Environment Plan
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Environment Plan

Otway Offshore Operations

Review record (record the last 3 revisions here or the revisions required to achieve current approval version)

Revision	Date	Reason for issue	Reviewer/s	Consolidator	Approver
12b	18/08/2022	Accepted by NOPSEMA	PWE	Xodus, PWE	KGA
13a	22/02/23	Revision Issued for review	PWE	Xodus, PWE	
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13c	28/04/2023	Resubmission to NOPSEMA	PWE	PWE	KGA

Review due	Review frequency
11/04/2028	5 year/s

THE THREE WHATS
What can go wrong?
What could cause it to go wrong?
What can I do to prevent it?

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Acronyms

Terms/acronym	Definition/Expansion
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
ALARP	As Low as Reasonably Practicable
AMOSC	Australian Marine Oil Spill Centre
AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
APPEA	Australian Petroleum Production and Exploration Association
ASAP	As Soon as Practicable
Bass Strait CZSF	Bass Strait Central Zone Scallop Fishery
bbl	Barrel
Beach	Beach Energy (Operations) Limited
BIA	Biologically Important Area
BOM	Bureau of Meteorology
BOP	Blow-out Preventer
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
CMMS	Computerised Maintenance Management System
CMT	Crisis Management Team
COLREG	Convention on The International Regulations for Preventing Collisions at Sea
CO	Carbon monoxide
CRA	Corrosion Resistant Alloy
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry formerly part of DAWE
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DCCEEW	Commonwealth Department of Climate Change, Energy, the Environment and Water formerly DAWE
DEECA	Victorian Department of Energy, Environment and Climate Action (formerly Victorian Department of Jobs, Precincts and Regions)
DEECA: ERR	Victorian Department of Energy, Environment and Climate Action: Earth Resources Regulation
DELWP	Victorian Department of Environment, Land, Water and Planning now DEECA
DIIS	Department of Industry, Innovation and Science
DISER	Department of Industry, Science, Energy and Resources
DJPR	Victorian Department of Jobs, Precincts and Regions now DEECA
DJPR: ERR	Victorian Department of Jobs, Precincts and Regions: Earth Resources Regulation now DEECA: ERR

Terms/acronym	Definition/Expansion
DNP	Commonwealth Director of National Parks
DO	Dissolved Oxygen
DotEE	Commonwealth Department of the Environment and Energy now DCCEEW
DNRET	Department of Natural Resources and Environment Tasmanian
DP	Dynamic Positioning
DPIPWE	Tasmanian Department of Primary Industries, Parks, Water and Environment now DNRET
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
EFL	Electrical Flying Leads
EFL	Electrical Flying Lead
EIS	Environmental Impact Statement
EMBA	Environment That May Be Affected
EMPCA	*Environmental Management and Pollution Control Act 1994*
EMT	Emergency Management Team
ENSO	El Niño – Southern Oscillation
EP	Environment Plan
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
EPO	Environment Performance Outcome
EPS	Environment Performance Standard
ERT	Emergency Response Team
ESD	Ecologically Sustainable Development
ETBF	Eastern Tuna and Billfish Fishery
FFG	Flora and Fauna Guarantee Act
GHG	Greenhouse gas
H_2S	Hydrogen Sulphide
HDD	Horizontal Directional Drilled
HFC	Hydrofluorocarbons
HISC	Hydrogen Induced Stress Cracking
HPU	Hydraulic Power Unit
HSE	Health, Safety and Environment
HSEMS	Health, Safety and Environment Management System
Hz	Hertz
IAPP	International Air Pollution Prevention
IBC	Intermediate Bulk Container
IMO	International Maritime Organisation

Terms/acronym	Definition/Expansion
IMOS	Integrated Marine Observing System
IMS	Invasive Marine Species
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
Lattice	Lattice Energy Limited
LOWC	Loss of Well Control
LOC	Loss of Containment
LPG	Liquefied Petroleum Gas
MARPOL	International Convention for The Prevention of Pollution from Ships
MC	Measurement Criteria
MCS	Master Control Station
MDO	Marine Diesel Oil
MEG	Monoethylene Glycol
MMSCF	Million Standard Cubic Feet
MMSCFD	Million Standard Cubic Feet per day
MNES	Matters of National Environmental Significance
MNP	Marine National Park
MO	Marine Order
MoC	Management of Change
MODIS	Moderate Resolution Imaging Spectroradiometer
MODU	Mobile Offshore Drilling Unit
MT	Metric Tonne
N_2O	Nitrous oxide
NatPlan	National Plan for Maritime Environmental Emergencies
NEBA	Net Environmental Benefit Analysis
NGER	National Greenhouse and Energy Reporting
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NORMs	Naturally Occurring Radioactive Materials
NO_2	Nitrogen dioxide
NPI	National Pollution Inventory
NSW	New South Wales
O_3	Ozone
OEMS	Operations Excellence Management System

Terms/acronym	Definition/Expansion
OGUK	Oil and Gas UK
OPEP	Oil Pollution Emergency Plan
OPGGS Act	Offshore Petroleum and Greenhouse Gas Storage Act 2006
OPGGS Regulations (Vic)	Victorian Offshore Petroleum and Greenhouse Gas Storage Regulations 2011
OPGGS(E)R	Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009
OPP	Offshore Project Proposal
Origin	Origin Energy Resources Limited
ORP	Oxidation-Reduction Potential
OSCP	Oil Spill Contingency Plan
OSMP	Operational and Scientific Monitoring Plan
OSTM	Oil Spill Trajectory Modelling
OSV	Offshore Support Vessel
OWR	Oiled Wildlife Response
Pb	Lead
PCM	Pipeline Corrosion Monitor
PFC	Perfluorocarbons
POLREP	Marine Pollution Report
POWBONS Act	Pollution of Waters by Oil and Noxious Substances Act 1986
ppm	Parts Per Million
PSZ	Petroleum Safety Zone
PTS	Permanent Threshold Shift
ROV	Remotely Operated Vehicle
SBTF	Southern Bluefin Tuna Fishery
SCCP	Source Control Contingency Plan
SCM	Subsea Control Module
SCSSV	Surface Controlled Subsurface Safety Valve
SDU	Subsea Distribution Unit
SEEMP	Ship Energy Efficiency Management Plan
SEL	Sound Exposure Level
SEMR	South-East Marine Region
SESSF	Southern and Eastern Scalefish And Shark Fishery
SETFIA	South East Trawl Fishing Industry Association
SF6	Sulphur hexafluoride
SHX	Subsea Heat Exchanger
SIMAP	Spill Impact Mapping Analysis Program

Terms/acronym	Definition/Expansion
SIV	Seafood Industry Victoria
SMC	Subsea Manifold Cooler
SMPEP	Shipboard Marine Pollution Emergency Plan
SMS	Short Message Service
SO_2	Sulphur dioxide
SPCU	Subsea Power and Control Unit
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SST	Sea surface temperature
SVS	Subsea Valve Skid
TEC	Threatened Ecological Community
TOLC	Top of Line Corrosion
TRH	Total Recoverable Hydrocarbon
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
TUTA	Topside Umbilical Termination Assembly
UTA	Umbilical Termination Assembly
VLSFO	Very Low Sulphur Fuel Oil
VWMS	Victorian Waterway Management Strategy
WBDF	Water-Based Drilling Fluid
WECS	Well Engineering and Construction Management System
WOMP	Well Operations Management Plan
Woodside	Woodside Petroleum Ltd
WRSSV	Wireline Retrievable Subsurface Safety Valve

1 Overview of the Activity

Beach Energy (Operations) Limited (Beach) is the part owner and nominated operator of the Otway Gas Development. The development consists of offshore and onshore infrastructure necessary for the commercialisation of gas and liquids in the Geographe and Thylacine fields off the coast of Victoria.

Development of the gas fields commenced in 2004 by Woodside Petroleum Ltd under a joint venture arrangement, with first production in mid-2007. Since this date, additional wells have been drilled at the Geographe location (VIC/L23) and the Thylacine location (T/L2) to maintain supply. A further exploration well was drilled in 2021 at the Artisan location (VIC/P43).

The Artisan well is located approximately 32 km to the south of Port Campbell, with the Geographe field located approximately 55 km to the south of Port Campbell and the Thylacine field located a further 15 km south of the Geographe field.

The production wells at the Geographe and Thylacine locations have all been drilled, completed and tied-back to existing infrastructure under separate environment plans (EPs). The Thylacine subsea wells have been commissioned and testing will be performed prior to gas entering the system. The anticipate time for production from these wells is described in section 3.4.

The current offshore operations at Otway are managed under the Otway Offshore Operations EP that was accepted in August 2022 and is valid until 2027 (NOPSEMA Reference 6731).

This EP is a minor amendment to the accepted Otway Offshore Operations EP and an is based on the potential of a 'new or increased environmental impact or risk' as defined under Regulation 17(6) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

The potential new or increased environmental impacts or risks from the development are:

- Greenhouse Gas Emissions – The currently accepted EP contained emissions forecasting that has been refined since acceptance. These refinements alter the risk assessment assumptions included within the accepted EP. It is, therefore, considered that these may constitute an increased impact to the environment. This has been addressed in Section 6.3.

- Physical disturbance to the seabed – The currently accepted EP does not consider the potential environmental impacts of the subsea flowlines and manifolds associated with the Thylacine wells. These potentially create an increased environmental impact to the seabed. These potential environmental impacts have been assessed in section 6.6 and section 6.7.

- Spill risk – In the unlikely event of a spill, the four subsea wells at Thylacine have the potential for an increased environmental impact. The platform wells at Thylacine were estimated to have a potential spill volume of approximately 28 MMscf/day. The Thylacine subsea wells have an estimated spill volume of 139 MMscf/day. This increased environmental impact has been assessed in section 6.14.

- Planned subsea discharges – The subsea wells at Thylacine may result in additional discharges of hydraulic fluid, dye, mono-ethylene glycol and other chemicals that could have an increased environmental impact. These additional discharges have been included in section 6.9.

The scope of this Environment Plan (EP), is the operation, inspection, maintenance, and repair (and associated activities) of the offshore assets associated with the Otway Gas Development (Figure 1-1):

- Thylacine-A well head platform with four production wells.
- Three subsea Geographe production wells (Geographe 2, Geographe 4, Geographe 5) and associated subsea infrastructure.
- Four subsea Thylacine production wells (Thylacine North-1, Thylacine North-2, Thylacine West-1, and Thylacine West-2 and associated subsea infrastructure.
- Four subsea suspended wells (Artisan1, Geographe 1, Geographe 3, Thylacine1).
- Otway Pipeline System consisting of two subsea pipelines – the Otway Gas Pipeline and the piggybacked MEG pipeline.

The onshore assets, which are not covered by this EP, include the Otway Gas Plant approximately 7 km north-east of Port Campbell, the onshore section of the Otway Gas Pipeline from the shore crossing to the Otway Gas Plant, the Halladale Black Watch Speculant wellsite located near Nirranda South, and the Halladale Black Watch Speculant gas pipeline to the Otway Gas Plant. The Otway Gas Plant produces gas, condensate, and liquefied petroleum gas (LPG) from these gas fields.

The following assets/activities are not included in the scope of this EP:

- The Halladale Black Watch Speculant wellsite and gas pipeline which are covered by the Halladale Black Watch Speculant Well Site Environmental Management Plan (CDN/ID 8255348) and the Halladale Black Watch Speculant Pipeline PL006009 Environment Management Plan (CDN/ID 8198931), respectively.
- Onshore section of the Otway Gas Pipeline which is covered by the Otway Onshore Pipeline PL250 Environmental Management Plan (CDN/ID 3977303).
- Otway Gas Plant which is covered by the Otway Gas Plant Environmental Management Plan (CDN/ID 8027333).
- Exploration, appraisal and drilling activities are covered by activity specific EPs as necessary.
- Well intervention, wireline or slickline campaigns on subsea production or suspended wells are covered by activity specific EPs as necessary.
- Decommissioning of any assets/facilities which will be covered by specific EPs as necessary.

1.1 Environment Plan Summary

This Otway Offshore Operations EP Summary has been prepared from material provided in this EP. The summary consists of the following (Table 1-1) as required by Regulation 11(4) of the Commonwealth Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009 (OPGGS(E)R) and the Victorian Offshore Petroleum and Greenhouse Gas Storage Regulations 2011 (OPGGS Regulations (Vic)).

Table 1-1: EP Summary of Material Requirements

EP Summary Material Requirement	Relevant Section of EP Containing EP Summary Material
The location of the activity	Section 3.1
A description of the receiving environment	Section 4
A description of the activity	Section 3
Details of the environmental impacts and risks	Section 6
A summary of the control measures for the activity	Section 6.16
A summary of the arrangements for ongoing monitoring of the titleholder’s environmental performance	Section 7
A summary of the response arrangements in the oil pollution emergency plan	Refer to OPEP
Details of consultation already undertaken and plans for ongoing consultation	Section 7.12.9
Details of the titleholders nominated liaison person for the activity	Section 1.2

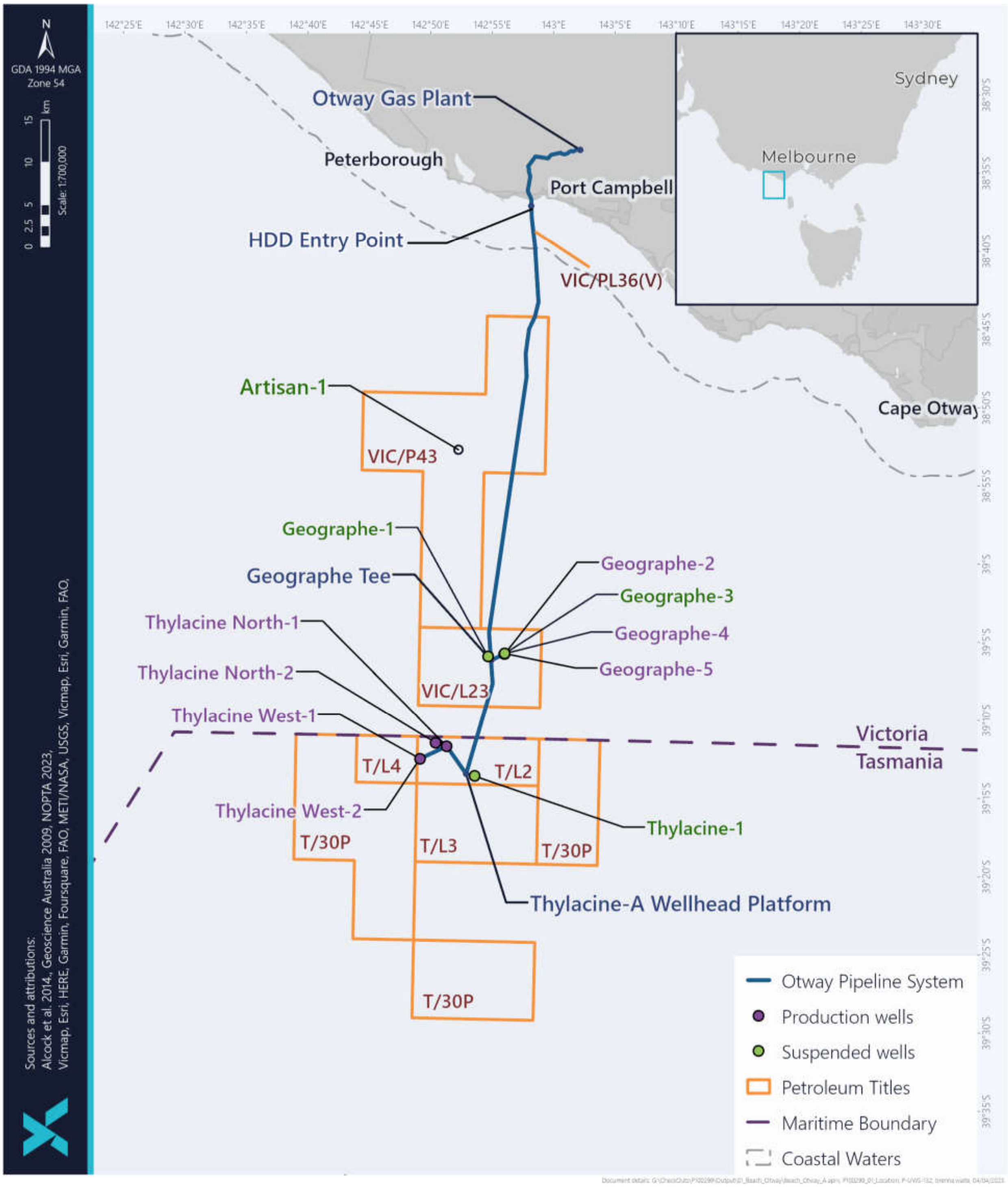


Figure 1-1: Otway Offshore Permits and Infrastructure Locations

1.2 Titleholder and Liaison Person Details

The operator of the Otway Gas Development is Beach Energy (Operations) Limited, a company wholly owned by Beach Energy Limited (Beach). Table 1-2 details the titleholder and the liaison person for the title applicable to the activity.

Beach is an Australian Stock Exchange listed oil and gas exploration and production company headquartered in Adelaide, South Australia. Beach has operated and non-operated, onshore and offshore oil and gas production assets in five producing basins across Australia and New Zealand and is a key supplier to the Australian east coast gas market.

Beach's asset portfolio includes ownership interests in strategic oil and gas infrastructure, as well as a suite of high potential exploration prospects. Beach's gas exploration and production portfolio includes acreage in the Otway, Bass, Cooper/Eromanga, Perth, Browse and Bonaparte basins in Australia, as well as the Taranaki and Canterbury basins in New Zealand (Figure 1-2).

Beach will notify National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA) and Department of Energy, Environment and Climate Action: Earth Resources Regulation (DEECA: ERR) 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.

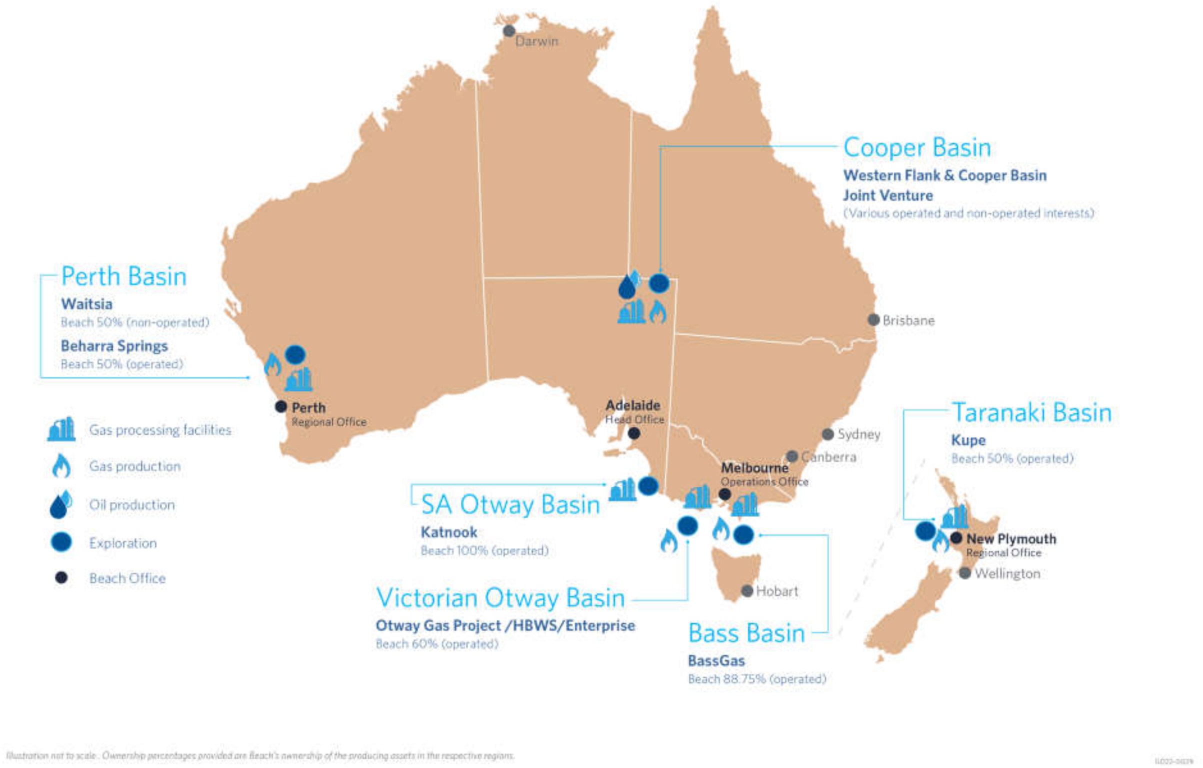


Figure 1-2: Beach Operations

Table 1-2: Details of Titleholder and Liaison Person

Petroleum Title	Details	
T/L2, T/L3, T/PL3, VIC/L23, VIC/P43, VIC/PL36, VIC/PL36(V)	Titleholder	Beach Energy (Operations) Limited – Operator Beach Energy (Otway) Limited OGOG (Otway) Pty Ltd
	Business address	Level 8 80 Flinders Street Adelaide South Australia 5000
	Telephone number	(08) 8338 2833
	Email address	info@beachenergy.com.au
	Australian Company Number	ACN: 007 845 338
Titleholder Liaison Person		
Mr David Ross General Manager Victoria	Business address	Level 15 150 Lonsdale Street Melbourne Victoria 3000
	Telephone number	(08) 9110 2180
	Email address	info@beachenergy.com.au

2 Applicable Requirements

This section provides information on the requirements that apply to the activity, in accordance with Regulation 13(4) of the OPGGS(E)R and Regulation 15 (3)(a) and 15 (3)(b) of the OPGGS Regulations (Vic). Requirements include relevant laws, codes, other approvals and conditions, standards, agreements, treaties, conventions or practices (in whole or part) that apply to the jurisdiction that the activity takes place in.

The proposed activity is located within Commonwealth and Victorian State waters. Relevant Commonwealth requirements are summarised in Table 2-2 and relevant Victorian requirements are described in Table 2-3. Victorian Requirements

Table 2-3On the basis that a worst-case credible oil spill has the potential to intersect Tasmanian waters, relevant Tasmanian requirements are described in Table 2-4.

2.1 EPBC Act Primary Approval

Woodside Petroleum Ltd (Woodside), as the original operator of the Otway Development, submitted an Environmental Impact Statement (EIS) under the Environment Protection and Biodiversity Conservation (EPBC) Act for the Otway Development which was approved by the Minister of the Environment in 2004 (EPBC 2002/621). In March 2010, Origin Energy Resources Ltd purchased the Otway Development from Woodside and commenced operatorship of the development (later changing its name to Lattice Energy Limited (Lattice)). In February 2018, Beach acquired Lattice, which included the acquisition of the Otway Development.

The EIS preferred development concept consisted of:

- Production from the Thylacine unmanned platform consisting of dry well heads and telecommunication control links to the onshore gas processing plant.
- Subsea well heads and infrastructure at the Geographe field.
- Subsea tie-ins consisting of the construction and operation of subsea wells, flowlines and other related infrastructure within the development area for the purpose of extracting gas from the Thylacine and Geographe gas discoveries.
- Subsea pipeline to bring gas from the Thylacine and Geographe fields to the onshore gas processing plant.
- Separation of produced water and compression of gas at the onshore gas processing plant.

To date the Otway Development consists of:

- Four production wells (dry wells) at the Thylacine-A Wellhead Platform and telecommunication control links to the Otway Gas Plant.
- Three subsea production wells (G-2, G-4, G-5) and the G-3 well that was constructed and never operated, at the Geographe field.
- Four subsea wells (TN-1, TN-2, TW-1, TW-2), at the Thylacine field.

- Subsea tie-in, flowlines and other related infrastructure for the purpose of extracting gas from the Geographe and Thylacine gas discoveries.
- Subsea pipeline to bring gas from the Thylacine and Geographe fields to the Otway Gas Plant.
- Separation of produced water and compression of gas at the onshore Otway Gas Plant.

The scope of this EP consists of:

- Operations of the Otway Offshore Operations, including:
    - Production from the Thylacine field.
    - Production from the Geographe field.

The operation of the Otway Offshore project described in this EP forms part of the Otway Development and was approved by the Minister (EPBC (2002/621). A separate Offshore Project Proposal is not therefore required (Regulation 5A(2) OPGGS(E)R). The activity approved by the Minister included:

- Gas production, subsea manifolds and flowlines and the possibility of an offshore platform at either Thylacine or Geographe and is therefore equivalent with the description of activity within this EP.
- The location of the development in the Geographe and Thylacine fields are the same as those described within the EIS and approved under EPBC (2002/621).
- The wells, Thylacine-A Wellhead Platform and subsea infrastructure are located in the same petroleum titles as those described within the EIS and approved under EPBC (2002/621).
- The environment that may be affected by the operations is the same as that previously considered during the development of the EIS.
- The environmental impact assessment within the EIS considered similar aspects and cause effect pathways to similar receptors as those detailed within this EP, although the EP includes a greater level of detail consistent with the requirements of regulation 13 (3) of the OPGGS(E) Regs 2009.
- The consequence evaluation for environmental impacts associated with the operations of the Thylacine and Geographe fields is consistent with those described within the EIS.
- As such, the proposed activity does not trigger a requirement for further approval under the EPBC Act (as would be met though an offshore project proposal) given the Environment Minister has approved, under Part 9 of the EPBC Act the taking of an action that includes the activity via the existing approval EPBC (2002/621) which is consistent with regulation 9(3)(b)(iii) of the OPGGS(E) Regulations 2009.

Conditions relating to the EPBC Act approval that are considered relevant to the scope of this EP are detailed in Table 2-1. Conditions are based on those in the Variation to Conditions Attached to Approval issued on the 22 June 2015.

2.2 EPBC Act Requirements

This EP considers the impacts to matters of national environmental significance (MNES) protected under Part 3 of the EPBC Act. Relevant requirements associated with the EPBC Act, related policies, guidelines, plans of management, recovery plans, threat abatement plans, and other relevant advice issued by Department of Climate Change, Energy, the Environment and Water (DCCEEW), are detailed in the applicable sections within Section 3.7 as part of the description of the existing environment.

Recovery plans, threat abatement plans and species conservation advice applicable to species are detailed in the description of threatened and migratory species (Section 4.4.7).

On 28 February 2014, following Australian Government decisions under the EPBC Act, the process for streamlined environmental approvals for offshore petroleum and greenhouse gas storage activities in Commonwealth waters came into effect.

Following a strategic assessment of NOPSEMA's environmental management authorisation process under the EPBC Act, the Federal Minister for the Environment endorsed NOPSEMA's process as a Program (the Program) that meets the requirements of Part 10 of the EPBC Act. Subsequently, the Minister also approved a class of actions which, if undertaken in accordance with the endorsed Program, will not require separate referral, assessment, and approval under the EPBC Act.

Key regulatory elements of the endorsed Program consist of the OPGGS(E)R and NOPSEMA's Program commitments in the Program Report - Streamlining Offshore Petroleum Environmental Approvals, Program Report February 2014.

In the preparation of this EP, Beach have had regard to relevant policy documents, guidelines, Statements of Outstanding Universal Value, and plans of management as per the requirement of the Program.

Table 2-1: Conditions from the Otway Development (2002/621) Applicable to the Otway Offshore Operations

Condition No.	Condition	Relevant Section of EP
8	If the person taking the action proposes to undertake any subsea tie-in not included in approved plans pursuant to conditions 1, 3, 4 and 5, the person taking the action must revise such plans or submit a new plan or plans so as to address the activities associated with, and potential environmental impacts of, the subsea tie-in. Activities associated with subsea tie-ins may not be commenced until each such plan or revised plan has been approved by the Minister. Each plan or revised plan that has been approved by the Minister must be implemented. Note: subsea tie-in is not defined in the conditions dated 22 June 2015. The definition in conditions dated 13 April 2004 is "the construction and operation of eight subsea wells, flowlines and other related infrastructure within the development area for the purpose of extracting gas from the Thylacine and Geographe discoveries." Conditions dated 22 June 2015 do not have conditions 3 or 4.	This EP.
11	A plan required by condition 1, 3, 5, 8 or 9 is automatically deemed to have been submitted to, and approved by, the Minister if the	This EP.

Condition No.	Condition	Relevant Section of EP
	measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that: a) was submitted to NOPSEMA after 27 February 2014; b) either: (i) is in force under the OPGGS(E)R; or (ii) has ended in accordance with regulation 25A of the OPGGS(E)R.	
11B	Where an environment plan which includes measures specified in the conditions referred to in conditions 11 is in force under the OPGGS(E)R that relates to the taking of the action, the person taking the action must comply with those measures as specified in that environment plan.	This EP. Section 6.16 Environmental Performance Outcomes, Standards and Measurement Criteria Section 7 – Implementation Strategy

2.3 Commonwealth Requirements

Table 2-2: Commonwealth Environmental Requirements Relevant to the Otway Offshore Operations

Requirements	Scope	Related International Conventions	Administering Authority
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	he Aboriginal and Torres Strait Islander Heritage Protection Act 1984 enables the Australian Government to protect important Indigenous areas and objects under immediate threat, if it appears that state or territory laws have not provided effective protection. Areas or objects protected under this Act are included in the National Heritage List and Commonwealth Heritage List. **Application to activity**: Areas or objects protected under this Act may be present within the operational or planning area as detailed in Section 0.	-	Department of Climate Change, Energy, the Environment and Water (DCCEEW)
Australian Ballast Water Management Requirements (Commonwealth of Australia, 2020)	The Australian Ballast Water Management Requirements set out the obligations on vessel operators with regards to the management of ballast water and ballast tank sediment when operating within Australian seas. **Application to activity**: Provides requirements on how vessel operators should manage ballast water when operating within Australian seas to comply with the Biosecurity Act. Section 6.10 details these requirements in relation to the management of ballast water.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (adopted in principle in 2004 and in force on 8 September 2017)	Department of Agriculture, Fisheries and Forestry (DAFF)
Australia Biofouling Management Requirements (DAWE 2022)	The Australian biofouling management requirements set out vessel operator obligations for the management of biofouling when operating vessels under biosecurity control within Australian territorial seas. **Application to activity**: Provides requirements on how vessel operators should manage biofouling when operating within Australian seas to comply with the Biosecurity Act. Section 6.10 details these requirements in relation to the management of biofouling.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (adopted in principle in 2004 and in force on 8 September 2017)	DAFF
Australian Maritime Safety Authority Act 1990	This Act facilitates international cooperation and mutual assistance in preparing and responding to a major oil spill incident and encourages countries to develop and maintain an adequate capability to deal with oil pollution emergencies.	International Convention on Oil Pollution Preparedness, Response and Cooperation 1990	Australian Maritime Safety

Requirements	Scope	Related International Conventions	Administering Authority
	Requirements are effected through Australian Maritime Safety Authority (AMSA) who administers the National Plan for Maritime Environmental Emergencies (NatPlan). **Application to activity**: AMSA is the designated Control Agency for oil spills from vessels in Commonwealth waters. These arrangements are detailed in the OPEP.	Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000 International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969 Articles 198 and 221 of the United Nations Convention on the Law of the Sea 1982	Authority (AMSA)
Biosecurity Act 2015 Biosecurity Regulations 2016 Biosecurity Amendment (Biofouling Management) Regulations 2021	This Act is the primary legislation for the management of the risk of diseases and pests that may cause harm to human, animal or plant health, the environment and the economy. The objects of this Act are to provide for: (a) managing biosecurity risks; human disease; risks related to ballast water; biosecurity emergencies and human biosecurity emergencies; (b) to give effect to Australia's international rights and obligations, including under the International Health Regulations, the Sanitary and Phytosanitary Agreement and the Biodiversity Convention. **Application to activity**: The Biosecurity Act and regulations apply to 'Australian territory' which is the airspace over and the coastal seas out to 12 m from the coastline. For the activity the Act and regulations regulates vessels entering Australian territory regarding ballast water and hull fouling. Biosecurity risks associated with the activity are detailed in Section 6.10.	International Convention for the Control and Management of Ships' Ballast Water and Sediments (adopted in principle in 2004 and in force on 8 September 2017)	DAFF
Climate Change Act 2022 Climate Change (Consequential Amendments) Act 2022	The Act sets out Australia's greenhouse gas emissions reduction targets. It outlines Australia's greenhouse gas emissions reduction targets of a 43% reduction from 2005 levels by 2030 and net zero by 2050; requires the minister to prepare and table an annual climate change statement; requires the Climate Change Authority to give the minister advice in relation to the annual statement and future greenhouse gas	The Act itself does not impose obligations directly on companies, but its passage into law sets the scene for sector-based reforms to implement the 2030 target and emissions budget, which will impact businesses.	DCCEEW

Requirements	Scope	Related International Conventions	Administering Authority
	emissions reduction targets; and provides for periodic reviews of the operation of the Act. The Act operates as 'umbrella' legislation to implement Australia's net-zero commitments and codifies Australia's net 2030 and 2050 GHG emissions reductions targets under the Paris Agreement. **Application to activity**: GHG requirements are detailed in Section 6.3	The Safeguard Mechanism reforms, which will apply principally to the industrial and resources sectors, is one such measure.	
Environment 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 **Application to activity**: Petroleum activities are excluded from within the boundaries of a World Heritage Area (Sub regulation 10A(f)). The activity is not within a World Heritage Area. The EP must describe matters protected under Part 3 of the EPBC Act and assess any impacts and risks to these. Section 3.7 describes matters protected under Part 3 of the EPBC Act. The EP must assess any actual or potential impacts or risks to MNES from the activity. Section 6 provides an assessment of the impacts and risks from the activity to matters protected under Part 3 of the EPBC Act.	1992 Convention on Biological Diversity and 1992 Agenda 21 Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 Agreement between the Government and Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment 1974 Agreement between the Government and Australia and the Government of the People’s Republic of China for the Protection of Migratory Birds and their Environment 1986 Agreement between the Government of Australia and the Government of the Republic of Korea on The Protection of Migratory Birds 2006 Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 (Ramsar) International Convention for the Regulation of Whaling 1946	DCCEEW

Requirements	Scope	Related International Conventions	Administering Authority
		Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979	
Environment Protection and Biodiversity Conservation Regulations 2000	Part 8 of the regulations provide distances and actions to be taken when interacting with cetaceans. **Application to activity**: The interaction requirements are applicable to the activity in the event that a cetacean is sighted. Section 6 details how these requirements will be applied.	-	DCCEEW
Marine Pest Plan 2018–2023: National Strategic Plan for Marine Pest Biosecurity	Australia's national strategic plan for marine pest biosecurity. It outlines a coordinated approach to building Australia's capabilities to manage the threat of marine pests over the next five years. It represents agreed priorities and actions of governments, marine industries, and other stakeholders to achieve a common purpose: to manage the risks posed by marine pests and minimise their potential harm to marine industries, communities and the environment. **Application to activity**: Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species Section 6.10 details how these requirements will be applied.	-	DAFF
Minamata Convention on Mercury	Australia ratified the Minamata Convention on 7 December 2021. The Minamata Convention on Mercury is an international treaty that seeks to protect human health and the environment from anthropogenic (caused by humans) emissions and releases of mercury and mercury compounds. The Convention covers all aspects of the life cycle of mercury, controlling and reducing mercury across a range of products, processes and industries. This includes controls on: • Mercury mining. • Manufacture and trade of mercury and products containing mercury. • Disposal of mercury waste. • Emissions of mercury from industrial facilities.	Minamata Convention on Mercury	DCCEEW

Requirements	Scope	Related International Conventions	Administering Authority
	Countries that have ratified the Convention are bound by international law to put these controls in place. **Application to activity**: Disposal of mercury waste is undertaken onshore as per Beach's procedure Control of Mercury (INT-1000-SAF-PRO). Which aligns with the convention as the procedure defines that contaminated and potentially contaminated mercury waste require treatment and disposal at an appropriate licensed waste management facility.		
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry 2009	The guidance document provides recommendations for the management of biofouling risks by the petroleum industry. **Application to activity**: Applying the recommendations within this document and implementing effective biofouling controls can reduce the risk of the introduction of an introduced marine species. Section 6 details the requirements applicable to vessel activities.	Certain sections of International Convention for The Prevention of Pollution from Ships (MARPOL) International Convention for the Safety of Life at Sea 1974 Convention on the International Regulations for Preventing Collisions at Sea (COLREG) 1972	DAFF
National Greenhouse and Energy Reporting Act 2007 (NGER Act) National Greenhouse and Energy Reporting Regulations 2008 National Greenhouse and Energy Reporting (Measurement) Determination 2008	Establishes the legislative framework for the NGER Scheme which is a national framework for reporting greenhouse gas emissions, greenhouse gas projects and energy consumption and production by corporations in Australia. **Application to activity**: Reporting requirements under the NGER Act and associated regulations are detailed in Section 6.3	United Nations Framework Convention on Climate Change 1992.	Clean Energy Regulator

Requirements	Scope	Related International Conventions	Administering Authority
National Greenhouse and Energy Reporting (Audit) Determination 2009 National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015			
National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (CoA 2020a) Draft Ecological Communities (DCCEEW 2022)	The Guidelines outline the process to be followed where there is the potential for artificial lighting to affect wildlife. **Application to activity**: Applying the recommendations within this document and implementing effective controls can reduce the impact of light to sensitive receptors. Section 6.2 details the requirements applicable to the activity.	-	DCCEEW
National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna (Commonwealth of Australia, 2017a)	The overarching goal of the strategy is to provide guidance on understanding and reducing the risk of vessel collisions and the impacts they may have on marine megafauna. **Application to activity**: Applying the recommendations within this document and implementing effective controls can reduce the risk of the vessel collisions with megafauna. Section 6.11 details the requirements applicable to vessel activities.	-	DCCEEW

Requirements	Scope	Related International Conventions	Administering Authority
Native Title Act 1993 Native Title Legislation Amendment Act 2021	The main objects of this Act are: (a) to provide for the recognition and protection of native title; and (b) to establish ways in which future dealings affecting native title may proceed and to set standards for those dealings; and (c) to establish a mechanism for determining claims to native title; and (d) to provide for, or permit, the validation of past acts, and intermediate period acts, invalidated because of the existence of native title. **Application to activity**: Native Title or Indigenous Land Use Agreements may be present within the operational or planning area as detailed in Section 0.	-	Attorney-General's Department
Navigation Act 2012	This Act regulates ship-related activities 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 offshore petroleum activities, including: MO 21: Safety and emergency arrangements. MO 30: Prevention of collisions. MO 31: SOLAS and non-SOLAS certification. **Application to activity**: The relevant vessels (according to class) will adhere to the relevant MO with regard to navigation and preventing collisions in Commonwealth waters. Section 6 details the requirements applicable to vessel activities.	Certain sections of MARPOL International Convention for the Safety of Life at Sea 1974 COLREG 1972	AMSA
Offshore Petroleum and Greenhouse Gas Storage Act 2006 (OPGGS Act) OPGGS(E)R	The Act addresses all licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations extending beyond the three-nautical mile limit. Part 2 of the OPGGS(E)R specifies that an EP must be prepared for any petroleum activity and that activities are undertaken in an ecologically sustainable manner and in accordance with an accepted EP.	-	NOPSEMA

Requirements	Scope	Related International Conventions	Administering Authority
	Application to activity: The OPGGS Act provides the regulatory framework for all offshore petroleum exploration and production activities in Commonwealth waters, to ensure that these activities are carried out: consistent with the principles of ecologically sustainable development as set out in section 3A of the EPBC Act. so that environmental impacts and risks of the activity are reduced to ALARP. so that environmental impacts and risks of the activity are of an acceptable level. Demonstration that the activity will be undertaken in line with the principles of ecologically sustainable development, and that impacts and risks resulting from these activities are ALARP and acceptable is provided in Section 6.		
Protection of the Sea (Prevention of Pollution from Ships) Act 1983	This Act regulates Australian regulated vessels with respect to ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, garbage, air pollution etc. **Application to activity**: All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act. Several MOs 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. Section 6 details the requirements applicable to vessel activities.	Various parts of MARPOL	AMSA
Protection of the Sea (Harmful Antifouling Systems) Act 2006	Under this Act, it is an offence for a person to engage in negligent conduct that results in a harmful anti-fouling compound being applied to or present on a ship. The Act also provides that Australian ships must hold 'anti-fouling certificates', provided they meet certain criteria.	International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001	AMSA

Requirements	Scope	Related International Conventions	Administering Authority
	Application to activity: All ships involved in offshore petroleum activities in Australian waters are required to abide to the requirements under this Act. The MO 98: Marine Pollution Prevention – Anti-fouling Systems is enacted under this Act. Section 6 details the requirements applicable to vessel activities.		
Threat Abatement Plan for the impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (Commonwealth of Australia, 2018)	The plans focus on strategic approaches to reduce the impacts of marine debris on vertebrate marine life. **Application to activity**: Section 6.12 details the requirements applicable to vessel and platform activities.	-	DCCEEW
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. **Application to activity**: In the event of removal, damage or interference to shipwrecks, sunken aircraft or relics declared to be historic under the legislation, activity is proposed with declared protection zones, or there is the discovery of shipwrecks or relics. Section 4.2.5 provides information on known shipwrecks or sunken aircraft in the planning area.	Agreement between the Netherlands and Australia concerning old Dutch Shipwrecks 1972	DCCEEW

2.4 Victorian Requirements

Table 2-3: Victorian Environment Requirements Relevant to Potential Impacts and Risks to State Waters and Lands

Requirements	Scope	Application to Activity	Administering Authority
Aboriginal Heritage Act 2006 Aboriginal Heritage Regulations 2018	The Act acts primarily to provide for the protection of Aboriginal cultural heritage in Victoria. It does this through: • Establishing the Victorian Aboriginal Heritage Council. Council provides a state-wide voice for Aboriginal people and advises the Minister for Aboriginal Affairs on cultural heritage management. • Establishing Registered Aboriginal Parties. This allows Aboriginal groups with connections to country to be involved in cultural heritage decision making. • Establishing the Victorian Aboriginal Heritage Register. The register records details about Aboriginal places, objects, and knowledge. • Cultural Heritage Management Plans (CHMPs) and Cultural Heritage Permit processes, to manage activities that may impact Aboriginal cultural heritage. • Providing sanctions and penalties to prevent harm to Aboriginal cultural heritage. • Powers for Authorised Officers and Aboriginal Heritage Officers, and increased fees and charges for breaches of the Act. The Regulations) give effect to the Act. The Regulations prescribe standards, set out the circumstances in which a CHMP should be prepared and set fees and charges.	There is the potential for aboriginal heritage and Registered Aboriginal Parties within the operational and planning area. Section 0 identifies aboriginal heritage sites and Section 8 identifies any Registered Aboriginal Parties within the operational and planning area.	Aboriginal Victoria
Climate Change Act 2017	This Act provides Victoria with the legislative foundation to manage climate change risks, maximise the opportunities that arise from decisive action, and drive transition to a climate-resilient community and economy with net-zero emissions by 2050. The Act also requires 5-yearly interim emissions reduction targets to be set to keep Victoria on track to meet the state's long-term target of net-zero. Victoria’s interim target for the period 2021–2025 is for emissions to reduce 28–33% below 2005 levels by the end of 2025. The interim target for the period 2026–2030 is for emissions to reduce 45–50% below 2005 levels by the end of 2030.	Management of GHG emissions from activities within Victorian waters and land. Section 6.3 Atmospheric Emissions and Table 7 29: Environmental Performance Outcomes, Standards and Measurement Criteria - Operations detail how Beach Energy will manage Scope 1, 2 and 3 GHG emissions to meet Victoria’s GHG targets.	Environment Protection Authority (EPA)

Requirements	Scope	Application to Activity	Administering Authority
Environment Protection Act 1970 (& various regulations)	This is the key Victorian legislation which controls discharges and emissions (air, water) to the environment within Victoria (including state and territorial waters). It gives the Environment Protection Authority (EPA) powers to licence premises discharges to the marine environment, control marine discharges and to undertake prosecutions. Provides for the maintenance and, where necessary, restoration of appropriate environmental quality.	Otway Gas Plant activities, including management of emissions to air and discharges are subject to an operating licence issued by the EPA. Emissions to air subject to an EPA operating licence are reported annually to the EPA.	EPA
	The State Environment Protection Policy (Waters of Victoria) designates: • spill response responsibilities by Victorian Authorities to be undertaken in the event of spills (DoTP) with EPA enforcement consistent with the *Environment Protection Act 1970* and the *Pollution of Waters by Oil & Noxious Substances Act 1986*. • requires vessels not to discharge to surface waters sewage, oil, garbage, sediment, litter or other wastes which pose an environmental risk to surface water beneficial uses. To 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 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 which leachates 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 waters. 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 ballast water contained on their ships (i.e. domestic/international), and to manage domestic ballast water discharges with EPA written approval.	Oil pollution management in Victorian State waters. Discharge of domestic ballast water from emergency response vessels into Victorian State waters must comply with these requirements.	

