992. Temperature-Dependant Production of Marine Copepods: A Global Synthesis. The American Naturalist 140(2): 201-42. DOI: 10.1086/285410.

Huys, S. 2012. Aboriginal Heritage Assessment of a Proposed Golf Course Development at Currie, King Island, Tasmania (Draft Report).

IAGC. 2017. IAGC Zooplankton Paper talking Point. International Association of Geophysical Contractors. Accessed April 2021 at https://globenewswire.com/news-release/2017/06/22/1027751/0/en/IAGC-Plankton-Study- Speculative-and-Needs-Better-Data.html.

IMAS. 2016. Tasmanian octopus Fishery Assessment 2015/16. Emery, T., Hartmann, K. Institute for Marine and Antarctic Studies. University of Tasmania.

IMAS. 2017. Tasmanian Rock Lobster Fishery 2017/18. Hartmann, K. Gardner, C. Leon, R. Rizzari, J. Institute for Marine and Antarctic Sciences. University of Tasmania.

IMCRA. 1998. Interim Marine and Coastal Regionalisation for Australia: An Ecosystem-based Classification for marine and coastal environments. IMCRA Technical Group, June 1998, Version 3.3.

IMO. 2017. International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM). International Maritime Organisation. Available at https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Control-and-Management-of-Ships%27-Ballast-Water-and-Sediments-(BWM).aspx.

IPIECA, 2002. Guideline on biological impacts of oil pollution: Volume One. International Petroleum Industry Environmental Conservation Association, UK.

IPIECA. 1999. Biological Impacts of Oil Pollution: Sedimentary Shores. International Petroleum Industry Environmental Conservation Association. London.

IPIECA/IOGP. 2015. Contingency planning for oil spills on water: Good practice guidelines for the development of an effective spill response capability. Accessed May 2021 at: https://www.ipieca.org/resources/good-practice/contingency-planning-for-oil-spills-on-water/.

IPIECA/IOGP. 2016. In-water surveillance of oil spills at sea: Good practice guidelines for incident management and emergency response personnel. Accessed May 2021 at: https://www.ipieca.org/resources/good-practice/in-water-surveillance-of-oil-spills-at-sea/.

IPIECA/OGP. 2015a. Aerial Observations of Oil Spills at Sea: Good practice guidelines for incident management and emergency response personnel. Developed by Cedre on behalf of IPIECA, IMO and

OGP. Accessed May 2021 at: https://www.environmentalunit.com/Documentation/01%20Aerial%20Observation/IPIECA%20Aerial%20Observation%20GPG.pdf.

ITOPF, 2011. Aerial Observations of Marine Oil Spills Technical Information Paper. The international tanker owners pollution federation, UK. Accessed May 2021 at: https://www.itopf.org/fileadmin/data/Documents/TIPS%20TAPS/TIP_1_Aerial_Observation_of_Marine_Oil_Spills.pdf.

ITOPF. 2011a. Effects of Oil Pollution on the Marine Environment. Technical Information Paper 13. The International Tanker Owners Pollution Federation Ltd. London.

Iwamura, T., Possingham, H.P., Chadès, I., Minton, C., Murray, N.J., Rogers, D.I., Treml, E.A., Fuller, R.A. 2013. Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. Proceedings of the Royal Society B, 281: 20130325.

Jackson, G.D., McGrath-Steer, B. 2003. FRDC Final Report: Arrow Squid in Southern Australian Waters – Supplying Management Needs through Biological Investigations, FRDC Project 1991/112. Institute of Antarctic and Southern Ocean Studies, University of Tasmania. Accessed May 2021 at http://www.afma.gov.au/wpcontent/uploads/2010/06/frdc_report_200504.pdf

Jackson, G.D., McGrath-Steer, B.L. 2003. Arrow squid in southern Australian waters—supplying management needs through biological investigations. Final report to the Fisheries Research and Development Corporation, project 1999/112. Institute of Antarctic and Southern Ocean Studies, University of Tasmania, Hobart.

Jardine, R.J., Chow, F.C. 1996. Marine Technology Directorate- Offshore structures. pp48.

Jensen, A.S., Silber, G.K. 2004. Large whale ship strike database. NOAA Technical Memorandum NMFS-OPR, National Oceanic and Atmospheric Administration.

Jenssen, B.M. 1994. Effects of Oil Pollution, Chemically Treated Oil, and Cleaning on the Thermal Balance of Birds. Env. Poll. 86:207– 215.

Jernakoff, P. 1990. Distribution of newly settled western rock lobsters Panulirus cygnus. Marine Ecology Progress Series. 66:63-67.

Jones, G., McCormick, M. 2002. Numerical and energetic processes in the ecology of coral reef fishes. In: Coral Reef Fishes: Dynamics and Diversity in a Complex Ecosystem. Eds., Sale P.F. Academic Press, San Diego, CA. pp221–238.

Jones, I.S.F. and Padman. L. 1983. Semi-diurnal internal tides in eastern Bass Strait, Aust. J. Mar. Freshw. Res., 34, 159-171

Jones, I.T., Stanley, J.A., Mooney, T.A. 2020. Impulsive pile driving noise elicits alarm responses in squid (Doryteuthis pealeii). Marine Pollution Bulletin 150: 110792. Accessed April 2021 at http://www.sciencedirect.com/science/article/pii/S0025326X19309488.

Jouventin, P. and Weimerskirch, H. 1990. Satellite tracking of wandering albatrosses. Nature 343: pp746–748.

Jung, J. 2011. Biomarker Responses in Pelagic and Benthic Fish Over One Year Following the Hebei Spirit Oil Spill (Taean, Korea). Mar. Poll. Bull. 62(8):1859– 1866

Kailola, P.J., Williams, M.J., Stewart, P.C., Reighelt, R.E., McNee, A., Grieve, C. 1993. Australian Fisheries Resources. Published by the Bureau of Resource Sciences, Department of Primary Industries and Fisheries and the Fisheries Research and Development Corporation, Canberra, Australia.

Kampf. 2015. Phytoplankton blooms on the western shelf of Tasmania: evidence of a highly productive ecosystem, Ocean Science 11: 1-11. DOI: 10.5194/os-11-1-2015

Kauss, P., Hutchinson, T.C., Soto, C., Hellebust, J., Griffiths, M. 1973. The Toxicity of Crude Oil and its Components to Freshwater Algae. International Oil Spill Conference Proceedings: March 1973, 1973(1) pp703-714.

Kelin, C., and Qiang, X. 2006. Conserving migratory shorebirds in the Yellow Sea region. In: Waterbirds around the World. Eds., Boere, G., Galbraith, C., Stroud, D. pp319. The Stationary Office, Edinburgh, UK.

Kemper, C.A. 2002a. Distribution of the pygmy right whale, Caperea marginata, in the Australasian region. Marine Mammal Science. 18(1): pp99-111.

Kemper, C.A. 2002b. Pygmy right whale (Caperea marginata). In: Encyclopedia of Marine Mammals. Eds., Perrin W.F., B. Würsig & H.G.M. Thewissen. pp1010-1012. Academic Press.

Kennish, M.J. 1996. Practical Handbook of Estuarine and Marine Pollution. CRC Press. Florida.

Kimmerer, W.J., McKinnon, A.D. 1984. Zooplankton Abundances in Bass Strait and WesteEnsco 102 Tasmanian Shelf Waters, March 1983.

King Island Council. 2016. King Island Visitor Survey (April 2015-March 2016). Prepared by the King Island Council. Supported by the Tasmanian Government and assisted by Ling Island Regional Development Organisation.

KIRDO. 2020. Annual Report 2019/20. King Island COunci, Tasmania. Accessed on May 2021 at: https://kingisland.tas.gov.au/wp-content/uploads/Annual-Report-2019-20-Full-Document-as-at-1-March-2021-reduced.pdf

Kirkwood, R., Warneke, R.M., Arnould, J.P. 2009. Recolonization of Bass Strait, Australia, by the New Zealand fur seal, Arctocephalus forsteri. Marine Mammal Science 25(2): pp441–449.

Klimley, P.A., Myrberg, A.A. 1979. Acoustic stimulai underlying withdrawal from a sound source by Adult Lemon Sharks (Negaprion Brevirostris). University of Miami. Bulletin of Marine Science 29(4): pp 447-458.

Knuckey, I., Sivakumaran, K. 1999. Spawning and Reproductive Characteristics of Blue Warehou in South-East Australian Waters. Accessed May 2021 at https://www.afma.gov.au/sites/default/files/uploads/2014/12/Blue-Warehou-Rebuilding-Strategy-2014.pdf.

Koessler, M.W., McPherson, C.R., Welch, S.J. 2020. Sequoia 3D Marine Seismic Survey: Acoustic Modelling for Assessing Marine Fauna Sound Exposures. Document 02225, Version 1.0 DRAFT. Technical report by JASCO Applied Sciences for Aventus Consulting Pty Ltd.

Kooyman, G.L., Gentry, R.L. and McAllister, W.B. 1976. Physiological impact of oil on pinnipeds. Report N.W. Fisheries Center. Natl. Mar. Fish. Serv. Seattle, WA.

Kordjazi Z., Frusher S., Buxton C., Gardner C., Bird T. 2015. The Influence of Mark-Recapture Sampling Effort on Estimates of Rock Lobster Survival. PLoS ONE 11(3): e0151683. Accessed May 2021 at https://doi.org/10.1371/journal.pone.0151683.

Kostyuchenko, L.P. 1973. Effects of elastic waves generated in marine seismic prospecting on fish eggs in the Black Sea. Hydrobiological Journal 9: 45-48.

Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., Podesta, M. 2001. Collisions between ships and whales. Marine Mammal Science 17: pp35–75.

Lamendella, R., Strutt, S., Borglin, S., Chakraborty, R., Tas., N., Mason, O., Hultman, J., Prestat, Hazen, T., Jansson, J. 2014. Assessment of the Deepwater Horizon oil spill impact on Gulf coast microbial communities. Frontiers in Microbiolgy 5: 130.

Lane, B.A. 1987. Shorebirds in Australia. Reed, Sydney, NSW.

Larcombe, J., Patterson, H., Mobsby, D. 2020. Eastern Tuna and Billfish Fishery. . Department of Agriculture, Water and the Environment. ABARES. Accessed May 2021 at https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status/eastern-tuna-billfish-fishery.

Law, R.J. 1997. Hydrocarbons and PAH in Fish and Shellfish from Southwest Wales following the Sea Empress Oil Spill in 1996. International Oil Spill Conference Proceedings 1997 (1): 205–211.

Lee, H.J., Shim, W.J., Lee, J. and Kim, G.B. 2011. Temporal and geographical trends in the genotoxic effects of marine sediments after accidental oil spill on the blood cells of striped beakperch (Oplegnathus fasciatus). Mar. Poll. Bull. 62:2264– 2268.

Levings, A.H. and Gill, P.C. 2010. Seasonal winds drive water temperature cycle and migration patterns of southern Australian giant crab Pseudocarcinus gigas. In: Biology and Management of Exploited Crab Populations under Climate Change. Eds., G.H. Kruse, G.L. Eckert, R.J. Foy, R.N. Lipcius, B. Sainte- Marie, D.L. Stram, D. Woodby. Alaska Sea Grant, University of Alaska Fairbanks.

Lewis, M. and Pryor, R. 2013. Toxicities of oils, dispersants and dispersed oils to algae and aquatic plants: Review and database value to resource sustainability. Env. Poll. 180:345–367.

Limpus, C.J., Kamrowski, R.L., Riskas K.A. 2015. Darkness is the best lighting management option at turtle nesting beaches. In Proceedings of the Second Australian and Second Western Australian Marine Turtle Symposia, Perth 25–27 August 2014. Eds., Whiting SD and Tucker A. Science Division, Department of Parks and Wildlife, Perth, Western Australia. pp 56.

Ling, S., Johnson, C. 2012. Marine reserves reduce risk of climate-driven phase shift by restoring size and habitat specific trophic interactions. Ecological applications : a publication of the Ecological Society of America. 22: pp1232-45. DOI: 10.2307/23213957.

Ling, S., Johnson, C., Frusher, D., Ridgway, K. 2009. Overfishing reduces resilience of kelp beds to climate- driven catastrophic phase shift. Proceedings of the National Academy of Sciences 106(52): pp22341-22345; DOI: 10.1073/pnas.0907529106.

Linnane A., Gardener, C., Reilly, D., How, J. 2018. Southern Rock Lobster, Fisheries Research and Development Corporation, https://fish.gov.au/report/174-Southern-Rock-Lobster-2018.

Lobel, P.S. 2009. Underwater Acoustic Ecology: Boat Noise and Fish Behabiour. In Diving for Science 2009. Eds., Pollock N.W. Proceedings of the American Academy of Underwater Sciences 28th Symposium, Dauphin Island, AL:AAUS; 2009.

Løkkeborg, S., Ona, E., Vold, A., Salthaug, A., 2012. Sounds from seismic air guns: gear-and species-specific effects on catch rates and fish distribution. Canadian Journal of Fisheries and Aquatic Sciences 69: pp1278–1291.

Lough, J.M, Gupta, A.S., Hobday, A.J. 2012. Marine Climate Change in Australia. Impacts and Adaptation Responses 2012 Report Card. Temperature. In A Marine Climate Change Impacts and Adaptation Report Card for Australia 2012. Eds., E.S. Poloczanska, A.J. Hobday and A.J. Richardson. Accessed April 2021 at http://www.oceanclimatechange.org.au>. ISBN: 978-0-643-10928-5.

Loyn, R.H., Lane, B.A., Chandler, C., Carr, G.W. 1986. Ecology of Orange-bellied Parrots Neophema chrysogaster at their main remnant wintering site. Emu. 86: pp195-206.

MacKinnon, J., Verkuil, Y.I., Murray, N. 2012. IUCN situation analysis on East and Southeast Asian intertidal habitats, with particular reference to the Yellow Sea (including the Bohai Sea). Occasional Paper of the IUCN Species Survival Commission No. 47. IUCN, Gland, Switzerland and Cambridge, UK. ii + 70 pp.

Maldonado, M., Aguilar, R., Bannister, R., Bell, J., Conwa, K., Dayton, P., Diaz, M., Gutt, J., Kelly, M., Kenchington, E., Leys, S., Pomponi, S., Rapp, H., Rutzler, K., Tendal, O., Vacelet, J. and Young, C. 2016. Sponge Grounds as Key Marine Habitats: A Synthetic Review of Types, Structure, Functional Roles, and Conservation Concerns. 10.1007/978-3-319-17001-5_24-1.

Marchant, S., Higgins PJ. 1990. Handbook of Australian, New Zealand and Antarctic Birds. Volume One — Ratites to Ducks. Oxford University Press, Melbourne.

Marton, N., Curtotti, R. 2020. Bass Strait Central Zone Scallop Fishery. Department of Agriculture, Water and the Environment, ABARES, accessed May 2021 at https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status/bass-strait.

Matishov, G.G. 1992 The reaction of bottom-fish larvae to airgun pulses in the context of the vulnerable Barents Sea ecosystem. Fisheries and Offshore Petroleum Exploitation, 2nd International Conference, Bergen, Norway, 6-8 April 1992.

Matsuoka, K., Yoshihiro, F., Pastene, L.A. 1996. A sighting of a large school of the pygmy right whale, Caperea marginata, in the southeast Indian Occean. Marine Mammal Science 12(4): pp594-597.

McCauley, R. D., Fewtrell, J., Duncan, A. J., Jenner, C., Jenner, M. N., Penrose, J. D., et al. 2000. Marine seismic surveys ’A study of environmental implications. APPEA Journal 40, 692’08.

McCauley, R. D., Kent, C.S. 2012. A lack of correlation between air gun signal pressure waveforms and fish hearing damage. Advances in Experimental Medicine and biology 730: pp245–250.