Requirements	Scope	Application to Activity	Administering Authority
Emergency Management Act 2013 (& Regulations 2003)	Provides for the establishment of governance arrangements for emergency management in Victoria, including the Office of the Emergency Management Commissioner and an Inspector-General for Emergency Management. Provides for integrated and comprehensive prevention, response and recovery planning, involving preparedness, operational co-ordination and community participation, in relation to all hazards. These arrangements are outlined in the Emergency Management Manual Victoria.	Emergency response structure for managing emergency incidents within Victorian State waters. Emergency management structure will be triggered in the event of a spill impacting or potentially impacting State waters. See OPEP.	Department of Justice and Regulation (Inspector General for Emergency Management)
Flora and Fauna Guarantee Act 1988 (& Regulations 2011)	The purpose of this Act is to protect rare and threatened species; and enable and promote the conservation of Victoria's native flora and fauna and to provide for a choice of procedures that can be used for the conservation, management or control of flora and fauna and the management of potentially threatening processes. Where a species has been listed as threatened an Action statement is prepared setting out the actions that have or need to be taken to conserve and manage the species and community.	Triggered if an incident results in the injury or death of a FFG Act listed species (e.g. collision with a whale).	Department of Energy, Environment and Climate Action (DEECA)
Heritage Act 1995	The purpose of the Act is to provide for the protection and conservation of historic places, objects, shipwrecks and archaeological sites in state areas and waters (complementary legislation to Commonwealth legislation). Part 5 of the Act is focused on historic shipwrecks, which are defined as the remains of all ships that have been situated in Victorian State waters for 75 years or more. The Act addresses, among other things, the registration of wrecks, establishment of protected zones, and the prohibition of certain activities in relation to historic shipwrecks.	May be triggered in the event of impacts to a known or previously un-located shipwreck in Victorian State waters whilst undertaking emergency response activities.	Heritage Victoria
Marine and Coastal Act 2018	The Act establishes clear objectives and new guiding principles that specifically recognise climate change and Traditional Owners. It also provides better direction for managers 'on the ground'.	Applies where there are activities within Victorian State waters.	DEECA

Requirements	Scope	Application to Activity	Administering Authority
Marine Safety Act 2010 (& Regulations 2012)	Act provides for safe marine operations in Victoria, including imposing safety duties on owners, managers and designers of vessels, marine infrastructure and marine safety equipment; marine safety workers, masters and passengers on vessels; regulation and management of vessel use and navigation in Victorian State waters; and enforcement provisions of Police Officers and the Victorian Director of Transport Safety. This Act reflects the requirements of international conventions - *Convention on the International Regulations for Preventing Collisions at Sea & International Convention for the Safety of Life at Sea*. The Act also defines marine incidents and the reporting of such incidents to the Victorian Director of Transport Safety.	Applies to vessel masters, owners, crew operating vessels in Victorian State waters.	Maritime Safety Victoria
National Parks Act 1975	Established a number of different types of reserve areas onshore and offshore, including Marine National Parks and Marine Sanctuaries. A lease, licence or permit under the OPGGS Act 2010 that is either wholly or partly over land in a marine national park or marine sanctuary is subject to the *National Parks Act 1975* and activities within these areas require Ministerial consent before activities are carried out.	Applies where there are activities within marine reserve areas.	DEECA
OPGGS Act 2010 and OPGGS Regulations 2011	The Act and Regulations apply to petroleum operations within three nautical miles of the Victorian coast and address licensing, health, safety, environmental and royalty issues for offshore petroleum exploration and development operations. Waters greater than 3 nautical miles offshore from the coast are Commonwealth waters and are covered by Commonwealth legislation (OPGGS Act 2006). The Commonwealth and Victorian legislation are, by agreement, very similar with regard to petroleum.	Applies where there are activities within Victorian State waters.	DEECA

Requirements	Scope	Application to Activity	Administering Authority
Pollution of Waters by Oil and Noxious Substances Act 1986 (POWBONS) (& Regulations 2002)	The purpose of the *Pollution of Waters by Oils and Noxious Substances Act 1986* (POWBONS) is to protect the sea and other waters from pollution by oil and noxious substances. This Act also implements the MARPOL Convention (the International Convention for the Prevention of Pollution from Ships 1973) in Victorian State waters. Requires mandatory Reporting of marine pollution incidents. Act restricts within Victorian State waters the discharge of treated oily bilge water according to vessel classification (>400 tonnes); discharge of cargo substances or mixtures; prohibition of garbage disposal and packaged harmful substances; restrictions on the discharge of sewage; regulator reporting requirements for incidents; ship construction certificates and survey requirements. Restriction on discharges within Victorian State waters incorporated into EP.	Triggered in the event of a spill impacting or potentially impacting State waters.	Jointly administered by DEECA and EPA
Wildlife Act 1975 (& Regulations 2013)	The purpose of this Act is to promote the protection and conservation of wildlife. Prevents wildlife from becoming extinct and prohibits and regulates persons authorised to engage in activities relating to wildlife (including incidents). The *Wildlife (Marine Mammal) Regulations 2009* prescribe minimum distances to whales and seals/seal colonies, restrictions on feeding/touching and restriction of noise within a caution zone of a marine mammal (dolphins (150 m), whales (300 m) and seals (50 m).	Applies where vessels are within State waters responding to a spill event. Prescribed minimum proximity distances to whales, dolphins and seals will be maintained. Triggered if an incident results in the injury or death of whales, dolphins or seals.	DEECA

2.5 Tasmanian Requirements

Table 2-4: Tasmanian Environment Requirements Relevant to Potential Impacts to State Waters and Lands

Requirements	Scope	Application to Activity	Administering Authority
Aboriginal Heritage Act 1975	The Act is the primary legislation for the protection of Aboriginal cultural heritage in Tasmania.	There is the potential for aboriginal heritage within the operational and planning area. No aboriginal heritage sites were identified within the planning area.	Department of Premier and Cabinet
Environmental Management and Pollution Control Act 1994 (EMPCA) (& Regulations)	EMPCA is the primary environment protection and pollution control legislation in Tasmania. It is a performance-based style of legislation, with the fundamental basis being the prevention, reduction and remediation of environmental harm. The clear focus of the Act is on preventing environmental harm from pollution and waste. Relevant regulations under the EMPCA include: • Environmental Management and Pollution Control (General) Regulations 2017 • Environmental Management and Pollution Control (Waste Management) Regulations 2010 The EPA Division Compliance Policy provides the Director of the EPA powers of compliance.	Defines the EPA's jurisdiction during a spill event. Prescribes the fee structure to waste events and environmental protection notices. Regulates the management and control of controlled wastes. See OPEP	Department of Natural Resources and Environment Tasmania (DNRET)
Nature Conservation Act 2022	An Act to make provision with respect to the conservation and protection of the fauna, flora and geological diversity of the State, to provide for the declaration of national parks and other reserved land and for related purposes.	Marine and terrestrial protected areas were identified within the planning area (Section 4.2.10 and 4.2.11).	Tasmania Parks and Wildlife Service
Pollution of Waters by Oil and Noxious Substances Act 1987	Pollution of the sea in Tasmanian State waters may be regulated by general pollution laws such as the EMPCA (see above), but the Pollution of Waters by Oil and Noxious Substance Act 1987 deals specifically with discharges of oil and other pollutants from ships. In accordance with current national arrangements, the Pollution of Waters by Oil and Noxious Substance Act 1987 gives effect in Tasmania to the MARPOL international convention on marine pollution.	Gives effect to MARPOL in Tasmanian waters.	DNRET

3 Description of the Activity

3.1 General Description and Location

The Otway Gas Development operations consist of producing natural gas including condensate from the Geographe and Thylacine fields which is processed onshore at the Otway Gas Plant located approximately 7 km northeast of Port Campbell. The Thylacine field is approximately 70 km offshore from Port Campbell, Victoria in approximately 100 m of water and the Geographe reservoir is approximately 55 km offshore in ~85 m of water.

This EP is a revision to the recently accepted EP (August 2022) to address potentially new or increased environmental impacts or risks as per Regulation 17(6) of the Offshore Petroleum and Greenhouse Gas Storage (Environment) Regulations 2009.

The current reserves forecast has an end of field life of 2037. Over this period the fields are expected to supply approximately:

- 494 billion cubic feet of gas, equivalent to 394 petajoules of sales gas.
- 5 million barrels of condensate.
- 0.6 million tonnes of LPG.

End of field life and recovery of resources are dependent on several factors including operational performance and possible future field developments which may lead to the end of field life extending beyond 2037. Section 3.7 provides further information the triggers and processes for decommissioning. Note that decommissioning of facilities is not included within the scope of this EP. An overview of the steps that will be taken prior to decommissioning are discussed further in section 3.7 below.

3.2 Operational Area

The operational area is defined as the area where activities managed under this EP will occur. For this petroleum activity, the operational area is a 500 m buffer around all subsea infrastructure and wells, including the Otway Pipeline System (Figure 3-1).

The indicative coordinates, petroleum titles, approximate water depth and distance from Port Campbell are presented in Table 3-1 for the main infrastructure components of the Otway Gas Development. Section 3.4.5 details the status of the main components of infrastructure associated with the Otway offshore operations.

Table 3-1: Otway Gas Development Main Infrastructure Locations

Infrastructure	**Title**	**Location**		**Water depth (m)**	**Distance from Port Campbell (km)**
		Latitude	**Longitude**		
Artisan-1 (A-1)	Vic/P43	38° 53.490' S	142° 52.948' E	~71 m	~32 km
Geographe-1 (G-1)	Vic/L23	39° 06.696' S	142° 55.731' E	~85 m	~55 km
Geographe-2 (G-2)	Vic/L23	39° 06.4945' S	142° 57.1033' E	~84 m	~54 km
Geographe-3 (G-3)	Vic/L23	39° 06.487' S	142° 57.097' E	~83.4m	~54 km
Geographe-4 (G-4)	Vic/L23	39° 06.494' S	142° 57.068' E	~84 m	~54 km
Geographe-5 (G-5)	Vic/L23	39° 06.480' S	142° 57.086' E	~84 m	~54 km
Thylacine-1 (T-1)	T/L2	39° 14.370' S	142° 54.819' E	~101 m	~69.5 km
Thylacine North-1 well (TN-1)	T/L2	39° 12.510' S	142° 52.496' E	~100 m	~66 km
Thylacine North-2 well (TN-2)	T/L2	39° 12.284' S	142° 51.557' E	~99 m	~66 km
Thylacine West-1 well (TW-1)	T/L2	39° 13.338' S	142° 50.318' E	~105 m	~68 km
Thylacine West-2 well (TW-2)	T/L2	39° 13.332' S	142° 50.310' E	~103 m	~68 km
Thylacine-A Wellhead Platform including platform wells TA-1, TA-2, TA-3, TA-4	T/L2	39° 14.402'S	142° 54.601' E	~101 m	~69.1 km
Geographe tee	Vic/PL36	39° 06.547'S	142° 55.719' E	~85 m	~55.4 km
Otway Gas Pipeline Hot tap tee X	Vic/PL36	38° 56.637'S	142° 57.627' E	~72 m	~35.3 km
Otway Gas Pipeline Hot tap tee Y	Vic/PL36	38° 51.909'S	142° 57.550' E	~66 m	~27 km
HDD offshore entry point	Vic/PL36(V)	38° 37.153'S	142° 58.454' E	~6 m	~2.2 km

Coordinates are provided as GDA94

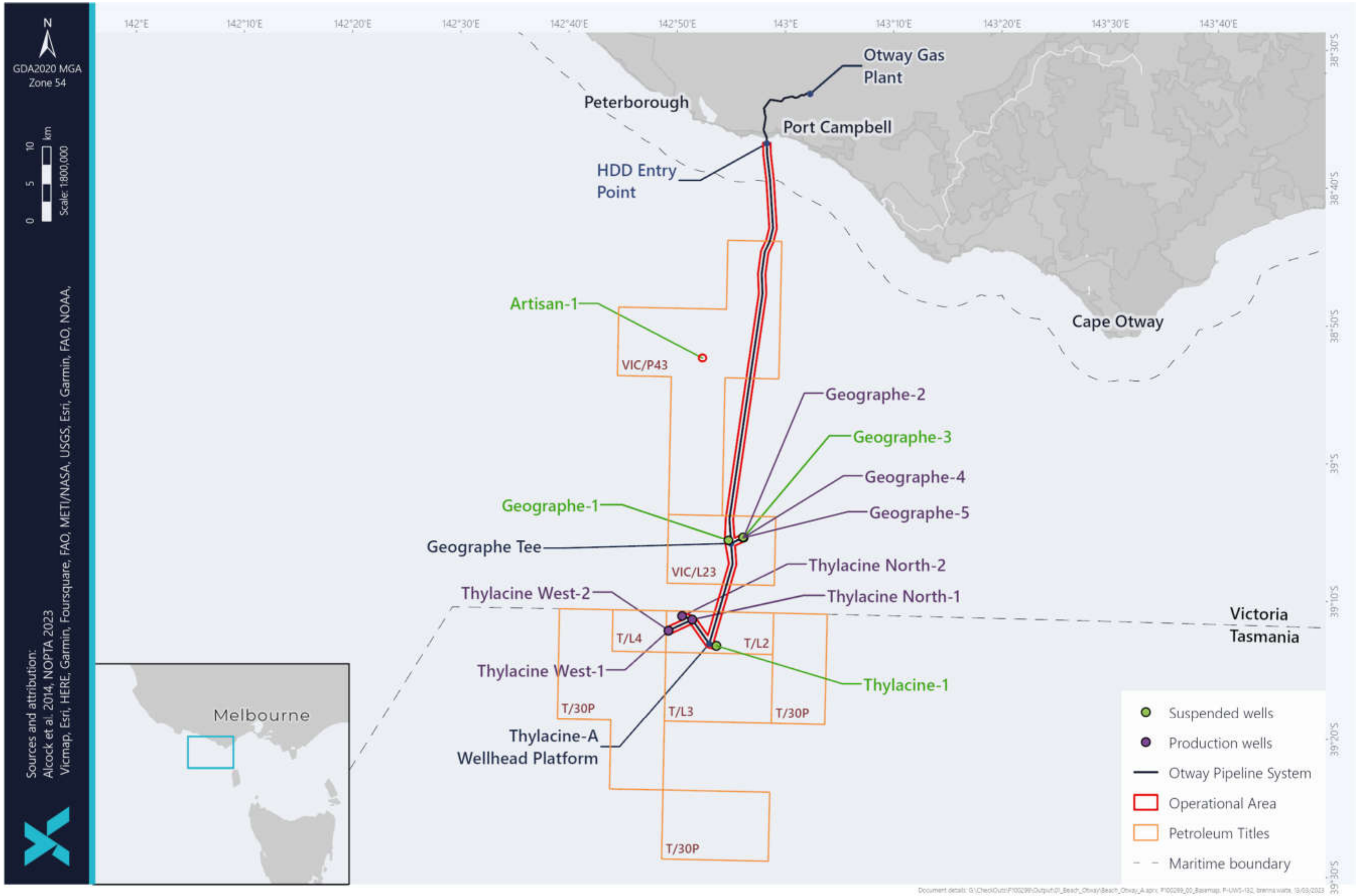


Figure 3-1: Otway Offshore Development Location and Operational Area

3.3 Field Characteristics

The Thylacine and Geographe field fluids are a mixture of reservoir gas, associated liquids, condensed water and formation water. The Thylacine and Geographe fields consist of natural gas reservoirs with associated condensate. No heavy oil is present. Condensate is a light hydrocarbon liquid comprised of C5 to C12 hydrocarbon compounds.

The condensate from the Geographe field is a light condensate with density of 0.751 g/cm^3 and viscosity of approximately 0.5cP at 25ºC. The condensate at Thylacine is again a light condensate with a slightly higher density of 0.805g/cm^3 and a viscosity of approximately 0.88cP at 20ºC. The reservoir properties for Thylacine and Geographe are provided in Table 3-2 and condensate boiling point ranges are provided in Table 3-3.

The composition of well fluids from the Thylacine-A Wellhead Platform and Geographe production wells are shown in Table 3-4. The composition of the Thylacine subsea wells fluid composition is the same as for TA-1.

The condensate ratio ranges from 10 to 20 barrels per 1 million standard cubic feet (MMSCF) of gas, dependent on the field, well and retrograde effects. Hydrogen sulphide (H_2S) exists in small quantities and the production system is designed for a concentration of 20 ppmv as a contingency in the event of an increase in H_2S levels. Combined Thylacine/Geographe raw gas at the plant inlet is tested quarterly for H_2S, test in January 2023 was 6 ppmv.

Other well fluid constituents (e.g. BTEX, mercury, organic acid salts, radon, naturally occurring radioactive material (NORMs) may be present in the well fluids.

The design allowance for mercury is 25 µg/m^3 in the gas and 40 ppb in the condensate. Traces of mercury have been detected in the condensate stream from the Thylacine and Geographe fields. Combined Thylacine/Geographe raw gas at the plant inlet is tested quarterly for mercury, test results in February 2023 were 7 µg/m^3. Combined Thylacine/Geographe condensate at the inlet of the Mercury Removal Unit is tested quarterly for mercury, test results in February 2023 were 8 ppb.

There has been no indication of NORMs/ Radon to date.

BTEX is defined as the light aromatic content of the reservoir fluid and largely comprises benzene, toluene, ethyl-benzene and xylenes. The design allowance for BTEX is 0.25 mol% in each well stream.

Table 3-2: Reservoir Physical Characteristics

Parameter	**Thylacine Condensate**	**Geographe Condensate**
Density (kg/m^3)	805 at 15ºC	751 at 15ºC
API	44.3	56.9
Dynamic viscosity (cP)	0.875 at 20ºC	0.500 at 25ºC
Pour point (ºC)	-50	-50
Oil category	Group I	Group I
Oil persistence classification	Non-persistent oil	Non-persistent oil

Table 3-3: Condensate Boiling Point Ranges

Parameter	**Volatiles (%)**	**Semi-volatiles (%)**	**Low-volatiles (%)**	**Residual (%)**
Boiling point (ºC)	<180	180-265	265-380	>380
Thylacine Condensate	64.0	19.0	16.0	1
Geographe Condensate	78.4	13.4	7.2	1
	⇦	Non-Persistent	⇨	⇦ Persistent ⇨

Table 3-4: Typical Well Fluid Composition

	Thylacine Field				Geographe Field		
Component	**TA-1**	**TA-2**	**TA-3**	**TA-4**	**G-2**	**G-4**	**G-5**
Carbon dioxide, CO2	10.04	9.49	9.69	9.55	4.309	5.717	1.679
Nitrogen, N2	1.42	1.46	1.45	1.31	1.700	1.584	2.313
Methane, C1	80.08	79.95	80.08	80.92	80.908	81.296	79.865
Ethane, C2	5.06	5.01	5.25	4.87	7.129	6.483	8.472
Propane, C3	1.82	1.71	1.89	1.64	2.950	2.565	4.057
iso-Butane, iC4	0.31	0.28	0.33	0.27	0.500	0.384	0.693
n-Butane, nC4	0.43	0.35	0.44	0.38	0.730	0.57	0.994
iso-Pentane, iC5	0.18	0.13	0.19	0.16	0.260	0.1986	0.343
n-Pentane, nC5	0.11	0.09	0.13	0.11	0.210	0.148	0.269
C6	0.27	0.48	0.28	0.28	0.250	0.253	0.369
C7	0.16	0.69	0.16	0.21	0.410	0.39	0.522
C8	0.047	0.181	0.047	0.126	0.310	0.1377	0.129
C9	0.025	0.057	0.034	0.053	0.110	0.1015	0.1
C10	0.014	0.026	0.024	0.034	0.060	0.06	0.0593
C11	0.0095	0.0112	0.0031	0.0179	0.040	0.0345	0.0361
C12A	0.0069	0.0146	0.0045	0.0134	0.039	0.02	0.024
C12B	0.0114	0.0296	0.0044	0.0252	0.027	0.039	0.049
C12C	0.0085	0.0303	0.0041	0.0241	0.038	0.014	0.0189
C12D	0.0055	0.0036	0.0022	0.0125	0.020	0.004	0.006
C12E	0.0013	0.0001	0.0005	0.0029	0.002	0.0006	0.0005

Note: C7 and upwards indicates heavier hydrocarbons than hexane, C6. The C6 to C12E are pseudo components based on the Fluid and Reservoir Properties Basis of Design Data Sheet.

3.4 Facilities and Infrastructure Description

Facilities and infrastructure associated with the recovery of natural gas from the Thylacine and Geographe fields are detailed in this section. Figure 3-2 provides an overview of the Thylacine and Geographe operations infrastructure described in this section.

3.4.1 Thylacine-A Wellhead Platform

The Thylacine-A Wellhead Platform is a steel jacket structure with topsides consisting of an integrated deck on four levels. The platform is designed to be operated as a normally unmanned installation. It is remotely operated from the Otway Gas Plant Central Control Room via duplicated communication links giving a high availability for the control and shutdown systems. All offshore equipment is capable of being started, stopped, controlled and monitored (including all process variables) from the Otway Gas Plant and where necessary this control is automated. All processes associated with normal operation are controlled from the Otway Gas Plant, including well valves and chokes, MEG supply, methanol and chemical injection and depressurisation.

The Integrated Control System on the platform (comprising the process control system, Emergency Shutdown and fire and gas systems) is designed for autonomous operations and shuts the platform down after a time delay or loss of communication with the Otway Gas Plant.

The Otway Gas Pipeline and MEG Pipeline risers are located inside the jacket structure and connect to a subsea umbilical.

Utilities required to support platform operations are described in Table 3-5. Sand removal facilities were initially installed but have been isolated (by physical barriers) as there is no evidence of sand production from the wells. Produced formation water is transported with the gas and other reservoir liquids to the Otway Gas Plant.

The Thylacine-A Wellhead Platform has aviation risks associated with the presence of migratory birds roosting on the platform. Several improvements have been made to the platform to deter birds from roosting including non-injuring bird spikes, anti-perching wires, sea water pump and spray system and primary and secondary horns sounded on helicopter arrival. The bird deterrent sea water pump and spray system is defined as a safety critical element within the platform’s register of Safety Critical Equipment for the prevention of a bird strike and a consequential helicopter related Major Accident Event.

Further information regarding the design and operating philosophy and the management of hazards and risks associated with the Thylacine-A Wellhead Platform is provided in the Thylacine-A Platform Safety Case (CDN/ID 17264708).

Figure 3-2: Beach Otway Development Infrastructure

Table 3-5 Thylacine-A Wellhead Platform Utilities

Utility	Description
Power Generation	Platform power is generated from two gas engines; one normally operating and one standby. A diesel generator (and associated diesel storage) can be installed on the platform to provide emergency power in the event the gas engines are not operational or to provide additional power in the event of a major campaigns (e.g. shutdown or well intervention).
Drains and Vents	All hydrocarbon depressurising, venting and relief devices are connected to the collection system and routed to the Drain Vessel for liquid removal prior to atmospheric discharge through the vent tip. Closed drain piping from the Pig Launcher and Fuel Gas Knockout Drum are also routed to the vent system for liquid removal in the drain vessel. The Drain Vessel not only accumulates liquid from equipment/piping maintenance drainage but also acts as a vent knockout drum separating liquid from gas released during blowdown. Liquid collected in the drain vessel is pumped to the Otway Gas Pipeline by the two drain pumps operating in lead/lag mode. The gas disposal system is required to safely collect and dispose of fluids released during continuous operation, pressure relief (including a fire event), maintenance depressurisation activities and Emergency Shutdown initiated blowdown. Atmospheric venting was selected over flaring because of its inherent simplicity and reliability. The platform has no interconnected open drains system. A collection pan with local isolation valve has been provided should a liquid release during maintenance or operational activities occur. These local isolation valves are normally closed during operation and maintenance.
Chemical injection	MEG distribution system: The MEG Pipeline provides MEG and corrosion inhibitor to protect the Otway Gas Pipeline. A MEG injection system controls and monitors the supply of hydrate and corrosion inhibitor delivered to the process. Methanol: Methanol is used for the initial start-up of the Geographe wells and is injected at the subsea wellheads via the main umbilical. The methanol injection system on the wellhead platform consists of a methanol storage/transfer tank, a single pump, and injection piping. This injection system feeds into the umbilical via the Topside Umbilical Termination unit. Other chemicals: Chemical injection may be required for the following: • Scale inhibitor injection. • Batch dosing of corrosion inhibitor into the Otway Gas Pipeline during V-jet pigging If required, temporary tanks would be connected to the MEG injection system via drain points.
Service water	The service water system receives and stores fresh water for process wash-down, personnel washing purposes and safety shower.
Heating, ventilation and air conditioning systems	Temperature in the equipment control room is controlled using Heating, Ventilation and Air Conditioning systems. In the event that the ventilation system shuts down whilst the Platform is unattended the ventilation system and the Subsea Power and Control Unit are equipped with a remote reset facility which enables remote re-start from the Otway Gas Plant.
Stored Chemicals and Other Hazardous Substances	Table 3-6 details the main hazardous substances and typically inventories stored on platform.

Table 3-6: Hazardous Substances and Typical Inventories Stored on Thylacine-A Wellhead Platform

Substance	Typical Inventory	Comments
Methanol	3,000 L	Stored in a dedicated double-skinned methanol tank. Tank capacity is 4,600L.
Diesel	2000 L	Crane fuel tank. Additional diesel may be required for a diesel driven temporary power generator during a shutdown campaign.
LPG	8 x 45 kg cylinders	LPG bottles may be required as back-up fuel supply to gas engines.
Carbon Dioxide	6 x G cylinders	CO_2 used for snuffing the vent system.
Nitrogen Gas	45 x G cylinders	Nitrogen bottles may be required for purging.
Hydraulic Fluid	1000 L	Hydraulic Fluid for Hydraulic Power Unit (HPU) is Oceanic HW-443 control fluid.
	Over 5,000 L	Contained within HPU supply and return tanks and within umbilicals to Thylacine and Geographe wells.
Miscellaneous	Up to 20 L containers	Cleaning/maintenance chemicals, paint/thinners, grit, lubricant/gear oils.

3.4.1.1 Emergency Shutdown and Isolation Systems

Instrumentation on subsea infrastructure provides a range of continuous monitoring data, such as pressure, temperature and flowrate. Where any of the monitored parameters fall outside of the pre-defined set points the emergency shutdown system is activated.

The shutdown system comprises of four levels:

- Unit Shutdown causes an individual piece of equipment to close-in without affecting the rest of the facilities.
- Process Shutdown shuts in the wellheads and leaves the platform pressurised for a fast re-start, gas engine generators continue to run for AC power supply.
- Emergency Shutdown (ESD) shuts in the platform (wellheads and Otway Gas Pipeline) and the gas engine generators are tripped so that AC power supply is unavailable.
- Total Platform Shutdown shuts in the wells at the Surface Controlled Subsurface Safety Valves and ensures Pipeline Riser Emergency Shutdown Valves are shut to activate blowdown and de-pressurise the Topsides. This decreases the potential for piping or equipment rupture and limits consequences of fire by safely removing both the fuel source and equipment inventory.

Safety critical subsea shutdowns will be achieved by using the Safety Instrumented System to vent the hydraulic supplies on the Thylacine Hydraulic Power Unit using fail safe (normally-energised) solenoid-controlled dump valves. The dump valves will fail open in the event of failure/fault or loss of function in the Safety Instrumented System. Loss of hydraulic supply pressure at the Subsea Control Modules at the subsea trees will result in fail- safe closure of all hydraulic functions, causing the subsea valves to fail closed (with the exception of the choke and MEG injection valves on the Xmas trees).

3.4.1.2 Platform Wells

There are four production wells on the Thylacine-A Wellhead Platform producing gas from the Thylacine field (TA-1, TA-2, TA-3, TA-4). Well stream production from the Thylacine wells is received on the Thylacine-A Wellhead Platform and transferred to the Otway Gas Plant via the Otway Gas Pipeline (refer to Section 3.4.2).

All four wells are platform wells with surface wellheads. The wells have surface trees with a Surface Controlled Subsurface Safety Valve, with the exception of TA-3 that has a Wireline Retrievable Subsurface Safety Valve due to failure of the Surface Controlled Subsurface Safety Valve during testing in 2012, and a platform wellhead with a Production Master Valve and Production Wing Valve to provide triple isolation from the reservoir. These valves are designed to fail closed. The valves are hydraulically operated from the Thylacine platform but can also be operated remotely from the Otway Gas Plant.

Each well has been fitted with a choke valve to allow flow control. The choke operations are by remote manual setting. Choke position feedback is provided to confirm the setting, and an alarm is initiated if the position registered is different to that set. These valves are controlled via the communications link with the Otway Gas Plant.

Further details on the wells are provided in the Thylacine Well Operations Management Plan (WOMP) [TA-1, TA-2, TA-3, TA-4, TN-1, TN-2, TW-1, and TW-2] (CDN/ID 4411890).

3.4.2 Otway Pipeline System

The Otway Pipeline System consists of two subsea pipelines – the Otway Offshore Gas Pipeline (Otway Gas Pipeline) and the MEG piggyback service pipeline (MEG pipeline). Figure 3-1 shows the path of the Otway Pipeline System. Stabilisation of the Otway Pipeline System is currently achieved using mattress (typically 5 m x 3 m) and rock bolts.

The Otway Gas and MEG Pipelines are equipped with Emergency Shutdown and isolation valves at the risers at the Thylacine-A Wellhead Platform and at the Otway Gas Plant.

The Otway Pipeline System is described in detail in the Otway Pipeline System Safety Case (CDN/ID 17265477), which also provided information regarding the design and operating philosophy.

3.4.2.1 Otway Gas Pipeline

The 500 mm (20”) Otway Gas Pipeline transports produced gas and well fluids from the Thylacine-A Wellhead Platform and Geographe wells to the Otway Gas Plant.

The Otway Gas Pipeline connects to the foot of the Production Riser at the Thylacine-A Wellhead Platform and runs approximately 14 km along the sea floor in a direct route to the Geographe tee for the Geographe subsea production manifold and then runs approximately 55 km in a direct route to the Horizontal Directional Drilled shore crossing at the Port Campbell Rifle Range. The physical boundaries of the Otway Gas Pipeline are from the riser Emergency Shutdown Valve at the platform to the isolation valve at the Otway Gas Pipeline inlet.

There are two hot tap tees located on the Otway Offshore Gas pipeline – Hot Tap Tee X and Hot Tap Tee Y – which allow for connection to be made to a live (“hot”) pipeline without shutting down production. The hot tap tees are covered by protection frames.

The risers, submerged pipelines, shore crossings and onshore buried pipelines have protective coatings to prevent external corrosion. The Otway Gas Pipeline is stabilised by a concrete weight coat along its length and in some sections mattress and rock bolts are used. The risers are located inside the Thylacine-A Wellhead Platform jacket structure for protection from impacts. Sacrificial anodes are installed along the full length of the Pipeline System to provide protection in case of coating damage. No internal pipe coating is provided, and internal corrosion is controlled by material selection and by the continuous injection of corrosion inhibitor with MEG into the Otway Gas Pipeline at the Thylacine-A Wellhead Platform.

Carbon dioxide levels in the production fluids are generally high (Table 3-4), which when combined with saturated water, makes the service conditions corrosive when untreated. Internal corrosion is primarily controlled by suitable material selection (Corrosion Resistant Alloy (CRA)/ duplex stainless steel at critical locations), continuous injection of corrosion inhibitor and pH stabiliser and taking appropriate action when on-line corrosion rate measurements become excessive. The addition of pH stabiliser is to neutralise organic acids accumulating in the MEG stream and address Top of Line corrosion.

3.4.2.2 MEG Pipeline

The 100 mm (4”) MEG Pipeline transports MEG and other chemicals (e.g. corrosion inhibitor) from the Otway Gas Plant to the Thylacine-A Wellhead Platform and Geographe and Thylacine subsea infrastructure for continuous injection into the Otway Gas Pipeline.

MEG is injected into the well stream at Thylacine to prevent hydrates forming in the Otway Gas Pipeline, and at the Geographe and Thylacine wellheads to prevent hydrates forming in the flowline to the Otway Gas Pipeline. A MEG injection system is provided to control and monitor the supply of hydrate suppression and corrosion inhibitor delivered to the process. The Thylacine-A Wellhead Platform topsides process piping is entirely duplex stainless steel, which is a corrosion resistant alloy and as such should not suffer from dead leg corrosion. Likewise, partial filming is not an issue with the piping as it does not suffer from corrosion by the production fluids.

The MEG Pipeline follows the Otway Gas Pipeline along its entire route in the reverse direction; from the Otway Gas Plant to the Thylacine-A Wellhead Platform. It is laid in the same buried trench as the Otway Gas Pipeline onshore and piggybacks the Otway Gas Pipeline for the subsea sections. The MEG Pipeline has a separate Horizontal Directional Drilled hole for the shore crossing.

The MEG delivery operates entirely within a closed system. MEG is supplied by positive displacement type pumps, located at the Otway Gas Plant. The MEG Pipeline has tie-ins and spare capacity for supplying both the Thylacine and Geographe wells, and future wells. Pipeline overpressure protection from the MEG injection pumps is provided onshore.

MEG flow is controlled offshore at Thylacine-A Wellhead Platform. The system is designed so that the MEG flow (controller set point) is calculated to achieve 30 to 40 wt% MEG in the aqueous phase onshore. The calculation considers gas flow and temperature to determine additional condensed water to the multiphase flow meter reading. The multiphase flow meter reading also directs MEG flow into the system.

The MEG in the MEG Pipeline is a typically 80-90 wt% MEG: 10-20 wt% water mixture plus a corrosion inhibitor and alkyl hydroxide. Some other chemicals may also be present, and these could include some residual hydrocarbons, anti-scale, biocide, demulsifier and anti-foam.

3.4.3 Geographe and Thylacine Subsea Systems

3.4.3.1 Geographe System

The Geographe subsea infrastructure consists of the following major components:

- Three subsea production wellheads (G-2, G-4 and G-5), located at the Geographe well sites.
- Three subsea Xmas trees (one at each production well) and a Subsea Control Module. Each Xmas trees has a rigid production spools to connection.
- Three wet gas meters; one downstream from G-2, G-4 and G-5.
- One subsea Xmas Tree for G-3 suspended well, including a Subsea Control Module.
- Subsea Distribution Unit. Each Xmas tree has electrical and hydraulic control lines (flying leads) to connect to the Subsea Distribution Unit.
- Umbilical Termination Assembly for connecting the main umbilical from Thylacine-A Wellhead Platform to the Subsea Distribution Unit.
- Two subsea coolers; Subsea Manifold Cooler and Subsea Heat Exchange, arranged in series and connected by a Cooler tie-in spool. Coolers may be required to reduce the temperature of the Geographe well fluids before entering the Otway Gas Pipeline to avoid Top of Line corrosion issues.

The Geographe Tee is where the Geographe subsea infrastructure connects to the Otway Pipeline System. At the Geographe Tee, there is a Subsea Valve Skid and an Umbilical Termination Assembly, which connects the in-field umbilical to the Subsea Valve Skid. The hydraulically actuated isolation valves located at the Subsea Valve Skid can be used to isolate the Geographe production fluids from the Otway Gas Pipeline, and to isolate the MEG supply to the Geographe subsea facilities. They also prevent water ingress into the Otway Gas Pipeline in case of any leaks into the Geographe production system.

Interconnections include:

- 1.8 km flexible flowline (11”) from Subsea Heat Exchange to the Subsea Valve Skid at the Geographe Tee.
- 16 km umbilical from the Thylacine-A Wellhead Platform to the Umbilical Termination Assembly in the Geographe Field, complete with an inline break-out box Umbilical Termination Assembly previously used to communicate with the Pipeline Corrosion Monitoring spool.
- 1.9 km in-field umbilical between the Subsea Distribution Unit and the Subsea Valve Skid at the Geographe Tee.
- Electrical and hydraulic flying leads.

The Geographe subsea infrastructure is controlled via two umbilicals which deliver hydraulic and electrical power, communications, and chemicals (MEG, methanol) services. The design also allows for future injection of scale inhibitor from the platform if required.

Stability and protection to interconnections and subsea facilities are provided by concrete mattresses (typically 5 m x 3 m) on the in-field umbilical, spools and main umbilical; grout bags to stabilise the electrical and hydraulic flying leads; inflatable grout bags for spool support (1-2 per spool); and protection covers for the Geographe Tee. The Geographe Tee on the Otway Pipeline System and the Subsea Valve Skid have rock bolts, mattresses, and grout bags. Stabilisation is not required on the flexible flowline and based on the known seabed surveys no spans of any significant length have been identified.

During the Geographe well installation and commissioning campaign some redundant electrical and hydraulic flying leads were not able to be recovered due to them being under existing live infrastructure, for example electrical and hydraulic flying leads. The ends of these leads have been stabilised on the seabed using grout bags to ensure they do not move around. The equipment has been document in Beach’s equipment register for future recovery and removal.

3.4.3.2 Thylacine System

The Thylacine subsea infrastructure (Figure 3-2) consists of the following major components:

- Four subsea production wells (TN-1, TN-2, TW-1, TW-2) located north and west of the Thylacine-A Wellhead Platform. TN-1 and TN-2 have been commissioned and testing will begin in late May 2023 with steady state flow expected sometime after that leading to production from these wells being added to the facility. TW1 and TW 2 have been commissioned and testing is anticipated to begin in mid-May 2024 after the installation of an 8” flowline.
- Rigid Well Jumpers tie-in each Xmas tree to an adjacent cluster type manifold, each fitted with a wet gas flowmeter to monitor production fluid flow rates from each well.
- Four seabed manifolds connecting the wells via a series of flexible flowlines.
- DN200 production spool and DN100 MEG spool ties in the T-DIS manifold to the TN-1 Riser and MEG pipeline branch at the base of the Thylacine-A Wellhead Platform.

The Thylacine-A Wellhead Platform provides electrical, hydraulic, and chemical services (methanol) to the Thylacine subsea development via the TA Umbilical which is housed in a J-tube. The TA Umbilical terminates in a Subsea Distribution Unit at the base of the Thylacine-A Wellhead Platform where it is supplied with lean MEG and corrosion inhibitor from the DN100 MEG Service Line via the T-DIS. A hydraulic valve within the T-DIS allows isolation of the MEG supply to the Thylacine fields from the DN100 pipeline.

The TN-1 Umbilical runs from the Subsea Distribution Unit at the base of the Thylacine-A Wellhead Platform to another Subsea Distribution Unit adjacent to the TN-1 Manifold where it is distributed to two more umbilicals and a series of flying leads to provide electrical, hydraulic, and chemical (methanol, MEG, and corrosion inhibitor) services to the subsea wells.

The umbilicals also carry a core dedicated to pressure balance functionality for hydrate remediation connecting the subsea trees to the Topsides Production Manifold, and future injection of scale inhibitor from the platform if required.

Stability and protection to infield flexible flowlines and umbilicals are provided by concrete mattresses, and grout saddle bags for the flying leads. The T-DIS tie-in spools are stabilised where required to ensure freespans are within an allowable length. The rigid well jumpers do not require seabed stabilisation.

3.4.3.3 Subsea Production Wells

The subsea production wells (G-2, G-4, G-5, TN-1, TN-2, TW-1, TW-2) have downhole Surface Controlled Subsurface Safety Valve and Production Master Valve and Production Wing Valve to provide triple isolation from the reservoir. These valves are designed to fail closed (i.e. they automatically close on loss of hydraulic pressure). The valves are all hydraulically operated, and this hydraulic power is supplied by the Subsea Control Module via the main umbilical from the Thylacine-A Wellhead Platform.

Each tree has been fitted with a choke valve to allow flow control. Well control and monitoring are achieved through a Subsea Control Module on each tree. All monitoring and control is from the Otway Gas Plant.

Well integrity monitoring is carried out in accordance with the respective Well Operations Management Plans:

- Geographe 2, 3, 4, and 5 Well Operations Management Plan (CDN/ID 18986455)
- Thylacine Well Operations Management Plan [TA-1, TA-2, TA-3, TA-4, TN-1, TN-2, TW-1, and TW-2] (CDN/ID 4411890), and

addressed by the Beach Energy Well Integrity Standard (CDN/ID 7726350).

Subsea system integrity monitoring and inspection is carried out in accordance with the respective integrity management plans:

- Otway Offshore Pipeline (T/PL3-COMM, VIC/PL36 AND VIC/PL36(V)) – Pipeline Integrity Management Plan (CDN/ID 17343820)
- Integrity Management Plan – Subsea Systems (CDN/ID 19006243)

3.4.3.4 Emergency Shutdown and Isolation Systems

Subsea process shutdown actions for Geographe and Thylacine are implemented by the Master Control Station in conjunction with the Safety Instrumented System on the Thylacine-A Wellhead Platform, via the subsea controls distribution umbilicals. The shutdown actions may be performed manually or autonomously in the event of subsea initiators (such as loss of MEG supply at a producing tree) or in conjunction with the Safety Instrumented System in the event of initiators from Thylacine or the Otway Gas Plant.

In the event of a platform shutdown (Emergency Shutdown or Total Platform Shutdown) a pre-determined well shutdown sequence with operational interlocks is generated for the Geographe wells. Sequenced commands will be transmitted to the Subsea Control Modules and then actioned by the Subsea Control Modules resulting in a controlled well shutdown.

3.4.4 Suspended Wells

The G-1 well was drilled in June 2001 discovering the Geographe field. It was completed with 7” liner across the target reservoir. The well was suspended with two cement plugs (permanent primary and secondary downhole barriers) in 9 5/8” casing for future abandonment. There is no subsea Xmas tree installed on the well or associated subsea infrastructure. The wellhead remains in place with a corrosion cap installed.