McCauley, R.D, Jenner M-N., Jenner C., McCabe K. A., 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. Australian Petroleum Production and Exploration Association Journal 38.

McCauley, R.D. 1994. 'Seismic Survey.' In: Environmental Implications of Offshore Oil and Gas Developments in Australia – the Findings of an Independent Scientific Review. Eds., Swan, J.M., Neff J.M., Young P.C. Australian Petroleum Exploration Association. Sydney.

McCauley, R.D. 1998. Radiated underwater noise measured from the drilling rig ocean general, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Prepared by Rob McCauley for Shell Australia.

McCauley, R.D., Day, R.D., Swadling, K.M., Fitzgibbon, Q.P., Watson, R.A., Semmens, J.M. 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution 1: 0195

McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., McCabe, K. 2000a. Marine seismic surveys: Analysis and propagation of airgun 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 p. Accessed April 2021 at https://cmst.curtin.edu.au/wp-content/uploads/sites/4/2016/05/McCauley-et-al-Seismiceffects-2000.pdf

McCauley, R.D., Fewtrell, J., Popper, A.N. 2003. High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am. 113: pp638–642.

McCauley, R.D., Jenner, C.K. 2010. Migratory patterns and estimated population size of pygmy blue whales (Balaenoptera musculus brevicauda) traversing the Western Australian coast based on passive acoustics. In: 62nd International Whaling Commission Annual Meeting, Agadir, Morocco 2010. International Whaling Commission (2010)

McDonald, M.A., Hildebrand, J.A., Webb, S. 1995. Blue and fin whales observer on a seafloor array in the Northeast Pacific. The Journal of the Acoustical Society of America 98: pp712-721. DOI: 10.1121/1.413565.

McInnes, K. L., Hubbert, G.D. 2003. A numerical modelling study of storm surges in Bass Strait. Australian Meteorological Magazine 52(3).

McLeay, L., Sorokin, S., Rogers, P. and Ward, T. 2003. Benthic Protection Zone of the Great Australian Bight Marine Park: 1. Literature review. South Australian Research and Development Institute (Aquatic Sciences). Final report to: National Parks and Wildlife South Australia and the Commonwealth Department of the Environment and heritage,

McLoughlin, K. 2007. Shark Gillnet and Hook Sectors. In: . Fishery Status Reports 2006: Status of Fish Stocks Managed by the Australian Government. Eds., Larcombe, J. & K. McLoughlin. Page(s) 174-186. Bureau of Rural Sciences, Canberra.

Menkhorst, P. 2010. A Survey of Colonially-breeding Birds on Mud Islands, Port Phillip, Victoria; with an annotated list of all terrestrial vertebrates. Department of Sustainability and Environment.

Menkhorst, P.W., Pescott, T.W., Gaynor G.F. 1984. Results of Banding White-faced Storm-Petrels, Pelagodroma marina at Mud Islands, Victoria. Corella 8: pp53–60.

MESA. 2018. Marine Worms – Annelids (Segmented worms). Marine Education Society of Australasia. Accessed April 2021 at http://www.mesa.edu.au/marine_worms/marine_worms02.asp.

MIAL. 2020. Marine Biosecurity Management of Vessels Servicing the Offshore Resources Industry. Melbourne, Victoria. Accessed May 2021 at: https://mial.com.au/files/201126%20Marine%20Biosecurity%20Management%20of%20Vessels%20Servicing%20the%20Offshore%20Resources%20Industry.pdf.

Mills, D. Haddon, M., Garderner C. 2006. Tasmania Giant Crab Fishery 2004/2005. Fishery Assessment report. Tasmania Aquiculture and Fisheries Institute. Hobart.

Milton, S.L. and Lutz, P. 2003. Physiological and Genetic response to Environmental Stress. The Biology of Sea Turtles 2. CRC Press, Boca Raton. pp163.

Minton, C., Gosbell, K., Johns, P. Christie, M., Klaassen, M., Hassel, C., Boyle, A., Jessop, R.. Fox, J. 2013. New insights from geolocators deployed on waders in Australia. Wader Study Group Bulletin 120: pp37-46.

Mitkus, M., Nevitt, G.A., Kelber, A. 2018. Development of the Visual System in a Burrow Nesting Seabird: Leach's Storm Petrel. Brain Behaviour Evolution 91: pp4–16.

Mobsby, D., Steven, A.H., Curtotti, R. 2020. Australian fisheries and aquaculture outlook 2020. ABARES, Canberra. Accessed May 2021 at https://doi.org/10.25814/5e4377eb3eea2. CC BY 4.0.

Mondon J, Sherwood J and Chandler F. 2003. Western Victorian Estuaries Classification Project. Prepared for the Western Coastal Board, Warrnambool, Victoria, 120 p.

Montevecchi, W.A. 2006. Influences of Artificial Light on Marine Birds in: Ecological consequences of artificial night lighting. Eds., Rich, C., Longcore, T. Island Press, Washington.

Mooney, T.A., Yamato, M., Branstetter, B.K. 2012. Hearing in cetaceans: From natural history to experimental biology. Advances in Marine Biology 63: pp197–246.

Moores, N. 2006. South Korea's shorebirds: a review of abundance, distribution, threats and conservation status. Stilt 50: pp62-72.

Morrice, M.G., Gill, P.C., Hughes, J. and Levings, A.H. 2004. Summary of mitigation aerial surveys for the Santos Ltd EPP32 seismic survey, 2-13 December 2003. Report # WEG-SO 02/2004, Whale Ecology Group-Southern Ocean, Deakin University.

MPSC. 2018. National biofouling management guidelines for non-trading vessels. Marine Pest Sectoral Committee, Department of Agriculture and Water Resources, Canberra, November. CC BY 4.0. Document modified in 2018 to meet accessibility requirements.

Murchy, K.A., Davies, H., Shafer, H., Cox, K., Nikolich, K., Juanes, F. (2019). Impacts of noise on the behaviour and physiology of marine invertebrates: A meta-analysis. Proc. Mtgs. Acoust. 37, 040002. DOI: 10.1121/2.0001217.

Murray, N.J., Clemens, R.S., Phinn, S.R., Possingham, H.P., Fuller, R.A. 2014. Tracking the rapid loss of tidal wetlands in the Yellow Sea. Frontiers in Ecology and the Environment.

Musgrove R., Geddes M. and Thomas C. 2005. Causes of tail fan necrosis in the southern rock lobster, Jasus edwardsii. New Zealand Journal of Marine and Freshwater Research 39(2): pp293-304, DOI: 10.1080/00288330.2005.9517309.

Myrberg, A.A. 2001. The acoustical biology of elasmobranchs. Environmental Biology of Fishes 60(3): pp31- 45.

Nelms, S.E., Piniak, W.E., Weir, C.R, Godley, B.J. 2016. Seismic surveys and marine turtles: An underestimated global threat? Biological Conservation 193: pp49–65.

Newall, P.R., Lloyd, L.N. 2012. Lavinia Ramsar Site Ecological Character Description. Lloyd Environmental report to NRM North. Lloyd Environmental, Syndal, Victoria. 2 March 2012.

Newton G. 1994. Estuarine Zooplankton Ecology in Relation to the Hydrological Cycles of a Salt-wedge Estuary. PhD Thesis Par I and II. School of Aquatic Science and Natural Resources Management, Deakin University, Australia.

Newton GM. 1996. Estuarine ichthyoplankton ecology in relation to hydrology and zooplankton dynamics in a salt-wedge estuary. Marine and Freshwater Research 47, 99-111.

Nichol, S., & Endo, Y. (1999) Krill Fisheries: Development, management and ecosystem implications. Aquatic Living Resources. 12(2) 105-120.

Nicholls, D.G., Murray, D., Butcher, E., Moors P. 1997. Weather systems determine the non-breeding distribution of wandering albatrosses over southern oceans. Emu 97: pp240–244.

Nicol, M., Shi, H., Campi, S. 2013. Economic Impact Analysis – Tourism of Tasmania's King Island. Report prepared for Tourism Tasmania and the Cradle Coast Authority, June 2013. REMPLAN and Department of Economic Development, Tourism and the Arts.

Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., Fox, C.G. 2004. Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean. The Journal of the Acoustical Society of America 115: pp1832–1843.

NMFS. 2014. Marine Mammals: Interim Sound Threshold Guidance. National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.

NMFS. 2018a. 2018 Revision to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. National Marine Fisheries Service, US Department of Commerce, NOAA. NOAA Technical Memorandum NMFS-OPR-59. pp167. Accessed May 2021 at https://www.fisheries.noaa.gov/webdam/download/75962998.

NMSC. 2010. Marine Incidents during 2009. Preliminary Data Analysis. Accessed May 2021 at http://www.nmsc.gov.au. Australian National Marine Safety Committee.

NOAA. 2002. Environmental Sensitivity Index Guidelines. Version 3. March 2002. National Oceanic and Atmospheric Administration. Washington.

NOAA. 2012. Managing Seafood Safety after an Oil Spill. Hazardous Materials Response Division, Office of Response and Restoration, National Oceanic and Atmospheric Administration, Seattle:, USA.

NOAA. 2013. Deepwater Horizon Oil Spill: Assessment of Potential Impacts on the Deep Softbottom Benthos. Interim data summary report. NOAA Technical Memorandum NOS NCCOS 166. National Oceanic and Atmospheric Administration. Washington.

NOAA. 2019. ESA Section 7 Consultation Tools for Marine Mammals on the West Coast. National Oceanic and Atmospheric Administration. Accessed May 2021 at https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/esa-section-7-consultation-tools-marine-mammals-west.

NOO. 2002. Ecosystems — Nature's diversity: The South-east Regional Marine Plan Assessment Reports. National Oceans Office, Hobart, Tasmania.

NOPSEMA. 2019. Oil spill modelling (NOPSEMA Environment Bulletin, April 2019). National Offshore Petroleum Safety and Environmental Management Authority. Accessed on February 2021 at: https://www.nopsema.gov.au/assets/Bulletins/A652993.pdf.

Noriega R, J Lyle, K Hall, B Moore. 2018. Gould's Squid. Fisheries Research and Development Corporation. Accessed May 2021 at https://fish.gov.au/report/164-Goulds-Squid-2018

Nowacek, D.P. et al. (2007) Responses of cetaceans to anthropogenic noise. Mamm. Rev. 37, 81–115

NRC. 2003. Ocean Noise and Marine Mammals. National Research Council (U.S.), Ocean Studies Board, Committee on Potential Impacts of Ambient Noise in the Ocean on Marine Mammals. National Research Council. The National Academies Press, Washington, DC.

NRDA. 2012. April 2012 Status Update for the Deepwater Horizon Oil Spill. Natural Resource Damage Assessment. Accessed May 2021 at http://www.gulfspillrestoration.noaa.gov.

NSF, USGS, NOAA (US). 2011. Final Programmatic Environmental Impact Statement/Overseas. National Science Foundation, US Geological Survey, National Oceanic and Atmospheric Administration, USA.

NSR Environmental Consultants. 2001. Basslink : draft integrated impact assessment statement. Hawthorn East, Vic : NSR Environmental Consultants

O'Sullivan, D., Cullen, J. 1983. Food of the squid Nototodarus gouldi in Bass Strait. Australian Journal of Marine and Freshwater Research 34(2): pp261 – 285.

O'Brian, P. and Dixon, P. 1976. The effects of oils and oil components on algae: A review. British Phycological Journal 11:115– 141.

OEH. 2012. National Recovery Plan for Eastern Bristlebird Dasyornis brachypterus. Office of Environment and Heritage, Department of Premier and Cabinet (NSW), Sydney. Accessed May 2021 at http://www.environment.gov.au/resource/national-recovery-plan-eastern-bristlebird-dasyornis-brachypterus. In effect under the EPBC Act from 30-Jan-2014.

Olsen, A.M. 1954. The biology, migration, and growth rate of the school shark, Galeorhinus australis (Macleay) (Carcharhinidae) in southeastern Australian waters. Australian Journal of Marine and Freshwater Research 5: pp353-410.

ORCV. 2021. King Island Ocean Yacht Race. Accessed May 2021 at: https://www.orcv.org.au/sailing/races/king-island.

Ovenden, JR, Brasher, DJ and White, R. 1992. Mitochondrial DNA analyses of the Red Rock Lobster Jasus edwardsii supports an apparent absence of population subdivision throughout Australasia. Marine Biology, 112: 319-326.

Pace, R.M. et al. (2017) State-space mark-recapture estimates reveal a recent decline in abundance of North Atlantic right whales. Ecol. Evol. 7, 8730–8741

Parry, G.D., Gason, A. 2006. The Effect of Seismic Surveys on Catch Rates of Rock Lobsters in Western Victoria, Australia. Fisheries Research 79(2006): pp272-284.

Parry, G.D., Heislers S., Werner G.F., Asplin Gason, A. 2002. Assessment of Environmental Effects of Seismic Testing on Scallop Fisheries in Bass Strait. Marine and Freshwater Resources Institute Report No. 50. Marine and Freshwater Institute, Queenscliff, Victoria.

Parsons, K. 2011. Nowhere Else on Earth: Tasmania's Marine Natural Values. Report for Environment Tasmania. Aquenal, Tasmania.

Parvulescu, A. 1967. The acoustics of small tanks. In:) Marine bio-acoustics 2. Pergamon, Oxford. Eds.,Tavolga, W.N. pp7–13.

Passlow, V., O'Hara, T., Daniell, J., Beaman, R. J., and Twyford, L.M, 2006. Sediments and Biota of Bass Strait: an Approach to Benthic Habitat Mapping. Geoscience Australia, Record 2004/23.

Patterson, H., Larcombe, J., Woodhams, J., Curtotti, R. 2020. Fishery status reports 2020, Australian Bureau of Agricultural and Resource Economics and Sciences, Canberra. CC BY 4.0.

Patterson, H., Mobsby, D. 2020. Skipjack Tuna Fishery. Department of Agriculture, Water and the Environment. ABARES. Accessed May 2021 at https://www.agriculture.gov.au/abares/research-topics/fisheries/fishery-status/skipjack-tuna-fishery.

Patterson, H., Noriega, R., Georgeson, L., Larcombe, J., Curtotti, R. 2019. Fishery status reports 2019. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra.

Patterson, H., Noriega, R., Georgeson, L., Larcombe, J., Curtotti, R. 2018. Fishery status reports 2018. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra.

Patterson, H., Noriega, R., Georgeson, L., Larcombe, J., Curtotti, R. 2017. Fishery status reports 2017. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra.

Patterson, H., Noriega, R., Georgeson, L., Larcombe, J.,Curtotti, R. 2020. Fishery status reports 2020. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra.

Patterson, H., Noriega, R., Georgeson, L., Stobutski, I., Curtotti, R. 2016. Fishery status reports 2016. Australian Bureau of Agricultural and Resource Economics and Sciences. Canberra.

Payne, J., Andrews, C., Fancey, L., White, D., Christian, J. 2008. Potential Effects of Seismic Energy on Fish and Shellfish: An Update since 2003. Report Number 2008/060. Canadian Science Advisory Secretariat.

Payne, J.F., Coady, J. and White, D., 2009. Potential Effects of Seismic Airgun Discharges on Monkfish Eggs (Lophius americanus) and Larvae Environmental Studies Research Funds Report No.170. St. John's, NL. 32 pp.

Peakall, D.B., Wells, P.G. and Mackay, D. 1987. A hazard assessment of chemically dispersed oil spills and seabirds. Mar. Env. Res. 22(2):91-106.

Pearson, W., Skalski, J., Sulkin, S., Malme, C. 1994. Effects of seismic energy releases on the survival and development of zoeal larvae of dungeness crab (Cancer magister). Mar. Environ. Res. 38: pp93-113.

Pemberton, D., Shaughnessy, P. 1993. Interaction between seals and marine fish-farms in Tasmania, and management of the problem. Aquatic Conservation 3: pp149-158.