The G-3 well was drilled between May and November 2012. The G-3 well is suspended at the surface casing shoe. It has a subsea Xmas tree installed and a ~27 m length of rigid flowline (containing ~1 m^3 dilute MEG / water solution with corrosion inhibitor) connecting the Xmas tree to the production manifold but has no completion installed. The G-3 well and associated infrastructure has never flowed hydrocarbons and G-3 has permanent primary and secondary downhole barriers installed and ~230 bbl (37 m^3) of seawater with corrosion inhibitor (suspension fluid) above the secondary barrier to the Xmas tree.

The T-1 well was drilled in May 2001 discovering the Thylacine field. It was completed with 7” liner across the target reservoir. The well was suspended with two cement plugs (permanent primary and secondary downhole barriers) in 9 5/8” casing for future abandonment. There is no subsea Xmas tree installed on the well or associated subsea infrastructure. The wellhead remains in place with a corrosion cap installed.

Beach is currently developing a strategy to permanently plug and abandon and decommission the G-1, G-3 and T-1 wells to international best practice. This work has been performed as part of a detailed engineering review of all the Beach owned suspended subsea exploration wells during 2022.

As per the Geographe 1 and Thylacine 1 Well Operations Management Plan (CDN/ID 14235732) and the Geographe 2, 3, 4, and 5 Well Operations Management Plan (CDN/ID 18986455) a General Visual Inspection with ROV will be undertaken on the G-1, G-3 and T-1 wells with a maximum duration of 2 years between inspections until the wells are permanently plug and abandoned.

Beach is planning to commence permanent well plug and abandonment including removal of the wellheads from seabed no later than the end of 2026. It is planned to utilise a drill rig in the area as part of the Trefoil production wells drilling campaign (first gas proposed in 2025), or combined with the plug and abandonment of the BassGas suspended wells.

The Artisan-1 well is a vertical exploration well drilled in February 2021. The well was suspended with shoe track cement, including an additional 20bbl of cement above the shoe track in the 7” cemented liner set across the reservoir. The shoe track barrier was inflow tested and verified (primary downhole barrier), and an additional combination barrier cement plug (permanent secondary downhole barrier) was set in 9 5/8” casing for future re-entry. There is no subsea Xmas tree installed on the well or associated subsea infrastructure. The wellhead remains in place with a corrosion cap installed. The aim is to complete this well in 2024 or 2025 as a production well. As per the Artisan-1 Well Operations

Management Plan (CDN/ID S4810AD718234) a General Visual Inspection with ROV will be undertaken on this well with a maximum duration of 12 months between inspections until the well is producing.

Well integrity monitoring of suspended wells is carried out in accordance with the Geographe 1 and Thylacine 1 Well Operations Management Plan (CDN/ID 14235732), the Geographe 2, 3, 4, and 5 Well Operations Management Plan (CDN/ID 18986455) and the Artisan-1 Well Operations Management Plan (CDN/ID S4810AD718234); and addressed by the Beach Energy Well Integrity Standard (CDN/ID 7726350).

3.4.5 Infrastructure Inventory and Status

Table 3-7 provides an inventory of the main infrastructure components for the Otway offshore operations and their status at February 2023.

Table 3-7: Otway Offshore Operations Infrastructure Inventory and Status

Infrastructure	Title	Status
Wells		
Artisan-1 (A-1)	Vic/P43	Suspended
Geographe-1 (G-1)	Vic/L23	Suspended
Geographe-2 (G-2)	Vic/L23	Operational
Geographe-3 (G-3)	Vic/L23	Suspended
Geographe-4 (G-4)	Vic/L23	Operational
Geographe-5 (G-5)	Vic/L23	Operational
Thylacine-1 (T-1)	T/L2	Suspended
Thylacine North-1 well (TN-1)	T/L2	Operational
Thylacine North-2 well (TN-2)	T/L2	Operational
Thylacine West-1 well (TW-1)	T/L2	Operational
Thylacine West-2 well (TW-2)	T/L2	Operational
Infrastructure		
Thylacine-A Wellhead Platform	T/L2	Operational
Geographe Subsea Control Module (G-2, G-3, G-4, G-5, SVS)	Vic/L23	Operational
Geographe Subsea Manifold Cooler (SMC)	Vic/L23	Operational
Geographe Subsea Heat Exchange (SHX)	Vic/L23	Operational
Geographe Subsea Valve Skid (SVS)	Vic/L23	Operational
Thylacine Subsea Control Modules (TN-1, TN-2, TW-1, TW-2)	T/L2	Operational
Thylacine North-1 Manifold (MAN)	T/L2	Operational
Thylacine North-2 Flowline End Termination (FLET)	T/L2	Operational
Thylacine West Flowline End Manifold (FLEM)	T/L2	Operational
Thylacine Diverless Interface Skid (T-DIS)	T/L2	Operational

Infrastructure	Title	Status
Geographe Umbilical Termination (SDU/UTA) Mudmat Foundations	Vic/L23	Operational
Thylacine Umbilical Termination (SDU/UTA) Mudmat Foundations	T/L2	Operational

Infrastructure	Title	From	To	Status
Flowlines				
Geographe Flexible Flowline	Vic/L23	Geographe Subsea Heat Exchange	Geographe Subsea Valve Skid	Operational
Export Pipeline Tie-in Spool	T/L2	Thylacine DN500 Production Riser	Otway Gas Export and piggybacked MEG Pipelines	Operational
MEG S Pipeline Tie-in pool	T/L2	Thylacine DN100 MEG Riser	Otway Gas Export and Piggybacked MEG Pipelines	Operational
Otway Gas Export and piggybacked MEG Pipelines	Vic/L23 Vic/PL36 Vic/PL36(V)	Thylacine Platform Tie-in Spools	HDD Entry (interface with Onshore Pipelines)	Operational
Cooler Spool	Vic/L23	Geographe Subsea Manifold Cooler	Geographe Subsea Heat Exchange	Operational
Rigid spool including wet gas meter	Vic/L23	G-2 well	Geographe Subsea Manifold Cooler	Operational
Rigid spool including wet gas meter	Vic/L23	NA	NA	Recovered
Rigid spool including wet gas meter	Vic/L23	G-4 well	Geographe Subsea Manifold Cooler	Operational
Rigid spool including wet gas meter	Vic/L23	G-5 well	Geographe Subsea Manifold Cooler	Operational
Geographe Production Tee Rigid Spool	Vic/L23	Geographe Tee	Geographe Subsea Valve Skid	Operational
Geographe MEG Tee Rigid Spool	Vic/L23	Subsea Valve Skid	Geographe Tee	Operational
Thylacine DN500 Production Riser	T/L2	Thylacine Export Pipeline Tie-in Spool	Topside pipework	Operational
Thylacine DN100 MEG Riser	T/L2	Topside pipework	MEG Pipeline Tie-in Spool	Operational

Infrastructure	Title	From	To	Status
Thylacine DN200 Production Riser	T/L2	N/A	Topside pipework	Operational
Thylacine Diverless Interface Skid Production Spool	T/L2	T-DIS	Thylacine DN200 Production Riser	Operational
Thylacine Diverless Interface Skid Production Spool	T/L2	T-DIS	Thylacine DN200 Production Riser	Operational
Thylacine Diverless Interface Skid MEG Spool	T/L2	Thylacine DN100 MEG Riser (tie-in branch)	Thylacine Diverless Interface Skid	Operational
Thylacine North-1 Flexible Flowline	T/L2	Thylacine North-1 Manifold	Thylacine Diverless Interface Skid	Operational
Thylacine North-2 Flexible Flowline	T/L2	Thylacine North-2 FLET	Thylacine North-1 Manifold	Operational
Thylacine West Flexible Flowline	T/L2	Thylacine North-2 FLET	Thylacine North-1 Manifold	Operational
Rigid spool including wet gas meter	T/L2	TN-1 well	Thylacine North-1 Manifold	Operational
Rigid spool including wet gas meter	T/L2	TN-2 well	Thylacine North-2 FLET	Operational
Rigid spool including wet gas meter	T/L2	TW-1 well	Thylacine West FLEM	Operational
Rigid spool including wet gas meter	T/L2	TW-2 well	Thylacine West FLEM	Operational
Umbilicals				
Geographe Infield Umbilical (complete with Subsea Distribution Unit SDU-500 and Umbilical Termination Assembly UTA-600)		Geographe Field (SDU-500)	Geographe Tee Approach (UTA-600)	Operational
Geographe Main Umbilical (complete with Umbilical Termination Assemblies UTA-500A and UTA-500T)		Thylacine-A Platform (UTA-500A at Platform Approach)	Geographe Wells Approach (UTA-500T)	Operational
G-2 Flying leads	Vic/L23	G-2 well	Geographe Subsea Distribution Unit	Operational

Infrastructure	Title	From	To	Status
G-3 Flying leads (P/C EFLs only, WGM EFL recovered)	Vic/L23	G-3 well	Geographe Subsea Distribution Unit	Operational
G-4 Flying leads	Vic/L23	G-4 well	Geographe Subsea Distribution Unit	Operational
G-5 Flying leads	Vic/L23	G-5 well	Geographe Subsea Distribution Unit	Operational
Pipeline Corrosion Monitor (PCM-1, PCM-2)	Vic/L23	Located within Export Pipeline		Not operating
PCM-1 Electrical flying lead	Vic/L23	N/A	N/A	Recovered
PCM-2 Electrical flying lead	Vic/L23		PCM-2	Not operating
Geographe SDU Flying leads	Vic/L23	Main Umbilical Termination Assembly	Subsea Distribution Unit	Operational
Geographe SVS Electrical flying leads	Vic/L23	Infield Umbilical Termination Assembly	Subsea Valve Skid	Operational
Thylacine-A (TA) Umbilical complete with TA-SDU	T/L2	Thylacine-A Platform	TA-SDU	Operational
Thylacine North-1 (TN-1) Umbilical complete with TN-1 SDU and TN-1 Umbilical Termination Head (UTH)	T/L2	TA-SDU	TN-1 Well Site (TN-1 SDU)	Operational
Thylacine North-2 (TN-2) Umbilical complete with TN-2 UTA and TN-2 UTH	T/L2	TN-1 SDU	TN-2 Well Site (TN-2 UTA)	Operational
Thylacine West (TW) Umbilical complete with TW SDU and TW UTH	T/L2	TN-1 SDU	TW Well Site (TW SDU)	Operational
TN-1 Flying Leads	T/L2	TN-1 SDU	TN-1 well	Operational
TN-2 Flying Leads	T/L2	TN-2 UTA	TN-2 well	Operational
TW-1 Flying Leads	T/L2	TW SDU	TW-1 well	Operational
TW-2 Flying Leads	T/L2	TW SDU	TW-2 well	Operational
TN-1 UTH Electrical Flying Leads	T/L2	TA-SDU	TN-1 UTH	Operational
TN-2 UTH Electrical Flying Leads	T/L2	TN-1 SDU	TN-2 UTH	Operational
TW UTH Electrical Flying Leads	T/L2	TN-1 SDU	TW UTH	Operational

3.5 Activities that have the Potential to Impact the Environment

This section outlines the planned activities covered within the scope of this EP which have the potential to result in environmental aspects, that could lead to impacts on receptors.

Emissions, discharges, and disturbances resulting from planned activities are summarised in Table 3-10.

3.5.1 Thylacine-A Wellhead Platform Operations

The Thylacine-A Wellhead Platform is normally unmanned. The platform is manned for approximately 60 days per year for planned maintenance. Additional days are required for specific maintenance activities and projects. The size of the visiting crew will vary depending on the nature of the visit but can involve up to ten personnel in total.

Operations on-board the platform take place during daylight hours with no planned overnight stays permitted under normal operations. However, to accommodate potential unforeseen emergencies, incidents (e.g. helicopter failure or sudden change of weather) or repairs; facilities are provided for emergency overnight stays should it be necessary. Overnights says have occurred twice in the last 10 years.

The freshwater system is recharged from Intermediate Bulk Containers (IBCs) of potable water delivered by the supply vessel. The system provides water for personnel washing purposes, safety showers, and general washing down of the platform e.g. helideck and walkways. The toilet on the platform is a portable chemical toilet with internal storage that is shipped back to shore for emptying and disposal.

There is no open drain system, therefore no liquid discharges occur during routine operations. Produced formation water is transported with the gas and other reservoir liquids to the Otway Gas Plant.

Chemicals including methanol and hydraulic fluid are transported to the platform in sealed containers. There are no bunkering facilities.

Seabirds and/or migrating birds are known to be attracted to, and rest on the platform. This poses significant risk to safe operations (i.e. take-off and landing) of helicopters. In order to mitigate these safety risks, bird deterrent techniques as described in Section 3.4.1 are installed to prevent birds from roosting on the helideck. The bird deterrent sea water pump and spray system results in discharge of washdown water to the marine environment.

3.5.2 Otway Pipeline System Operations

The Otway Pipeline System (Otway Gas Pipeline and MEG Pipeline) operate within a closed system, with no planned discharges.

3.5.3 Geographe Field and Thylacine Field Subsea Facilities Operations

Geographe field subsea facilities are operated within a closed system, though actuation of valves will result in small releases of control fluid.

3.5.4 Inspection, Maintenance and Repair

Inspection, maintenance and repair (IMR) programs are undertaken on subsea infrastructure and the Thylacine-A Wellhead Platform to confirm and maintain their integrity and to ensure property can be removed unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP.

IMR programs are detailed in the following:

- Otway Offshore Pipeline Safety Case
- Thylacine-A Platform Safety Case
- Geographe 1 and Thylacine 1 Well Operation Management Plan
- Geographe 2, 3, 4, and 5 Well Operation Management Plan
- Thylacine Well Operation Management Plan [TA-1, TA-2, TA-3, TA-4, TN-1, TN-2, TW-1, and TW-2]
- Artisan-1 Well Operations Management Plan

The Integrity Management System for the Otway Gas Development is described in the Beach's Operations Excellence Management System (OEMS) Element 6 – Asset Management. The Computerised Maintenance Management System (CMMS) is used to manage maintenance IMR programs to:

- Ensure a consistent, cost effective and efficient system of maintenance management.
- Provide optimum levels of inspection and maintenance to ensure that equipment and the facilities remain fit for purpose over the life of the operation.

Inspection and testing intervals (including any minimum requirements), survey frequencies, condition monitoring and surveillance, and reporting/record keeping are described in the respective asset integrity management plans (IMPs).

3.5.4.1 Inspection

Inspection programs are undertaken of the Thylacine-A Wellhead Platform, production and suspended wells, Geographe and Thylacine subsea infrastructure and Otway Pipeline System to detect external features, damage or signs of damage, and deterioration that could present a risk. They are typically undertaken from a vessel using an ROV.

The following are typically inspections undertaken:

- General Visual Inspection /Close Visual Inspection – undertaken by ROV in close proximity (within 1 m) of wells, along the pipeline, pipeline spools, risers and associated clamps, and platform jacket members.
- Visual inspection and non-destructive testing of welds and areas of interest for selected high fatigue nodes.

- Cathodic Protection Survey.
- Wall thickness measurements.

Inspection program and frequency are described in detail in the applicable Safety Cases and Well Operation Management Plans.

3.5.4.2 Maintenance and Repair

Maintenance and repair activities may occur to:

- Prevent deterioration and/or failure of infrastructure; and
- Maintain reliability and performance of infrastructure.

Maintenance and repair activities are typically conducted in response to inspection findings, engineering analyses, and/or external events. The activities are typically performed by ROV from a vessel or by divers from a dive support vessel. Table 3-8 summarises the maintenance and repair activities that may be undertaken but this list is not exhaustive. The table also includes details of the initiation triggers for the various maintenance programs.

Where an activity is necessary that is not adequately described in this EP, Beach will undertake a review of the EP and risk register in accordance with Section 7.12.5 and if necessary, revise the EP. Revisions will be reviewed as per Section 7.12.6 to determine if the revised EP is required to be submitted to NOPSEMA and/or DEECA (as appropriate) for assessment.

Major maintenance and shutdown of the Thylacine-A Wellhead Platform for inspection is based on statutory or risk-based inspection which sets the shutdown frequency in conjunction with activity requirements. Shutdown may result in purging of nitrogen to the vent.

Table 3-8: Summary of Typical Maintenance and Repair Activities

Maintenance and Repair activity	Description	Initiation Triggers
Pipeline integrity / Leak testing	Pipeline integrity / leak testing is undertaken as required to verify the pressure integrity of components. Leak testing involves filling the component with water dosed with inhibitor, biocide and dye (normally fluorescent) and pressurising the pipeline to an appropriate test pressure.	Where the integrity of the pipeline system must be re-confirmed following a significant wall thickness defect.
V-jet pigging	Routine maintenance (V-jet) pigging is conducted on the platform to transmit liquid held-up in the Otway Gas Pipeline to the Otway Gas Plant. Pigging is undertaken in a closed system with no discharges to the marine environment.	Routine
Pipeline Top of Line Corrosion remediation	The first 2 km of the Otway Gas Pipeline (starting immediately downstream of the corrosion resistant alloy spool) has been found to be subject to Top of Line Corrosion which may require intervention in the future. This may be in the form of the installation of a single or multiple repair clamps at specific locations	Inspection identifies remediation is required

Maintenance and Repair activity	Description	Initiation Triggers
	on the carbon steel section, or the isolation and installation of approximately 2 km of carbon steel line pipe with corrosion resistant alloy. The latter option is outside the scope of this EP.	
Well intervention, wireline, slickline campaigns	The Thylacine-A Wellhead Platform has been designed to facilitate access to the wells for both slick line and electric line well intervention. A well intervention may be needed to repair a faulty Surface Controlled Subsurface Safety Valve, install a storm choke, remediate well integrity failures, fish lost tools, perforate new production intervals, operate sliding sleeves, install tubing plugs to isolate production intervals or perform well surveillance (pressure or production logs). Wireline or well intervention campaigns are undertaken as required and in accordance with the Well Operations Management Plan. Well intervention, wireline or slickline campaigns for subsea wells are not covered by this EP.	Inspection or event results in repair valve required
Cathodic protection system maintenance	Replacement of anodes and continuity straps. Installation of cathodic skids.	Anodes are retrofitted when the existing anodes have depleted, or are about to deplete, beyond 90% of their original volume.
Excavation for intervention	To undertake subsea IMR, localised excavation may be required directly adjacent to the subsea system, allowing access to buried infrastructure. Typically, this is conducted by jetting, mechanical and/or digging equipment from an ROV, vessel, or by using divers, depending on the location, depth, and seabed characteristics.	Access required to buried subsea infrastructure for inspection, maintenance or repair.
Marine growth and hard deposit removal	Marine growth and deposits may be removed by water jetting or manual cleaning from an ROV or by divers to access equipment. Water jetting may use potable or sea water. Chemicals, typically Sulfamic Acid (or equivalent such as Citric Acid), may be used to assist clean-up for removing limescale.	Access required to subsea infrastructure for inspection, maintenance or repair.
Removal of debris or fishing net	Removal of debris such as ropes and fishing nets that may become entangled on infrastructure.	Inspection identifies hazardous debris on infrastructure.
Rectification of electrical or hydraulic fault	Rectification of an electrical or hydraulic fault associated with an umbilical and associated connected equipment. Replacement of electrical/hydraulic/chemical umbilical or jumper, cleaning of connectors, testing of connectors.	Electrical or hydraulic fault.
Pipeline repair	Pipeline repair which may, depending upon the damage the pipeline has sustained, include composite wrap application, mechanical clamp installation and anode retrofit.	Inspection identifies significant corrosion or damage to pipeline or a

Maintenance and Repair activity	Description	Initiation Triggers
		loss of containment from the pipeline.
Flowline jumper replacement	Replacement of flowline jumper with either rigid or flexible flowline between existing flange connections.	Flowline jumper significantly damaged or not functioning.
Service line/hydraulic capping plate removal and reinstallation	Replacement or institute servicing of hydraulic multi quick connect plate including cleaning of interface (ROV and hydraulic) and testing of connections.	Testing / inspection indicates an issue, or local control / intervention required.
Subsea control unit change out	Replacement or institute servicing of Subsea Control Module including cleaning of interface (ROV, hydraulic and electrical) and testing of connections.	Subsea Control Module significantly damaged or not functioning:
Replacement of equipment on the seafloor	Where subsea equipment cannot be repaired it may be replaced. This would typically occur in the same location or near to the previous location.	Subsea equipment significantly damaged or not functioning:
Subsea tree choke replacement	Choke replacement is undertaken from a vessel by ROV and/or divers. The first choke replacement requires top plate trimming. Trimming is performed using a disk cutting tool installed onto the subsea tree to enable access the choke. Cut material is captured and retained on the tool in a magnetic tray beneath the cutting disk. The choke is located on the subsea tree between two valves. Prior to removal, MEG is injected upstream of the choke to flush the line. Fluid is displaced into the Otway Gas Pipeline for processing at the Otway Gas Plant. During change-out of the choke, the volume of MEG between the two valves is approximately 75 L, with a small amount lost to the environment.	Failed, faulty or damaged choke.
Stabilisation and protection	Existing stabilisation / protection may need to be replaced, or visual inspections may identify that additional stabilisation / protection may be required. This may include using rock bolts, mattresses, sandbags or grout bags. Stabilisation mattresses and gravity weights are lowered over the infrastructure (pipeline, flowlines, leads) from a vessel and depending on the infrastructure may cover an area of 18 m^2 (6 m x 3 m x 0.5 m). Rock bolt structures are installed by divers using a small installation frame/structure covering 1 m^2.	Inspection identifies stabilisation is required
Subsea trees, flowlines, well bore penetrations, flanges and mechanical connections servicing	Tensioning, blanking or polymer sealant intervention to restore or preserve integrity to subsea conduits.	Subsea equipment significantly damaged or not functioning.

Maintenance and Repair activity	Description	Initiation Triggers
Fabric maintenance	Consists of surface preparation and painting across the entire wellhead platform, over selected areas of structural and process equipment. This involves sand/grit/wet blasting for paint and corrosion product removal followed by painting. Where practicable these activities will be contained with bottom lined humpies (enclosures) to contain as much removed paint and blasting debris as practical.	Inspection identified fabric maintenance required

3.5.5 Geophysical Surveys

Geophysical surveys maybe undertaken to identify the location of buried infrastructure such as pipelines. The frequency and duration of surveys is estimated to be a maximum of 10 days once a year though more likely to be between two and five years.

Geophysical surveys may use the following equipment:

- Single-beam or Multi-beam echo sounder to measure bathymetry.
- Side scan sonar to detect location of buried infrastructure.
- Sub-bottom profile to detect location of buried infrastructure.

3.5.6 Support Operations

3.5.6.1 Vessels

Vessel will be used to support offshore operations and inspection, maintenance, and repair campaigns. Table 3-9 details the main types of vessel activities, type of vessel and frequency.

Due to the distance to shore no fuel bunkering is required. Vessels typically operate out of Victorian ports.

Table 3-9: Vessel Activity, Type and Frequency

Activity	**Example Vessel type**	**Extent of time on site**
Platform resupply Vessel resupply in daylight hours only from ~9.00 to 1500. Daily vessel resupply commences after crew arrives by helicopter and finishes prior to helicopter arriving to take crew to shore.	Siem Offshore VS491	2 days every 3 months ~6 hrs per day
Standby vessel at platform when working over water. Activity typically aligns with supply run. Vessel on standby within 500 m of platform for ~ 6 hrs per day while work being undertaken on the platform.		Twice per year ~ 6 hrs per day
Planned suspended and operational wells ROV inspection	Siem Topaz Tekocean Spirit Bhagwan Dryden	Up to 2 days once per year and up to 5 days every two years
Planned platform subsea (jacket) ROV inspection Planned pipeline, umbilical & subsea equipment ROV inspection		Up to 30 days every 5 years
Planned platform subsea (jacket) inspection – potential for divers	DOF Singapore Sapura Constructor	Up to 15 days every 10 years
Unplanned inspection, maintenance, and repair campaigns – ROV and/or divers		Up to 30 days every 2 years
Oil spill response, including operational and scientific monitoring	Siem Topaz Tekocean Spirit Bhagwan Dryden	In event of a spill

3.5.6.2 Diving Activities

Diving may be carried out as part of inspection and maintenance activities and will require the use of a diving support vessel.

3.5.6.3 ROV Operations

Underwater ROVs are deployed and controlled from a vessel to undertake IMR activities.

ROVs are generally equipped with a video camera, lighting and have the ability to monitor the subsea infrastructure and the surrounding environment. ROVs are also used to deploy specialist tooling and equipment. Tooling and equipment may be operated with the use of electrics or hydraulics. Hydraulics on ROVs are closed system, where hydraulic fluid is circulated to move components and is designed not to release hydraulic fluid.

ROVs are generally moored on the deck of the vessel and are occasionally temporarily parked on the seabed during IMR activities.

3.5.6.4 Helicopters

Helicopters are the primary form of transport for personnel to and from the Thylacine-A Wellhead Platform and the preferred means of evacuating the platform. However, depending on the accident event and scenario, evacuation by helicopter may not be safe or practicable and alternative means of evacuating the platform are provided. Helicopters may also be used in responding to a hydrocarbon spill, including operational and scientific monitoring.

There are no helicopter refuelling facilities on the Thylacine-A Wellhead Platform, helicopters carry enough fuel to travel to the platform and return. Approximate flight time (one way) between the primary helicopter base at Warrnambool (Victoria) and the Thylacine-A Wellhead Platform is 25 minutes.

3.6 Summary of Planned Emissions, Discharges and Disturbance

A summary of planned emissions, discharges and disturbance from activities covered by this EP is provided in Table 3-10.

Table 3-10 Planned Emissions, Discharges and Disturbances

Activity	Description	Planned Emission, Discharge or Disturbance
Thylacine-A Wellhead Platform Operations		
Power generation	Gas (and possibly diesel) combustion products discharged to atmosphere	Atmospheric emissions
Drains and vents	Continuous gas purge and venting for maintenance activities Closed drain system so no liquid discharges during routine operations.	Atmospheric emissions
Chemical injection	Closed system	None
Service water	Closed system	None

Activity	Description	Planned Emission, Discharge or Disturbance
Heating, ventilation and air conditioning systems	Closed system	None
Stored hazardous substances	Hazardous substances are stored in accordance with the relevant Safety Data Sheet.	None
Emergency Shutdown	Venting via dump valves	Atmospheric emissions
Personnel onboard	All wastes and discharges are contained, with no offshore disposal.	None
Routine platform operations	Navigational lighting	Light emissions
	Petroleum Safety Zone	Physical presence
	Water overboard from bird deterrent system Deck drainage from rainwater areas	None
Thylacine platform wells	Closed system	None
Bird deterrent system	System to deter birds from roosting on the helideck which is a safety issue for safe helicopter operations.	Disturbance to marine fauns
Otway Pipeline System Operations		
Otway Pipeline System	Closed system	None
Geographe Field and Thylacine Field Subsea Facilities Operations		
Geographe and Thylacine subsea infrastructure and wells	Valve actuation – subsea wells and subsea valve skid	Planned marine discharges – operations and IMR
	Choke valve operation	Underwater sound emissions
IMR		
Inspection	Undertaken using vessel and ROV (refer below). No discharges, emissions or disturbance from inspection activities.	None
Maintenance and Repair	Pipeline integrity / Leak testing	Planned marine discharge – operations and IMR
	V-jet pigging - closed system	None
	Pipeline Top of Line Corrosion remediation – installation of repair clamps	Benthic disturbance
	Thylacine-A Wellhead Platform well intervention, wireline or slickline campaigns - closed system	None
	Cathodic protection system maintenance – installation of cathodic skids	Benthic disturbance
	Excavation for intervention - jetting, mechanical and/or digging equipment (ROV) or divers	Benthic disturbance
	Marine growth and hard deposit removal	Benthic disturbance

Activity	Description	Planned Emission, Discharge or Disturbance
		Planned marine discharge – operations and IMR
	Removal of debris or fishing net	None
	Rectification of electrical or hydraulic fault	None
	Pipeline repair – includes mechanical clamp installation	Benthic disturbance
	Flowline jumper replacement	Benthic disturbance
	Service line/hydraulic capping plate removal and reinstallation	Benthic disturbance
	Subsea control unit change out	Benthic disturbance
	Subsea tree choke replacement	Underwater sound emissions Planned marine discharge – operations and IMR
	Replacement of equipment on the seafloor	Benthic disturbance
	Stabilisation and protection	Benthic disturbance
	Subsea trees, flowlines, well bore penetrations, flanges and mechanical connections servicing	None
	Fabric maintenance	Planned marine discharge – operations and IMR
Support Operations		
Vessels	Food scraps, sewage and grey water Discharge of bilge water treated to contain <15ppm oil in water Uncontaminated engine cooling water Water and approved cleaning chemical	Planned marine discharge – vessel
	Fuel combustion products discharged to atmosphere	Atmospheric emissions
	Navigational lighting	Light emissions
	Resupply and standoff at the platform	Underwater sound emissions
	IMR campaigns	Underwater sound emissions
Diving activities	Vessel-based activity (refer above). No additional impacts.	None
ROV operations	Hydraulic control fluid - closed system	None
Helicopters	Landing and take-off	Underwater sound emissions

3.7 Decommissioning

Decommissioning of the Otway Gas Development will be undertaken in accordance with the relevant Commonwealth and Victorian State regulatory requirements in force at the time of decommissioning or as described in an approved decommissioning EP. In accordance with EPBC referral 2002/621 (Condition 5) a decommissioning plan will be submitted for approval prior to decommissioning of any components associated with the development (i.e. the platform, wells, flowlines or any associated infrastructure). Section 572(3) of the OPGGS Act imposes an obligation on the duty holder to remove all structures, equipment and property within the title area that will not be used for the purposes of petroleum production, and there may be requirements under the Environmental Protection (Sea Dumping) Act 1981 (Cth) that apply to some decommissioning activities.

Beach fully acknowledges that the default position through Section 572 of the OPGGS Act and NOPSEMA Policy Section 572 Maintenance and Removal of Property (N-00500-PL1903, A720369, November 2020) is for removal of all property when it is no longer in use and that any deviations from this position will need to be evaluated and approved by NOPSEMA. Beach will incorporate the requirements of this policy into the Otway Offshore decommissioning concept study.

The decision to commence decommissioning activities will be based on whether Beach can continue to economically commercialise the extracted reservoir fluids from the gas fields in a responsible manner that protects people, communities and environmental values. The current variation to the field development plan has an end of field life of 2037.

All structures, equipment and property associated within the Beach title areas in Table 1-2 will be maintained in good condition and repair to ensure it can be removed, unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP.

3.7.1.1 Decommissioning Planning Process

Decommissioning is covered by Beach’s OEMS Element 6. The suspension of assets is divided into:

1. Temporary suspension
2. Mothballing
3. Preliminary abandonment
4. Final abandonment and removal

The requirement to initiate preliminary or final abandonment for assets of the scale of the Otway Gas Development is managed through a dedicated capital project and the decommissioning process requires a multi-disciplinary team. Final approval to undertake the work must be granted by the regional General Manager Operations and General Manager Development. Consideration for the environmental approvals process is part of the decommissioning standard.

3.7.1.2 Decommissioning Environmental Approvals

Decommissioning guidelines will be considered during the decommissioning planning process, including:

- Guideline: Offshore Petroleum Decommissioning Guideline (DISER 2022)
- Decommissioning Compliance Strategy (NOPSEMA 2021)

Issues likely to be explored in the decommissioning EP (and addressed through the stakeholder consultation process) include:

- Decommissioning options (leave platform and pipeline in situ vs complete removal vs partial removal).

- If equipment is left in situ:
  - Ongoing monitoring requirements.
  - Impacts to commercial fisheries of remaining infrastructure.
  - Clearance below sea level for commercial fishers (current regulatory requirements in Commonwealth waters for decommissioned platforms are to provide a 30 m clearance from the sea surface in the water column).
- Re-purposing of decommissioned infrastructure to create marine habitat for recreational fishers and divers, either in situ or moved to more accessible location/s.

The timeframe allocated to planning for decommissioning allows for the preparation of a Cessation of Production (CoP) EP and/or decommissioning EP and to have each assessed by NOPSEMA sufficiently in advance of activities commencing to ensure each EP is accepted prior to activities commencing.

Beach has undertaken some initial decommissioning planning and developed a preliminary decommissioning methodology and cost estimate for the development in line with current decommissioning practices in Australia (Worley Parsons 2015).

Aspects of the preliminary plan considers:

- Platform decommissioning: all or partial removal of equipment above the seabed, transportation to shore for dismantling and recycling or reuse as scrap.
- Well decommissioning: removal of wellheads and tubing where feasible. Where feasible, the well will be sealed, and the conductor and casing strings cut off below the seabed. All conductor and casing strings above that point will be removed.
- Subsea equipment decommissioning: removal of equipment such as the manifold with transportation to shore for recycling. Pipeline decommissioning - thorough cleaning and disconnection. The offshore pipeline is likely to be flooded and left open ended on the seabed.

3.7.1.3 Maintaining Inventory

All property owned by Beach, including its condition, is listed in an asset register that is retained within the CMMS and maintained by the Technical Services Team. If any equipment is retained in the title areas after the decommissioning process is complete, the assets register will be updated to reflect this.

All equipment associated with the Otway Gas Development is being inspected, monitored and maintained in accordance with the CMMS to ensure that it is in good condition and can be safely decommissioned when required.

4 Description of the Environment

The physical, biological and socio-economic existing environment that may be affected by the activity and/or is used to input into the impact and risk assessment sections is described in this section, together with the particular relevant values and sensitivities.

The existing environment area has been defined as an area where a change to ambient environmental conditions may potentially occur as a result of planned activities or unplanned events. It is noted that a change does not always imply that an adverse impact will occur; for example, a change may be required over a particular exposure value or over a consistent period of time for a subsequent impact to occur.

Table 4-1 and Figure 4-1 detail the areas associated with the Activity that are used to describe the environmental context relevant to the Activity and to support the impact and risk assessments.

Table 4-1: Description of Existing Environment Areas

Zones	Description
Operational area	For the activity, the operational area is a 500 m radius around the Thylacine-A Wellhead Platform, subsea wells and infrastructure and suspended wells (as described in Section 3.2). Planned operational discharges, physical presence and seabed disturbance that occur during the activity will be within the operational area. The EPBC Protected Matters Report for the operational area is provided in Appendix A.1.
Planning area	The planning area is within Commonwealth, Victorian and Tasmanian waters and reaches Victorian and Tasmanian shorelines (Figure 4-1). The planning area is based on a combination of the diesel planning area and condensate planning area that are based on the spill modelling to the low thresholds as detailed in Section 6.14.6. The EPBC Protected Matters Report for the planning area is in Appendix A.2.

4.1 Regulatory Context

The OPGGS(E)R define ‘environment’ as the ecosystems and their constituent parts, natural and physical resources, qualities and characteristics of areas, the heritage value of places and includes the social, economic and cultural features of those matters. In accordance with the Regulations, this document describes the physical, ecological, and social components of the environment.

Under the OPGGS(E)R, the EP must describe the existing environment that may be affected by the activity (Regulation 13(2a)), including details of the particular values and sensitivities (if any) within that environment (Regulation 13(2b)), Identified values and sensitivities must include, but are not necessarily limited to, the matters protected under Part 3 of the EPBC Act.

A greater level of detail is provided for those particular values and sensitivities as defined by the Regulations 13(3) of the OPGGS(E)R which states that particular relevant values and sensitivities may include any of the following:

a. the world heritage values of a declared World Heritage property within the meaning of the EPBC Act;

b. the national heritage values of a National Heritage place within the meaning of that Act;

c. the ecological character of a declared Ramsar wetland within the meaning of that Act;

d. the presence of a listed Threatened species or listed Threatened Ecological Community within the meaning of that Act;

e. the presence of a listed Migratory species within the meaning of that Act;

f. any values and sensitivities that exist in, or in relation to, part or all of:

    i) Commonwealth marine area within the meaning of that Act; or

    ii) Commonwealth land within the meaning of that Act.

With regards to 13(3)(d) and (e) more detail has been provided where listed Threatened or Migratory species have a spatially defined biologically important area (BIA), habitat critical to survival or identified biologically important behaviour such as breeding, foraging, resting or migration.

With regards to 13(3)(f) more detail has been provided in Section 4.2.12 for Key Ecological Features (KEFs) as they are considered as conservation values of the Commonwealth marine area; and in Section 4.2.2 for Australian Marine Parks (AMPs) as they are enacted under the EPBC Act.

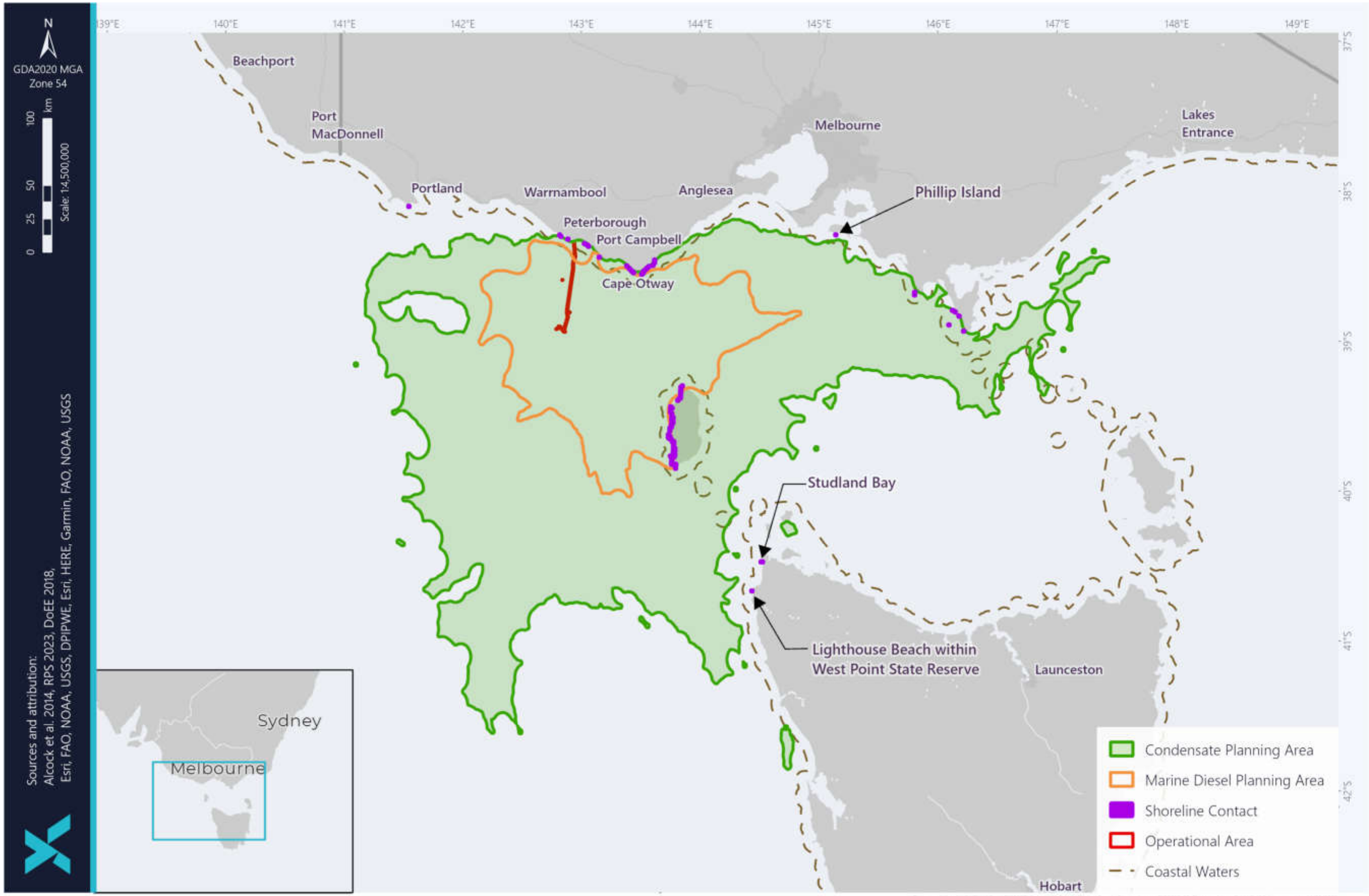


Figure 4-1: Planning and Operational Areas for the Otway Offshore Operations

4.2 Conservation Values and Sensitivities

The following section details the conservation values and sensitivities identified within the planning area identified from PMST Reports, referenced material and relevant person consultation.

4.2.1 World Heritage Properties

The PMST Reports (Appendix A) did not identify any World Heritage Areas in the operational area or planning area.

4.2.2 Australian Marine Parks

No Australian Marine Parks (AMPs) were identified within the operational area (PMST Report (Appendix A) (Figure 4-2). Four AMPs were identified within the planning area (PMST Report (Appendix A) (Figure 4-2) are:

- Apollo
- Beagle
- Franklin
- Zeehan

All the AMPs, excluding a Section of Zeehan Marine Park, are classified as International Union for Conservation of Nature (IUCN) VI – Multiple Use Zone, in which a wide range of sustainable activities are allowed if they do not significantly impact on benthic (seafloor) habitats or have an unacceptable impact on the values of the area. Allowable activities include commercial fishing, general use, recreational fishing, defence and emergency response. Some forms of commercial fishing, excluding demersal trawl, Danish seine, gill netting (below 183 m) and scallop dredging, are allowed, provided that the operator has approval from the Director of National Parks and abides by the conditions of that approval.

The Zeehan AMP also has an IUCN VI - Special Purpose Zone, which allows for limited mining and low-level extraction of natural resources. Permitted activities are similar to Multiple Use Zones; however, commercial fishing is not permitted.

The South-east Marine Reserves are managed under the South-east Marine Reserves Management Plan (DNP, 2013).

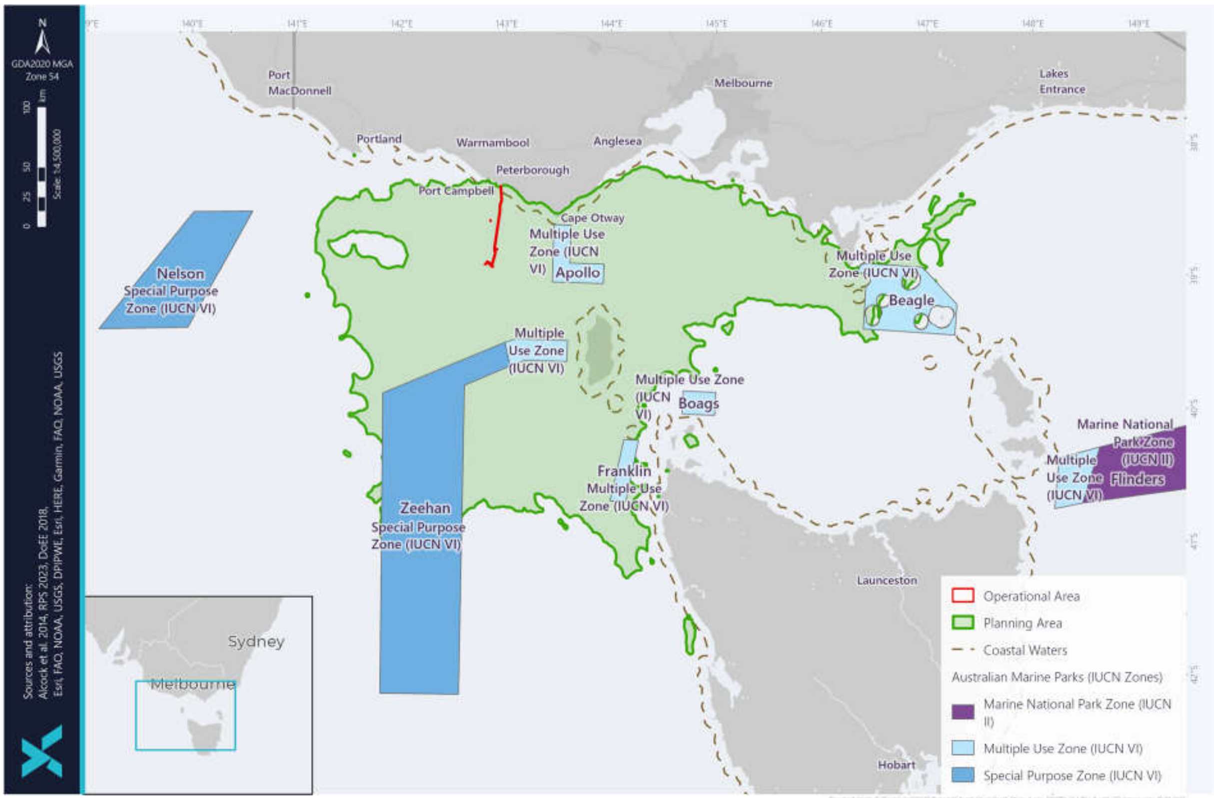


Figure 4-2: Australian Marine Parks within the Planning Area

4.2.2.1 Apollo AMP

The Apollo AMP is located off Apollo Bay on Victoria's west coast in waters 80 m to 120 m deep on the continental shelf. The reserve covers 1,184 km^2 of Commonwealth ocean territory (DNP, 2013). The reserve encompasses the continental shelf ecosystem of the major biological zone that extends from South Australia to the west of Tasmania. The area includes the Otway Depression, an undersea valley that joins the Bass Basin to the open ocean. Apollo AMP is a relatively shallow reserve with big waves and strong tidal flows; the rough seas provide habitats for fur seals and school sharks (DNP, 2013).

The major conservation values of the Apollo AMP are:

- ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features: deep/hole/valley and shelf.
- important migration area for blue, fin, sei and humpback whales.
- important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern.
- cultural and heritage site - wreck of the MV City of Rayville (DNP, 2013).

4.2.2.2 Beagle AMP

The Beagle AMP is an area in shallow continental shelf depths of about 50 m to 70 m, which extends around south-eastern Australia to Tasmania covering an area of 2,928 km^2 (DNP, 2013). The reserve includes the fauna of central Bass Strait; an area known for its high biodiversity. The deeper water habitats are likely to include rocky reefs supporting beds of encrusting, erect and branching sponges, and sediment composed of shell grit with patches of large sponges and sparse sponge habitats.

The reserve includes islands that are important breeding colonies for seabirds and the Australian fur seal, and waters that are important foraging areas for these species. The species-rich waters also attract top predators such as killer whales and great white sharks.

The major conservation values of the Beagle AMP are:

- ecosystems, habitats and communities associated with the Southeast Shelf Transition and associated with the seafloor features: basin, plateau, shelf and sill.
- important migration and resting areas for southern right whales.
- it provides important foraging habitat for the Australian fur-seal, killer whale, great white shark, shy albatross, Australasian gannet, short-tailed shearwater, Pacific and silver gulls, crested tern, common diving petrel, fairy prion, black-faced cormorant and little penguin.
- cultural and heritage sites including the wreck of the steamship SS Cambridge and the wreck of the ketch Eliza Davies (DNP, 2013).

4.2.2.3 Franklin AMP

The Franklin AMP covers an area of 671 km^2 west of the north-western corner of Tasmania and south-east of King Island (DNP, 2013). At its northern end, the waters are only 40 m deep, and in much of the reserve the sea floor slopes gently and is covered by fine and coarse sediments. At the southern end of the reserve there is a valley where the water is up to 150 m deep.

The major conservation values for the Franklin AMP are:

- examples of ecosystems, habitats and communities associated with:
  - the Tasmanian Shelf Province
  - the Western Bass Strait Shelf Transition
- and associated with sea-floor features:
  - shelf
  - deep/hole/valley
  - escarpment
  - plateau
- Important foraging area for shy albatross, short-tailed shearwater, Australasian gannet, fairy prion, little penguin, common diving petrel, black-faced cormorant and silver gull.

Black Pyramid Rock, 6 km north of the reserve supports the largest breeding colony of the Australasian gannet in Tasmania, and one of only eight breeding sites for this species in Australia. White shark also forage in the reserve.

4.2.2.4 Zeehan AMP

The Zeehan AMP covers an area of 19,897 km^2 to the west and south-west of King Island in Commonwealth waters surrounding north-western Tasmania (DNP, 2013). It covers a broad depth range from the shallow continental shelf depth of 50 m to the abyssal plain which is over 3,000 m deep. The reserve spans the continental shelf, continental slope and deeper water ecosystems of the major biological zone that extends from South Australia to the west of Tasmania. Four submarine canyons incise the continental slope, extending from the shelf edge to the abyssal plains. A rich community made up of large sponges and other permanently attached or fixed invertebrates is present on the continental shelf, including giant crab (*Pseudocarcinus gigas*). Concentrations of larval blue wahoo (*Seriolella brama*) and ocean perch (*Helicolenus spp.*) demonstrate the role of the area as a nursery ground.

Rocky limestone banks provide important seabed habitats for a variety of commercial fish and crustacean species including the giant crab. The area is also a foraging area for a variety of seabirds such as fairy prion, shy albatross, silver gull, and short tail shearwater (DNP, 2013).

The major conservation values for the Zeehan AMP are:

- examples of ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features: abyssal plain/deep ocean floor, canyon, deep/hole/valley, knoll/abyssal hill, shelf and slope.
- important migration area for blue and humpback whales.
- important foraging habitat for black-browed, wandering and shy albatrosses, and great-winged and cape petrels (DNP, 2013).

4.2.3 National Heritage Places

Two places of National Heritage that were identified in the planning area with one within the operational area (PMST Report Appendix A) (Figure 4-3). These are:

- Great Ocean Road and Scenic Environs (historic) - operational area and planning area
- Western Tasmania Aboriginal Cultural Landscape - planning area

4.2.3.1 Great Ocean Road and Scenic Environs

The Australian Heritage Council found the Great Ocean Road and its scenic environs road from Torquay to Allansford, a journey of 242 kms, as a place of outstanding national heritage significance. Constructed by workers, including more than 3000 returned servicemen, as a memorial to First World War servicemen, the Great Ocean Road is a significant reminder of the participation of Australian servicemen in the First World War, the Australian community's appreciation of their service, and the support provided for the welfare of servicemen and women upon returning to Australia.

The scenic environs include all views from the Great Ocean Road and Great Ocean Walk, including the Twelve Apostles, the Bay of Islands and Bay of Martyrs. The coastline from Lorne to Kennett River is among the world's most dramatic cliff and ocean scenery able to be viewed from a vehicle.

Along the length of the Great Ocean Road, the pullover points and lookouts beside or nearby the road provide travellers with spectacular views of the coastline, hinterland, and Bass Strait seascape, framed only by cliffs, lighthouses and unencumbered by intrusive built structures. The place is also listed for its; outstanding rocky coastline, dinosaur fossil sites, geomorphological monitoring sites, its association with the pioneering landscape architect Edna Walling, and for the significance of Bells Beach to surfing.

4.2.3.2 Western Tasmania Aboriginal Cultural Landscape

The Western Tasmania Aboriginal Cultural Landscape represents the best evidence of an Aboriginal economic adaptation which included the development of a semi-sedentary way of life with people moving seasonally up and down the north west coast of Tasmania. This way of life began approximately 1,900 years ago and lasted until the 1830s.

Dotted along the wind-swept coastline of the Western Tasmania Cultural Landscape are the remains of numerous hut depressions found in Aboriginal shell middens. These huts and middens are the remnants of an unusual, specialised and more sedentary Aboriginal way of life which was based on the hunting of seals and land mammals, and the gathering of shellfish.

The Western Tasmania Cultural Landscape covers approximately 21,000 ha. Much of the area is remote and uninhabited with its remoteness being a significant factor in the area's relatively low level of resource use since European settlement.

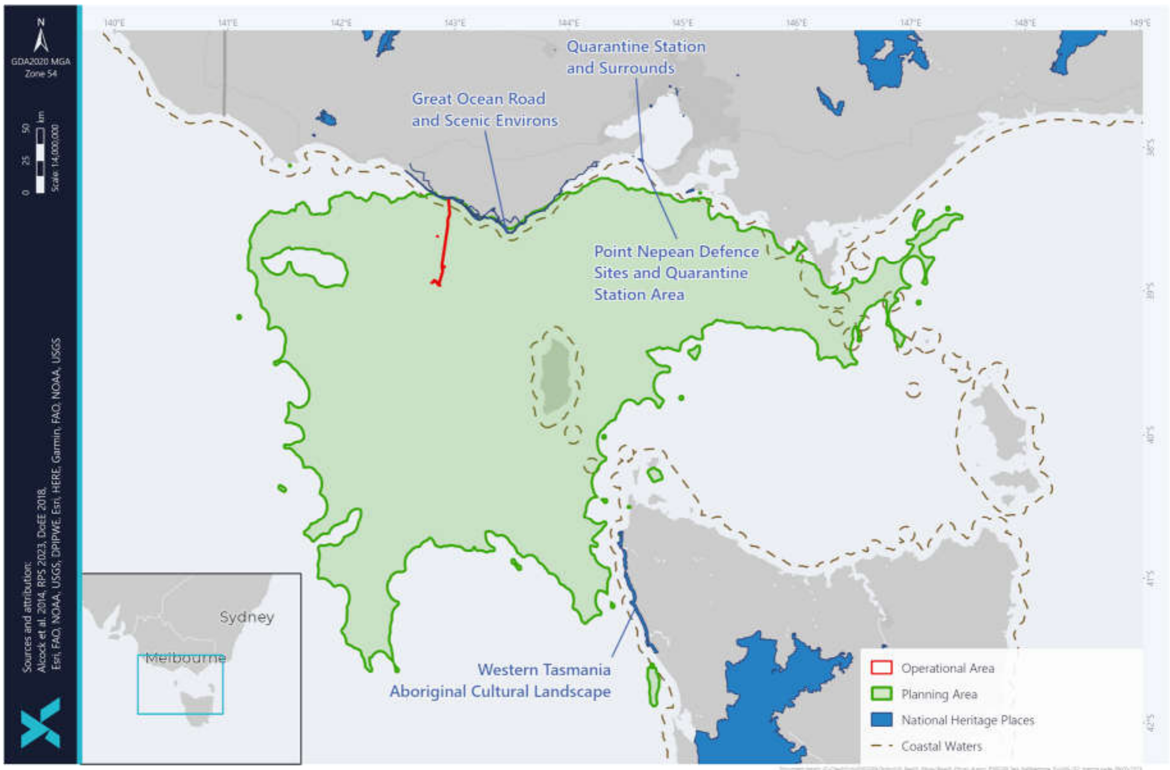


Figure 4-3: National Heritage Places within the Planning Area

4.2.4 Commonwealth Heritage Places

No Commonwealth Heritage Places were identified within the operational area (PMST Report (Appendix A) (Figure 4-4). Two Commonwealth Heritage Places were identified within the planning area (PMST Report (Appendix A) (Figure 4-4):

- Cape Wickham Lighthouse (Historic, Listed place)
- Wilsons Promontory Lighthouse (Historic, Listed place)

These historic heritage places are located inland of the coastal area that may be affected by a spill and therefore the heritage values associated with lighthouses are not affected (Figure 4-4).

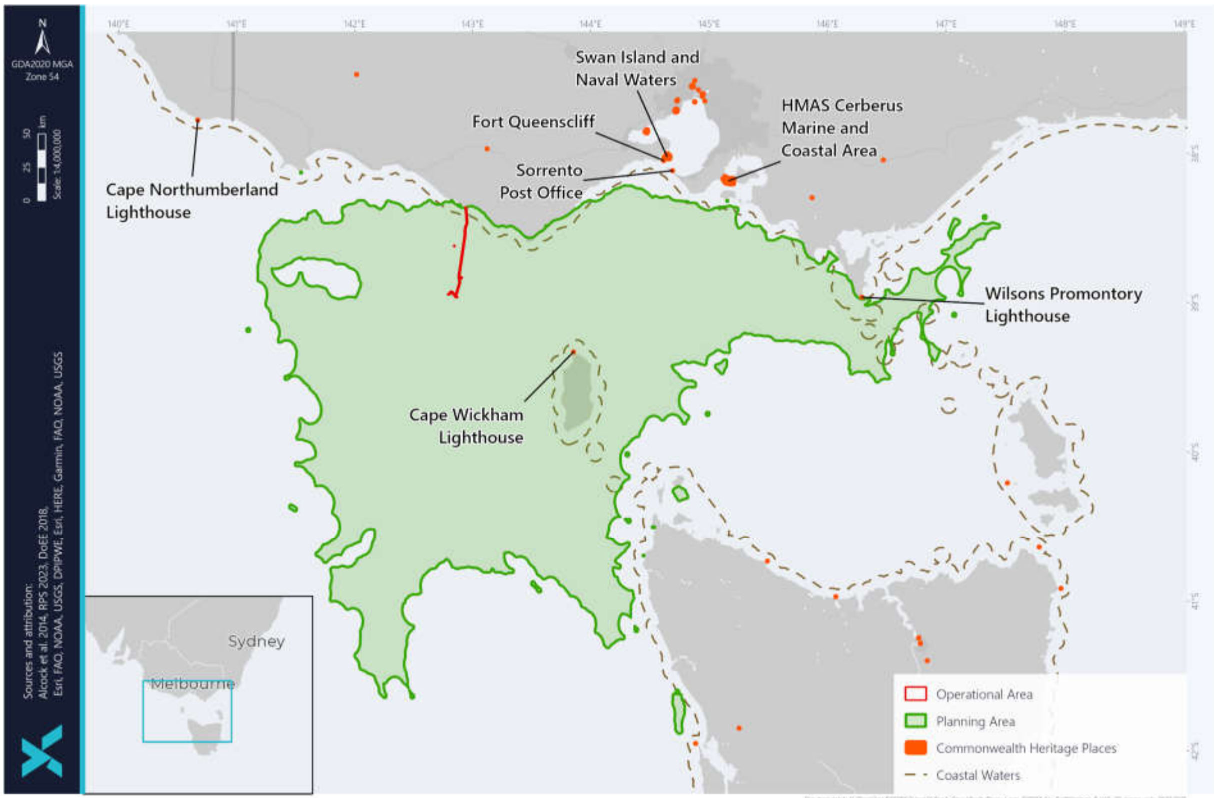


Figure 4-4: Commonwealth Heritage Places within the Planning Area

4.2.5 Maritime Archaeological Heritage

Shipwrecks over 75 years old are protected within Commonwealth waters under the *Underwater Cultural Heritage Act 2018* (Cth), in Victorian State waters under the *Victorian Heritage Act 1995* (Vic) and in Tasmanian waters under the *Historic Cultural Heritage Act 1995*. Some historic shipwrecks lie within protected zones of up to 800 m radius, typically when the shipwreck is considered fragile or at particular risk of interference. In Tasmania, the Historic Heritage Section of the Parks and Wildlife Service is the government authority responsible for the management of the State's historic shipwrecks and other maritime heritage sites.

Within the planning area there is a 130 km stretch of coastline known as the 'Shipwreck Coast' because of the large number of shipwrecks present, with most wrecked during the late nineteenth century. The strong waves, rocky reefs and cliffs of the region contributed to the loss of these ships. More than 180 shipwrecks are believed to lie along the Shipwreck Coast (DELWP, 2016b) and well-known wrecks include Loch Ard (1878), Thistle (1837), Children (1839), John Scott (1858) and Schomberg (1855).

The wrecks represent significant archaeological, educational and recreational (i.e. diving) opportunities for locals, students and tourists (Flagstaff Hill, 2015).

There are over 200 historic wrecks in the planning area, but none have a protection zone (Figure 4-5). There is no identified underwater cultural heritage within the operational area.

Beach commissioned a seabed site assessment for the Otway Gas Development (Fugro, 2020a; Fugro, 2020b). The survey extent, including the Thylacine and Geographe gas fields and infrastructure routes, are shown in Figure 4-14. As part of the seabed site assessment a sub-bottom profiler was used to identify any buried objects. The penetration of the sub-bottom profiler was limited to a maximum of ~100 cm, with the average thickness of the sand patches being ~20-30 cm; precluding burial of a shipwreck.

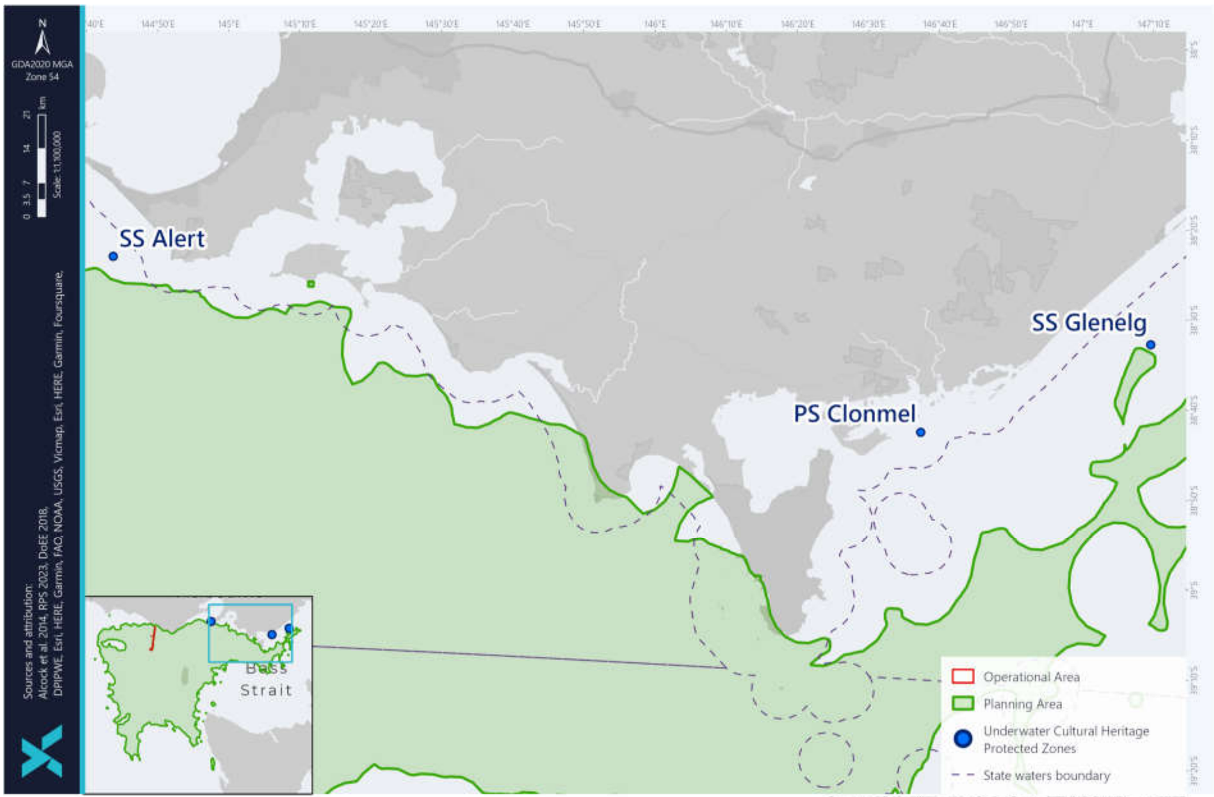


Figure 4-5: Shipwrecks with Protection Zones

4.2.6 Wetlands of International Importance

No Wetlands of International Importance were identified within the operational area (PMST Report Appendix A) (Figure 4-6).

One Wetland of International Importance (Lavinia Ramsar-listed wetlands) was identified within the planning area (PMST Report Appendix A) (Figure 4-6).

As defined in Regulations 13(3)(c) of the OPGGS(E)R, particular relevant values and sensitivities include: the ecological character of a declared Ramsar wetland within the meaning of that Act.

The ecological character and values of the Lavinia Ramsar listed wetlands area is described in the following section.

4.2.6.1 Lavinia

The Lavinia Ramsar site is located on the north-east coast of King Island, Tasmania. The boundary of the site forms the Lavinia State Reserve, with major wetlands in the reserve including the Sea Elephant River estuary area, Lake Martha Lavinia, Penny's Lagoon, and the Nook Swamps. It is subject to the Lavinia Nature Reserve Management Plan (2000) (in draft).

The shifting sands of the Sea Elephant River's mouth have caused a large back-up of brackish water in the Ramsar site, creating the saltmarsh which extends up to 5 km inland. The present landscape is the result of several distinct periods of dune formation. The extensive Nook Swamps, which run roughly parallel to the coast, occupy a flat depression between the newer parallel dunes to the east of the site and the older dunes further inland. Water flows into the wetlands from the catchment through surface channels and groundwater and leaves mainly from the bar at the mouth of the Sea Elephant River and seepage through the young dune systems emerging as beach springs.

The Lavinia State Reserve is one of the few largely unaltered areas of the island and contains much of the remaining native vegetation on King Island. The vegetation communities include Succulent Saline Herbland, Coastal Grass and Herbfield, Coastal Scrub and King Island Eucalyptus globulus Woodland. The freshwater areas of the Nook Swamps are dominated by swamp forest. Nook Swamps and the surrounding wetlands contain extensive peatlands.

The site is an important refuge for a collection of regional and nationally threatened species, including the nationally endangered, orange-bellied parrot. This parrot is heavily dependent upon the samphire plant, which occurs in the saltmarsh, for food during migration. They also roost at night in the trees and scrub surrounding the Sea Elephant River estuary.

Several species of birds which use the reserve are rarely observed on the Tasmanian mainland, including the dusky moorhen, nankeen kestrel, rufous night heron and the golden-headed cisticola.

The site is currently used for conservation and recreation, including boating, fishing, camping and off-road driving. There are artefacts of Indigenous Australian occupation on King Island that date back to the last ice age when the island was connected to Tasmania and mainland Australia via the Bassian Plain.

There are ten critical components and processes identified in the Ramsar site: wetland vegetation communities, regional and national rare plant species, regionally rare bird species, Kind Island scrubtit, orange-bellied parrot, water and sea birds, migratory birds, striped marsh frog and the green and gold frog. Elements essential to the site are the marine west coast climate, mild temperatures along with wind direction and speed. Sandy deposits dominant the site, inland sand sheets cover majority of the western area of the site (PWS, 2000). Between these sand sheets and the eastern coast there is an important geoconservation feature, several sand dunes. The dunes impede drainage from inland causing extensive swamps, lakes and river reflections. Terrestrial vegetation communities are important in providing the overall structure by buffering and supporting habitat (PWS, 2000). Wetland vegetation in the Ramsar site include swamp forest and forested peatlands are rare and vulnerable in the region. Along with other types the vegetation, the wetland provides support and provides habitat for rare flora and fauna highlighting the significance of the wetlands. Six wetland associated species have been recorded within the site. Rare bird and frog species are dependent on the wetland habitat along with ten migratory birds and other water and sea birds. Benefits provided by the Lavinia Ramsar site include aquaculture (oyster farming), tourism, education and scientific value.

There has been considerable damage caused to the saltmarsh community by vehicle disturbance in the Sea Elephant Estuary and the coastal strip (PWS, 2000). Vegetation clearance in parts of the catchment upstream as contributed to altered water balance due to less evapotranspiration of rainfall and build-up of the groundwater. There are threats to flora and fauna by invasive weeds and fungus. Although aquaculture plays a role in the Lavinia benefits risk from inputs of nutrients from feeding and occasional opening of the barred estuary for tidal flushing although with farm vehicles disturbance can impact the site.

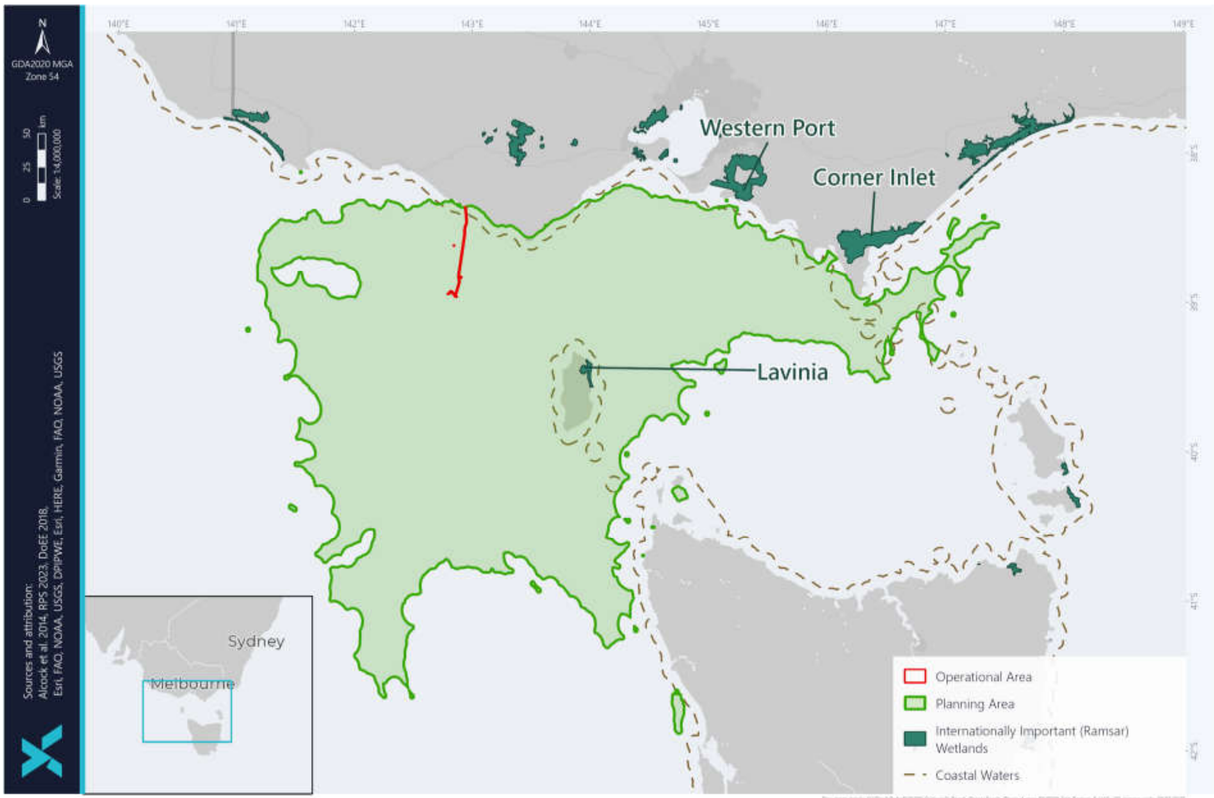


Figure 4-6: Ramsar Wetlands within the Planning Area

4.2.7 Nationally Important Wetlands

No Nationally Important Wetlands were identified within the operational area (PMST Report Appendix A) (Figure 4-7).

The planning area PMST Report (Appendix A) identified nine Nationally Important Wetlands (Figure 4-7). The following wetlands with no connection to the ocean so would not be impacted by a spill or any other aspects associated with the activity, and are not further described:

- Bungaree Lagoon (Tas)

- Lake Flannigan (Tas)
- Pearshape Lagoon 1,2,3,4 (Tas)

Information provided on the wetlands is from the DCCEEW Directory of Important Wetlands in Australia.

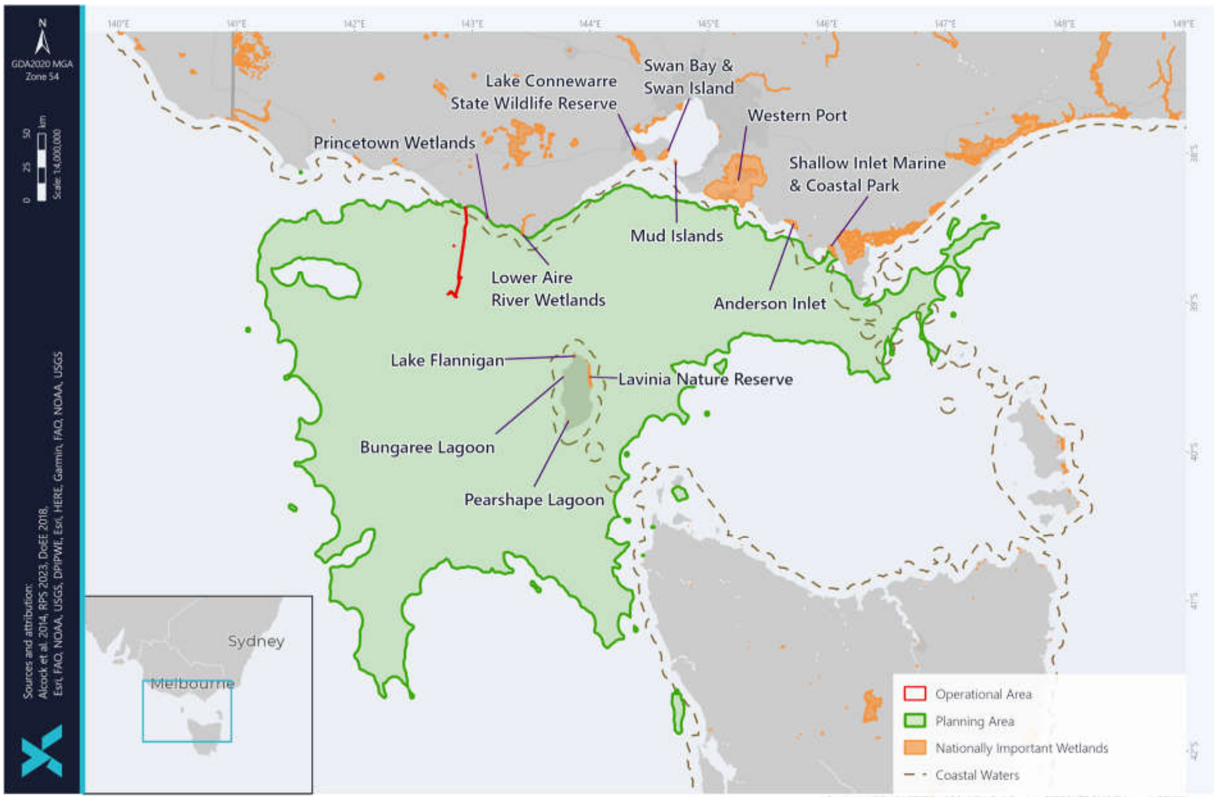


Figure 4-7: Nationally Important Wetlands within the Planning Area

4.2.7.1 Aire River/Lower Aire River Wetlands

These Victorian wetlands consist of three shallow freshwater lakes, brackish to saline marshes and an estuary on the Aire River floodplain. This floodplain occurs at the confluence of the Ford and Calder Rivers with the Aire River. It is surrounded by the Otway Ranges and dune-capped barrier along the ocean shoreline.

The Lower Aire River Wetlands have extensive beds of Common Reed and groves of Woolly Tea-tree which can support large numbers of waterbirds. These wetlands act as a drought refuge for wildlife.

Lake Hordern is considered to be of State significance for its geomorphology.

4.2.7.2 Lavinia Nature Reserve

Lavinia Nature Reserve is within the Lavinia Ramsar wetland see Section 4.2.6.1

4.2.7.3 Princetown

The Princetown Wetlands consist of swamps of varying salinity on the floodplains of the Gellibrand River and its tributary, the Serpentine (Latrobe) Creek. Wetland types present are a deep freshwater marsh, semi- permanent saline marshes and a shallow freshwater marsh.

The wetlands have extensive beds of Common Reed (*Phragmites australis*) and meadows dominated by Beaded Glasswort (*Sarcocornia australis*) which can support large numbers of waterbirds. Significant numbers of the Swamp Greenhood (*Pterostylis tenuissima* (Nv)) occur in the Princetown Wetlands; this species is found under dense Woolly Tea-tree groves.

The wetlands are used for camping, fishing, boating, duck hunting with parts of the wetlands in the Otway National Park and the Serpentine Creek State Wildlife Reserve.

4.2.7.4 Shallow Inlet Marine and Coastal Park

Shallow Inlet is a large tidal embayment with a single channel to the sea. The seaward side is enclosed by a sandy barrier complex of spits, bars and mobile dunes. The inlet is wholly within the Shallow Inlet Marine and Coastal Reserve. Thirteen sites of State, regional and local geological and geomorphological significance has been documented for the Shallow Inlet Marine and Coastal Park.

Recent vegetation survey work has recorded 180 species including 37 introduced species. The establishment of the Shallow Inlet Marine and Coastal Park was primarily in recognition of its high value as habitat for migratory waders and other shorebirds.

Shallow Inlet is used occasionally by local schools for environmental education. Tertiary institutions have used the area as a field study site for post-graduate research, mainly in geology and geomorphology. Shallow Inlet is a popular tourist destination offering attractive surroundings and a variety of recreational activities including fishing, sailboarding, swimming, camping and picnicking.

Aboriginal middens are found along the coast west of Shallow Inlet.

4.2.7.5 Western Port

Western Port is a large bay with extensive intertidal flats, mangroves, saltmarsh, seagrass beds, several small islands and two large islands.

Western Port is a high value wetland for its ecological, recreational, tourist, scientific, educational, cultural and scenic features. It is a very good example of a saltmarsh-mangrove-seagrass wetland system.

Western Port is of high value for its avifauna and flora. The bays seagrass flats are nursery grounds for King George Whiting and other species of fish and many birds depend on these areas. Many sites in Western Port are of special significance as breeding, roosting or feeding sites for waterbirds, including migratory waders.

4.2.8 Victorian Protected Areas – Marine

Victoria has a representative system of 13 Marine National Parks and 11 Marine Sanctuaries established under the National Parks Act 1975 (Vic).

No Victorian marine protected areas were identified within the operational area (PMST Report Appendix A) (Figure 4-8).

Seven Victorian marine protected areas were identified within the planning area (PMST Report Appendix A) (Figure 4-8).

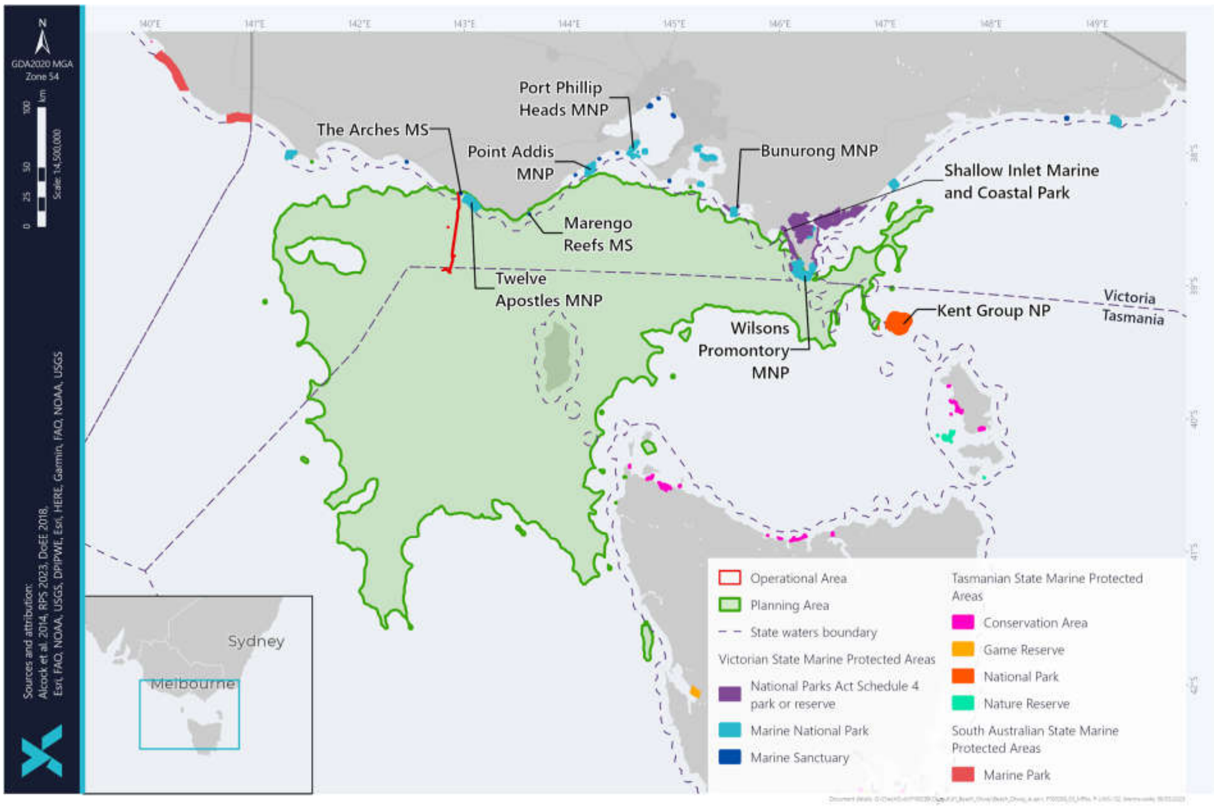


Figure 4-8: State Marine Protected Areas within the Planning Area

4.2.8.1 Bunurong Marine National Park

The Bunurong Marine National Park and Bunurong Marine Park are managed through the Bunurong Marine National Park Management Plan (Parks Victoria, 2006a). The Plan identifies the key values of the Parks as:

- extensive intertidal rock platforms and subtidal rocky reefs with a geology and form that is uncommon along the Victorian coast.
- abundant and diverse marine flora and fauna including over 22 species of marine flora and fauna recorded, or presumed to be, at their eastern or western distributional limits (Plummer et al., 2003).
- highest diversity of intertidal and shallow subtidal invertebrate fauna recorded in Victoria on sandstone (ECC 2000).
- a high proportion of the common invertebrates occurring along the Victorian coast.
- high diversity of vegetation communities, many of which are considered rare, depleted or endangered within the region (WGCMA, 2003; Carr, 2003).

- important coastal habitat for several threatened species.
- spectacular coastal scenery, featuring rugged sandstone cliffs, rocky headlands, intertidal rock platforms and sandy cove.
- Eagles Nest, a prominent rock stack, recognised as a site of national geological and geomorphological significance (Buckley 1993).
- one of the richest Mesozoic fossil areas in Victoria.
- landscape and seascape of cultural significance to Indigenous people.
- numerous places and objects of significance to Indigenous people.
- a European history rich in diversity, including sites associated with shipping, coal mining, holidaying and living on the coast.
- two historical shipwrecks listed on the Victorian Heritage Register (Heritage Victoria, 2004).
- opportunities for cultural values investigation in an area protected from human disturbance.
- extensive subtidal reefs with magnificent underwater seascapes, offering numerous opportunities for diving and snorkelling.
- highly accessible intertidal rock platforms offering opportunities for rock-pooling, marine education and interpretation.
- spectacular coastal drive, with numerous lookouts and panoramic views of the coast and surrounding waters.
- coastline offering opportunities for swimming, surfing, boating, fishing and rock-pooling in a natural setting.
- the Bunurong Marine National Park is classified as IUCN II (National Parks) and the Bunurong Marine Park as IUCN IV (Habitat/species management area).

4.2.8.2 Marengo Reefs Marine Sanctuary

The Marengo Reefs Marine Sanctuary (12 ha) is in Victorian State waters near Marengo and Apollo Bay, which are on the Great Ocean Road, approximately 220 km south-west of Melbourne. The sanctuary protects two small reefs and a wide variety of microhabitats. Protected conditions on the leeward side of the reefs are unusual on this high wave energy coastline and allow for dense growths of bull kelps and other seaweed. There is an abundance of soft corals, sponges, and other marine invertebrates, and over 56 species of fish have been recorded in and around the sanctuary. Seals rest on the outer island of the reef and there are two shipwrecks (the Grange and Woolamai) in the sanctuary (Parks Victoria, 2007a).

The Marengo Reefs Marine Sanctuary Management Plan (Parks Victoria, 2007a) identifies the environmental, cultural and social values as:

- subtidal soft sediments, subtidal rocky reefs and intertidal reefs.

- high diversity of algal, invertebrate and fish species.
- Australian fur seal haul out area.
- evidence of a long history of Indigenous use, including many Indigenous places and objects nearby.
- wrecks of coastal and international trade vessels in the vicinity of the sanctuary.
- spectacular underwater scenery for snorkelling and scuba diving.
- intertidal areas for exploring rock pools.
- opportunities for a range of aquatic recreational activities including seal watching.

4.2.8.3 Point Addis Marine National Park

Point Addis Marine National Park lies east of Anglesea and covers 4,600 ha. This park protects representative samples of subtidal soft sediments, subtidal rocky reef, rhodolith beds and intertidal rocky reef habitats. The park also provides habitat for a range of invertebrates, fish, algae, birds and wildlife. The world-famous surfing destination of Bells Beach is within Point Addis Marine National Park.

It is managed under the Management Plan for Point Addis Marine National Park, Point Danger Marine Sanctuary and Eagle Rock Marine Sanctuary (Parks Victoria, 2005a) and is classified as IUCN II. The plan identifies the following environmental, cultural and social values for the parks and sanctuaries:

- sandy beaches, subtidal soft sediments, subtidal rocky reefs, rhodolith beds and intertidal reefs.
- a high diversity of algal, invertebrate and fish species.
- a high diversity of sea slugs (opisthobranchs) and other invertebrate communities within Point Danger Marine Sanctuary.
- evidence of a long history of Indigenous use, including many Indigenous places and objects adjacent to the park and sanctuaries near dunes, headlands, estuaries and creeks.
- surf breaks, including those at Bells Beach, which are culturally important to many people associated with surfing.
- coastal seascapes of significance for many who live in the area or visit.
- recreational and tourism values.
- spectacular underwater scenery for snorkelling and scuba diving.
- intertidal areas for exploring rock pools.
- opportunities for a range of recreational activities.
- a spectacular seascape complementing well-known visitor experiences on the Great Ocean Road.

4.2.8.4 Shallow Inlet Marine and Coastal Park

Shallow Inlet Marine and Coastal Park is also a Nationally Importance Wetland. Details are provided in Section 4.2.7.4.

4.2.8.5 The Arches Marine Sanctuary

The Arches Marine Sanctuary protects 45 ha of ocean directly south of Port Campbell. It has a spectacular dive site of limestone formations, rocky arches and canyons. The sanctuary is also ecologically significant, supporting habitats such as kelp forests and a diverse range of sessile invertebrates on the arches and canyons. These habitats support schools of reef fish, seals and a range of invertebrates such as lobster, abalone and sea urchins. The Arches Marine Sanctuary is managed in conjunction with the Twelve Apostles Marine Park under the Management Plan for Twelve Apostles Marine National Park and The Arches Marine Sanctuary.

4.2.8.6 Twelve Apostles Marine National Park

The Twelve Apostles Marine National Park (75 km^2) is located 7 km east of Port Campbell and covers 16 km of coastline from east of Broken Head to Pebble Point and extends offshore to 5.5 km (Plummer et al, 2003).