Pemberton, M. 2004. Geodiverstiy and geological development of King Island in E. Finzel (Ed.), From Gentle Giants to Green Pastures: A History of Environmental Change on King Island. King Island Natural Resource Management Group, Inc., Currie, King Island.

Peña, H., Handegard, N.O., Ona, E. 2013. Feeding herring schools do not react to seismic air gun surveys. ICES Journal of Marine Science 70: pp1174–1180.

Peter, J.M. 1990. Bird Study in the Nooramunga: The Possible Effects of Oyster Farming. RAOU Report Series 74: pp1-18.

Pichegru, L., Nyengera, R., McInnes, A.M. et al. 2017. Avoidance of seismic survey activities by penguins. Sci Rep 7, 16305 (2017). https://doi.org/10.1038/s41598-017-16569-x.

PIRSA. 2002. A Report Prepared for Environment Australia on the Management of the South Australian Giant Crab (Pseudocarcinus gigas) Fishery for the purposes of Section 303FN (Approved Wildlife Trade Operation) of the Environment Protection and Biodiversity Conservation Act 1999. Accessed April 2021 at http://www.pir.sa.gov.au/ data/assets/pdf_file/0006/12777/giant_crab2002.pdf

Pogonoski, J.J., Pollard, D.A., Paxton, J.R. 2002. Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes. Environment Australia, Canberra, ACT. Accessed May 2021 at http://www.environment.gov.au/coasts/publications/marine-fish-action/pubs/marine-fish.pdf.

Poore, G.C.B., Wilson, R.S., Gomon, M., Lu, C.C. 1985. Museum of Victoria Bass Strait Survey, 1979-1984. Museum of Victoria: Melbourne.

Popper, A. 2018. Potential for Impact of Cumulative Sound Exposure on Fishes During a Seismic Survey. Produced for Santos Ltd. Bethany 3D Seismic Survey Environment Plan Summary.

Popper, A., Hawkins, A. 2018. The importance of particle motion to fishes and invertebrates. The Journal of the Acoustical Society of America. 143. 470-488. DOI: 10.1121/1.5021594.

Popper, A.N., Carlson, T.J., Gross, J.A., Hawkins, A.D., Zeddies, D., Powell, L., Young, J. 2016. Effects of seismic air guns on pallid sturgeon and paddlefish. Advances in Experimental Medicine and Biology 875: pp871-878. NLM.

Popper, A.N., Halvorsen, M.B., Kane, E., Miller, D.D., Smith, M.E., Stein, P. and Wysocki, L.E. 2007. The effects of high-intensity, low-frequency active sonar on rainbow trout. The Journal of the Acoustical Society of America 122: pp623–635.

Popper, A.N., Hawkins, A.D., Fay, R.R., Mann, D.A., Bartol, S., Carlson, T.J., Coombs, S., Ellison, W.T., Gentry, R.L. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI- Accredited Standards Committee S3/SC1 and registered with ANSI. SpringerBriefs in Oceanography, Volume ASA S3/SC1.4 TR-2014. ASA Press.

Popper, A.N., Smith, M.E., Cott, P.A., Hanna, B.W., MacGillivray, A.O., Austin, M.E., Mann, D.A. 2005. Effects of exposure to seismic airgun use on hearing of three fish species. The Journal of the Acoustical Society of America 117:3958-3971.

Prideaux. 2017. Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities.

Przeslawski, R., Bruce, B., Carroll, A., Anderson, J., Bradford, R., Brock, M., Durrant, A., Edmunds, M., Foster, S., Huang, Z., Hurt, L., Lansdell, M., Lee, K., Lees, C., Nichols, P., Williams, S. 2016a. Marine Seismic Survey Impacts on Fish and Invertebrates: Final Report for the Gippsland Marine Environmental Monitoring Project. Geoscience Australia, Canberra.

Przeslawski, R., Hurt, L., Forrest, A., Carroll, A. 2016b. Potential short-term impacts of marine seismic surveys on scallops in the Gippsland Basin. FRDC Project No 2014/041. Geoscience Australia. Canberra.

PV. 2005a. Corner Inlet Marine National Park Management Plan. Parks Victoria, Melbourne.

PV. 2006. Bunurong Marine National Park, Bunurong Marine Park, Bunurong Coastal Reserve and Kilcunda-Harmers Haven Coastal Reserve management plan. Parks Victoria. Melbourne.]

PV. 2020. Marine pests. Parks Victoria, Melbourne. Accessed May 2021 at https://www.parks.vic.gov.au/get-into-nature/conservation-and-science/conserving-our-parks/marine-pests.

PWS. 2018. Hooded Plover – Thinornis rubicollis. Accessed April 2021 at https://www.parks.tas.gov.au/?base=17069.

R.D. 1998. Radiated underwater noise measured from the drilling rig Ocean General, rig tenders Pacific Ariki and Pacific Frontier, fishing vessel Reef Venture and natural sources in the Timor Sea, Northern Australia. Report to Shell Australia.

Ramachandran, S.D., Hodson, P.V., Khan, C.W. and Lee, K. 2004. Oil dispersant increases PAH uptake by fish exposed to crude oil. Ecotoxicology and Environmental Safety 59:300– 308.

Rawson, C., Gagnon, M.M. and Williams, H. 2011. Montara Well Release Olfactory Analysis of Timor Sea Fish Fillets. Curtin University, Perth, Western Australia, November 2011.

Reid, T.A., Hindell, M.A., Eades, D.W., Newman, N. 2002. Atlas of the Seabirds of Southeast Australia. Monograph 4, Birds Australia, Melbourne.

Ribera Siguan, MA. 2002. Review of non-native marine plants in the Mediterranean Sea. In: Invasive Aquatic Species of Europe Distribution, Impact and Management, Kluwer Academic Publishers. Eds., E Leppäkoski, S Gollasch & S Olenin. The Netherlands. pp291–310.

Ribera Siguan, MA. 2003. Pathways of biological invasions of marine plants, In: Invasive species: Vectors and management strategies. Eds., GM Ruiz & JT Carlton. Island Press, Washington, D.C. pp183–226.

Richardson, A.J., Matear, R.J. and Lenton, A. 2017. Potential impacts on zooplankton of seismic surveys. CSIRO, Australia.

Richardson, W. J., Greene, C.R., Maime, C. I. and Thomson, D. H. 1995. Marine Mammals and Noise. Academic Press. California.

Richer de Forges, B., Koslow, J.A., Poore, G.C.B. (2000). Diversity and endemism of the benthic seamount fauna in the southwest Pacific. Nature 405: 944-947.

Robertson K., Booth D.T., Limpus C.J. 2016. An assessment of 'turtle-friendly' lights on the sea-finding behaviour of Loggerhead Turtle hatchlings (Caretta caretta). Wildlife Research 43: 27–37.

Robertson, C.J.R. 1993. Survival and longevity of the Northern Royal Albatross Diomedea epomophora sanfordi at Taiaroa Head 1937–93. Emu 93: pp269–276.

Rogers P. H., Hawkins A. D., Popper A. N., Fay R. R., Gray M. D. 2016. Parvulescu revisited: small tank acoustics for bioacousticians. In: The Effects of Noise on Aquatic Life, II. Eds., Popper A. N., Hawkins A. D. Springer Science + Business Media, New York. pp933–941.

Rogers, D.I., Piersma, T., Hassell, C.J. 2006. Roost availability may constrain shorebird distribution: exploring the energetic costs of roosting and disturbance around a tropical bay. Biological Conservation 133: pp225-235.

Ross P., Minchinton T. and Ponder W. 2009. The ecology of molluscs in Australian saltmarshes. In: Australian Saltmarsh Ecology. (ed. N Saintilan). CSIRO Publishing, Victoria.

Ross, G.J.B. 2006. Review of the Conservation Status of Australia's Smaller Whales and Dolphins. Report to the Australian Department of the Environment and Heritage, Canberra. pp124. Accessed May 2021 at http://www.environment.gov.au/resource/review-conservation-status-australias-smaller-whales-and-dolphins.

Ross, G.J.B., P.B. Best, Donnelly, B.G. 1975. New records of the pygmy right whale (Caperea marginata) from South Africa, with comments on distribution, migration, appearance, and behaviour. Journal of the Fisheries Research Board of Canada 32(7): pp1005-1017.

RPS. 2020. Sequoia 3D Marine Seismic Survey. Oil Spill Modelling. Rev 1. date 2020. Prepared by RPS for ConocoPhillips

Russell, M. 2006. Fishermen face charges over seal slaughter - 3 September 2006. The Age. Accessed May 2021 at http://www.theage.com.au/news/national/fishermen-face-charges-over-seal-slaughter/2006/09/02/1156817151227.html.

Saddlier, S., J. Jackson, M. Hammer. 2010. National Recovery Plan for the Dwarf Galaxias (Galaxiella pusilla). Department of Sustainability and Environment, Melbourne. Accessed May 2021 at: http://www.environment.gov.au/biodiversity/threatened/recovery-plans/national-recovery-plan-dwarf-galaxias-galaxiella-pusilla. In effect under the EPBC Act from 12-Mar-2010 as Galaxiella pusilla.

Saetre, R., Ona, E. 1996. The effects of seismic surveys on fish eggs and larvae. Fiskens Og Havet 8:24.

Sagar, P.M., Weimerskirch H. 1996. Satellite tracking of southern buller's albatrosses from the Snares, New Zealand. Condor 98: 649–652.

Samson, J.E., Mooney, T.A., Gussekloo, S.W., Hanlon, R.T. 2016. A Brief Review of Cephalopod Behavioral Responses to Sound. Adv. Exp. Med. Biol. 875: pp969-75.

Sandery P.A. and Kampf J. 2005. Winter Spring flushing of Bass Strait, South Eastern Australia; Numerical modelling study. Estuarine and coastal shelf science 63

Santulli, A., Modica, A., Messina, C., Ceffa, L., Curatolo, A., Rivas, G., Fabi, G., D'Amelio, V. 1999. Biochemical Responses of European Sea Bass (Dicentrarchus labrax L.) to the Stress Induced by Off Shore Experimental Seismic Prospecting. Marine Pollution Bulletin 38: pp1105-1114.

Schlacher, T., Schlacher-Hoenlinger, M., Williams, A., Althaus, F., Hooper, J. and Kloser, R. 2007. Richness and distribution of sponge megabenthos in continental margin canyons off southeastern Australia. Marine Ecology Progress Series. 340: 73-88.

Schmitt, N.T., Double, M.C., Jarman, S.N., Gales, N., Marthick, J.R., Polanowski, A.M., Baker, C., Steel, D., Jenner, K.C.S., Jenner, M.-N.M., Gales, R., Paton, D., Peakall, R. 2014. Low levels of genetic differentiation characterize Australian humpback whale (Megaptera novaeangliae) populations. Marine Mammal Science 30: pp221-241.

Scholten MCT, Kaag NHBM, van Dokkum HP, Jak RG, Schobben HPM, Slob W. 1996. Toxische effecten van olie in het aquatische milieu. Den Helder, The Netherlands: TNO Report number TNO-MEP R96/230.

Schreiber, E.A., Burger, J. 2001. Biology of Marine Birds. Eds., Boca Raton: CRC Press.

Seiche Ltd. 2020. Review of Existing Data on Underwater Sounds Produced by the Oil and Gas Industry. Prepared by Seiche Ltd for the Joint Industry Programme on E&P Sound and Marine Life. JIP Topic – Sound Characterisation and propagation.

Sekiguchi, K., Best, P.B., Kaczmaruk, B.Z. 1992. New information on the feeding habits and baleen morphology of the pygmy right whale Caperea marginata. Marine Mammal Science 8(3): pp288-293.

SETFIA and Fishwell Consulting 2018. Final Report to 3D Oil on Dorrigo Marine Seismic Survey. Prepared by the South East Trawl Fishing Industry Association and Fishwell Consulting.

SETFIA and Fishwell Consulting 2020. Update to ConocoPhillips on the Project Sequoia Marine Seismic Survey. Prepared by the South East Trawl Fishing Industry Association and Fishwell Consulting.

Shapiro M.A. 1975. Westernport Bay Environmental Study, 1973 -1974. Ministry for Conservation, Victoria.

Shaughnessy, P. 1999. The Action Plan for Australian Seals. Environment Australia, Canberra.

Shaughnessy, P.D. and P. Chapman. 1984. Commensal Cape fur seals in Cape Town docks. South African Journal of Marine Science 2: 81-91.

Shenkar, N., Zeldman, Y and Loya, Y. 2008. Ascidianrecruitment patterns on an artificial reef in Eilat (Red Sea), Biofouling, 24:2, 119 – 12.

Sherwood J. 1983. Hydrodynamics of the Gellibrand River Estuary. Report to the Victorian S.R.W.S. Commission. Warrnambool Institute of Advanced Education, Faculty of Applied Science and Technology, Report 83/1.

Shigenaka, G. 2003. Oil and Sea Turtles: Biology, Planning, and Response. National Oceanographic and Atmospheric Administration, United States of America.

Shigenaka, G. 2011. Chapter 27 – Effects of Oil in the Environment. In: Oil Spill Science and Technology. Gulf Professional. Pp 985-1024.

Short, M (2011) Michael Short OWR training Module.

Sim, R. 1991. Prehistoric Archeological Investigations on King and Flinders Islands, Bass Strait, Tasmania. A Thesis submitted for the Degree of Master of Arts in Prehistory. Department of Prehistory and Anthropology, Faculty of Arts, Australian National University.

Skalski, J.R., Pearson, W.H., Malme, C.I., 1992. Effects of sounds from a geophysical survey device on catch-per-unit- effort in a hook-and-line fishery for rockfish (Sebastes spp.). Canadian Journal of Fisheries and Aquatic Sciences 49, pp1357–1365.

Skira, I.J., Brothers, N.P., Pemberton D. 1996. Distribution, abundance and conservation status of Short-tailed Shearwaters Puffinus tenuirostris in Tasmania, Australia. Marine Ornithology 24:pp 1–14.

Slotte, A., Hansen, K., Dalen, J., Ona, E., 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. Fisheries Research 67, pp143–150.

Smithsonian Institute. 2014. Marine Station at Fort Pierce – What is a Bryozoan. Accessed April 2021 at http://www.sms.si.edu/irlspec/IntroBryozoa.html.

Song, J., Mann, D.A., Cot, P.A., Hanna, B.W., Popper, A.N. 2008. The inner ears of northern Canadian freshwater fishes following exposure to seismic air gun sounds. Journal of the Acoustical Society of America 124, pp1360-6.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A and Tyack, P.L. 2007. Marine Mammal Noise Exposure Criteria: Initial Scientific Recommendations. Aquatic Mammals 33(4): pp411–521.

Southall, B.L., Nowaceck, D.P., Miller, P.J.O., Tyack, P.L. 2016. Experimental field studies to measure behavioural responses of cetaceans to sonar. Endangered Species Research 31: pp293-315.

SRL. 2020. The life of a Southern Rocklobster. Southern Rocklobster Ltd. Accessed May 2021 at https://www.southernrocklobster.com/assets/7.-SRL-Life-Cycle.pdf.

Stahl, J.C., Sagar, P.M. 2006. Long and short trips in non-breeding Buller's albatrosses: relationships with colony attendance and body mass. Condor 108: pp348–365.

Stamation, K, Watson, M., Moloney, P., Charlton, C. and Bannister, J.(2020) Population estimate and rate of increase of southern right whales Eubalaena australis in south eastern Australia. Endangered Species Research. 41:373-383, DOI: 10.3354/esr01031

Stephenson, L.H. 1991. Orange-bellied Parrot Recovery Plan: Management Phase. Tasmanian Department of Parks, Wildlife and Heritage, Hobart.