The area is representative of the Otway Bioregion and is characterised by a submarine network of towering canyons, caves, arches and walls with a large variety of seaweed and sponge gardens plus resident schools of reef fish. The park contains areas of calcarenite reef supporting the highest diversity of intertidal and sub-tidal invertebrates found on that rock type in Victoria (DSE, 2012).

The park includes large sandy sub-tidal areas consisting of predominantly fine sand with some medium to coarse sand and shell fragment (Plummer et al, 2003). Benthic sampling undertaken within the park in soft sediment habitats at 10 m, 20 m and 40 m water depths identified 31, 29 and 32 species respectively based upon a sample area of 0.1 m^2. These species were predominantly polychaetes, crustaceans and nematodes with the mean number of individuals decreasing with water depth (Heisler & Parry, 2007). No visible macroalgae species were present within these soft sediment areas (Plummer et al, 2003; Holmes et al, 2007). These sandy expanses support high abundances of smaller animals such as worms, small molluscs and crustaceans; larger animals are less common.

The Twelve Apostles Marine Park is managed in conjunction with the Arches Marine Sanctuary under the Management Plan for Twelve Apostles Marine National Park and The Arches Marine Sanctuary (Parks Victoria, 2006b) and is classified as IUCN II. The Plan describes the key environmental, cultural and social values as:

- unique limestone rock formations, including the Twelve Apostles.
- a range of marine habitats representative of the Otway marine bioregion.
- indigenous culture based on spiritual connection to sea country and a history of marine resource use.
- the wreck of the Loch Ard (shipwreck).
- underwater limestone formations of arches and canyons.

- a diverse range of encrusting invertebrates.
- a spectacular dive site (Parks Victoria, 2006b).

4.2.8.7 Wilsons Promontory Marine National Park

Wilsons Promontory National Park is in South Gippsland, about 200 km south-east of Melbourne and at 15,550 ha is Victoria’s largest Marine Protected Area. It extends along 17 km of mainland coastline around the southern tip of Wilsons Promontory and is managed through the Wilsons Promontory Marine National Park and Wilsons Promontory Marine Park Management Plan May 2006 (Parks Victoria, 2006a) and is classified as IUCN II (National Parks). The Plan describes the key environmental, cultural and social values as;

- granite habitats, which are unusual in Victorian marine waters, including extensive heavy reefs with smooth surfaces, boulders and rubble and low-profile reefs.
- biological communities with distinct biogeographic patterns, including shallow subtidal reefs, deep subtidal reefs.
- intertidal rocky shores, sandy beaches, seagrass and subtidal soft substrates.
- abundant and diverse marine flora and fauna, including hundreds of fish species and invertebrates such as sponges, ascidians, sea whips and bryozoans.
- 68 species of marine flora and fauna recorded, or presumed to be, at their eastern or western distributional limits.
- important breeding sites for a significant colony of Australian fur seals.
- important habitat for several threatened shorebird species, including species listed under international migratory bird agreements.
- outstanding landscapes, seascapes and spectacular underwater scenery.
- seascape, cultural places and objects of high traditional and cultural significance to Indigenous people.
- Indigenous cultural lore and interest maintained by the Gunai / Kurnai and Boonwurrung people.
- important maritime and other history.
- historic shipwrecks, many of which are listed on the Victorian Heritage Register (Parks Victoria, 2006a).

4.2.9 Victorian Protected Areas – Terrestrial

One Victorian terrestrial protected area (Port Campbell National Park) was identified within the operational area (PMST Report Appendix A) (Figure 4-8).

Numerous Victorian terrestrial protected areas were identified within the planning area PMST Report (Appendix A). However, only the following terrestrial protected areas are within the area where shoreline oil may reach the Victorian coastline (Figure 4-9):

- Aire River Heritage River
- Bay of Islands Coastal Park
- Cape Liptrap Coastal Park
- Great Otway National Park
- Phillip Island Nature Park
- Port Campbell National Park
- Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks

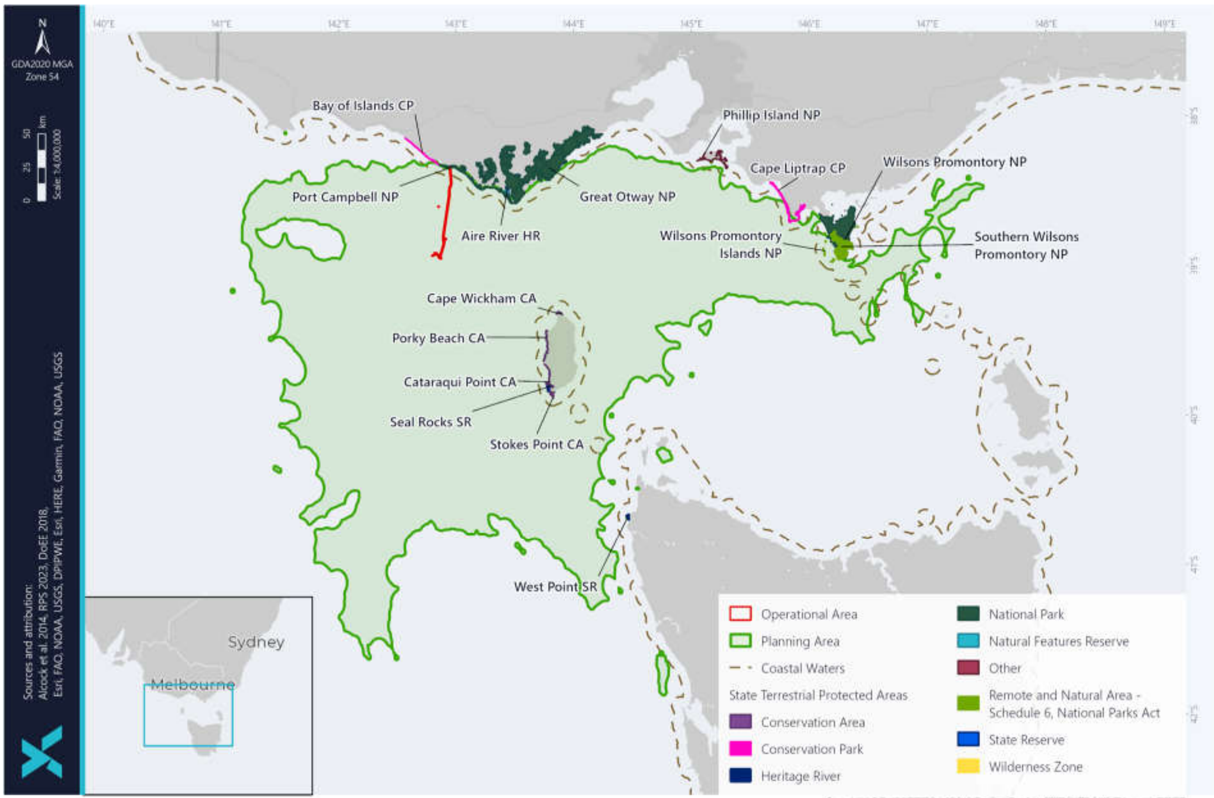


Figure 4-9: State Terrestrial Protected Areas within the Planning Area

4.2.9.1 Aire River Heritage River

The Aire River is a perennial river of the Corangamite catchment, located in the Otway region. The river generally flows west by south then south through the Great Otway National Park, joined by three minor tributaries, before reaching its mouth and emptying into Bass Strait west of Cape Otway. It is a popular fishing and camping area.

4.2.9.2 Bay of Islands Conservation Park

This coastal park has outstanding ocean views and geological features and covers an extensive area of the coastline (~32 km in length and 950 ha), stretching east from Warrnambool to Peterborough. Sheer cliffs and rock stacks dominate the bays, and the heathlands contain wildflowers. Beaches are accessible at some points (Parks Victoria, 1998).

This park protects the terrestrial environment above the low water mark of this coastline. This Coastal Park is protected under the Port Campbell National Park and Bay of Islands Coastal Park Management Plan (Parks Victoria, 1998).

4.2.9.3 Cape Liptrap Conservation Park

Cape Liptrap Coastal Park is located in South Gippsland, 180 km south-east of Melbourne. It is protected under the Cape Liptrap Coastal Park Management Plan (Parks Victoria, 2003), which identifies the environmental, cultural and social values as:

- extensive heathland and coastal forest vegetation communities.
- the occurrence of about 270 species of flowering plants, including 27 orchid species.
- thirty threatened fauna species, including ten species listed as threatened under the Flora and Fauna Guarantee Act 1988 (Vic.), 17 migratory bird species and ten threatened flora species.
- one of the most interesting and complex geological sequences in the State, ranging from ancient Cambrian rocks to Recent sands.
- spectacular coastal landforms at Cape Liptrap, Arch Rock and at Walkerville.
- numerous middens and other significant Aboriginal sites.
- relics of the lime-burning industry at Walkerville.
- Cape Liptrap lighthouse.
- spectacular and diverse coastal scenery.
- opportunities for fishing, nature observation, camping, and walking in natural settings.

This park protects the terrestrial environment above the low water mark of this coastline.

4.2.9.4 Great Otway National Park

The Great Otway National Park (103,185 ha) is located near Cape Otway and stretches from the low water mark inland on an intermittent basis from Princetown to Apollo Bay (approximately 100 km).

Landscapes within the park are characterised by tall forests and hilly terrain extending to the sea with cliffs, steep and rocky coasts, coastal terraces, landslips, dunes and bluffs, beaches and river mouths. There is a concentration of archaeological sites along the coast, coastal rivers and reefs. The park contains many sites of international and national geological and geomorphological significance including Dinosaur Cove (internationally significant dinosaur fossil site), Lion Headland and Moonlight Head to Milanesia Beach (internationally significant coastal geology and fossils).

The park provides habitats for the conservation of the rufous bristlebird, hooded plover, white-bellied sea eagle, fairy tern, Caspian tern and Lewin’s rail and native fish such as the Australian grayling.

The park contains significant Aboriginal cultural sites adjacent to rivers, streams and the coastline including over 100 registered archaeological sites, particularly shell middens along the coast, as well as non-physical aspects such as massacre sites, song lines, family links and stories. The park also contains four sites listed on the Victorian Heritage Register including the Cape Otway Light Station and several shipwreck features along the coast (i.e. anchors) (Parks Victoria and DSE, 2009).

This park protects the terrestrial environment above the low water mark of this coastline. The Park is protected under the Great Otway National Park and Otway Forest Park Management Plan (Parks Victoria and DSE, 2009) and relevant values are:

- a large area of essentially unmodified coastline, linking the land to marine ecosystems and marine national parks.
- a diverse range of lifestyle and recreation opportunities for communities adjacent to the parks – for local permanent residents and holiday homeowners Regionally, nationally and internationally.
- significant tourist attractions, close to access routes and accommodation, such as spectacular coastal scenery along the Great Ocean Road, access to beautiful beaches, clifftop lookouts, picnic areas, historic sites, waterfalls and walking tracks such as the Great Ocean Walk.
- the basis for continued growth of nature-based tourism associated with the parks and the region, providing economic opportunities for accommodation providers, food and services providers, and recreation, tourism and education operators.

4.2.9.5 Phillip Island Nature Park

Phillip Island is east of Melbourne and forms a natural breakwater for the shallow waters of Western Port. Phillip Island is Biologically Important Area (BIA) for the little penguin, with breeding and foraging sites present (DAWE, 2021). There is no management plan for Phillip Island Nature Park.

4.2.9.6 Port Campbell National Park

Port Campbell National Park is slightly west of Twelve Apostles Marine National Park and 10 km east of Warrnambool. The park is 1,750 ha that presents an extraordinary collection of wave-sculptured rock formations. Port Campbell National Park is home to various fauna such as the little penguin, short-tailed shearwater and various whale species (Parks Victoria, 2019b).

4.2.9.7 Wilsons Promontory National Park including South Wilsons Promontory and Wilsons Promontory Islands

The Wilsons Promontory National Park is in South Gippsland, about 200 km southeast of Melbourne and includes the Wilsons Promontory Wilderness Zone, Southern Wilsons Promontory Remote and Natural Area and Wilsons Promontory Islands. It is managed under the Wilsons Promontory National Park Management Plan. The Plan identifies the key environmental, social and cultural values as (Parks Victoria, 2002):

- entire promontory of national, geological and geomorphological significance containing a number of sites of State and regional significance.

- diverse vegetation communities, including warm temperate and cool temperate rainforest, tall open forests, woodlands, heathlands, and swamp and coastal communities.
- unmodified rivers and streams with no introduced fish species.
- half of Victoria's bird species.
- intertidal mudflats, which are an internationally important habitat for migratory wading birds.
- the largest coastal wilderness area in Victoria.
- numerous middens and other significant Aboriginal sites.
- remains of sites of several small European settlements and past uses including timber milling, mining and grazing.
- a number of shipwrecks in the waters around Wilsons Promontory.
- the heritage buildings of Wilsons Promontory Light Station.
- outstanding natural landscapes including spectacular and diverse coastal scenery.

This park protects the terrestrial environment above the low water mark of this coastline.

4.2.10 Tasmanian Protected Areas - Marine

No Tasmanian marine protected areas were identified within the operational area (PMST Report Appendix A) (Figure 4-8).

One Tasmanian marine protected area was identified within the planning area (PMST Report Appendix A) (Figure 4-8).

4.2.10.1 Kent Group National Park

Kent Group National Park is made up of islands and islets, situated halfway between Wilsons Promontory in Victoria and Flinders Island off Tasmania's north-eastern tip. Kent Group National Park is in the middle of Bass Strait where it is subject to a constant barrage of wild seas and currents that with it brings richness in nutrients that supports a unique diversity of marine life. The islands are an important refuge for seabirds along with providing a sanctuary for the Australian fur-seals who make their home on the rocky outcrops (DPIPWE, 2020)

4.2.11 Tasmanian Protected Areas – Terrestrial

No Tasmanian terrestrial protected areas were identified within the operational area (PMST Report Appendix A) (Figure 4-9).

Numerous Tasmanian terrestrial protected areas were identified within the planning area PMST Report (Appendix A). However, only the following terrestrial protected areas are within the area where shoreline oil may reach the Tasmanian coastline (Figure 4-8):

- Cape Wickham Conservation Area

- Cataraqui Point Conservation Area
- Porky Beach Conservation Area
- Seal Rocks State Reserve
- Stokes Point Conservation Area
- West Point State Reserve

4.2.11.1 Cape Wickham Conservation Area

The Cape Wickham Conservation Area on the northern tip of King Island and contains Cape Wickham lighthouse and the gravesites of the crew of Loch Leven, a ship that was wrecked nearby. It is designated as IUCN Category V which is a protected landscape/seascape. There is no management plan for the Cape Wickham Conservation Area.

4.2.11.2 Cataraqui Point Conservation Area

Cataraqui Point Conservation Area is located on the west coast of King Island covering an area of 3.05 km^2 and extending from the coast to 100-200 m inland. The conservation area is designated as IUCN Category V and there is no management plan in place.

4.2.11.3 Porky Beach Conservation Area

Porky Beach Conservation Area is located on the west coast of King Island covering an area of 4.55 km^2 and extending from the coast to 100-200 m inland. The conservation area is designated as IUCN Category V and there is no management plan in place.

4.2.11.4 Seal Rocks State Reserve

Seal Rocks State Reserve is a 5.84 km^2 area on the southwestern coast of King Island. The state reserve is an IUCN category III and there is no management plan in place. Images produced by google maps and google earth, show the coastal sections of the reserve consist primarily of large rocks and rocky cliffs.

4.2.11.5 Stokes Conservation Area

Stokes Conservation Area is a 2.44 km^2 area on the southwestern coast of King Island. The state reserve is an IUCN category V and there is no management plan in place.

4.2.11.6 West Point State Reserve

West Point State Reserve is a 5.56 km^2 area on the northwest coast of Tasmania. The state reserve is an IUCN category V and there is no management plan in place.

4.2.12 Key Ecological Features

Key Ecological Features (KEFs) are elements of the marine environment, based on current scientific understanding, and are considered to be of regional importance for either the region's biodiversity or ecosystem function and integrity of a Commonwealth Marine Area.

The operational area PMST Report (Appendix A) identified the West Tasmanian Marine Canyons KEF within the operational area but as shown in Figure 4-10 this KEF is at least 15 km from the operational area. As shown in Figure 4-10 the Bonney Coast Upwelling is outside of the operational and planning area.

Two KEFs were identified within the planning area (PMST Report Appendix A) (Figure 4-10):

- Bonney Coast Upwelling
- West Tasmanian Marine Canyons

The following KEF was also identified as potentially occurring within the planning area:

- Shelf Rocky Reefs and Hard Substrates
- Bass Cascade

4.2.12.1 Bonney Coast Upwelling

The Bonney Coast upwelling is a predictable, seasonal upwelling bringing cold nutrient rich water to the sea surface and supporting regionally high productivity and high species diversity in an area where such sites are relatively rare and mostly of smaller scale (DAWE 2015). The Bonney Coast upwelling is defined as a key ecological feature as it is an area of enhanced pelagic productivity and has high aggregations of marine life (DAWE 2015). In addition to whales, many endangered and listed species frequent the area, possibly also relying on the abundance of krill that provide a food source to many seabirds and fish. The high productivity of the Bonney coast upwelling is also capitalised on by other higher predator species such as little penguins and Australian fur seals feeding on baitfish (CoA 2015c).

The Bonney Coast Upwelling KEF lies on the continental shelf situated ~120 northwest of Cape Jaffa, South Australia to Portland, Victoria (Figure 4-10). The location of the Bonney Coast Upwelling KEF was originally derived through a review of enhanced chlorophyll occurrence for summer seasonal data between the years of 1998 and 2010 (Research Data Australia 2013).

The Bonney Coast Upwelling KEF is situated ~83 km to the west of the operational area (Artisan-1 being the closest point). As shown in Figure 4-10 the Bonney Coast Upwelling is outside of the operational and planning area.

4.2.12.2 West Tasmanian Canyons

The West Tasmanian Canyons are located on the relatively narrow and steep continental slope west of Tasmania. This location has the greatest density of canyons within Australian waters where 72 submarine canyons have incised a 500 km-long section of slope (Heap & Harris 2008). The canyons in the Zeehan AMP are relatively small on a regional basis, each less than 2.5 km wide and with an average area of 34 km^2 shallower than 1,500 m (Adams et al., 2009). The Zeehan canyons are typically gently sloping and mud-filled with less exposed rocky bottoms compared with other canyons in the south-east marine region (e.g. Big Horseshoe Canyon).

Submarine canyons modify local circulation patterns by interrupting, accelerating, or redirecting current flows that are generally parallel with depth contours. Their size, complexity and configuration of features determine the degree to which the currents are modified and therefore their influences on local nutrients, prey, dispersal of eggs, larvae and juveniles and benthic diversity with subsequent effects which extend up the food chain.

Eight submarine canyons surveyed in Tasmania, Australia, by Williams et al (2009) displayed depth-related patterns with regard to benthic fauna, in which the percentage occurrence of faunal coverage visible in underwater video peaked at 200-300 m water depth, with averages of over 40% faunal coverage. Coverage was reduced to less than 10% below 400 m depth. Species present consisted of low-relief bryozoan thicket and diverse sponge communities containing rare but small species in 150 to 300 m water depth.

Sponges are concentrated near the canyon heads, with the greatest diversity between 200 m and 350 m depth. Sponges are associated with abundance of fishes and the canyons support a diversity of sponges comparable to that of seamounts. Based upon this enhanced productivity, the West Tasmanian canyon system includes fish nurseries (blue wahoo and ocean perch), foraging seabirds (albatross and petrels), white shark and foraging blue and humpback whales (TSSC, 2015a).

The West Tasmania Canyon is situated ~16 km south of the operational area (Thylacine-A Wellhead Platform being the closest point).

4.2.12.3 Shelf Rocky Reefs and Hard Substrates

Rocky reefs and hard grounds are located in all areas of the SEMR continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break. The continental shelf break generally occurs in 50 m to 150– 220 m water depth. The shallowest depth at which the rocky reefs occur in Commonwealth waters is approximately 50 m.

On the continental shelf, rocky reefs and hard grounds provide attachment sites for macroalgae and sessile invertebrates, increasing the structural diversity of shelf ecosystems. The reefs provide habitat and shelter for fish and are important for aggregations of biodiversity and enhanced productivity.

The shelf rocky reefs and hard substrates are defined as a key ecological feature as they are an area of high productivity and aggregations of marine life. This KEF has not yet been spatially defined (DoE, 2015a).

4.2.12.4 Bass Cascade

The Bass Cascade refers to the "underwater waterfall" effect brought about by the northward flow of Bass Strait waters in winter which are more saline and slightly warmer than surrounding Tasman Sea waters. As the water approaches the mainland in the area of the Bass Canyon group it forms an undercurrent that flows down the continental slope. The cascading water has a displacing effect causing nutrient rich waters to rise, which in turn leads to increased primary productivity in those areas. The cascading water also concentrates nutrients, and some fish and whales are known to aggregate along its leading edge.

Bass Cascade is defined as a key ecological feature as it is an area of high productivity. The Bass Cascade occurs during winter months only and has not yet been spatially defined (DoE, 2015a).

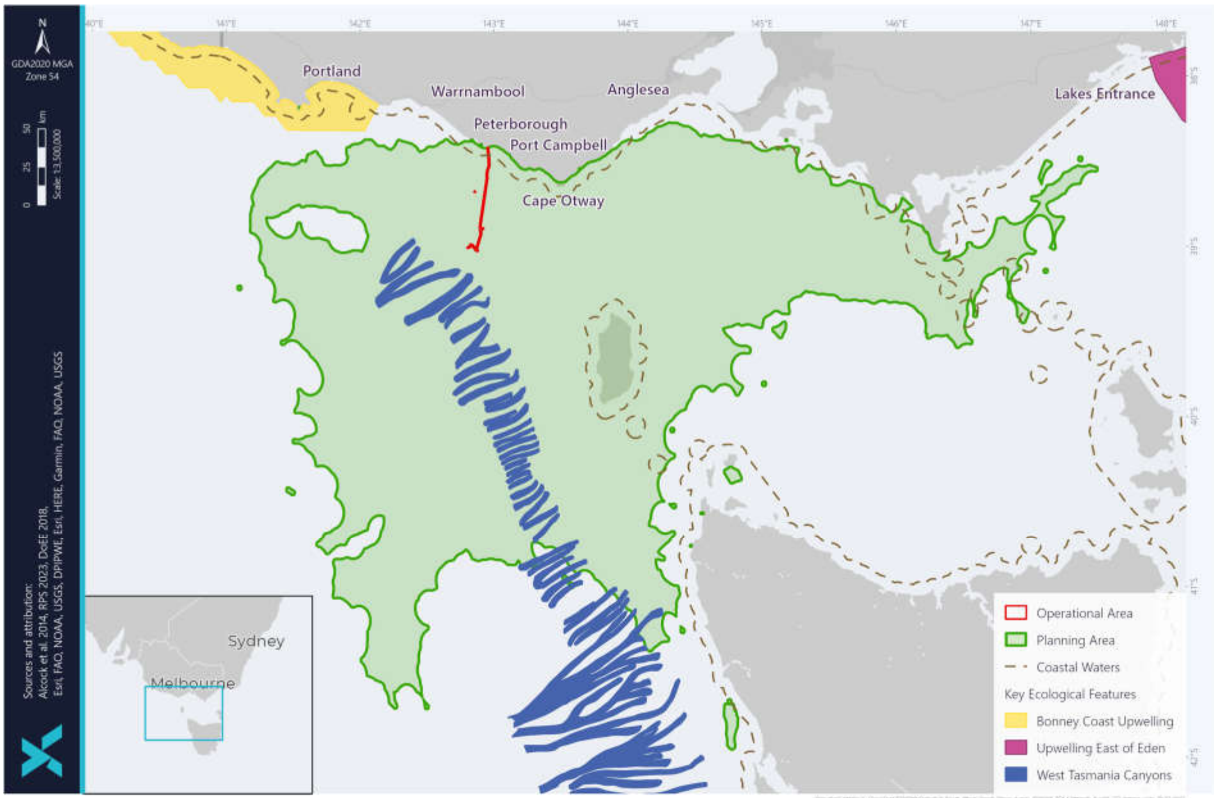


Figure 4-10: Key Ecological Features within the Planning Area

4.3 Physical Environment

The physical marine environment of the Otway region is characterised by very steep to moderate offshore gradients, high wave energy and temperate waters subject to upwelling events.

4.3.1 Geomorphology

The south-eastern section of Australia's continental margin comprises the Otway Shelf and the Bonney Coast, Bass Strait, and the western shelf of Tasmania. The 400 km long Otway Shelf lies between 37° and 43.5°S and 139.5°E (Cape Jaffa) and 143.5°E (Cape Otway). The narrowest point is off Portland, where the shelf is less than 20 km wide. It broadens progressively westward, to 60 km of Robe, SA, and eastward to 80 km of Warrnambool. The Otway shelf is comprised of Miocene limestone below a thin veneer of younger sediments.

Boreen et al. (1993) examined 259 sediment samples collected over the Otway Basin and the Sorell Basin of the west Tasmanian margin. Based on assessment of the sampled sediments the authors concluded the Otway continental margin is a swell-dominated, open, cool-water, carbonate platform. A conceptual model was developed which divided the Otway continental margin into five depth-related zones – shallow shelf, middle shelf, deep shelf, shelf edge and upper slope (Figure 4-11).

The planning area is within the five zones while the operational area is within the shallow and middle shelf.

In the shallow shelf are exhumed limestone substrates that host dense encrusting mollusc, sponge, bryozoan and red algae assemblages. The middle shelf is a zone of swell-wave shoaling and production of mega-rippled bryozoan sands. The deep shelf is described as having accumulations of intensely bioturbated, fine, bio clastic sands. At the shelf edge and top of slope, nutrient-rich upwelling currents support extensive, aphotic bryozoan/sponge/coral communities. The upper slope sediments are a bioturbated mixture of periplatform bioclastic debris and pelleted foraminiferal/nanno-fossil mud. The lower slope is described as crosscut by gullies with low accumulation rates, and finally, at the base of the slope the sediments consist of shelf-derived, coarse-grain turbidites and pelagic ooze.

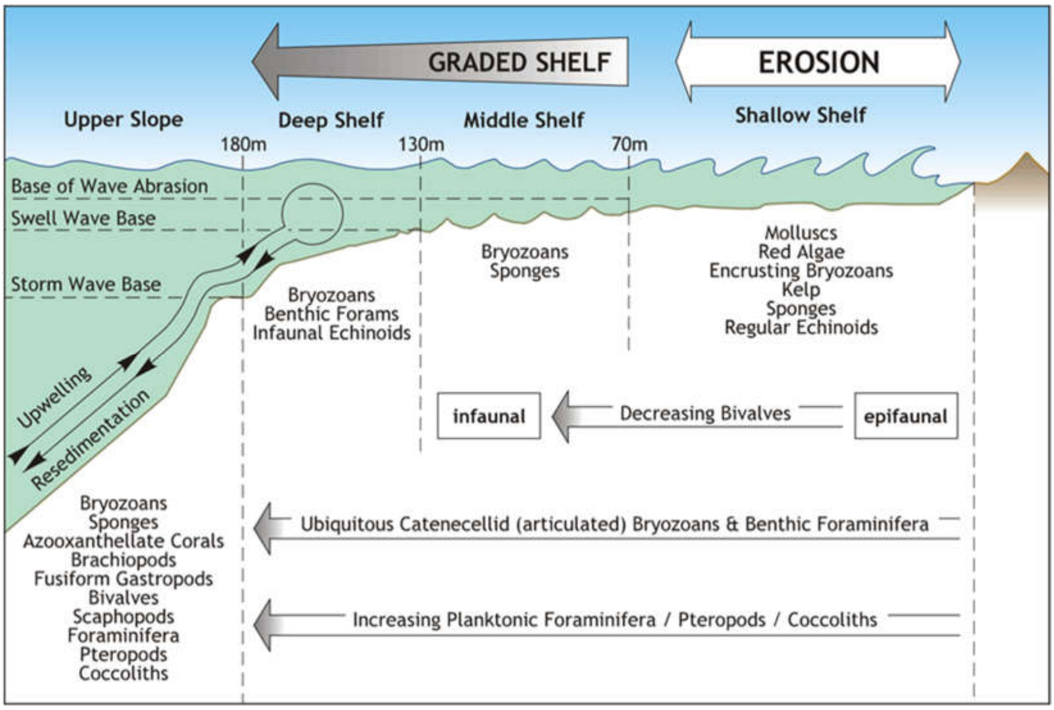


Figure 4-11: Model of the Geomorphology of the Otway Shelf

4.3.2 Otway Assessments and Surveys – Planning Area

A comprehensive assessment of the coast to continental shelf margin has been undertaken within approximately 4 km^2 of bathymetric data and video footage collected of the pipeline right-of-way options from the Otway Gas Project EIS (Woodside, 2003). These data have been supplemented by numerous benthic sampling events; however, data for this assessment have been referenced primarily from Boreen et al., (1993), and the Otway Gas Project EIS (Woodside, 2003).

In 2002, 2003 and 2004, Fugro undertook a number of bathymetric surveys of the two proposed pipeline rights of way: one constructed for the Thylacine Geographe pipeline and one extending from the completed Geographe A well to Flaxman's Hill.

A review of the available geotechnical data was carried out in March 2011 for the Geographe location (Advanced Geomatics, 2011). Overall, the seabed in the Otway area surveyed slopes to the south at a gentle average gradient of less than 1. However, the local topography is predominantly irregular in nature, varying from gently undulating and locally smooth in areas of increased sediment deposition, to areas of outcropping cemented calcrete features that are from smooth to jagged relief. These areas are covered in marine growth. ROV video survey confirmed the presence of a shallow hard underlying substrate at a depth of 50 mm below the sediment in areas of marine growth (JP Kenny, 2012).

The Flaxman's Hill alignment traverses the Thistle drilling area and the Thylacine Geographe pipeline runs parallel and north east of this area. During 2003, bathymetric data was collected, and the right of way was assessed and recorded using an underwater video camera (CEE Consultants Pty Ltd, 2003). The Flaxman's Hill pipeline route travels approximately 68 km from the Geographe gas field to the shoreline. Visual assessment of the sea floor was undertaken from a water depth of 99 m to 16 m terminating at Flaxman's Hill.

A summary of the seabed morphology and benthic assemblages is provided in Table 4-2toTable 4-6.

Table 4-2: Otway margin geomorphology (Boreen et al., 1993)

Zone	**Depth (m)**	**Width (m/km)**	**Gradient**	**Features**
Shallow Shelf	30 - 70	4 - 28	1.5 - 10	Drops rapidly from strandline to depths of 30 m, characterised by rugged but subdued topography
Middle Shelf	70 - 130	7 - 65	1 - 8.5	Generally smooth topography with occasional rock out crops

Table 4-3: Thylacine to Geographe seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

Depth (m)	**Seabed morphology**	**Benthic assemblage**
92	High profile reef stone with deep sand gutters.	Diverse, high density sessile: sponge, coral dominated crinoids common and mobile species
88	Low profile with areas of high profile limestone ridges; incomplete sand veneer.	Diverse, high density sessile: sponge, dominated and mobile species

Table 4-4: Geographe to Flaxman's Hill seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

Depth (m)	**Seabed morphology**	**Benthic assemblage**
82	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density sessile: sponge, dominated low density mobile species. (small shark)
82	Equal % of exposed low profile limestone and sand. Two reef outcrops. Low profile with areas of high profile limestone ridges; incomplete sand veneer.	Medium density, sessile: sponge, dominated
78	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density, sessile: sponge, dominated Motile: sea urchins dominated
76		Medium density, sessile: sponge, dominated
76		Low - Medium density, sessile: sponge, dominated
70		Diverse, med density sessile, sponge dominated
68		Medium density, sessile: sponge, dominated
65		Diverse, med density sessile, sponge dominated

Depth (m)	Seabed morphology	Benthic assemblage
60		Medium density, sessile: sponge, dominated

Table 4-5: Geographe to Rifle Range seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

Depth (m)	Seabed morphology	Benthic assemblage
82	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Very low density sessile; large sponge.
79		Diverse, low – high density sessile
75	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density, sessile: sponge, dominated. Motile: sea urchins dominated
74		Medium density, sessile: sponge, dominated
70		Low - Medium density, sessile: sponge, dominated
67		Diverse, med density sessile, sponge dominated
66	Low profile limestone with sand gutters	Medium density, sessile: sponge, dominated
66	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Diverse, med density sessile, sponge dominated
70	(Pock marks) Data not documented.	Medium density, sessile: sponge, dominated
63	Corse gravel to fine sand	High density sessile: micro algae dominated

Table 4-6: Nearshore seabed morphology and benthic assemblages (CEE Consultants Pty Ltd, 2003)

Depth (m)	Seabed morphology	Benthic assemblage
53	Sand	None observed
45		Only sea pens noted
16-30	Very high profile l/stone reef to sand	High density, sessile: sponge, macroalgae (Bull Kelp common)

A sampling survey of the surficial sediments, benthic invertebrates and demersal fishes of Bass Strait was undertaken by the Victorian Museum between 1979 and 1983 (Wilson and Poore, 1987). More than 200 sites were sampled with sites 51 through 61, 118, 119, 120, 121, 183, 186 and 192 representatives of the area (Figure 4-12). Sediments were described in the field from a visual impression or according to the classification of Shepard (Shepard, 1954) (Table 4-7). Carbonate percentage of sediments was also assessed. These samples indicate that surficial sediments throughout the area are dominated by carbonate rich medium to coarse sands. Data on benthic invertebrates and demersal fishers has not been summarised and published.

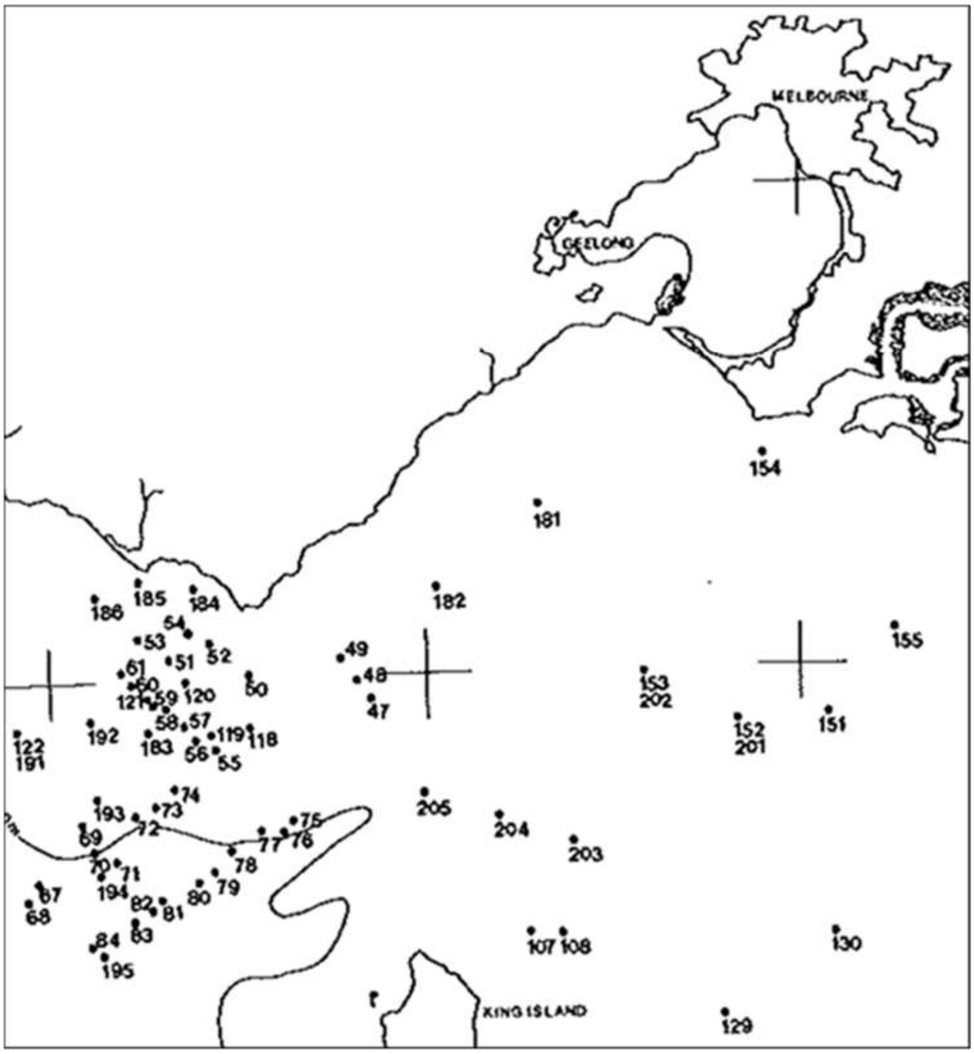


Figure 4-12: Sampling sites for the Bass Strait survey in the region of the Planning Area (Wilson and Poore, 1987)

Table 4-7: Classification of surficial sediments sampled during the Bass Strait survey in the vicinity of the planning area (Wilson and Poore, 1987)

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
51	67	Medium sand	ND
52	49	Coarse sand	72
53	67	Medium sand	45
54	70	Very coarse shelly sand	70
55	85	Coarse carbonate sand	93
56	77	Medium sand	ND
57	59	Coarse sand	97
58	47	Coarse sand	92
59	70	Coarse sand	89
60	79	Medium carbonate sand	100

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
61	68	Coarse sand	ND
118	95	Fine sand	96
119	92	Fine sand	99
120	84	Medium sand	90
121	84	Medium sand	ND
183	84	Coarse sand	99
186	69	Fine sand	ND
192	81	Medium sand	100

*ND – None detected

A video survey of the seabed at selected sites along proposed offshore pipeline routes for the Otway Gas Development was undertaken by BBG during 2003 (Figure 4-13). BBG (2003) found that the substrate in water depths between 82 and 66 m were predominantly low profile limestone with an incomplete sand veneer that supported a low to medium density, sponge dominated filter feeding community. Fish and other motile organisms were uncommon.

In shallower depths of between 63 and 30 m, the video surveys showed a rippled, sand or sand/pebble substrate with minor sponge dominated benthic communities. The epibenthic organisms were generally attached to outcropping or sub-outcropping limestone pavements. Only in waters shallower than approximately 20 m, was an area of significant, high profile reef and associated high density macroalgae dominated epibenthos encountered. Details of the seabed and benthic epifaunal assemblage are provided in Table 4-8.

Table 4-8: Seabed characteristics and epifaunal assemblage at video survey sites (BBG, 2003)

Site No.	Depth (m)	Seabed type	Benthic Assemblage
3097	99	Bare rippled sand; minor limestone outcrops	Low density sessile; small sponge dominated
3118	99	Low profile limestone reef with sand veneer; isolated areas of raised l/stone	Low density sessile; sponge dominated
3084	99	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3072	99	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3054	98	Mix of low and high profile l/stone; shallow and deep sand	Low density sessile on low l/stone; high density sessile on high l/stone plus fish; sponge dominated
3185	95	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3196	94	Low profile limestone reef with incomplete sand veneer	Low density sessile; sponge dominated
3232	92	High profile reef stone with deep sand gutters.	Diverse, high density sessile: sponge, coral dominated crinoids common and mobile species

Site No.	Depth (m)	Seabed type	Benthic Assemblage
3267	88	Low profile with areas of high profile limestone ridges; incomplete sand veneer.	Diverse, high density sessile: sponge, dominated and mobile species
2801	82	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Very low density sessile; large sponge.
2720	79		Diverse, low – high density sessile
2590	75	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Medium density, sessile: sponge, dominated. Motile: sea urchins dominated
2490	74		Medium density, sessile: sponge, dominated
2339	70		Low - Medium density, sessile: sponge, dominated
2291	67		Diverse, med density sessile, sponge dominated
2191	66	Low profile limestone with sand gutters	Medium density, sessile: sponge, dominated
2181	66	Low profile with areas of high profile limestone ridges; incomplete sand veneer	Diverse, med density sessile, sponge dominated
1191	63	Coarse gravel to find sand	High density sessile: micro algae dominated
1668	53	Sand	None observed

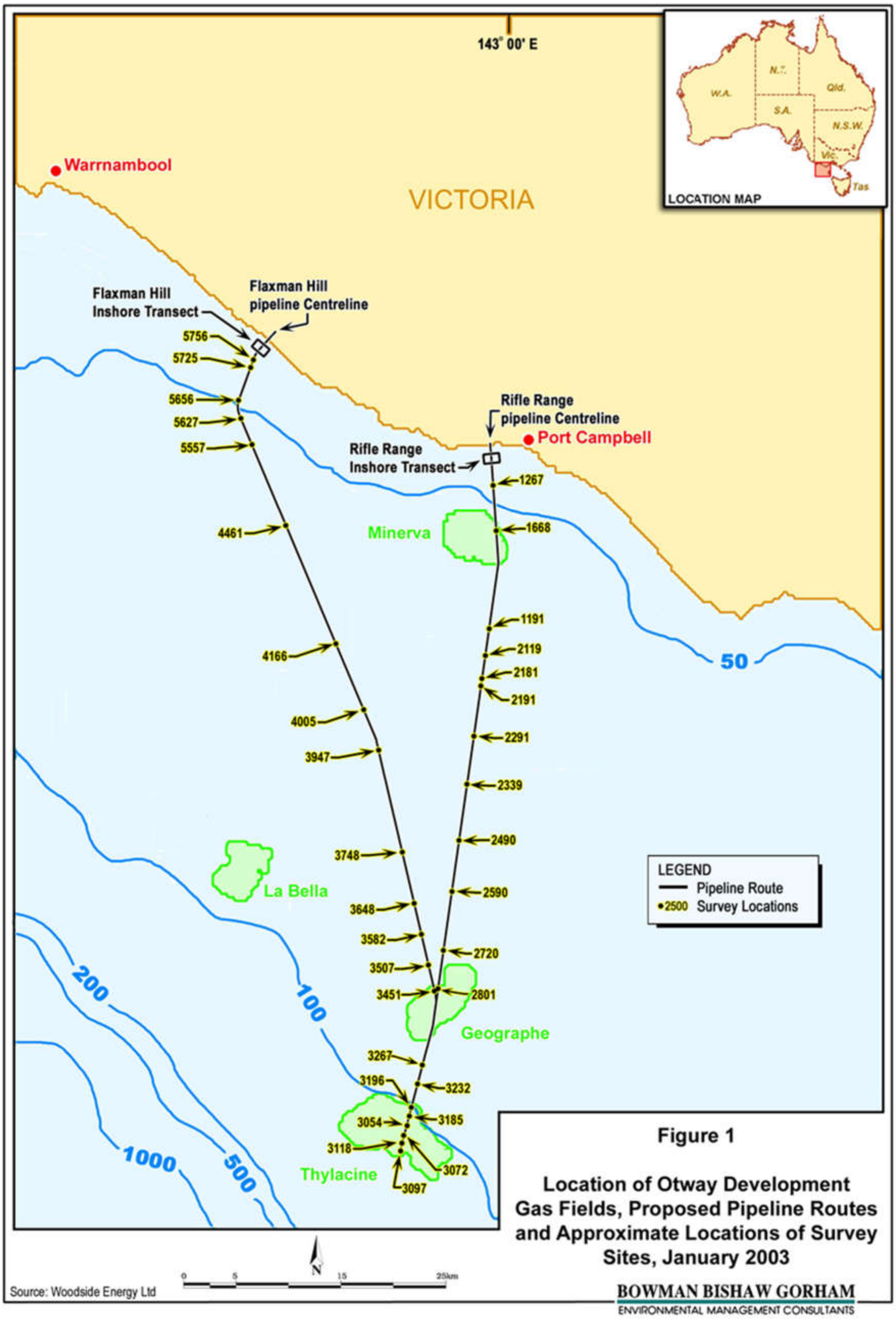


Figure 4-13: Seabed Sites Assessed by Video Survey During 2003 (BBG, 2003)

Beach commissioned a seabed site assessment for the Otway Gas Development. The seabed site assessment was undertaken from November 2019 to January 2020 and ranged in water depths from 70 to 104 m. The survey extent including the gas fields and infrastructure routes which are shown in Figure 4-14.

The objective of the seabed site assessment was to determine suitable locations for anchoring and MODU placement for drilling operations and the installation of infrastructure to connect new production wells to the existing platform or pipeline. Several different investigation techniques were used to examine and describe the seabed, as well as identify possible hazards from manmade, natural and geological features.

Sediment samples for infauna were collected at two of the gas fields, Artisan and Thylacine (Ramboll, 2020. Appendix B). Due to poor weather conditions sampling had to be reduced. It was decided that the Artisan field would be representative of the infauna closer to shore (such as along the pipeline route), while the Thylacine field which is further offshore would represent the Geographe field.

The benthic infauna identified and counted from samples collected at the Thylacine and Artisan sites were relatively depauperate in both abundance and diversity. A total of 22 morpho-species were identified, from a total of 45 organisms collected from the grab samples, most of which were polychaete worms or crustaceans. These results are reflective of the sedimentary environment at the Thylacine and Artisan fields. All sites were dominated by sand, which typically have a lower abundance and diversity of infauna given that this abrasive type of substrate tends to be more easily subjected to laminar flows that move the sediment more dynamically than muddy substrates. The consequence of this is a physical environment that is not favourable for filter feeding and burrowing infauna species to inhabit. The types of species that were present in the samples were all those which can be expected to tolerate this somewhat dynamic environment. There were no discernible spatial trends in the distribution of sediment particle size. Likewise, there were no clear trends in the abundance, diversity or composition of benthic infauna.

The composition and percent coverage of epifauna was assessed from photographs of the seafloor taken with a drop camera system (Ramboll, 2020. Appendix B). Photographs were taken at the anchor points for proposed well locations to provide a represented sample of the area where the seabed could potentially be disturbed by the drilling activity.

Percent cover ranged from 0 to 80% of the sample photograph for all samples but on average the percent cover was typically no more than 37%. The seabed at Hot Tap X had the greatest average coverage of epibiota while the lowest coverage of epibiota was recorded along the route between Artisan and Hot Tap Y (Figure 4-14). Of the gas field sites, Artisan and Hercules had a slighted greater coverage of epifauna, while the routes between gas fields and Hot Tap Y have the least coverage of epifauna. Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant.

Further analysis of epifauna from a grab samples at Artisan showed that much of the epifauna is comprised of branching bryozoans, feather-like gorgonian cnidarians and sponges. This complex of encrusting/branching fauna provides refuge for macrofauna such as amphipods, isopods, polychaete worms and molluscs.

Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of a unmodifed marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2. A microscopic examination of a qualitative sample of this epibiota indicated that this complex of fauna provide microhabitat for a range of macrofauna such as amphipods, isopods, polychaete worms and molluscs. Such epifaunal habitats are known to provide refuge and other resources for benthic species (Jones, 2006). By comparison, there was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.

Ramboll (2020) summarise that the epibiota on the seabed in the vicinity of the Thylacine and Artisan gas fields is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates. No species or ecological communities listed as threatened under the *Environmental Protection and Biodiversity Conservation Act* 1999 (the EPBC Act) were observed.

The findings from Ramboll (2020) align with findings from the Otway Gas Development studies (CEE Consultants Pty Ltd, 2003; BBG, 2003) and Boreen et al., (1993) concerning the subsea features and biological communities likely to dominate the planning area. In summary the seabed of the planning area can be characterised as a carbonate mid shelf and deeper sections (60 – 70 m) of the shallow shelf with surficial sediments of carbonate rich coarse to medium sands with areas of exposed limestone substrate. The epifauna is dominated by low density, sessile sponge assemblages.

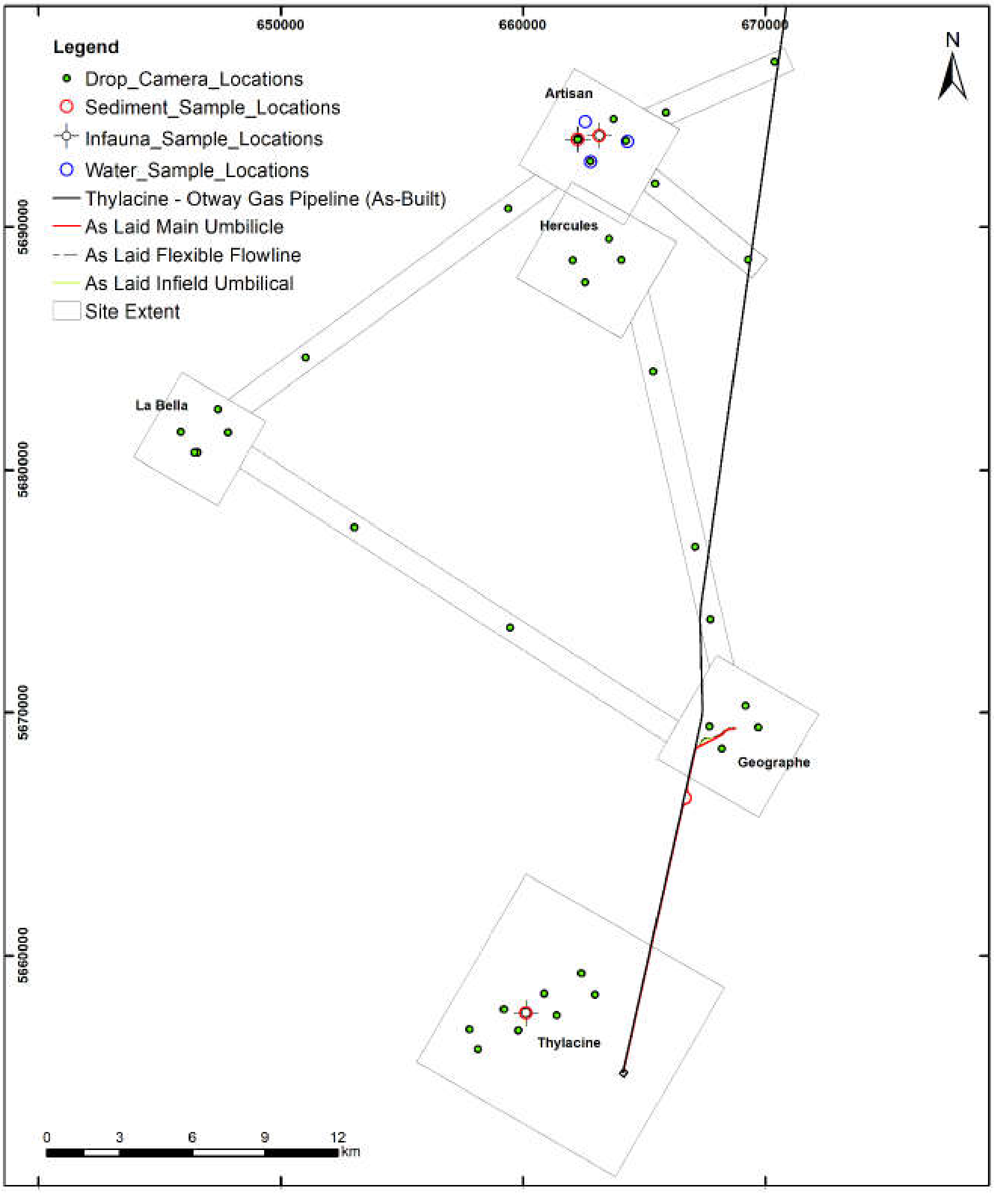


Figure 4-14: Location of the Otway Gas Development Seabed Site Assessment

4.3.3 Otway Assessments and Surveys - Operational Area

As detailed in Section 4.3.2 Beach commissioned a seabed site assessment for the Otway Gas Development. The seabed site assessment was undertaken from November 2019 to January 2020 and ranged in water depths from 70 to 104 m. The survey extent included the gas fields and infrastructure routes are shown in Figure 4-14.

The objective of the seabed site assessment was to determine suitable locations for anchoring and MODU placement for drilling operations and the installation of infrastructure to connect new production wells to the existing platform or pipeline, however the information gathered is relevant to the Otway Offshore Operations due to the locations surveyed. The geophysical survey comprised of multibeam bathymetry, side scan sonar, magnetometer and sub-bottom profiling. The geotechnical investigation comprised of cone penetration tests and seabed samples. In addition, sediment samples for infauna were collected at the Artisan and Thylacine gas fields and the composition and percent coverage of epifauna was assessed from photographs of the seafloor taken with a drop camera at several locations including the Thylacine and Geographe gas fields (Ramboll, 2020. Appendix B). The drop camera locations for the Geographe and Thylacine locations are shown in Figure 4-15. These investigation techniques were used to examine and describe the seabed and benthic biota, as well as identify possible hazards from manmade, natural and geological features.

The seabed site assessment for the Thylacine field (Fugro, 2020a; Ramboll, 2020) identified:

- the seabed depths vary ranging from 92 m to 115 m. LAT, with an overall southwestern slope.
- the seabed topography compromises of rocky outcrops of the regionally-dipping Port Campbell limestones.
- sands are coarse (siliceous) calcareous medium sand.
- a local relief of up to 3 m is identified on the rocky scarp surfaces, which are separated by shallow depressions often with a transgressive sandy infill.
- the percentage epifauna cover from the eight drop camera sites ranged from zero to 65% with an average percentage cover of 14%.
- predominantly hard seabed with coarse sand substrates that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges).
- the epibiota on the seabed in the vicinity of the Thylacine gas fields is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates.

The seabed site assessment for the Geographe field (Fugro, 2020b; Ramboll, 2020) identified:

- there is very little bathymetric variation across the survey area with water depths ranging from 80 m to 91 m. the seabed is characterised by rocky outcrop on the seabed
- rocky outcrops of the Port Campbell Limestone show some variable relief up to 2 m.
- sand is clean washed and well sorted and comprising predominantly of angular broken shells and bryozoans.
- the percentage cover from the four drop camera sites ranged from zero to 55% with an average percentage cover of 13%.
- predominantly hard seabed with coarse sand substrates that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges).

Based on the information from the seabed site assessment for the Otway Gas Development, Condition 1 (d) of EPBC 2002/621 is met as information from the seabed site assessment was used to determine the final selection of the Thylacine and Geographe well locations. No high relief outcrops, reefs, sponge beds or historic shipwrecks were identified within the well locations.

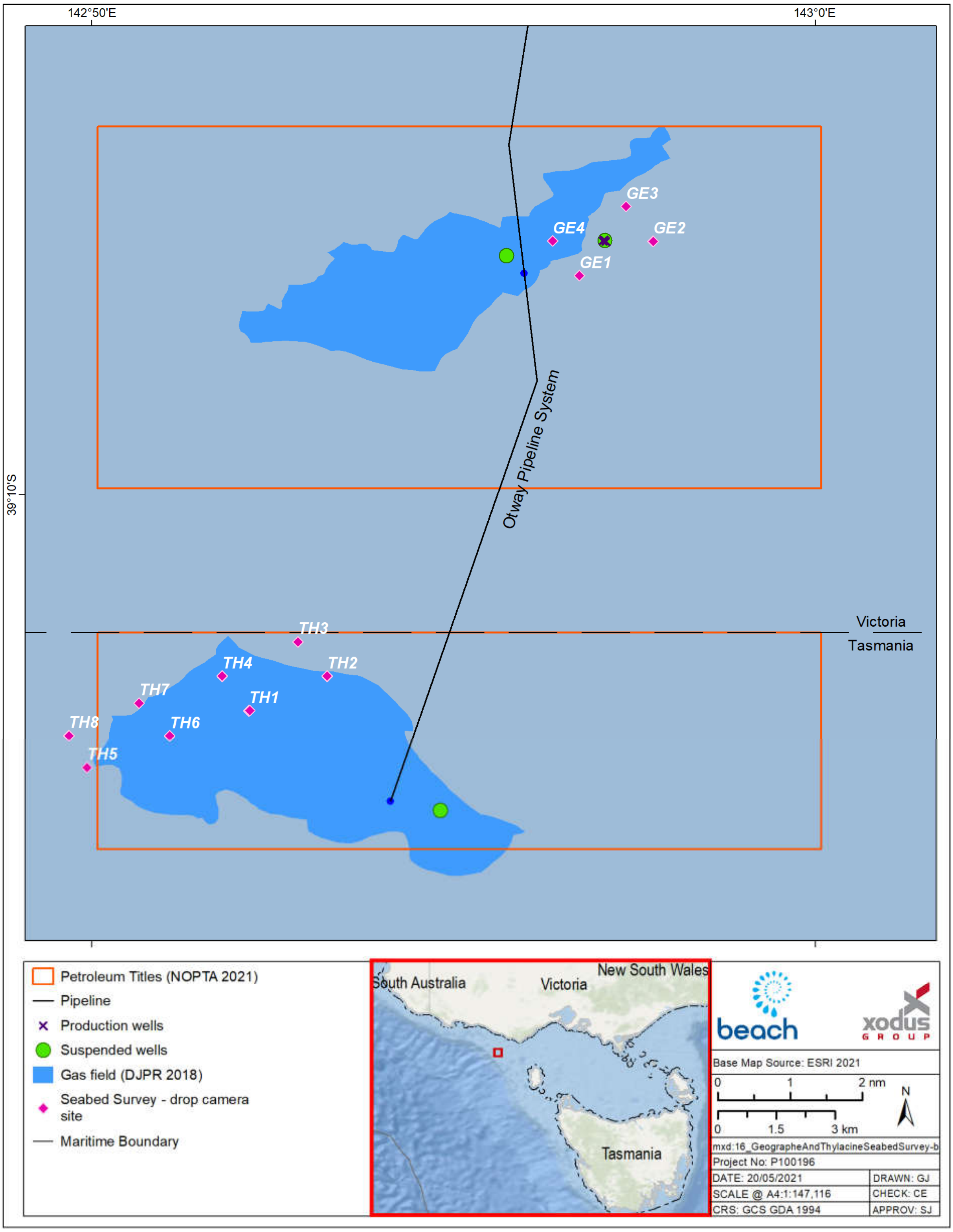


Figure 4-15: Drop Camera Locations within Operational Area


TH 1


TH 2


TH 3


TH 4

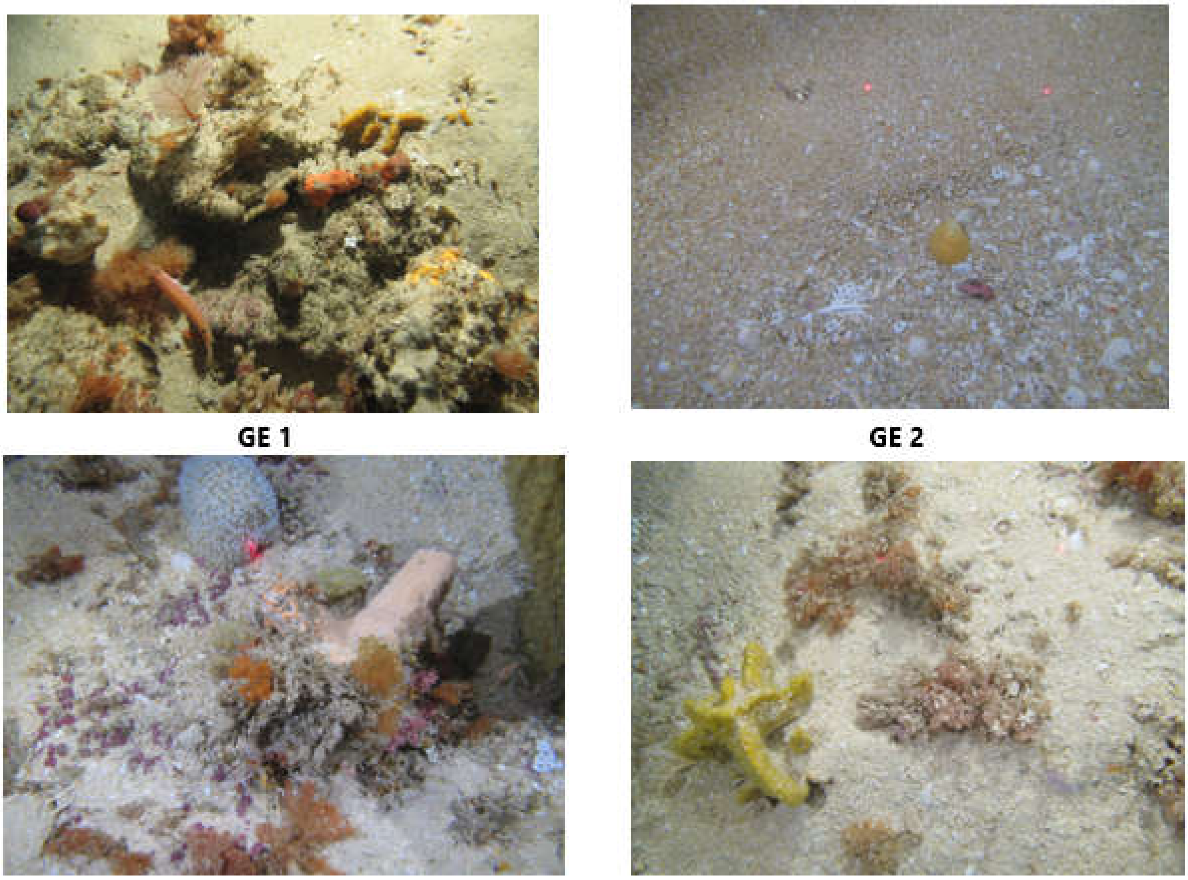

TH 5


TH 6


TH 7


TH 8

Figure 4-16: Drop Camera Images TH 1-8



GE 1

GE 2

GE 3

GE 4

Figure 4-17: Drop Camera Images GE 1-4

4.3.4 Metocean Conditions

4.3.4.1 Climate

The area is typical of a cool temperate region with cold, wet winters and warm dry summers. The regional climate is dominated by sub-tropical high-pressure systems in summer and sub-polar low pressure systems in winter. The conditions are primarily influenced by weather patterns originating in the Southern Ocean. The low-pressure systems are accompanied by strong westerly winds and rain-bearing cold fronts that move from south-west to north-east across the region, producing strong winds from the west, north-west and south-west.

The day-to-day variation in weather conditions is caused by the continual movement of the highs from west to east across the Australian continent roughly once every 10 days.

4.3.4.2 Winds

Bass Strait is located on the northern edge of the westerly wind belt known as the Roaring Forties. In winter, when the subtropical ridge moves northwards over the Australian continent, cold fronts generally create sustained west to south-westerly winds and frequent rainfall in the region (McInnes and Hubbert, 2003). In summer, frontal systems are often shallower and occur between two ridges of high pressure, bringing more variable winds and rainfall.

Winds in this section of the Otway basin and western Bass Strait generally exceed 13 knots (23.4 km/h) for 50% of the time. Winds contribute to the predominant moderate to high wave-energy environment of area and are predominantly south-westerly cycling to north-westerly. September is the windiest month, with average wind speeds of 29 km/h (Figure 4-18).

4.3.4.3 Tides

Tides are semi-diurnal with some diurnal inequalities (Jones and Padman, 1983), generating tidal currents along a north-east/south-west axis, with speeds generally ranging from 0.1 to 2.5 m/s (Fandry, 1983). The maximum range of spring tides in western Bass Strait is approximately 1.2 m. Sea level variation in the area can arise from storm surges and wave set up (Santos, 2004).

4.3.4.4 Ocean currents

The East Australian Current is one of the four major currents known to heavily influence on the conditions and biodiversity in Australian oceans and coastal environments. There are also a number of smaller and more complex current systems. All these ocean features can change from season to season, and may be more or less extensive and energetic, depending on climate factors.

Ocean currents in Bass Strait are primarily driven by tides, winds and density-driven flows (Figure 4-19). During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Straight. In winter and spring, waters within the straight are well mixed with no obvious stratification, while during summer the central regions of the straight become stratified.

Furthermore, during winter, the Bass Strait cascade occurs, a wintertime downwelling caused by cooling of the shallow waters of Bass Strait in the Gippsland Basin. Downwelling currents that originate in the shallow eastern waters of Bass Strait flow down the continental slope to depths of several hundred meters or more into the Tasman Sea. Lateral flushing within the strait results from inflows from the South Australian Current, East Australian Current, and sub-Antarctic surface waters. The importance of this phenomenon is recognised through the designation of the seasonal Bass Cascade Key Ecological Feature.

Surface currents within the permit area have been modelled by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2009 – 2013 inclusive to produce monthly surface currents. These show a rotational aspect because of inflow and outflow to Bass Strait. Although unimodal the currents are stronger from the west in all months excepting February when the currents from the east are the strongest. Minimum currents have been derived as 0.2-0.4 m/s and maximum currents as 0.8-2.0 m/s, with the strongest currents during the months July to October.

4.3.4.5 Waves

Bass Strait is a high-energy environment exposed to frequent storms and significant wave heights. The Otway coast has a predominantly south-westerly aspect and is highly exposed to swell from the Southern Ocean.

There are two principal sources of wave energy in the Otway Basin:

1. from the westerly swell from the Great Australian Bight and Southern Ocean.
2. from locally generated winds, generally from the west and east.

The Otway area is fully exposed to long period 13 second average south-westerly swell from the Southern Ocean as well as periodic shorter 8 second average period waves from the east. Wave heights from these winds generally range from 1.5 m to 2 m, although waves heights to 10 m can occur during storm events and a combination of wind forcing against tidal currents can cause greater turbulence. The largest waves are associated with eastward-moving low pressure and frontal systems that cross the site every 4 to 6 days in winter.

4.3.4.6 Sea temperature

The waters have average surface temperatures ranging from 14°C in winter to 21°C in summer. However, subductions of cooler nutrient-rich water (upwellings) occur along the seafloor during mid to late summer, though this is usually masked in satellite images by a warmer surface layer.

The upwelled water is an extension of the regional Bonney coast upwelling system, which affects southern Australia because of south-east winds forcing surface water offshore thus triggering a compensatory subduction along the bottom. If the wind is strong enough the water sometimes shoals against the coast. The water originates from a subsurface water flow called the Flinders current and has the characteristics of reheated Antarctic Intermediate Water (Levings and Gill, 2010).

During winter and spring onshore winds cycling from the southwest to northwest mound the surface layer against the land and cause a south-easterly flow along the coast that fills the shelf from the shore outwards to a depth of 500 m deep. Shelf water temperatures at these times range from between 18°C to 14°C with seafloor temperatures warmer in winter than in summer.

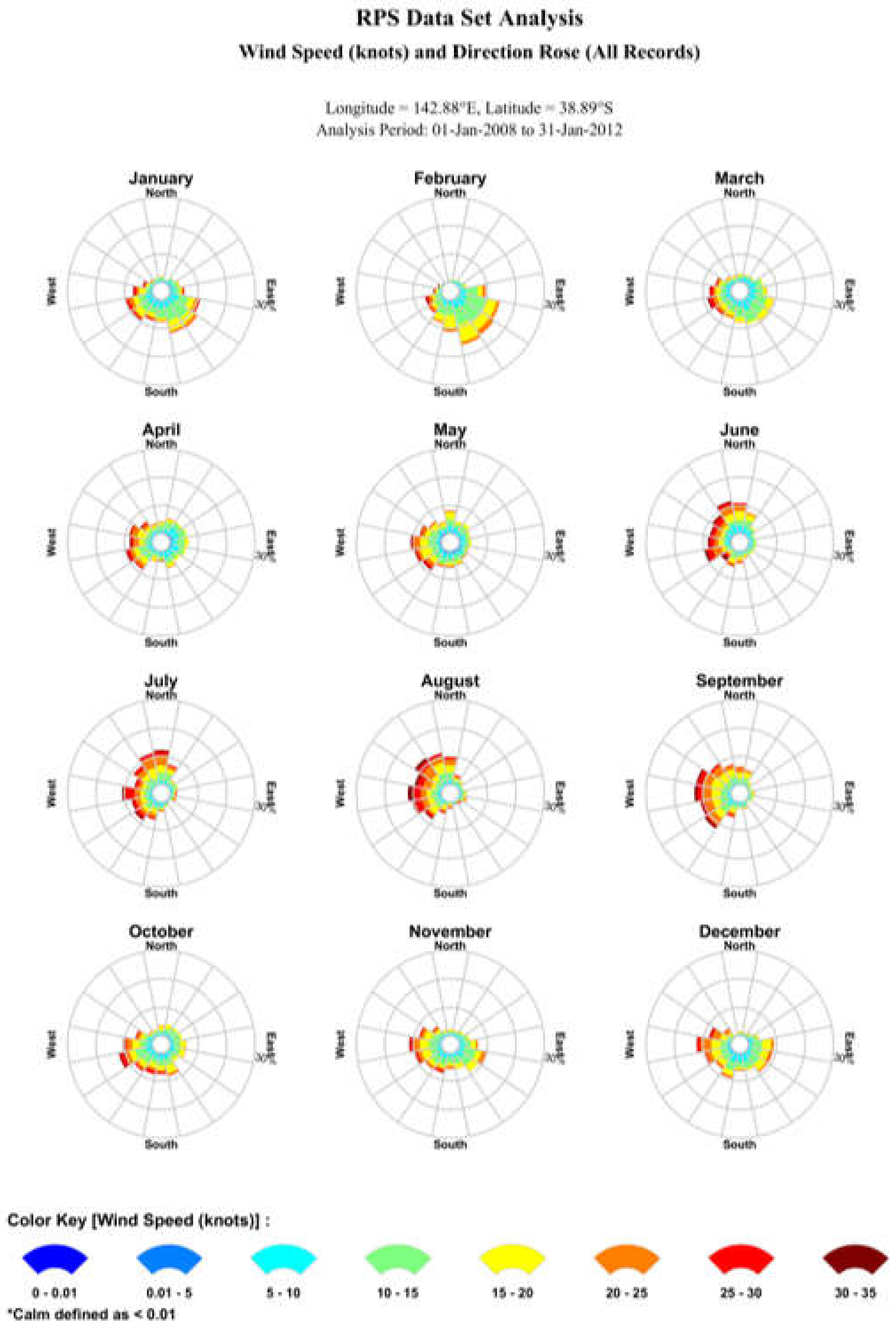


Figure 4-18: Modelled Monthly Wind Rose Distributions (RPS, 2019)

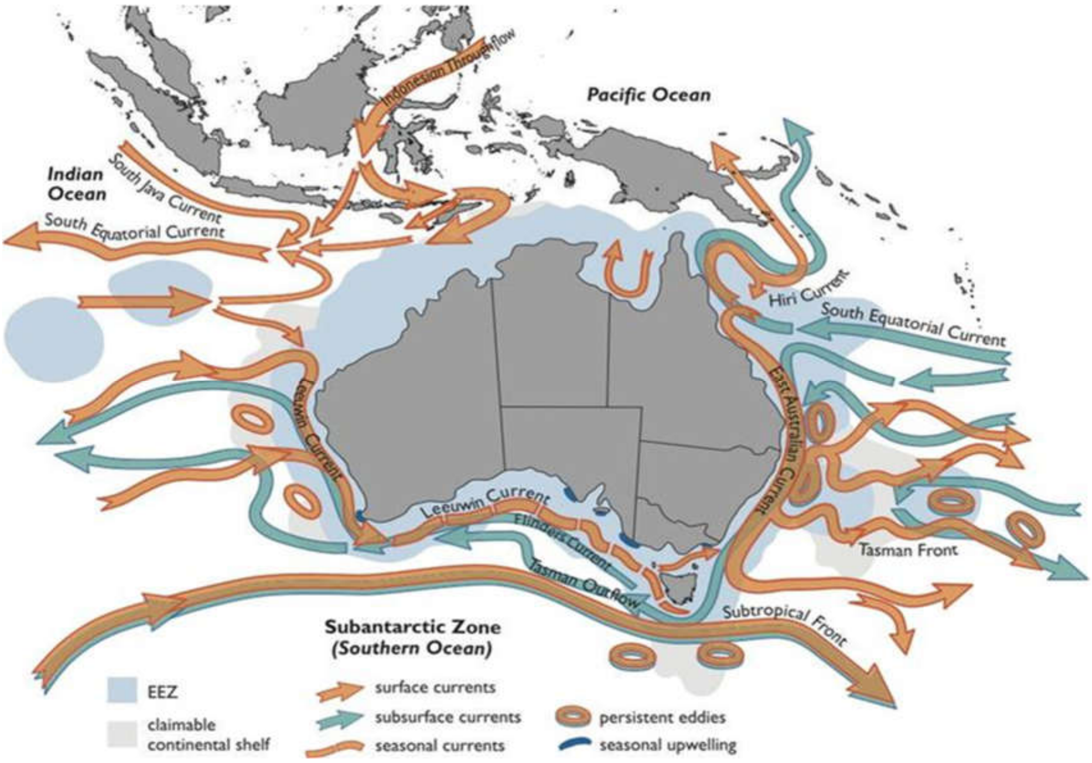


Figure 4-19: Australian Ocean Currents

4.3.5 Ambient Sound Levels

McCauley and Duncan (2001) undertook a desktop review of natural and man-made sea sound sources likely to be encountered in the Otway Basin. They concluded that natural sea sound sources are dominated by wind noise, but also include rain noise, biological noise and the sporadic noise of earthquakes. Man-made underwater sound sources in the region comprise shipping and small vessel traffic, petroleum production and exploration drilling activities and sporadic petroleum seismic surveys.

In terms of monitoring work with the Otway and Bass Strait regions, between 2009 and 2016 the Integrated Marine Observing System (IMOS) recorded underwater sound south of Portland, Victoria (38°32.5' S, 115°0.1'E). Prominent sound sources identified in recordings include blue and fin whales at frequencies below 100 Hz, ship noise at 20 to 200 Hz, and fish at 1 to 2 kHz (Erbe et al. 2016). In the broader region, primary contributors to background sound levels were wind, rain and currents-and waves-associated sound at low frequencies under 2 kHz (Przeslawski et al. 2016), and biological sound sources including dolphin vocalisations were also recorded.

To gain an understanding of the existing marine acoustic environment to inform the impact assessment for the Otway Gas Development acoustic monitoring was undertaken by Woodside (2003). During April-May 2001 two underwater noise loggers were placed (5.1 km and 2.9 km south-west of an exploration petroleum drilling vessel at the Thylacine site to measure underwater noise before, during and after drilling activity. Only one of the loggers (5.9 km) was able to be recovered. A further logger was placed in the shipping lane approximately 60 kms due south of Port Fairy to measure ambient noise produced by physical, man-made and biological sources between late November 2001 and early March 2002.

The following features were noted with respect to underwater noise environment at the Thylacine location:

- the Thylacine site was relatively quiet with only the passage of several boats (about ten) evident.
- the rig tender and drill rig noise show clearly from 13:00 on the 3 May 2001.
- drill rig noise was evident as sharp tones.
- rig tender noise was evident either at a low but persistent level for days or in short bursts of high level noise for several hours associated with manoeuvring, use of thrusters or as a close passage by the receiver.
- the horizontal banding characteristic of persistent calling by pygmy blue whales was not evident, rather these call types occurred infrequently and at low levels indicating the respective sources were at long range.
- evidence of low-level, distant evening fish choruses only.

The following features were noted with respect to underwater noise environment at the shipping lane location:

- regular passages of boats evident.
- regular evening fish choruses, there were also dawn choruses and persistent low level calling by these sources over daytime.
- blue whale calling persisted over many hours, an example is the first close passage for the season just before midday on 4 January 2002 followed by several more animals a day later.
- evidence of calling from at least three other whale species.
- baseline broadband underwater noise for the period was in the order of 93 to 97 dB re 1 µPa with shipping raising the averaged noise level above 105 dB re 1 µPa for 6% of the deployment time.

An acoustic monitoring program was also undertaken during exploratory drilling of the Casino-3 well. A sound logger located 28.03 km from the drill site did not detect drilling noise and recorded ambient noise that ranged between 90 and 110 dB re 1 µPa (McCauley, 2004). Passive acoustic monitoring commissioned by Origin from April 2012 to January 2013, 5 km offshore from the coastline east of Warrnambool, identified that ambient underwater noise in coastal areas are generally higher than further offshore, with a mean of 110 dB re 1 µPa and maximum of 161 dB re 1 µPa (Duncan et al., 2013).

More recently, JASCO Applied Sciences (Australia), JASCO, completed a monitoring study for Beach in relation to exploration drilling activities at the Artisan-1 well with the aim of completing an acoustic characterisation of the drilling and associated vessel activity within the Otway Basin. McPherson et al. (2021) details the monitoring program and results. Four recorders were deployed in February and retrieved in early April 2021 with Stations 1 through 4 deployed at distances of 0.336, 1.13, 5.11, and 25 km from the Ocean Onyx drill rig.

The results for Station 4, the furthest from the drill rig, were a median broadband ambient noise of 104.5 dB re 1 µPa, a mean of 118.3 dB re 1 µPa, a minimum of 86.6 dB re 1 µPa, and a maximum of 153.6 dB re 1 µPa. This is both quieter and louder than those for Casino 3. The mean levels at Station 4 are 8.3 dB higher than those recorded 5 km offshore of Warrnambool, while the maximum recorded at Station 4 is lower by 7.4 dB. For Station 4 contributors to the soundscape were weather, shipping, and marine mammals. Local variations in ambient noise and received levels can depend upon water depth and the proximity to contributors. In this case, the shipping lanes and the frequency and proximity of vessel passes are strong drivers of the ambient noise at Station 4. The quieter levels reported at Thylacine in Lattice Energy (2017) are likely due to the placement of the monitoring station at a distance from the shipping lanes, which limited their contributions to the data set and thus resulted in a lower reported range of received sound levels.

4.3.6 Water Quality

Marine water quality considers chemical, physical and biological characteristics with respect to its suitability to support marine life, or for a purpose such as swimming or fishing. Marine water quality can be measured by several factors, such as the concentration of dissolved oxygen (DO), the salinity, the amount of material suspended in the water (turbidity or total suspended solids) as well as the concentration of contaminants such as hydrocarbons and heavy metals.

The Otway Basin is characterised by high wave energy and cold temperature waters subject to upwelling events (Bonney coast upwelling) around the continental shelf margin (Origin, 2015). Significant upwelling of colder, nutrient rich deep water during summer can cause sea surface temperatures to decrease by 3°C compared with offshore waters (Butler et al., 2002).

The Bass Strait and Otway Basin are known for a complex, high energy wave climate and strong ocean currents (Origin, 2015), and therefore water column turbidity on the Victorian coastline is subject to high natural variability. Weather conditions in the coastal environment around Port Campbell and Port Ferry are known to influence offshore hydrodynamic conditions and are a driver of sediment dynamics, impacting benthic and pelagic habitats and changing water column turbidity. Wave-driven sediment resuspension generates high turbidity levels within coastal zones, commonly exceeding 50 mg/L (Larcombe et al. 1995, Whinney 2007, Browne et al., 2013), but coastal communities appear generally well adapted to deal with these extrinsic stresses.

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020. Appendix B). Water samples were collected at two of the gas fields, Artisan and Thylacine. Due to poor weather conditions sampling had to be reduced. It was decided that the Artisan field would be representative of the water quality closer to shore and of the LaBella and Hercules fields, while the Thylacine field which is further offshore would represent the Geographe field.

Insitu measurements were taken for DO, pH and oxidation-reduction potential (ORP) and Do and pH were assessed against the default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000). Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types.

DO was between the lower and upper limits of 90 and 110% saturation for marine waters in all samples. Likewise, pH was between the lower and upper limits of 8.0 and 8.4 for all samples. The range of ORP measurements indicated a well oxygenated, ecologically healthy environment.

Laboratory analyses for a suite of analytes were undertaken and compared to the ANZECC (2000) default trigger values for physical and chemical stressors for nutrient analytes and the trigger values for toxicants at alternative levels of protection for all other analytes.

The concentration of ammonia, nitrite and reactive phosphorus was at or below the level of reporting (LOR) for all samples. Only one sample contained a concentration of nitrate-nitrite, NO_{-3}, TKN and TN above the LOR, however, none of the measurements exceeded ANZECC trigger values. Concentrations of TP were recorded in all samples, but all measurements were well below ANZECC trigger values. TSS was typically within the range expected for unmodified marine waters.

The concentrations of Cd, Cr, Co, Pb, Hg, and Ni were at or below LOR in all samples. The concentration of Cu was below, at or very close to the LOR for all samples. The concentration of Zn against ANZECC protection level (or trigger values) were below the 90% protection level but concentrations variously exceeded 95 or 99% protection levels. This result is consistent with a slightly disturbed marine system which is described in (ANZECC 2000) as an ecosystem in which biodiversity may have been affected to small degree by human activity.

BTEXs and PAHs were below the detection limit in all water samples. Very low traces of Total Recoverable Hydrocarbon (TRHs) were detected in the Thylacine_1_2 water sample but were at levels of no concern. TRHs were below detection limits in all other samples. The level of chlorophyll a in filtered samples was below the detection level.

In summary, the water quality at the Thylacine and Artisan survey areas indicated an undisturbed mid-depth environment.

It is expected that water quality within the operational area and planning area will be typical of the offshore marine environment of the Otway Basin, which is characterised by high water quality with low background concentrations of trace metals and organic chemicals.

4.3.7 Sediment Quality

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020. Appendix B). Sediment samples were collected at two of the gas fields, Artisan and Thylacine using a Double Van Veen grab sampler. Due to poor weather conditions sampling had to be reduced. It was decided that the Artisan field would be representative of the sediments closer to shore, while the Thylacine field which is further offshore would be representative of the Geographe field. Three replicate sediment samples were to be collected at each of the fields, however, this was not always possible because of the compacted substrate. The resulting samples included four replicate samples from Thylacine and two replicate samples from Artisan.

The sediment within all samples and, therefore at both fields, was predominantly sand with a range of 95-97% as a proportion of each sample. There was very little silt and a maximum of 4.7% for the clay fraction. There were no discernible trends based on the location of sample collection.

The ORP or oxidation reduction potential of sediments within the samples was measured and the anoxic layer with low ORP was not detected in any of the sediments analysed and the range of measurements indicated that these sediments maintain a well oxygenated, unmodified environment.

There was a notable degree of variability in the nutrient samples collected in the Thylacine field, however the small number of samples means that a trend or pattern is not discernible. Nitrate-nitrite was not detected in any samples. Total organic content and detectable nitrogen concentrations were slightly higher in the Artisan samples compared to the Thylacine samples. Generally, the concentrations of nutrients in the marine sediments were to be expected for this environment and type of sediment.

Of the inorganic compounds tested, Cd, Cu, Pb, Hg, Ni and Sn were below the limit of reporting in all sediment samples. The concentration of Cr in sediments was low, and well below the Interim Sediment Quality Guidelines low trigger value of 80 mg/kg from the recommended sediment quality guidelines set out in ANZECC (2000). The concentration of Cr was slightly higher in the samples from Artisan than those from Thylacine. Zn was detected in two of the six samples (one sample from each field) and was well below the ISQC-Low trigger value.

BTEXs, PAHs, PCBs and TRHs were either below the LOR or at levels of no concern.

In summary, sediments had a high ORP and low or undetectable levels of toxicants indicating an unmodified seabed environment.

It is expected that sediment quality within the operational area and planning area will be typical of the offshore marine environment of the Otway Basin.

4.3.8 Air Quality

Historical air quality data for the region is available from the Environment Protection Authority (EPA) Victoria air quality monitoring stations, and Cape Grim Baseline Air Pollution Station on Tasmania's west coast, which is one of the three premier baseline air pollution stations in the World Meteorological Organisation-Global Atmosphere Watch (WMO-GAW) network, measuring greenhouse and ozone depleting gases and aerosols in clean air environments.

The Victorian air quality data is collected at 15 performance monitoring stations representing predominantly urban and industrial environments in the Port Phillip and Latrobe Valley regions of Victoria. Results are assessed against the requirements of the National Environment Protection (Ambient Air Quality) Measure for the pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), particles less than 10 micrometres in diameter (PM10) and particles less than 2.5 micrometres in diameter (PM2.5). The most recent annual air monitoring report shows Victoria's air quality in 2015 was generally good with AAQ NEPM (Ambient Air Quality National Environmental Protection Measure) goals and standards being met for carbon monoxide (CO), nitrogen dioxide (NO_2), Ozone (O_3) and sulphur dioxide (SO_2). There were some exceedances for particles.

The Geelong monitoring station is the closest to the operational area; however, it is situated in an urban environment and is not representative of the clean air environment over the majority of the planning area. The Cape Grim Baseline Air Pollution Station data is likely a more reliable point of reference for air quality in the operational area and planning area as the air sampled arrives at Cape

Grim after long trajectories over the Southern Ocean and is representative of a large area unaffected by regional pollution sources (cities or industry) (CSIRO, 2017). The Cape Grim station monitors greenhouse gases (GHGs), including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and synthetic GHGs such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

Historical air quality data from Cape Grim show that most GHGs have shown continuous increases in concentration since the mid-to-late 1970s with carbon dioxide levels increasing by more than 15% since 1976, and concentrations of methane and nitrous oxide increasing by around 20% and 8% respectively since 1978. The increase in methane levels however has slowed recently and CFCs and halons are in decline. Increases have been attributed to anthropogenic causes, for example, fossil fuel consumption and agricultural practices (CSIRO, 2017).

4.3.9 Bonney Coast Upwelling

The Bonney coast upwelling is mainly driven by the frequent south-easterly winds during the austral summer (Lewis, 1981; Middleton and Bye, 2007; Nieblas et al., 2009; Schahinger, 1987). The frequent south-easterly winds are the result of southern migration of the subtropical ridge (Nieblas et al., 2009; Schahinger, 1987). The upwelling occurs via Ekman dynamics, where the ocean surface experiences a steady wind stress which results in a net transport of water at right angles to the left of the wind direction which brings cold, nutrient rich water to the sea surface.

Huang and Wang (2019) developed an image processing technique to map upwelling areas along the south-eastern coast of Australia. This study used monthly Moderate Resolution Imaging Spectroradiometer (MODIS) sea surface temperature (SST) composites between July 2002 and December 2016, which were generated from daily SST images with a spatial resolution of ~1 km. As upwelling in winter is unlikely to occur images during this period were not analysed. Upwelling reaching the surface often displays a colder SST signature than the adjacent area (e.g., Dabuleviciene et al., 2018; Gill et al., 2011; Kampf et al., 2004; McClatchie et al., 2006; Oke and Griffin, 2011; Oke and Middleton, 2001; Roughan and Middleton, 2002; Roughan et al., 2003; Willis and Hobday, 2007). This negative SST anomaly is the foundation of upwelling mapping using SST data (Huang and Wang 2019).