Stevens, J. 2005. Tope or school shark Galeorhinus galeus (Linneaus, 1758). In: Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Eds., Fowler, S.L., R.D. Cavanagh, M. Camhi, G.H. Burgess, G.M. Cailliet, S.V. Fordham, C.A. Simpfendorfer & J.A. Musick. Gland: IUCN.

Streever, B., Raborn, S.W., Kim, K.H., Hawkins, A.D., Popper, A.N. 2016. Changes in fish catch rates in the presence of air gun sounds in Prudhoe Bay, Alaska. Arctic 69(4): pp346-358. Accessed May 2021 at http://dx.doi.org/10.14430/arctic4596.

Sutherland, W.J., Alves, J.A., Amano, T., Chang, C.H., Davidson, N.C., Finlayson, C.M., Gill, J.A., Gill, R.E., González, P.M., Gunnarsson, T.G., Kleijn, D., Spray, C.J., Székely, T.,Thompson, D.B.A. 2012. A horizon assessment of current and potential future threats to migratory shorebirds. Ibis 54: pp663-679.

Tang, K.W., Gladyshev, M.I., Dubovskaya. O.P, Kirillin, G and Grossart H-P. 2014. 'Zooplankton carcasses and nonpredatory mortality in freshwater and inland sea environments.' Journal of Plankton Research 36: 597–612.

Tasmanian Government. 2020. Tasmanian Government Gazette No. 22042, Living Marine Resources. Tasmanian Government. Accessed on May 2021 at http://www.gazette.tas.gov.au/editions/2020/december_2020/22042_-_Special_4_December_2020.pdf.

Tasmanian SMPC. 1999. Iron Baron oil spill, July 1995: long term environmental impact and recovery. Tasmania State Marine Pollution Committee. Long Term Impact Assessment Group.

Taylor, I.R., Bester, A. 1999. The response of foraging waders to human recreation disturbance at Rhyll, Phillip Island, Victoria. Stilt 35.

Terauds, A., Gales, R., Baker, G.B., Alderman, R. 2006. Population and survival trends of Wandering Albatrosses (Diomedea exulans) breeding on Macquarie Island. Emu 106: pp211–218.

Thursby, G.B. and Steele, R. L. 2004. Toxicity of arsenite and arsenate to the marine macroalga Champia parvula (rhodophyta). Environmental Toxicology and Chemistry 3 (3):391-397.

TSS. 2006. Threatened Tasmanian Eagles Recovery Plan 2006-2010. Threatened Species Section. Department of Primary Industries and Water, Hobart. Accessed May 2021 at http://www.environment.gov.au/resource/threatened-tasmanian-eagles-recovery-plan-2006-2010. In effect under the EPBC Act from 16-Apr-2007.

TSS. 2012. King Island Biodiversity Management Plan. Threatened Species Section. Department of Primary Industries, Parks, Water and Environment, Hobart. Accessed April 2021 at https://www.environment.gov.au/system/files/resources/f15149a7-f50d-42a9-b6df-7b275c235ccc/files/king-island-bmp.pdf.

TSS. 2021. Neophema chrysogaster (Orange-bellied Parrot): Species Management Profile for Tasmania's Threatened Species Link. Threatened Species Section. Department of Primary Industries, Parks, Water and Environment, Tasmania. Accessed April 2021 at https://www.threatenedspecieslink.tas.gov.au/pages/orange-bellied-parrot.aspx.

TSSC, 2005. Inclusion of species in the list of threatened species under section 178 of the Environment Protection and Biodiversity Conservation Act 1999 (31/01/2005) (Australian Sea-lion). Canberra: Department of the Environment.

TSSC. 2009. Commonwealth Listing Advice on Galeorhinus galeus. Threatened Species Scientific Committee. Department of the Environment, Water, Heritage and the Arts. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/68453-listing-advice.pdf. In effect under the EPBC Act from 22-Jan-2009.

TSSC. 2010. Commonwealth Listing Advice on Neophoca cinerea (Australian Sea-lion). Threatened Species Scientific Committee. Department of Sustainability, Environment, Water, Population and Communities. Canberra, ACT.

TSSC. 2013. Commonwealth Conservation Advice for Subtropical and Temperate Coastal Saltmarsh. Accessed May 2021 at: ttp://www.environment.gov.au/biodiversity/threatened/communities/pubs/118conservationadvice.p df. Threatened Species Scientific Committee. Canberra.

TSSC. 2015. Conservation Advice Rhincodon typus whale shark. Threatened Species Scientific Committee. Canberra. Department of the Environment. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/66680-conservation-advice-01102015.pdf. In effect under the EPBC Act from 01-Oct-2015

TSSC. 2015a. Conservation Advice Platycercus caledonicus brownii green rosella (King Island). Threatened Species Scientific Committee. Canberra: Department of the Environment. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/67041-conservation-advice-31102015.pdf. In effect under the EPBC Act from 31-Oct-2015.

TSSC. 2015b. Conservation Advice Strepera fuliginosa colei black currawong (King Island). Threatened Species Scientific Committee. Canberra: Department of the Environment. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/67113-conservation-advice-31102015.pdf. In effect under the EPBC Act from 31-Oct-2015.

TSSC. 2015c. Approved Conservation Advice for Megaptera novaengliae (humpback whale). Threatened Species Scientific Committee, Canberra, Australia. Accessed April 2021 at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/38-conservation-advice-10102015.pdf.

TSSC. 2015d. Conservation Advice Balaenoptera physalus fin whale. Threatened Species Scientific Committee, Department of the Environment, Canberra. Accessed April 2021 at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/37-conservation-advice-01102015.pdf.

TSSC. 2015e. Conservation Advice Balaenoptera borealis sei whale. Canberra: Department of the Environment. Accessed April 2021: http://www.environment.gov.au/biodiversity/threatened/species/pubs/34-conservation-advice-01102015.pd.

TSSC. 2015f. Conservation Advice for the blue petrel (Halobaena caerulea). Threatened Species Scientific Committee. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/1059-conservation-advice-01102015.pdf.

TSSC. 2016. Conservation Advice Limosa lapponica baueri Bar-tailed godwit (western Alaskan). Threatened Species Scientific Committee. Canberra: Department of the Environment.Accessed May

2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/86380-conservation-advice-05052016.pdf. In effect under the EPBC Act from 05-May-2016.

TSSC. 2016a – Conservation Advice for the Red Knot (Calidris canutus). Threatened Species Scientific Committee. Accessed may 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/855-conservation-advice-05052016.pdf.

TSSC. 2016b. Conservation Advice for the Lesser Plover (Charadrius mongolus). Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/879-conservation-advice-05052016.pdf.

TSSC. 2016c. Conservation Advice Lathamus discolor swift parrot. Canberra: Department of the Environment. Accessed on May 2021 at: http://www.environment.gov.au/biodiversity/threatened/species/pubs/744- conservationadvice-05052016.pdf

TSSC. 2017. Conservation Advice Astacopsis gouldi (giant freshwater crayfish, Tasmanian giant freshwater lobster). Threatened Species Scientific Committee. Canberra: Department of the Environment and Energy. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/64415-conservation-advice-13072017.pdf. In effect under the EPBC Act from 13-Jul-2017.

TSSC. 2019. Conservation Advice Hirundapus caudacutus White-throated Needletail. Threatened Species Scientific Committee, Canberra: Department of the Environment and Energy. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/682-conservation-advice-04072019.pdf. In effect under the EPBC Act from 04-Jul-2019.

TSSC. 2019a. Conservation Advice Botaurus poiciloptilus Australasian Bittern. Threatened Species Scientific. Canberra, ACT: Department of the Environment and Energy. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/1001-conservation-advice-18012019.pdf. In effect under the EPBC Act from 18-Jan-2019.

TSSC. 2020. Conservation Advice Falco hypoleucos Grey Falcon. Threatened Species Scientific Committee. Canberra: Department of Agriculture, Water and the Environment. Accessed May 2021 at http://www.environment.gov.au/biodiversity/threatened/species/pubs/929-conservation-advice-09072020.pdf. In effect under the EPBC Act from 09-Jul-2020.