The spatial patterns of the mapped Bonney coast upwelling have been shown to follow a clear temporal pattern. When the upwelling season starts during late spring and early summer (November and December), the influence of the Bonney coast upwelling was found to be often restricted to the coast. During the mid-summer and early autumn (January to March) when the upwelling is the strongest, the upwelling influence often extended to the shelf break before retreating in April (Huang and Wang 2019).

Gill et al (2011) states that the Bonney coast upwelling generally starts in the eastern part of the Great Australian Bight and spreads eastwards to the Otway Basin. At the height of the Bonney coast upwelling during February and March, the upwelling's area of influence often exceeds 12,000 km^2, its SST anomaly often exceeds 1°C, and its chlorophyll-a concentrations are often >1.5 times of its adjacent areas (Huang and Wang 2019).

Variability

While the general characteristics of the Bonney coast upwelling are broadly understood virtually nothing is known of the longer-term variability of the phenomenon. Alongshore wind is the predominant mechanism in the upwelling, which is, therefore, directly impacted by any changes to the strength or frequency of these winds. However, not all favourable upwelling winds lead to an upwelling event. Huang and Wang (2019) state that each year for the period of 14 years (Sept 2002 to May 2016) of their study there was large variability in the distribution of the upwelling influence areas, month to month, season to season and year to year.

The El Niño – Southern Oscillation (ENSO) has been identified by some authors as a potential driver of upwelling strength along the south Australian coast. The ENSO is the dominant global mode of inter-annual climate variability, is a major contributor to Australia’s climate and influences Australia’s marine waters to varying degrees around the coast. The two phases of ENSO, El Niño and La Niña, produce distinct and different changes to the climate.

Middleton et al., (2007) examined meteorological and oceanographic data and output from a global ocean model. The authors concluded that El Niño events lead to enhanced upwelling along Australia’s southern shelves. However, it has been found that relationships between ENSO events and upwelling and production indices off southern Australia are weak due to the high interannual and inter-seasonal variability in these indices.

Huang and Wang (2019) results indicate that the ENSO events are likely to have a low-to-moderate impact on the upwelling intensity although the El Nino events tend to strengthen upwelling intensity along the south-east coast of Australia with La Nina events tending to weaken upwelling intensity. Previous studies (Middleton and Bye, 2007; Middleton et al., 2007) indicated that the El Nino events would raise the thermocline (along the Australian margin) which effectively forms a colder and nutrient-rich pool at shallower depths. This is likely to enhance upwelling intensity, with higher SST and chlorophyll-a anomalies and a larger area of influence.

Ecological importance

The primary ecological importance of the Bonney coast upwelling is as a feeding area for the blue whale (*Balaenoptera musculus*). The upwelled nutrient-rich re-heated Antarctic intermediate water promotes blooms of coastal krill, *Nyctiphanes australis*, which in turn attracts blue whales to the region to feed.

The Bonney coast upwelling is one of only two identified seasonal feeding areas for blue whales in Australian coastal waters and is one of 12 known blue whale feeding aggregation areas globally. Sightings of the sei whale in the upwelling indicate this is potentially an important feeding ground for the species (Gill et al., 2015). There have also been sightings of the fin whale, which indicate this could potentially be an important feeding ground (Morrice et al., 2004)

The high productivity of the Bonney coast upwelling also leads to other attributes such as algal diversity and its productivity as a fishery. This productivity is also capitalised on by other higher predator species such as little penguins and fur-seals feeding on baitfish. Robinson et al. (2008) postulated that upwelling waters may bring fish prey of Australian fur-seals to surface waters, which are then flushed into Bass Strait within foraging range of seals.

Linkages between climate, upwelling strength and blue whale abundance

The complex interaction between climatic conditions, upwelling strength and seasonal blue whale distribution and abundance within the Bonney coast upwelling is currently poorly understood other than at a general level. Factors to be resolved to enable a more detailed understanding include observations that not all strong upwelling-favourable winds necessarily lead to strong upwelling events (Griffin et al. 1997) and that increased upwelling does not necessarily equate to increased productivity as conditions may be less optimal for plankton growth. Huang and Wang (2019) found a generally weak and unclear correlation between chlorophyll-a and SST. This weak correlation may be due to chlorophyll-a concentrations (a remote measure of plankton population) are also influenced by other complex oceanographic and biological mechanisms such as grazing, seasonality and transportation

Further an increase in plankton biomass does not necessarily coincide with the presence of the blue whales. Review of pygmy blue whale aerial observation data from Gill et al. (2011) from the 2001-02 to 2006-07 seasons, and additional surveys in the Otway Basin commissioned by Origin during February 2011 and November -December 2012 did not find a significant positive correlation between El Niño conditions and pygmy blue whale abundance. Such a positive correlation could be expected if El Niño conditions caused stronger upwelling, stronger upwelling led to increased planktonic productivity and blue whales were more likely to be present when productivity is higher.

Two of the six seasons subject to aerial surveys in the eastern section of the Otway Basin (Gill et al, 2011) were determined by the Bureau of Meteorology to demonstrate weak to moderate El Nino conditions. The remainder of the years were assessed to be neutral. The two El Nino seasons (2002-03 and 2006-07) corresponded with the lowest observation frequencies (sightings/1,000 km) for pygmy blue whales of all the yearly surveys.

Aerial surveys commissioned by Origin undertaken during February 2011 and November-December 2012 were undertaken during La Nina events classified by the Bureau of Meteorology (BOM) as very strong and strong respectively. Although observation frequencies are not available, the absolute numbers of pygmy blue whales observed was substantially higher than during the 2001-01 to 2006-07 surveys. Also, of note is that pygmy blue whales observed during February 2011 were congregated along the seaward edge of a plume of terrestrial runoff, potentially suggesting use of this plume as a feeding resource, which has no relationship to upwelling.

As such, the interactions between climate and ecology for this upwelling system are complex and no definitive linkages between climatic events, upwelling strength and blue whale abundance have yet been described. Given this, development of management strategies for petroleum activities in the area using prevailing climatic conditions as a predictor of seasonal blue whale abundance is not currently feasible.

Operational Setting

Mapping of the Bonney coast upwelling frequency by Huang and Wang (2019) identified that the occurrence of an upwelling event between 2002 and 2016 (measured by remote sensing of a combination of SST anomaly and chlorophyll-a) within the operational area was unlikely with an upwelling frequency for this area of <10%. The closest areas of increased frequency of upwelling events to the operational area (10-30% occasional/semi-seasonal) were small, isolated areas situated in coastal areas (Figure 4-20) >35 km from the Thylacine-A Wellhead Platform. Areas of further increased frequencies of Bonney coast upwellings (30-50% seasonal) were found to the west >235 km of the operational area.

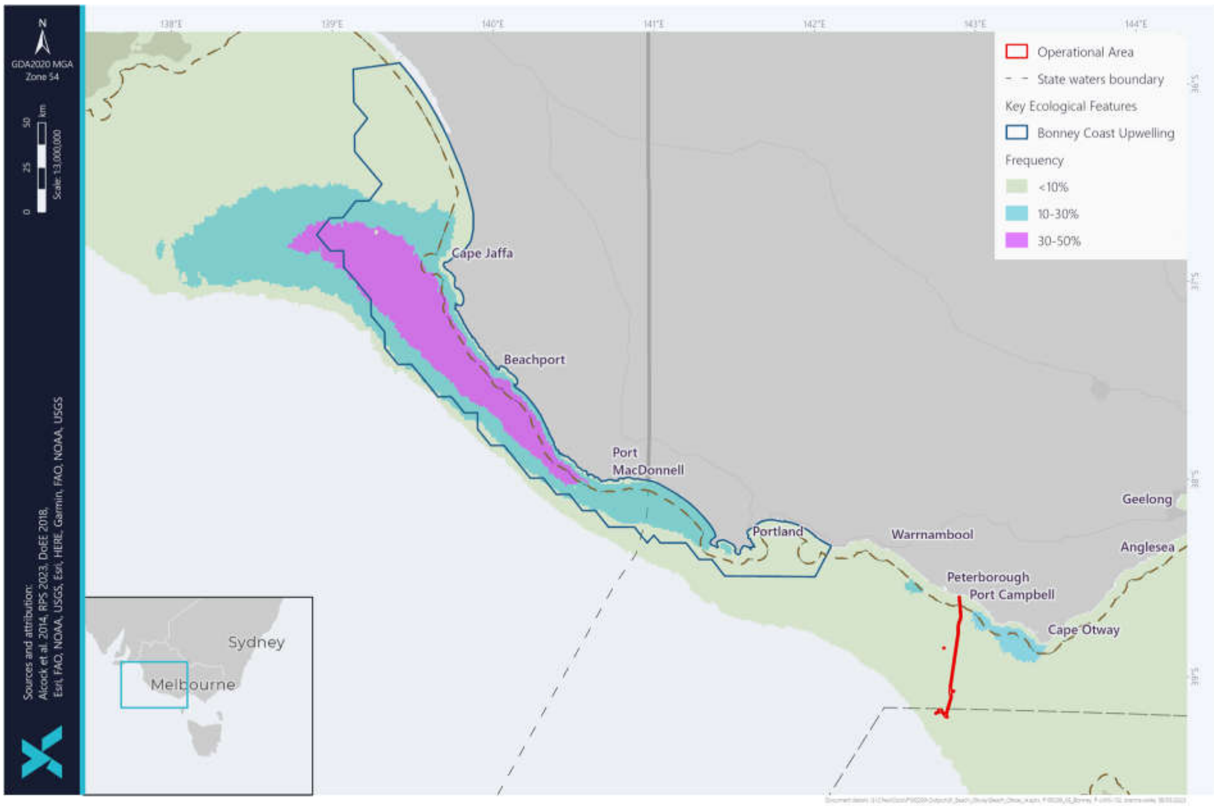


Figure 4-20: Bonney Coast Upwelling Frequency (*Source: Huang and Wang 2019; Geoscience Australia 2020*).

4.4 Ecological Environment

To characterise the ecological environment, a literature search and online resources and databases were reviewed to identify and assess flora and fauna species known to be present or potentially present in the operational area and planning area. The following information sources were reviewed to assure consistency with previous assessments and to develop an up-to-date overview of the existing environment.

- Online government databases, publications, and interactive mapping tools, such as the SPRAT database.
- Protected Matters Search Tool (PMST) for Matters of National Environmental Significance (MNES) protected under the EPBC Act.
- Published observations, data and statistics on marine mammals.
- Reports from scientific experts and institutions, marine biologist and experts in blue whale and southern right whale populations in the Otway area.
- Woodside's Otway Gas Project Environmental Effects Statement/Environmental Impact Assessment (EES/EIS) (2003) (Woodside, 2003).

- Santos Casino Gas Field Development Environmental Report (2004) (Santos, 2004).
- BHP Billiton's Minerva Environmental Impact Statement and Environmental Effects Statement and Associated Supplemental Environmental Monitoring published research papers (BHP Billiton, 1999).
- Origin Energy's Environment Plans for previous activities in the region.
- National Conservation Values Atlas.
- Relevant listings under the Victorian FFG Act 1988 (DELWP, 2017b)
- Relevant listings under the Tasmanian Threatened Species Conservation Act (1995) (TSC Act)
- Relevant environmental guidelines and publicly available scientific literature on individual species.

4.4.1 Benthic Habitats and Species Assemblages

Benthic communities are biological communities that live in or on the seabed. These communities typically contain light-dependent taxa such as algae, seagrass and corals, which obtain energy primarily from photosynthesis, and/or animals such as molluscs, sponges and worms. Benthic habitats are the seabed substrates that benthic communities grow on or in; these can range from unconsolidated sand to hard substrates (e.g. limestone) and occur either singly or in combination.

The Otway continental margin is a swell-dominated, open, cool-water carbonate platform which can be divided into depth-related zones (Figure 4-11, Boreen et al., 1993):

1. shallow shelf: consisting of exhumed limestone substrates that host encrusting mollusc, sponge, bryozoan and red algae assemblages.
2. middle shelf: a zone of swell wave shoaling and production of mega-rippled bryozoan sands.
3. deep shelf: accumulations of intensely bioturbated, fine bioclastic sands.
4. shelf edge/top of Slope: nutrient-rich upwelling currents support extensive, aphotic bryozoan/sponge/coral communities.

The dominant benthic habitat throughout the area, as indicated by the seabed and benthic habitat studies detailed in Section 4.3.2 and 4.3.3, is medium to coarse carbonate sands with areas of low relief exposed limestone. The benthic species assemblages known or likely to be associated with these habitats are described in the following sections.

4.4.1.1 Soft Sediment

Unvegetated soft sediments are a widespread habitat in both intertidal and subtidal areas, particularly in areas beyond the photic zone. Factors such as depth, light, temperature and the type of sediment present can vary the biodiversity and productivity of soft sediment habitat.

The Middle Otway Shelf (70-130 m depth) is a zone of large tracts of open sand with little or no epifauna to characterise the area: infaunal communities and bivalves, polychaetes and crustaceans dominate in the open sand habitat. The Deep Otway Shelf (130 – 180 m) sediments consist of accumulations of intensely bioturbated, fine, bio clastic sands. The Upper Slope of Otway Shelf (>180 m) incorporates the edge/ top of the shelf which displays nutrient-rich upwelling currents support extensive, aphotic bryozoan/sponge/coral communities. The upper slope is dominated by bioturbated mixture of periplatform bioclastic debris and pelleted foraminiferal/nannofossil mud. Turbidites and resedimentation features are common. Bioturbation and shelf-derived skeletal content decrease progressively downslope and pelagic muds dominate below 500 m.

Scientific surveys have shown that some shallow Victorian sandy environments have the highest levels of animal diversity in the sea ever recorded (Parks Victoria, 2016a). Some of the larger animals found in these soft sediment environments in Victoria include smooth stingray (*Dasyatis brevicaudata*), pipi (*Plebidonax deltoids*), dumpling squid (*Euprymna tasmanica*), common stargazer (*Kathetostoma leave*) and heart urchin (*Echinocardium cordatum*) (Parks Victoria, 2016a).

4.4.1.2 Seagrass

Seagrasses are marine flowering plants, with around 30 species found in Australian waters (Huisman, 2000). While seagrass meadows are present throughout southern and eastern Australia, the proportion of seagrass habitat within the south-eastern sector is not high compared to the rest of Australia (in particular with parts of South Australia and Western Australia) (Kirkham, 1997).

Seagrass generally grows in soft sediments within intertidal and shallow subtidal waters where there is sufficient light and are common in sheltered coastal areas such as bays, lees of islands and fringing coastal reefs (McClatchie et al., 2006; McLeay et al., 2003). Known seagrass meadows within the planning area include Corner Inlet, Port Phillip Bay and Western Port Bay. Seagrass meadows are important in stabilising seabed sediments, and providing nursery grounds for fish and crustaceans, and a protective habitat for the juvenile fish and invertebrates species (Huisman, 2000; Kirkham, 1997).

Within the planning area, seagrass is present along the Victorian coastline (Figure 4-21).

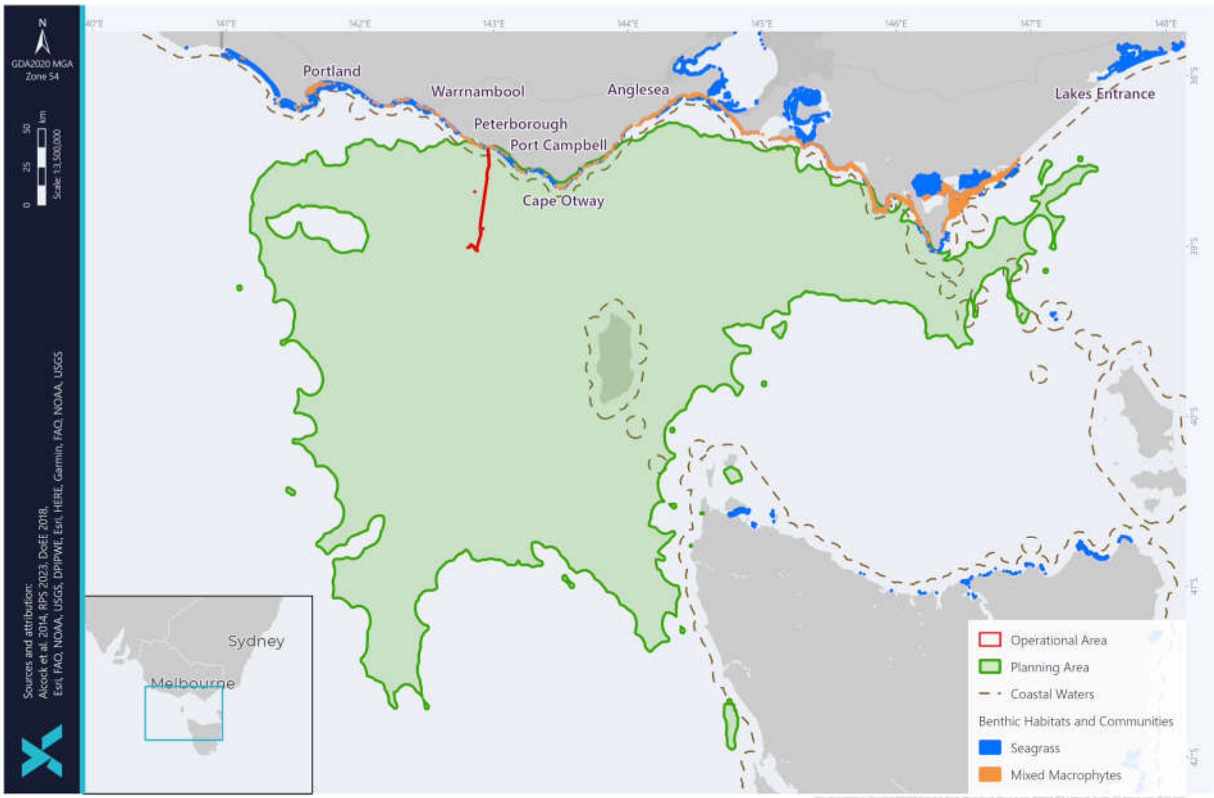


Figure 4-21: Presence of Seagrass (and mixed macrophyte) Habitat within Planning Area

4.4.1.3 Algae

Benthic microalgae are present in areas where sunlight reaches the sediment surface. Benthic microalgae are important in assisting with the exchange of nutrients across the sediment-water interface; and in sediment stabilisation due to the secretion of extracellular polymetric substances (Ansell et al. 1999). Benthic microalgae can also provide a food source to grazers such as gastropod and amphipods (Ansell et al, 1999).

Macroalgae communities occur throughout the Australian coast and are generally found on intertidal and shallow subtidal rocky substrates. Macroalgal systems are an important source of food and shelter for many ocean species; including in their unattached drift or wrack forms (McClatchie et al. 2006). Macroalgae are divided into three groups: Phaeophyceae (brown algae), Rhodophyta (red algae), and Chlorophyta (green algae). Brown algae are typically the most visually dominant and form canopy layers (McClatchie et al. 2006). The presence and growth of macroalgae are affected by the principal physical factors of temperature, nutrients, water motion, light, salinity, substratum, sedimentation and pollution (Sanderson, 1997). Macroalgae assemblages vary, but *Ecklonia radiata* and *Sargassum* sp. are typically common in deeper areas.

Within the planning area, macroalgae are present along the Victorian coastline (Figure 4-21).

Kelp are a special group of large brown algae that attach themselves to solid structures to form forests. They extend their leaf-like fronds into the waters above them reaching towards the sunlight. These larger algae in turn create a habitat for smaller algae, invertebrates and fish (VFA 2023). On Victoria's coast kelp forests grow on most rocky reefs in waters to a depth of around 30 metres, although most are found in shallower waters (VFA 2023).

Bull kelp or southern bull kelp (*Durvillaea potatorum*) is a fast-growing brown macroalgae (seaweed) with large dark brown and leathery strap-like blades. It consists of a body, called the thallus, with a stipe connecting the blades to the holdfast (a structure adhering the bull kelp to the seafloor.

Offshore Victoria and Tasmania there are two main species of Durvillaea, these are *D. potatorum* and *D. amatheiae*. The approximate distribution of the species is shown in Figure 4-22.

Durvillaea spp are a significant habitat. The holdfast can be inhabited by a diverse array of epifauna and infauna invertebrates. These burrow into the holdfast creating holes that can be used by a wide variety of animals. In addition, *Durvillaea spp* grow in large groups or forests that can become important nursery areas and sanctuary areas for fish, crustaceans and other fauna.

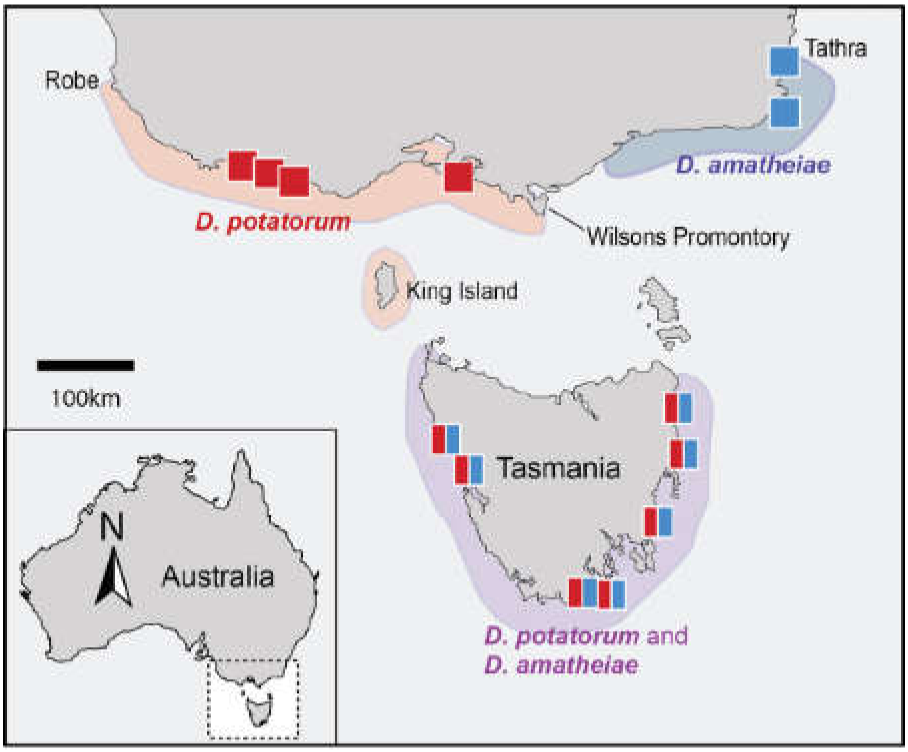


Figure 4-22: Distribution of Bull Kelp off Victoria and Tasmania (Velasquez et al. 2029)

Thurstan et al. (2018) gathered historical data on the use of bull kelp by First Nations. Bull kelp has a long history of use by First Nations in Australia, New Zealand and Chile. In Australia this reportedly dates back 65,000 years (Thurstan et al. 2028). First Nation people in Tasmania used dried bull kelp to transport water and food. The species name came from this use: potatorum means ‘to drink’ in Latin (Govt of SA, 2023).

Thurstan et al. (2018) details a number of First Nations historical references for bull kelp including:

- Cultural activities and cultural history –mythology and sacred songs.
- Ceremonial activities –being burned or being used during smoking ceremonies.
- Medicinal use –bandages and medicinal poultice.
- Clothing – cloaks and shoes.

- Diet – raw, jelly, dried and roasted (preserving for several months).
- Fishing – ropes and fishing nets / traps, traps for short-finned eels, also used to assist during diving for crayfish.
- Shelter – waterproofing, wind proofing and carpeting.

Bulk kelp is also collected by the seaweed industry as described in Section 4.5.12.

4.4.1.4 Coral

Corals are generally divided into two broad groups: the zooxanthellate ('reef-building', 'hermatypic' or 'hard') corals, which contain symbiotic microalgae (zooxanthellae) that enhance growth and allow the coral to secrete large amounts of calcium carbonate; and the azooxanthellate ('ahermatypic' or 'soft') corals, which are generally smaller and often solitary (Tzioumis and Keable, 2007). Hard corals are generally found in shallower (<50 m) waters while the soft corals are found at most depths, particularly those below 50 m (Tzioumis and Keable, 2007).

Corals do not occur as a dominant habitat type within the operational area and planning area, however, their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway. Reef development by hard corals does not occur further south than Queensland (Tzioumis and Keable, 2007). Soft corals are typically present in deeper waters throughout the continental shelf, slope and off-slope regions, to well below the limit of light penetration.

Reproduction methods for cold water corals are not as well understood as warm water corals such as those of the Great Barrier Reef, but it is likely that some are still broadcast spawners (like their tropical counterparts), while others brood and release formed larvae (Roberts et al., 2009).

4.4.1.5 Carbonate Sands and Exposed Limestone

Boreen et al., (1993) reported that carbonate sands in the Otway middle shelf support a benthic fauna dominated by bryozoans, infaunal echinoids and assemblages of sponges. Other components include bivalves (commonly *Mysella donaciformis* and *Legrandina bernardi*), *Chlamys* sp. scallops and small gastropods. The sand octopus (*Octopus kaurna*) also inhabits sandy sediments. This description is broadly supported by video footage of the Otway pipeline, which also indicates that hard substrates in mid shelf areas in the west of the operational support low to medium density sponge dominated communities.

Within the inner shelf, Boreen et al., (1993) reported that the benthic communities associated with hard limestone substrates were comprised of sponges, encrustlng and branching corailine algae, poysonellid algae, bryozoa, benthic forams, robust sarpullds, brachiopods, bivalves, gastropods, fleshy red algae and kelp.

A benthic survey of inner shelf sediments in the vicinity of the Minerva Gas Field development, found the seafloor was composed of course, well-sorted sand (Currie and Jenkins, 1994). This survey identified 196 species and a total of 5,035 individuals comprised of 63% crustaceans, 15% polychaetes, 8% molluscs and 5% echinoderms. The most abundant species were the bivalve *Katlysia* sp. (12.4 individuals/m^2), the sarconid *Triloculina affinis* (8.9 individuals/m^2), the tanaid isopod *Apsuedes* sp. (8.3 individuals/m^2) and the spionid polychaete *Prionospio coorilla* (4.8 individuals/m^2) (Currie, 1995).

Demersal fishes likely to be associated with carbonate sands on the middle and inner shelf include (LCC, 1993) eastern stargazer (*Kathetostoma laeve*), elephant shark (*Callorhynchus milli*), greenback flounder (*Rhombosolea taoarina*), gummy shark (*Mustelus antarcticus*), long-snouted flounder (*Ammotretis rostraus*), saw shark (*Pristiophorus nudipinnis*), southern sand flathead (*Platycephalus bassensis*) and southern school whiting (*Sillago bassensis*).

4.4.1.6 Basalt Rises

No basalt rises were identified within the operational are or planning area.

4.4.2 Mangroves

Mangroves grow in intertidal mud and sand, with specially adapted aerial roots (pneumatophores) that provide for gas exchange during low tide (McClatchie et al., 2006). Mangrove forests are important in helping stabilise coastal sediments, providing a nursery ground for many species of fish and crustacean, and providing shelter or nesting areas for seabirds (McClatchie et al., 2006).

The mangroves in Victoria are the most southerly extent of mangroves found in the world and are located mostly along sheltered sections of the coast within inlets or bays (MESA, 2015). There is only one species of mangrove found in Victoria, the white or grey mangrove (*Avicennia marina*), which is known to occur at Western Port and Corner Inlet outside of the planning area. (Figure 4-23).

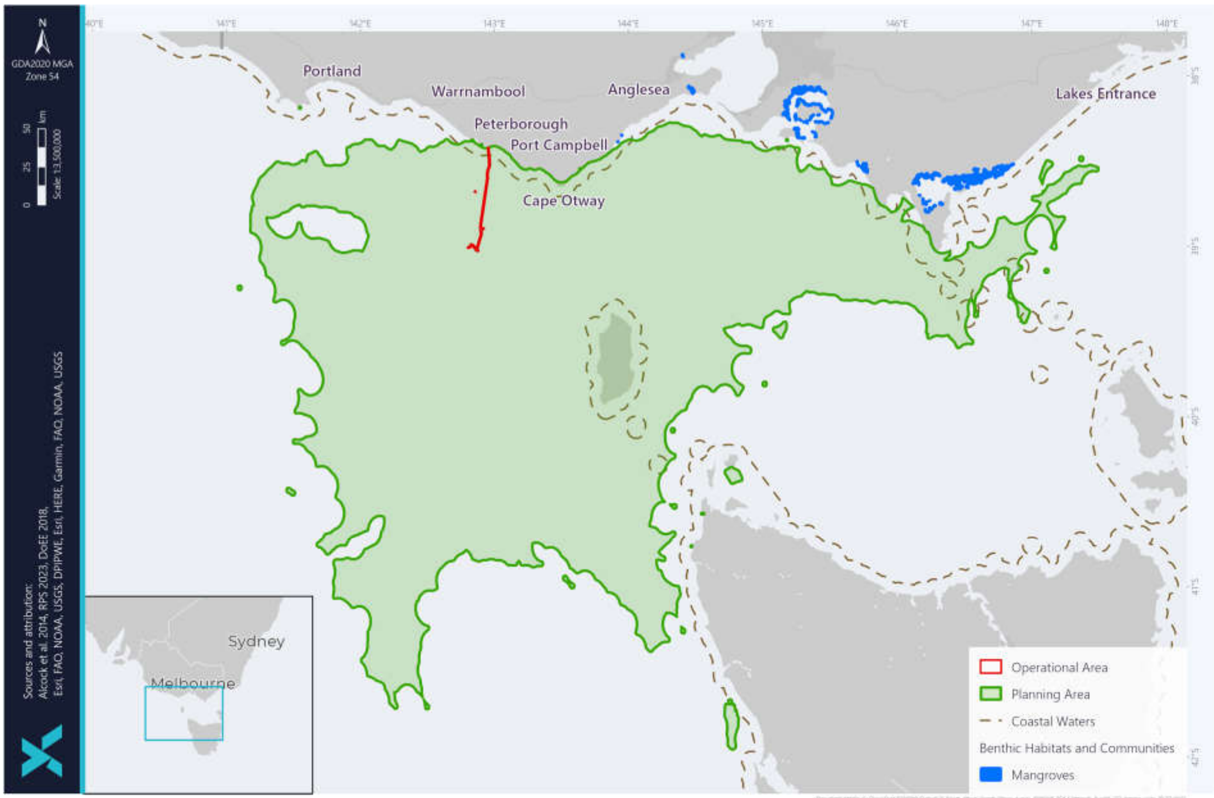


Figure 4-23: Presence of Mangrove Habitat

4.4.3 Saltmarsh

Saltmarshes are terrestrial halophytic (salt-adapted) ecosystems that mostly occur in the upper-intertidal zone and are widespread along the coast. Saltmarshes are typically dominated by dense stands of halophytic plants such as herbs, grasses and low shrubs. In contrast to mangroves, the diversity of saltmarsh plant species increases with increasing latitude. The vegetation in these environments is essential to the stability of the saltmarsh, as they trap and bind sediments. The sediments are generally sandy silts and clays and can often have high organic material content. Saltmarshes provide a habitat for a wide range of both marine and terrestrial fauna, including infauna and epifaunal invertebrates, fish and birds.

Saltmarsh is found along many parts of the Victorian coast, although is most extensive in western Port Phillip Bay, northern Western Port, within the Corner Inlet-Nooramunga complex, and behind the sand dunes of Ninety Mile Beach in Gippsland (Figure 4-24) (Boon et al., 2011).

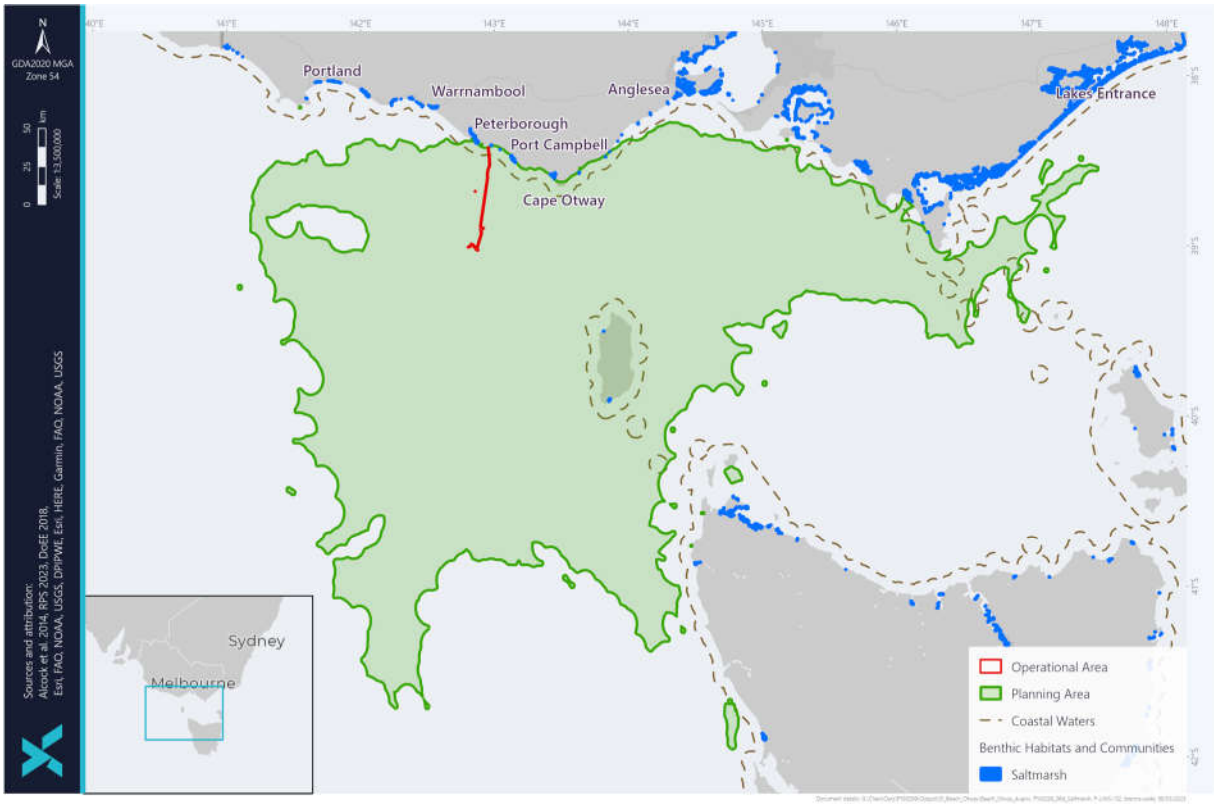


Figure 4-24: Presence of Saltmarsh Habitat within the Planning Area

4.4.4 Plankton

Plankton species are the key component of the food web and support nearly all marine life. Copepods are the most common zooplankton and are some of the most abundant animals on earth. Plankton communities are highly diverse, with members from almost all phyla. Phytoplankton are photosynthetic organisms that drift with ocean currents and are mostly microscopic; however, some gelatinous plankton can be up to 2 m in diameter. Phytoplankton is grazed by zooplankton such as small protozoa, copepods, decapods, krill and gelatinous zooplankton.

The carrying capacity of marine ecosystems (the mass of fish resources) and recruitment of individual stocks is strongly related to plankton abundance, timing and composition. In the planning area, the seasonal Bonney coast upwelling is a productivity hotspot, with high densities of zooplankton and are important for fish and whales. Of importance in the region is the coastal krill, *Nyctiphanes australis*, which swarms throughout the water column of continental shelf waters primarily in summer and autumn, feeding on microalgae and providing an important link in the blue whale food chain. The fisheries in this region account for half of Australia's total annual catch and the main fishery in the region is sardine, which feeds on plankton, which illustrates the interdependence of the fishing industry on plankton.

There have been relatively few studies of plankton populations in the Otway and Bass Strait regions, with most concentrating on zooplankton. Watson and Chaloupka (1982) reported a high diversity of zooplankton in eastern 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.

Plankton distribution is dependent upon prevailing ocean currents including the East Australia Current, flows into and from Bass Strait and Southern Ocean water masses. Plankton distribution in the planning area is expected to be highly variable both spatially and temporally and are likely to comprise characteristics of tropical, southern Australian, central Bass Strait and Tasman Sea distributions.

4.4.5 Invertebrates

There is a very large number of marine invertebrates in deep waters around Australia. Knowledge of the species in different habitats is extremely patchy; the number of deep-water benthic fauna is large but almost unknown. Throughout the region, a variety of seabed habits support a range of animal communities such as sparse sponges to extensive 'thickets" of lace corals and sponges, polychaete worms and filter feeders (Director of National Parks, 2013).

Characteristics of large species of crustacea, such as lobster, prawn and crab, which are significant commercial species in southern Australia, are well known. Mollusc species, such as oysters, scallops and abalone are also commercially fished, and their biology and abundance are well known. Major fisheries for the blacklip and to a lesser extent, greenlip abalone and scallops have been founded. The cooler waters of southern Australia also support the Maori octopus commercial fishery, which is one of the largest octopuses in Australia (with arm spans longer than 3 m and weighing more than 10 kg. Other molluscs are abundant in southern Australia and Tasmania such as the sea-slug with more than 500 species. Volutes and cowries represent a relic fauna in southern Australia, with several species being very rare and can be highly sought after by collectors.

Echinoderms, such as sea stars, sea urchins and sea cucumbers are also an important fauna species of the southern Australian and Tasmanian waters, with several species at risk of extinction (DPIPWE, 2016).

Studies by the Museum of Victoria found that invertebrate diversity was high in southern Australian waters although the distribution of species was patchy, with little evidence of any distinct biogeographic regions (Wilson and Poore, 1987). Results of sampling in shallower inshore sediments reported high diversity and patchy distribution (Parry et al., 1990). In these areas, crustaceans, polychaetes and molluscs were dominant.

4.4.6 Threatened Ecological communities

Threatened Ecological Communities (TECs) provide wildlife corridors or refugia for many plant and animal species, and listing a TEC provides a form of landscape or systems-level conservation (including threatened species).

The operational area PMST Report (Appendix A) identified that the Giant Kelp Marine Forests of South East Australia may occur within the operational area, however as detailed in Figure 4-8 the Giant Kelp Marine Forests of South East Australia are to the east of the operational area not within it.

The planning area PMST Report (Appendix A) (Figure 4-8) identified the following TECs:

- Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community.
- Giant Kelp Marine Forests of South East Australia.
- Natural Damp Grassland of the Victorian Coastal Plains.
- Subtropical and Temperate Coastal Saltmarsh.
- Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (*Eucalyptus ovata / E. brookeriana*).
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland.

Of the TECs listed above, only the assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community, the giant kelp marine forests of South East Australia and the subtropical and temperate coastal saltmarsh are marine/coastal features; the rest are terrestrial listings (Figure 4-25).

4.4.6.1 Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community

This ecological community is the assemblage of native plants, animals and micro-organisms associated with the dynamic salt-wedge estuary systems that occur within the temperate climate, microtidal regime (< 2 m), high wave energy coastline of western and central Victoria. The ecological community currently encompasses 25 estuaries in the region defined by the border between South Australia and Victoria and the most southerly point of Wilsons Promontory (TSSC, 2018).

Salt-wedge estuaries are usually highly stratified, with saline bottom waters forming a ‘salt-wedge’ below the inflowing freshwater layer of riverine waters. The dynamic nature of salt-wedge estuaries has important implications for their inherent physical and chemical parameters, and ultimately for their biological structure and ecological functioning. Some assemblages of biota are dependent on the dynamics of these salt-wedge estuaries for their existence, refuge, increased productivity and reproductive success. The ecological community is characterised by a core component of obligate estuarine taxa, with associated components of coastal, estuarine, brackish and freshwater taxa that may reside in the estuary for periods of time and/or utilise the estuary for specific purposes (e.g. reproduction, feeding, refuge, migration) (TSSC, 2018).

4.4.6.2 Giant Kelp Marine Forests of South East Australia

Giant kelp (*Macrocystis pyrifera*) is a large brown algae that grows on rocky reefs in cold temperate waters off south east Australia. The kelp grows up from the sea floor 8 m below the sea surface and deeper, vertically toward the water surface. It is the foundation species of this TEC in shallow coastal marine ecological communities. The kelp species itself is not protected, rather, it is communities of closed or semi-closed giant kelp canopy at or below the sea surface that are protected (DSEWPaC, 2012).

Giant kelp is the largest and fastest growing marine plant. Their presence on a rocky reef adds vertical structure to the marine environment that creates significant habitat for marine fauna, increasing local marine biodiversity. Species known to shelter within the kelp forests include weedy sea dragons (*Phyllopteryx taeniolatus*), six-spined leather jacket (*Mesuchenia freycineti*), brittle stars (ophiuroids), sea urchins, sponges, blacklip abalone (*Tosia spp*) and southern rock lobsters (*Jasus edwardsii*). The large biomass and productivity of the giant kelp plants also provides a range of ecosystem services to the coastal environment.

Giant kelp requires clear, shallow water no deeper than approximately 35 m deep (Edyvane, 2003; Shepherd and Edgar, 2012; cited in DoE, 2012). They are photo-autotrophic organisms that depend on photosynthetic capacity to supply the necessary organic materials and energy for growth. O'Hara (in Andrew, 1999) reported that giant kelp communities in Tasmanian coastal waters occur at depths of 5-25 m.

Figure 4-25 shows that the largest extent of giant kelp marine forests are along the SA coastline with patches around the Victorian coastline.

James et al (2013) undertook extensive surveys of macroalgal communities along the Otway Shelf from Warrnambool to Portland in south-west Victoria. Sites were adjacent to shore or on offshore rocky reefs covering a depth range of 0 to 36 meters water depth. These surveys did not locate giant kelp at any site but identified that other brown algae species (*Durvillaea, Ecklonia, Phyllospora, Cystophora, and Sargassum*) are prolific to around 20 m water depth. Brown algae tend to be replaced by red algae in deeper waters.

Surveys of the Arches Marine Sanctuary (Edmunds et al. 2010) and Twelve Apostles Marine National Park (Holmes et al. 2007 cited in Barton et al., 2012) have not located giant kelp. The species has been recorded in Discovery Bay National Park forming part of a mixed brown algae community (Ball and Blake, 2007) (not part of the TEC), on basalt rocky reefs. An assemblage dominated by the species has been recorded from Merri Marine Sanctuary occupying a very small area (0.2 ha) of rocky reef (Barton et al., 2012).

4.4.6.3 Subtropical and Temperate Coastal Saltmarsh

The Subtropical and Temperate Coastal Saltmarsh TEC occurs in a relatively narrow strip along the Australian coast, within the boundary along 23°37' latitude along the east coast and south from Shark Bay on the west coast (Threatened Species Scientific Committee, 2013). The community is found in coastal areas which have an intermittent or regular tidal influence. Figure 4-25 shows that from Corner Inlet to Marlo there is a substantial amount of subtropical and temperate coastal saltmarsh along the Victorian coastline.

The coastal saltmarsh community consists mainly of salt-tolerant vegetation including grasses, herbs, sedges, rushes and shrubs. Succulent herbs, shrubs and grasses generally dominate and vegetation is generally less than 0.5 m in height (Adam, 1990). In Australia, the vascular saltmarsh flora may include many species, but is dominated by relatively few families, with a high level of endism at the species level.