Tsvetnenko, Y. 1998. Derivation of Australian Tropical Marine Water Quality Criteria for Protection of Aquatic Life from Adverse Effects of Petroleum Hydrocarbons. Environmental Toxicology and Water Quality 13(4):273284.

Tyack, P. (1998) Acoustic communication under the sea. In Animal acoustic communication: recent technical advances (Hopp, S. L. et al., eds), pp. 163–220, Springer-Verlag

University of Michigan. 2018. Animal Diversity Web. – Hydrozoa. Accessed April 2021 at http://animaldiversity.org/accounts/Hydrozoa.

Van de Kam, J., Battley, P.F., McCaffery, B.I., Roger, D.I., Hong, J-S., Moores, N., Ki, J.-Y., Lewis, J., Piersma, T. 2010. Invisible Connections: Why Migrating Shorebirds Need the Yellow Sea. CSIRO Publishing, Melbourne.

Van Meter, R.J., Spotila, J.R. and Avery, H.W. 2006. Polycyclic Aromatic Hydrocarbons Affect Survival and Development of Common Snapping Turtle (Chelydra serpentina) Embryos and Hatchlings. Env. Poll. 142(3): 466–475.

Van Overbeek, J., & Blondeau, R. 1954. Mode of Action of Phytotoxic Oils. Weeds, 3(1), 55-65.

VFA. 2017. Victorian Rock Lobster Management Plan. Victorian Fisheries Authority.

VFA. 2020. Commercial fisheries. Victorian Fisheries Authority, Melbourne. Accessed May 2021 at: https://vfa.vic.gov.au/commercial-fishing.

VFA. 2020a. Victorian Rock Lobster Fishery. Stock Assessment Report, 2018/19 Season. Victorian Fisheries Authority. Accessed on May 2021 at https://vfa.vic.gov.au/__data/assets/pdf_file/0005/596867/FINAL_RL-Stock-Assessment-Report-201819.pdf.

VFA. 2021a. Fisheries Overview. Victorian Fisheries Authority. Accessed May 2021 at https://vfa.vic.gov.au/commercial-fishing/giant-crab/fishery-overview.

VFA. 2021b. Commercial Pipi Fishery. Victorian Fisheries Authority. Accessed May 2021 at https://vfa.vic.gov.au/commercial-fishing/pipi-fishery.

VFA. 2021c. Scallop. Victorian Fisheries Authority. Accessed May 2021 at https://vfa.vic.gov.au/commercial-fishing/scallop.

VFA 2021d. 2019/20 Victorian Rock Lobster Stock Assessment. Victorian Fisheries Authority Report Series No.18

Volkman, J.K., Miller, G.J., Revill, A.T. and Connell, D.W. 1994. Oil spills. In: Environmental Implications of offshore oil and gas development in Australia - the findings of an independent scientific review. Edited by Swan, J.M., Neff, J.M. and Young, P.C. Australian Petroleum Exploration Association. Sydney.

Wåhlin AK. 2002. Topographic steering of dense currents with application to submarine canyons. Deep-Sea Res Part I 49:305–320

Walker, T.I., Cavanagh. R.D., Stevens, J.D. 2005. Galeorhinus galeus. 2006 IUCN Red List of Threatened Species.

Wardle, C.S., Carter, T.J., Urquhart, G.C., Johnstone, A.D.F., Ziolkowski, A.M., Hampson, G., Mackie, D. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21: pp1005–1027.

Wartzok, D., Ketten, D.E. 1999. Marine Mammal Sensory Systems. In: Biology of Marine Mammals. Eds., Reynolds, J. and Rommel. Smithsonian Institution Press, Washington DC. pp117–175.

Watson, C.F., and Chaloupka, M.Y. 1982. Zooplankton of Bass Strait: Species Composition, Systematics and Artificial key to Species. Tasmanian Institute of Marine Science Technical Report No. 1

Watson, M., Stamation, K., Charlton, C., & Bannister, J. (2021). Calving rates, long-range movements and site fidelity of southern right whales (Eubalaena australis) in south-eastern Australia. Journal of Cetacean Research and Management. 22-2021 pp. 17-28

Waugh, S.M., Sagar, P.M., Cossee, R.O. 1999. New Zealand black-browed albatross Diomedea melanophrys impavida and greyheaded albatross D. chrysostoma banded at Campbell Island: Recoveries from the South Pacific region. Emu 99: pp29–35.

WDCS. 2006. Vessel collisions and cetaceans: What happens when they don't miss the boat. Whale and Dolphin Conservation Society. United Kingdom.

Weimerskirch, H., Cherel, Y. 1998. Feeding ecology of short-tailed shearwaters: breeding in Tasmania and foraging in Antarctica? Marine Ecology Progress Series 167: pp261–234.

Wells, F. 2018. A low number of invasive marine species in the tropics: a case study from Pilbara (Western Australia). Management of Biological Invasions (2018) 9(3): pp227–237. Accessed May 2021 at: https://www.reabic.net/journals/mbi/2018/3/MBI_2018_Wells.pdf.

Whitehead, H. 2002a. Estimates of the current global population size and historical trajectory for sperm whales. Marine Ecology Progress Series. 242: pp295-304.

Whitehead, H. 2002b. Sperm Whale. In: The Encyclopedia of Marine Mammals. Eds., Perrin W.F., B. Würsig & J. Thewissen. San Diego: Academic Press. pp62-72.

Wiese, F.K., Montevecci, W.A., Davoren, G.K., Huettmann, F., Diamond, A W. and Linke J. 2001. Seabirds at risk around offshore oil platforms in the northwest Atlantic. Marine Pollution Bulletin 42: pp1285–1290.

Williams, A., Gardner, C., Althaus, F. and Barker, B. 2009. Understanding shelf-break habitat for sustainable management of fisheries with spatial overlap. Final Report to the Fisheries Research and Development Corporation; Project No. 2004/066. June 2009

Wilson, R., Poore, G. 1987. The Bass Strait survey: biological sampling stations, 1979-1984. Occasional papers from the Museum of Victoria 3, pp1–14.

Wilson, S., Swan, G. 2005. A Complete Guide to the Reptiles of Australia. Reed New Holland. Sydney

Woodside. 2003. Otway Gas Project Environmental Impact Statement/Environment Effects Statement (EIS/EES). Prepared by Woodside Energy Ltd. Perth.

Woodside. 2008. Browse LNG Development. Torosa South-1 Pilot Appraisal Well Environment Plan. Woodside Energy Ltd. Perth.

Woodside. 2012a. Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 2 – Impacts of Seismic Airgun Noise on Fish Diversity and Abundance: A Coral Reef Case Study. Woodside Energy Ltd. Perth.

Woodside. 2012b. Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 1 – Impacts of Seismic Airgun Noise on Fish Behaviour: A Coral Reef Case Study. Woodside Energy Ltd. Perth.

Woodside. 2012c. Browse LNG Development, Maxima 3D MSS Monitoring Program Information Sheet 2 – Impacts of Seismic Airgun Noise on Fish Pathology, Physiology and Hearing Sensitivity: A Coral Reef Case Study. Woodside Energy Ltd. Perth.

Young, M.A., Lerodiaconou, D., Edmunds, M., Hulands, L., Schimel, A.C. G. 2016. Accounting for habitat and seafloor structure characteristics on southern rock lobster (Jasus edwardsii) assessment in a small marine reserve. Mar. Bio. 163: pp1–13., FRDC 2002/007, Final Report, CSIRO Marine and Atmospheric Research.

9. Appendix A – EIA Tool

10. Appendix B – Justification for screening out receptors

11. Appendix C – Consultation Report

12. Appendix D – Sensitive Information Report

13. Appendix E – Sound Modelling

14. Appendix F – SETFIA Reports (2018 & 2020)

15. Appendix G – Spill Modelling

16. Appendix H – Existing Environment

17. Appendix I – OPEP/OSMP

18. Appendix J – PMST Reports

19. Appendix K – Indicative Marine Mammal Adaptive Management Procedure Flowchart