The saltmarsh community is inhabited by a wide range of infaunal and epifaunal invertebrates and low and high tide visitors such as fish, birds and prawns (Adam, 1990). It is often important nursery habitat for fish and prawn species. Insects are also abundance and an important food source for other fauna. The dominant marine residents are benthic invertebrates, including molluscs and crabs (Ross et al., 2009).

The coastal saltmarsh community provides extensive ecosystem services such as the filtering of surface water, coastal productivity and the provision of food and nutrients for a wide range of adjacent marine and estuarine communities and stabilising the coastline and providing a buffer from waves and storms. Most importantly, the saltmarshes are one of the most efficient ecosystems globally in sequestering carbon, due to the biogeochemical conditions in the tidal wetlands being conducive to long-term carbon retention. A concern with the loss of saltmarsh habitat is that it could release the huge pool of stored carbon to the atmosphere.

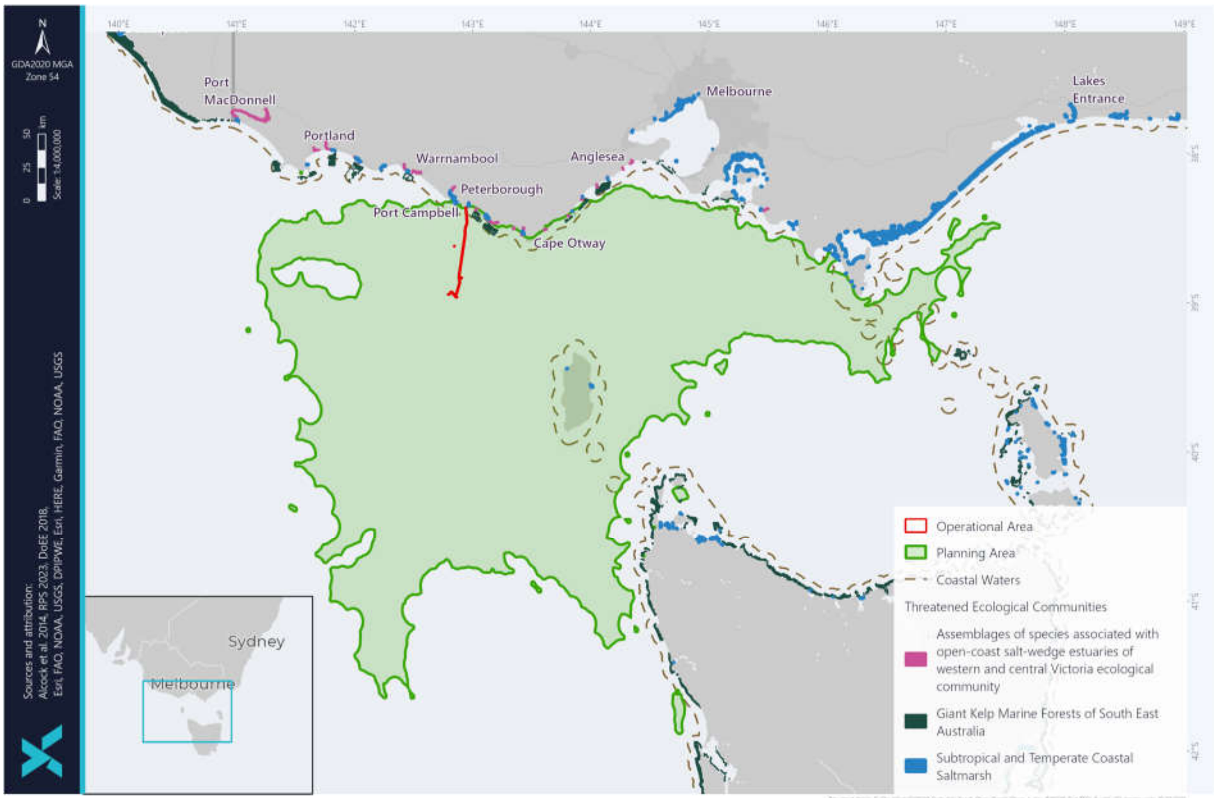


Figure 4-25: Threatened Ecological Communities within the Planning Area

4.4.7 Threatened and Migratory Species

PMST reports were generated for the operational area and planning area to identify the listed Threatened and Migratory species that may be present (Appendix A). The planning area encompasses the smaller operational area.

4.4.7.1 Marine Fauna of Conservation Significance

Under Part 13 of the EPBC Act, species can be listed as one, or a combination, of the following protection designations:

- Threatened (further divided into categories; extinct, extinct in the wild, critically endangered, endangered, vulnerable, conservation-dependent)
- Migratory
- Whale or other cetaceans
- Marine.

Details of listed fauna and their likely presence in the operational area or planning area are provided in the following sections.

For the purpose of the EP, only species listed as threatened or migratory under the EPBC Act likely to occur in the operational area or planning area are considered to have conservation significance warranting further discussion. Likely occurrence was determined by the PMST report or through designation of important habitat (e.g. BIA).

4.4.7.2 Biologically Important Areas and Critical Habitat to the survival of the species

Biologically Important Areas (BIAs) are areas that are particularly important for the conservation of protected species and where aggregations of individuals display biologically important behaviour such as breeding, foraging, resting or migration. Their designation is based on expert scientific knowledge about species' distribution, abundance and behaviour. The presence of the observed behaviour is assumed to indicate that the habitat required for the behaviour is also present.

There is no habitat critical to the survival of listed species within the operational area or planning area. BIAs within the operational area and planning area are summarised in Table 4-9 with further details in the relevant species sections.

Table 4-9: BIAs identified within the Operational Area and Planning Area

Receptor	Operational area (500 m)	Planning area	Type of BIA
Birds			
Antipodean albatross	Overlap	Overlap	Foraging
Australasian gannet	>80 km	Overlap	Foraging
	>115 km	Overlap	Aggregation
Black-browed albatross	Overlap	Overlap	Foraging
Black-faced Cormorant	>90 km	Overlap	Breeding
	>80 km	Overlap	Foraging
Buller's albatross	Overlap	Overlap	Foraging
Campbell albatross	Overlap	Overlap	Foraging
Common diving-petrel	Overlap	Overlap	Foraging
	>85 km	Overlap	Breeding
Indian yellow-nosed albatross	Overlap	Overlap	Foraging
Little penguin	>80 km	Overlap	Foraging
	>90 km	Overlap	Breeding
Short-tailed shearwaters	Overlap	Overlap	Foraging
	>130 km	Overlap	Breeding
Shy albatross	Overlap	Overlap	Foraging
Soft-plumaged Petrel	>200 km	Overlap	Foraging
Wandering albatross	Overlap	Overlap	Foraging
Wedge-tailed shearwater	Overlap	Overlap	Foraging
	>7 km	Overlap	Breeding
White-faced storm petrel	>50 km	Overlap	Foraging
	160 km	Overlap	Breeding
Fish			
White shark	Overlap	Overlap	Distribution
	>278 km	Overlap	Breeding
	>55 km	Overlap	Foraging
Cetaceans			
Pygmy blue whale	180 km	Overlap	Possible Foraging Area
	Overlap	Overlap	Foraging (annual high use area)
	>45 km	Overlap	Known Foraging Area
	Overlap	Overlap	Distribution
Southern right whale	>20 km	Overlap	Aggregation

Receptor	Operational area (500 m)	Planning area	Type of BIA
	Overlap	Overlap	Migration and resting on migration
	Overlap	Overlap	Known core range
	90 km	Overlap	Connecting habitat

4.4.7.3 Fish

Fish species present in the operational area or planning area are either pelagic (living in the water column), or demersal (benthic). Fish species inhabiting the region are largely cool temperate species, common within the SEMR. Table 4-10 details the listed fish species identified in the planning area and operational area PMST Reports (Appendix A).

Two fish species identified in the PMST Reports are freshwater species, dwarf galaxias and Yarra pygmy perch as they will be outside of the area potentially affected by the activity they are not discussed further.

Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the operational area or planning area are discussed in more detail.

Six species of fish are classed as conservation dependent which do not receive special protection, as they are not considered "matters of national environmental significance” under the EPBC Act. The six species are targeted by commercial fisheries as detailed in Section 4.5.9 and 4.5.10.

Information on eels is also provided as Beach’s consultation with the Eastern Maar Aboriginal Corporation for the Phase 5 installation and commissioning activities identified that they have interests regarding eels and their possible presence within the planning area during their migration and spawning seasons.

Table 4-10: Listed Fish Species identified in the Operational and Planning Areas

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Fish						
Australian grayling	*Prototroctes maraena*	V	-	-	SHK	SHL
		National Recovery Plan for the *Prototroctes maraena* (Australian grayling) (Backhouse et al., 2008). No threats relevant to the activity identified.				
Blue Warehou	*Seriolella brama*	CD	-	-	SHK	SHK
Eastern Dwarf Galaxias, Dwarf Galaxias	*Galaxiella pusilla*	V	-	-	SHL	SHM
Eastern Gemfish	*Rexea solandri (eastern Australian population)*	CD	-	-	SHL	
Orange Roughy, Deep-sea Perch	*Hoplostethus atlanticus*	CD	-	-	SHL	SHL
Southern Bluefin Tuna	*Thunnus maccoyii*	CD	-	-	SHL	SHL
Yarra Pygmy Perch	*Nannoperca obscura*	V	-	-	SHM	SHM
Sharks and rays						
Porbeagle, mackerel shark	*Lamna nasus*	-	M	-	SHL	SHL
School Shark, Eastern School Shark	*Centrophorus zeehaani*	CD	-	-	SHL	SHM
Shortfin mako	*Isurus oxyrinchus*	-	M	-	SHL	SHL
Southern Dogfish, Endeavour Dogfish	*Centrophorus zeehaani*	CD	-	L	SHM	SHL
Whale shark	*Rhincodon typus*	V	M	-	SHM	

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
		Approved Conservation Advice for the *Rhicodon typus* (whale shark) (TSSC, 2015b). Threats relevant to the activity are: • Vessel strike				
White shark	*Carcharodon carcharias*	V	M	-	BK	SHK
		Recovery Plan for the *Carcharodon carcharias* (white shark) (DSEWPaC, 2013a). No threats relevant to the activity identified.				
Pipefish, seahorse, seadragons						
Australian smooth pipefish	*Lissocampus caudalis*	-	-	L	SHM	SHM
Bigbelly seahorse	*Hippocampus abdominalis*	-	-	L	SHM	SHM
Black pipefish	*Stigmatopora nigra*	-	-	L	SHM	SHM
Briggs' crested pipefish	*Histiogamphelus briggsii*	-	-	L	SHM	SHM
Brushtail pipefish	*Leptoichthys fistularius*	-	-	L	SHM	SHM
Bullneck Seahorse	*Hippocampus minotaur*	-	-	L	SHM	
Common seadragon	*Phyllopteryx taeniolatus*	-	-	L	SHM	SHM
Deep-bodied pipefish	*Kaupus costatus*	-	-	L	SHM	SHM
Double-end pipehorse	*Syngnathoides biaculeatus*	-	-	L	SHM	
Hairy pipefish	*Urocampus carinirostris*	-	-	L	SHM	SHM
Half-banded pipefish	*Mitotichthys semistriatus*	-	-	L	SHM	SHM
Javelin pipefish	*Lissocampus runa*	-	-	L	SHM	SHM
Knife-snouted pipefish	*Hypselognathus rostratus*	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed Threatened	**Listed Migratory**	**Listed marine**		
Leafy seadragon	*Phycodurus eques*	-	-	L	SHM	SHM
Longsnout Pipefish, Australian Long-snout Pipefish,	*Vanacampus poecilolaemus*	-	-	L	SHM	
Mollison's pipefish	*Mitotichthys mollisoni*	-	-	L	SHM	
Mother-of-pearl pipefish	*Vanacampus margaritifer*	-	-	L	SHM	SHM
Port Phillip pipefish	*Vanacampus phillipi*	-	-	L	SHM	SHM
Pug-nosed pipefish	*Pugnaso curtirostris*	-	-	L	SHM	SHM
Red pipefish	*Notiocampus ruber*	-	-	L	SHM	SHM
Rhino pipefish	*Histiogamphelus cristatus*	-	-	L	SHM	SHM
Ring-backed pipefish	*Stipecampus cristatus*	-	-	L	SHM	SHM
Robust pipehorse	*Solegnathus robustus*	-	-	L	SHM	SHM
Sawtooth pipefish	*Maroubra perserrata*	-	-	L	SHM	SHM
Short-head seahorse	*Hippocampus breviceps*	-	-	L	SHM	SHM
Spiny pipehorse	*Solegnathus spinosissimus*	-	-	L	SHM	SHM
Spotted pipefish	*Stigmatopora argus*	-	-	L	SHM	SHM
Trawl pipefish	*Kimblaeus bassensis*	-	-	L	SHM	
Tucker's pipefish	*Mitotichthys tuckeri*	-	-	L	SHM	SHM
Upside-down pipefish	*Heraldia nocturna*	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Listed Threatened V: Vulnerable CD: Conservation Dependent Listed Migratory M: Migratory Listed Marine L: Listed		Likely Presence SHM: Species or species habitat may occur within area. SHL: Species or species habitat likely to occur within area. SHK: Species or species habitat known to occur within area. BK: Breeding known to occur within area.				

Australian Grayling

The Australian grayling (*Prototroctes maraena*) is a dark brown to olive-green fish attaining 19 cm in length. The species typically inhabits the coastal streams of NSW, Victoria and Tasmania, migrating between streams and the ocean. Spawning occurs in freshwater, with timing dependant on many variables including latitude and temperature regimes. Most of its life is spent in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters (Department of Sustainability and Environment, 2008a), though its precise marine habitat requirements remain unknown (Department of Sustainability and Environment, 2008b). They are a short-lived species, usually dying after their second year soon after spawning (a small proportion may reach four or five years) (Department of Sustainability and Environment, 2008a).

The Australian grayling has been recorded from the Gellibrand River (Department of Sustainability and Environment, 2008b), making it likely that it occurs in coastal waters. As marine waters are not part of the species' spawning grounds, the operational area and planning area are not likely to represent critical habitat for the species.

Eels

Ecology & Biology

The shortfinned eel (*Anguilla australis australis*) and the longfinned eel (*A. reinhardtii*) both occur naturally within Victoria and are the target species of the Victorian eel fishery (See Section 4.5.10). The eels have differing but overlapping distributions east and south of the Great Dividing Range in estuarine and freshwater catchments (VFA, 2022b) (Figure 4-26).

The shortfinned eel is widespread across the southern parts of the Victoria and occurring occasionally in northern streams draining into the Murray River, while the longfinned eel is found within southeast parts of Victoria only (VFA, 2022a). Both species spend the majority of their life cycle in fresh water or estuaries before travelling to the ocean to spawn once before dying (VFA, 2022a). Short-finned eels are listed as 'near threatened' on the IUCN red list, with barriers to riverine movement and freshwater habitat loss being key threats. Additionally changes in ocean currents, primary production, and thermal regimes may also affect eel migration, spawning success, and recruitment (Koster et al., 2021). The long-finned eel is listed as 'least concern' by the IUCN. Neither species are listed as threatened under the EPBC Act.

Both species of eel are primarily carnivorous, however, they will both opportunistically eat plant material (VFA, 2022a; 2022c). The short-finned eel is known to eat various types of fish, worms, insects, small crustaceans, molluscs, and water plants and can grow up to 1.1 m long and weigh up to 6.8 kg (VFA, 2022a). The long-finned eel consumes primarily fish and insects The long-finned eel is larger in size compared to the short-finned, reported to grow up to 2 m and weigh up to 16 kg, however, they are usually much smaller and often reach 1 m in length (VFA, 2022c). Both species are believed to follow a seasonal feeding pattern, with the most intense feeding window being at night during summer and spring (VFA, 2022a; 2022c). Both species sexes are determined by influences such as salinity, temperature, diet, and population density (more females as the population density decreases) (VFA, 2017a).

Migration & Spawning

Both species of eel have a remarkable lifecycle that is not entirely understood, remaining a natural phenomenon. They spend most of their life cycle in freshwater or estuaries before undergoing a mass migration into the ocean, travelling in excess of 3,000 km to spawn once (VFA, 2022b). Spawning location is believed to be in the Coral Sea near New Caledonia although no precise spawning location for either species has been identified (VFA, 2022a). Both species migrate to the ocean once matured; male short-finned eels generally mature at 8-12 years of age, whilst females mature at 10-20 years and long-finned eels can take double this time to mature. Migration occurs during late summer to autumn, and after a period of insatiable feeding and significant growth, the eels undergo a series of physical changes to prepare for their migration (VFA, 2022a).

Once the eels are prepared for spawning, they move out of their freshwater environments into the ocean in total darkness and swim north against the current to reach the Coral Sea. By the time they arrive, they have used up all their energy resources then they spawn and die, and their young commence the cycle over again. Their life begins at unknown spawning sites at a depth of 200 m as larvae. The pelagic larvae are then carried southwards by the ocean currents that parallel the east coast of Australia such as the EAC and swing east past Tasmania and then north to New Zealand. Along the way, they feed on microscopic organisms and develop into transparent, leaf-shaped larvae and eventually metamorphose into 'glass eels' which are eel-shaped, but extremely small and still transparent. At this stage, they move closer to land and commence migrating towards estuaries. Most short-finned glass eels migrate in the winter and spring, while long-finned glass eels migrate during summer and autumn (VFA, 2022a), although glass eels of both species may continue to arrive anytime throughout the year (VFA, 2017).

Koster et al (2021) tracked the short-finned eel spawning migration for the first time in Australia. Sixteen eels were collected and tagged from the Hopkins and Fitzroy River estuaries as they migrated from the river mouths outwards to the Southern Ocean over a sandbar in 2019. They were then released at either Warrnambool Harbour, Hopkins mouth beach or Killarney beach. Of the 16 tags twelve returned data. The results showed that the shortfinned eels exhibit diel vertical migration, meaning they travel in the top layers of water during the night and travel further down in the water column during the day (Koster et al. 2021). Of the small number of eels that made the entire journey to the spawning location their last movements were recorded in the Coral Sea. Many of the eels (about 30%) migrations were cut short due to predation, suspected by sharks, tuna, or other marine mammals. The conclusion of the study talks about the need for further research to determine the eel’s exact spawning locations and timing and how the information can be used to support conservation management, particularly when looking at anthropogenic impacts on the species. Koster et al (2021) listed construction and operation of energy developments as having potential to interact with eel migration.

Victorian Eel Fishery

Both the long-finned and short-finned eel are the target species for the Victorian eel fishery. The first commercial catches of eel were recorded in 1914, and up until 1950 eel was primarily fished for bait. Export of frozen shortfinned eel to Europe began in the 1960s (VFA, 2022a). Eel are harvested in Victorian coastal river basins south of the Great Dividing Range using fyke nets, with a maximum of 18 licences allowed in Victoria. Certain waterways are closed to fishing to allow for eels to escape and spawn (VFA, 2022a). Short-finned eels are the most abundant and the most keenly targeted eel species in Victoria, productivity from the fishery is highly susceptible to short and long term and seasonal environmental variations, particularly drought (VFA, 2017).

The eel fishery comprises both a wild catch sector and a culture (stock enhanced) sector. The culture sector has developed strategies for growth consistent with the species life cycle by translocating juvenile eels from other parts of Victoria into lakes and impoundments (culture waters) in western inland Victoria where they continue to grow (VFA, 2017). Fishing for glass eels has been of limited success due to the highly variable abundance in Victoria. Most of Victoria’s eel catch is taken by commercial fishers and is comprised of adult eels during different stages of their migration.

First Nations connection to eels

Eels were, and continue to be, an important resource for certain First Nation communities. Their use for communal gatherings and for barter and trade was extensive in pre-colonial times. Today, eel remains a popular food for community events (VFA, 2017). Short-finned eels in particular hold a cultural significance to First Nations people. For example, the Gunditjmara people of south-western Victoria built and used sophisticated aquaculture systems throughout the Budj Bim cultural landscape to exploit eel migrations at least 7,000 years ago. These systems and their eel catches have since provided a lasting and sustainable economic and social base for the Gunditjmara society (Koster et al., 2021).

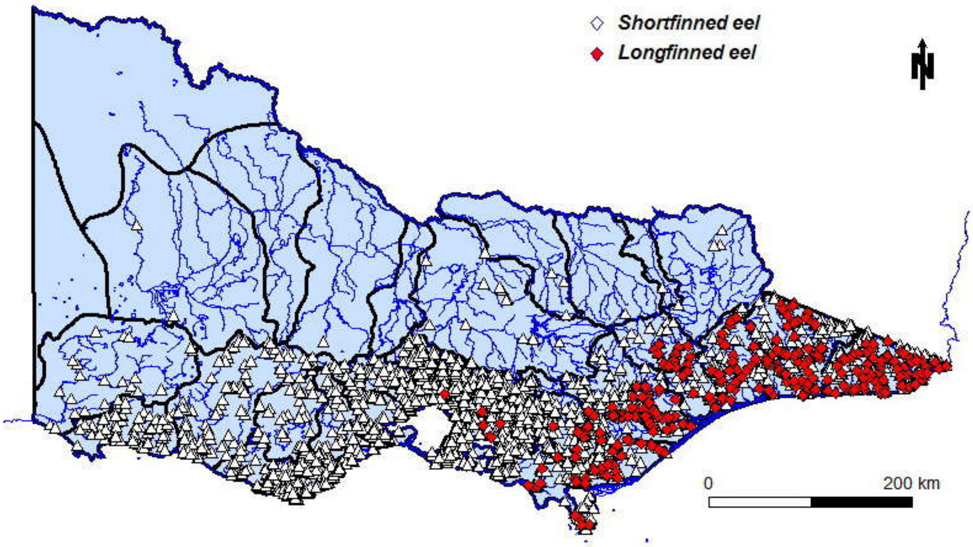


Figure 4-26: Distribution of Longfinned and Shortfinned Eels in Victoria (VFA 2017)

Porbeagle shark

The porbeagle shark (*Lamna nasus*) is widely distributed in the southern waters of Australia including Victorian and Tasmanian waters. The species preys on bony fishes and cephalopods and is an opportunistic hunter that regularly moves up and down in the water column, catching prey in mid-water as well as at the seafloor. It is most commonly found over food-rich banks on the outer continental shelf, but does make occasional forays close to shore or into the open ocean, down to depths of approximately 1,300 m. It also conducts long-distance seasonal migrations, generally shifting between shallower and deeper water (Pade et al., 2009). The porbeagle shark is likely to be present in the planning area in low numbers.

Shortfin mako shark

The shortfin mako shark (*Isurus oxyrinchus*) is a pelagic species with a circum-global oceanic distribution in tropical and temperate seas (Mollet et al., 2000). It is widespread in Australian waters, commonly found in water with temperatures greater than 16°C. Populations of the shortfin mako are considered to have undergone a substantial decline globally. These sharks are a common by-catch species of commercial fisheries (Mollet et al., 2000).

The use of dorsal satellite tags on 10 juvenile shortfin mako sharks captured in the Great Australian Bight (GAB) between 2008 and 2011 investigated habitat and migration patterns. It revealed GAB and south east of Kangaroo Island near the norther extent of the Bonney coast upwelling region, to be areas of highest fidelity and indicating critical habitats for juvenile shortfin mako (Rogers, 2011). The tagged sharks also showed migration to south west Western Australia, Victoria, Bass Strait and south west of Tasmania. Stomachs of shortfin mako sharks were also analysed from specimens collected by game fishing competitors in Port Mac Donnell, South Australia and Portland, Victoria from 2008 and 2010 found they specialise in larger prey including pelagic teleosts and cephalopods (Rogers, 2011). Due to their widespread distribution in Australian waters, shortfin mako sharks are likely to be present in the operational area and planning area in low numbers.

Syngnathids

All of the marine ray-finned fish species identified in the EPBC PMST Report are syngnathids, which includes seahorses and their relatives (sea dragon, pipehorse and pipefish). The majority of these fish species are associated with seagrass meadows, macroalgal seabed habitats, rocky reefs and sponge gardens located in shallow, inshore waters (e.g., protected coastal bays, harbours and jetties) less than 50 m deep (Fishes of Australia, 2015). They are sometimes recorded in deeper offshore waters, where they depend on the protection of sponges and rafts of floating seaweed such as sargassum.

Of the 30 species of syngnathids identified in the EPBC PMST Report, only one (*Hippocampus abdominalis*, big-belly seahorse) has a documented species profile and threats profile, indicating how little published information exists in general regarding syngnathids. The PMST Report species profile and threats profiles indicate that the syngnathid species listed in the planning area are widely distributed throughout southern, south-eastern and south-western Australian waters.

Whale shark

The whale shark (*Rhincodon typus*) is most commonly seen in waters off Western Australia, Northern Territory and Queensland however is occasionally seen off Victoria and South Australia (DoE, 2017w). It is generally found in areas where the surface temperature is 21–25 °C, preferably with cold water of 17 °C or less upwelling into it. It is generally observed singularly at the surface but can occasionally be in schools or aggregations of up to hundreds of sharks (Compagno, 1984). The whale shark is a suction filter feeder and feeds on a variety of planktonic and nektonic prey, including small crustaceans, small schooling fishes and, to a lesser extent, on small tuna and squid. The whale shark (*Rhincodon typus*) is listed as Vulnerable and Migratory under the EPBC Act (TSSC, 2015b) and is not likely to occur in the operational area but may be present in the planning area in low numbers.

White shark

The white shark (*Carcharodon carcharias*) is widely distributed and located throughout temperate and sub-tropical waters with their known range in Australian waters including all coastal areas except the Northern Territory (DotEE, 2010). Studies of white sharks indicate that they are largely transient. However, individuals are known to return to feeding grounds on a seasonal basis (Klimley and Anderson, 1996). In the Australasian region, white sharks differ genetically from other populations and data suggest there are two populations in southern Australia east and west by Bass Strait (Blower et al. 2012). A recent long-term electronic tagging study of juvenile white sharks off eastern Australia, indicated complex movement patterns over thousands of kilometres, including annual fidelity to spatially restricted nursery areas, directed seasonal coastal movements, intermittent areas of temporary nearshore residency and offshore movement into the Tasman Sea (Bruce et al., 2019). This study also supported the two-population model for the species in Australian waters with restricted east to west movements through Bass Strait. Bruce et al., (2019) observed seasonal movements of juvenile white sharks being in the northern region during winter− spring (June−November) and southern region during summer−autumn (December−May).

Observations of adult sharks are more frequent around fur-seal and sea lion colonies, including Wilsons Promontory and the Skerries. Juveniles are known to congregate in certain key areas including the Ninety Mile Beach area (including Corner Inlet and Lakes Entrance) in eastern Victoria and the Portland area of western Victoria).

The distribution BIA for the white shark intersects the operational area and the breeding and foraging BIAs also overlap the planning area (Figure 4-27). The known distribution is on the coastal shelf/upper slope waters out to 1000 m and the broader area where they are likely to occur extends from Barrow Island in WA to Yeppoon in New South Wales (NSW). They are more likely to be found between the 60–120 m depth contours than in the deeper waters. There is a known nursery area at Corner Inlet, and they are known to forage in waters off pinniped colonies throughout the SEMR. It is likely that white sharks are present in the planning area.

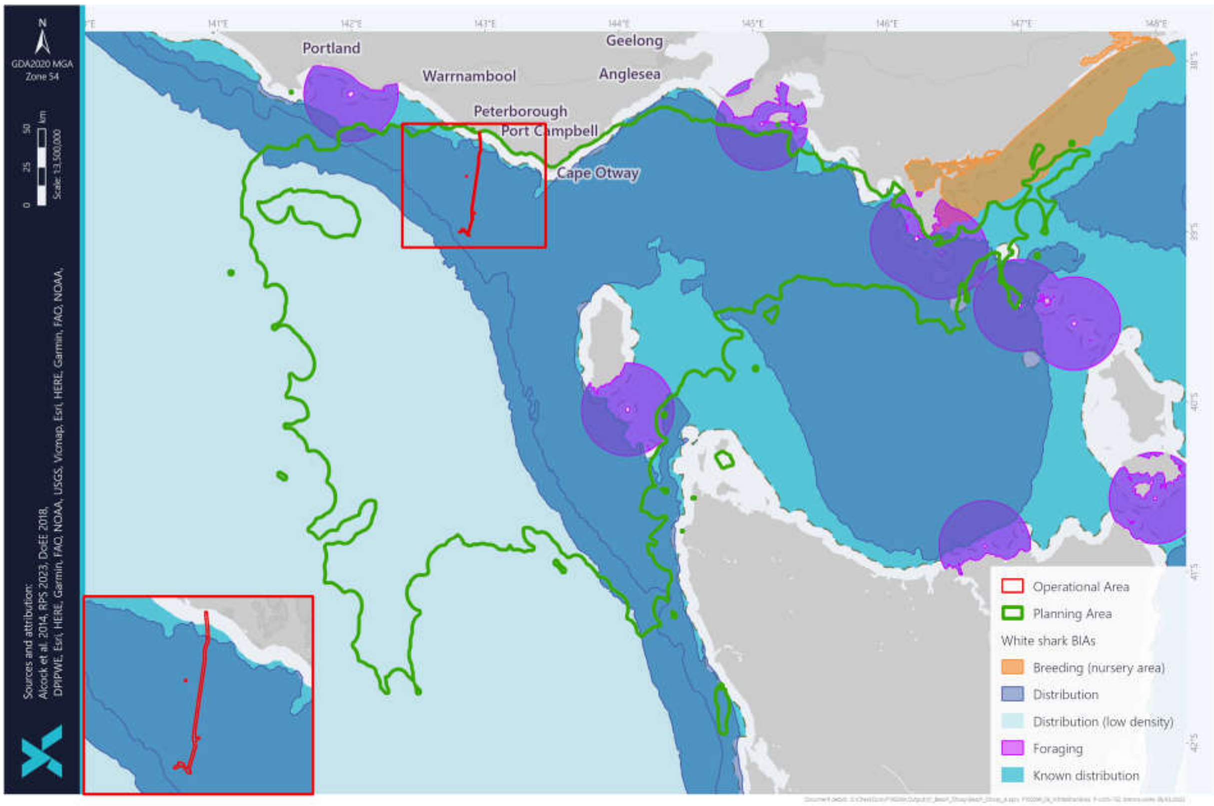


Figure 4-27: BIAs for the White Shark within the Planning Area

4.4.7.4 Birds

A diverse array of seabirds and terrestrial birds utilise the Otway region and may potentially forage within or fly over the operational area and planning area, resting on islands during their migration. Infrequently and often associated with storm events, birds that do not normally cross the ocean are sometimes observed over the Otway shelf, suggesting the birds have been blown off their normal course or are migrating.

Bird species listed in the PMST reports, as possibly or known to occur in the operational area and planning area (this includes species or species habitat), are shown in Table 4-11. Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the operational area and planning area are discussed in more detail.

The following conservation and recovery plans apply to birds with conservation and recovery plans and conservation advice relevant to individual species detailed in Table 4-11.

National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). The recovery plan is a co-ordinated conservation strategy for albatrosses and giant petrels listed as threatened. Threats identified relevant to the activity:

- Marine pollution - Minimise the effects of marine debris, plastics and pollution.
- Marine debris - Minimise the effects of marine debris, plastics and pollution.
- Artificial lighting – no specific actions relevant to the activity.
- Climate variability and change - no specific actions relevant to the activity.

Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015b). The long-term recovery plan objective for migratory shorebirds is to minimise anthropogenic threats to allow for the conservation status of these bird species. Threats identified relevant to the activity:

- Habitat degradation/ modification (oil pollution).

Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). The Plan aims to provide a national framework for the research and management of listed marine and migratory seabirds and to outline national activities to support the conservation of listed seabirds in Australia and beyond. The Plan includes a summary of Australia's commitments under international conventions and agreements, and the identification of important habitats within Australia.

Threats identified relevant to the activity:

- Climate change
- Resource extraction
- Marine debris
- Light pollution
- Acute pollution – oil spills, discharges

With the action of manage the effects of anthropogenic disturbance to seabird breeding and roosting areas.

Table 4-11: Listed bird species identified in the Planning and Operational Area

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Albatrosses						
Antipodean albatross	*Diomedea antipodensis*	V	M	L	FL	FL
Black-browed albatross	*Thalassarche melanophris*	V	M	L	FL	FL
Buller's albatross	*Thalassarche bulleri*	V	M	L	FL	FL
Campbell albatross	*Thalassarche impavida*	V	M	L	FL	FL
Gibson's albatross	*Diomedea antipodensis gibsoni* *Diomedea gibsoni*	V	-	L	FL	
Grey-headed albatross	*Thalassarche chrysostoma*	E	M	L	SHM	SHM
Indian Yellow-nosed Albatross	*Thalassarche carteri*	L	M	L	SHL	SHL
Northern buller's albatross, Pacific albatross	*Thalassarche bulleri platei*	V	-	-	FL	FL
Northern royal albatross	*Diomedea sanfordi*	E	M	L	FL	FL
Salvin's albatross	*Thalassarche salvini*	V	M	L	FL	FL
Shy albatross	*Thalassarche cauta*	E	M	L	FL	FL
Sooty albatross	*Phoebetris fusca*	V	M	L	SHL	SHL
Southern royal albatross	*Diomedea epomophora*	V	M	L	FL	FL
Wandering albatross	*Diomedea exulans*	V	M	L	FL	FL
White-capped albatross	*Thalassarche steadi*	V	M	L	FK	FK

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Shearwaters						
Flesh-footed shearwater	*Ardenna carneipes*	-	M	L	FL	FL
Short-tailed shearwater	*Ardenna tenuirostris* *Puffinus tenuirostris*	-	M	L	BK	
Sooty shearwater	*Ardenna grisea* *Puffinus griseus*	-	M	L	SHL	SHM
Petrels						
Blue petrel	*Halobaena caerulea*	V	-	L	SHM	SHM
		Approved Conservation Advice for the *Halobaena caerulea* (blue petrel) (TSSC, 2015e). No threats relevant to the activity were identified.				
Common diving petrel	*Pelecanoides urinatrix*	-	-	L	BK	
Gould's petrel	*Pterodroma leucoptera*	E	-	-	SHM	SHM
		National Recovery Plan for *Pterodroma leucoptera leucoptera* (Gould's petrel) (DEC NSW, 2006). No threats relevant to the activity were identified.				
Northern giant-petrel	*Macronectes halli*	V	M	L	FL	FL
Soft-plumaged petrel	*Pterodroma mollis*	V	-	L	SHM	SHM
		Approved Conservation Advice for *Pterodroma mollis* (soft-plumaged petrel) (TSSC, 2015c). No threats relevant to the activity were identified.				
Southern giant-petrel	*Macronectes giganteus*	E	M	L	FL	SHM
White-bellied storm-petrel	*Fregetta grallaria grallaria*	V	-	-	SHL	
White-faced storm petrel	*Pelagodroma marina*	-	-	L	BK	
Other						

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Australasian bittern	*Botaurus poiciloptilus*	E	-	-	SHK	SHL
		Approved Conservation Advice for *Botaurus poiciloptilus* (Australasian bittern) (TSSC, 2019). No threats relevant to the activity were identified.				
Australian fairy tern	*Sternula nereis nereis*	V	-	-	SHK	BL
		Approved Conservation Advice for *Sternula nereis nereis* (Australian fairy tern) (DSEWPC, 2011c). Threats identified relevant to the activity: • Marine pollution - Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. National Recovery Plan for the Australian Fairy Tern (*Sternula nereis nereis*) (Commonwealth of Australia, 2020c). Threats identified relevant to the activity: • Habitat degradation • Climate variability • Pollution No actions specific to the activity were identified.				
Australian painted-snipe	*Rostratula australis*	E	-	-	SHL	SHL
		Approved Conservation Advice for *Rostratula australis* (Australian painted snipe) (DSEWPaC, 2013c). No threats relevant to the activity were identified. National Recovery Plan for the Australian Painted Snipe (Commonwealth of Australia, 2022). Threats identified relevant to the activity: • Deterioration of water quality, human disturbance.				
Bar-tailed godwit	*Limosa lapponica*	-	W	L	SHK	SHL
		Conservation Advice *Limosa lapponica baueri* (bar-tailed godwit (western Alaskan)) (TSSC, 2016a). Threats identified relevant to the activity: • Habitat degradation/ loss.				
Black currawong	*Strepera fuliginosa colei*	V	-	-	BL	
Black-eared cuckoo	*Chrysococcyx osculans*	-	-	L	SHL	
Black-faced cormorant	*Phalacrocorax fuscescens*	-	-	L	BK	

Common name	**Species name**	**EPBC Act status**			**Planning Area**	**Operational area**
		Listed Threatened	**Listed Migratory**	**Listed marine**		
Black-faced monarch	*Monarcha melanopsis*	-	T	L	SHK	
Black-tailed godwit	*Limosa limosa*	-	W	L	RK	
Blue-winged parrot	*Neophema chrysostoma*	-	-	-	SHK	
Broad-billed sandpiper	*Limicola falcinellus*	-	W	L	RK	
Caspian tern	*Hydroprogne caspia* *Sterna caspia*	-	M	L	BK	
Cattle egret	*Bubulcus ibis*	-	-	L	SHM	
Common greenshank	*Tringa nebularia*	-	W	L	SHK	SHL
Common sandpiper	*Actitius hypoleucos*	-	W	L	SHK	SHK
Curlew sandpiper	*Calidris ferruginea*	CE	W	L	SHK	SHM
		Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f). Threats identified relevant to the activity: • Habitat degradation/ loss (oil pollution)				
Double-banded plover	*Charadrius bicinctus*	-	W	L	RK	
Eastern curlew	*Numenius madagacariensis*	CE	W	L	SHK	SHM
		Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015e). Threats identified relevant to the activity: • Habitat degradation/ loss (oil pollution)				
Eastern hooded plover	*Thinornis cucullatus cucullatus*	V	-	L	SHK	SHL
Fairy prion	*Pachyptila turtur*	-	-	L	SHK	SHK
Fairy prion (southern)	*Pachyptila turtur subantarctica*	V	-	-	SHK	SHK
		Approved Conservation Advice for *Pachyptila subantarctica* (fairy prion (southern)) (TSSC, 2015d). No threats relevant to the activity were identified.				

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	**Listed Migratory**	**Listed marine**		
Fairy tern	*Sterna nereis*	-	-	L	BK	
Fork-tailed swift	*Apus pacificus*	-	M	L	SHL	SHL
Gang-gang cockatoo	*Callocephalon fimbriatum*	E	-	-	SHK	SHL
Great knot	*Calidris tenuirostris*	CE	W	L	RK	
Great skua	*Catharacta skua*	-	-	L	SHM	
Greater crested tern	*Thalasseus bergii* *Sterna bergii*	-	W	L	BK	
Greater sand plover	*Charadrius leschenaultii*	V	W	L	SHK	
		Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016b). Threats identified relevant to the activity: • Habitat degradation/ loss (oil pollution)				
Green rosella (King Island)	*Platycercus caledonicus brownie*	V	-	-	SHK	
Grey falcon	*Falco hypoleucos*	V	-	-	SHL	SHM
Grey plover	*Pluvialis squatarola*	-	W	L	RK	
Grey-tailed tattler	*Heteroscelus brevipes*	-	W	-	RK	
Hooded plover	*Thinornis rubricollis*		-	L	SHK	
Kelp gull	*Larus dominicanus*	-	-	L	BK	
King Island brown thornbill	*Acanthiza pusilla archibaldi*	E	-	-	SHK	
King Island scrubtit	*Acanthornis magna greeniana*	CE	-	-	SHK	
Latham's snipe	*Gallinago hardwickii*	-	W	L	SHK	SHL
Lesser sand plover	*Charadrius mongolus*	E	W	L	RK	

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Little curlew	*Numenius minutus*	-	W	L	RL	
Little penguin	*Eudyptula minor*	-	-	L	BK	
Little tern	*Sternula albifrons*	-	M	L	SHM	SHM
Magpie Goose	*Anseranas semipalmata*	-	-	L	SHM	
Marsh sandpiper	*Tringa stagnatilis*	-	W	L	RK	
Masked Owl (Tasmanian)	*Tyto novaehollandiae castanops (Tasmanian population)*	V	-	-	BK	
Nunivak bar-tailed godwit	*Limosa lapponica baueri*	V	-	-	SHK	SHM
Orange-bellied parrot	*Neophema chrysogaster*	CE	-	L	MK	ML
		National Recovery Plan for the *Neophema chrysogaster* (orange-bellied parrot) (DELWP, 2016). Threats identified relevant to the activity: • Illuminated boats and structures: evaluate risk of lighting on vessels and offshore structures.				
Osprey	*Pandion haliaetus*	-	W	L	SHK	
Pacific golden plover	*Pluvialis fulva*	-	W	L	RK	
Pacific gull	*Larus pacificus*	-	-	L	BK	
Painted honeyeater	*Grantiella picta*	V	-	-	SHK	
Pectoral sandpiper	*Calidris melanotos*	-	W	L	SHK	SHM
Pied stilt	*Himantopus himantopus*	-	-	L	RK	
Pilotbird	*Pycnoptilus floccosus*	V	-	-	SHK	
Pin-tailed snipe	*Gallinago stenura*	-	W	L	RK	
Plains-wanderer	*Pedionomus torquatus*	CE	-	-	SHM	
Rainbow bee-eater	*Merops ornatus*	-	-	L	SHM	

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	Listed Migratory	Listed marine		
Red knot	*Calidris canutus*	E	W	L	SHK	SHM
		Approved Conservation Advice for *Calidris canutus* (red knot) (TSSC, 2016d). Threats identified relevant to the activity: • Marine pollution - Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented.				
Red-capped plover	*Charadrius ruficapillus*	-	-	L	RK	
Red-necked stint	*Calidris ruficollis*	-	W	L	RK	
Regent honeyeater	*Anthochaera Phrygia*	CE	-	-	FL	SHM
Ruddy turnstone	*Arenaria interpres*	-	W	L	RK	
Ruff (Reeve)	*Philomachus pugnax*	-	M	L	SHK	
Rufous fantail	*Rhipidura rufifrons*	-	T	L	SHK	SHL
Sanderling	*Calidris alba*	-	W	L	RK	
Satin flycatcher	*Myiagra cyanoleuca*	-	T	L	SHK	SHK
Sharp-tailed sandpiper	*Calidris acuminata*	-	W	L	RK	SHM
Silver gull	*Larus novaehollandiae*	-	-	L	BK	
Sooty tern	*Sterna fuscata*	-	-	L	BK	
Swift parrot	*Lathamus discolour*	CE	-	L	SHK	SHM
		National Recovery Plan for the Swift Parrot *Lathamus discolour* (Saunders and Tzaros, 2011). Draft National Recovery Plan for the Swift Parrot (*Lathamus discolor*) (CoA, 2019d). No threats relevant to the activity were identified.				
Swinhoe's snipe	*Gallinago megala*	-	W	L	RL	
Tasmanian azure kingfisher	*Ceyx azureus diemenensis*	E	-	-	SHK	

Common name	Species name	EPBC Act status			Planning Area	Operational area
		Listed Threatened	**Listed Migratory**	**Listed marine**		
Tasmanian wedge-tailed eagle	*Aquila audax fleayi*	E	-	-	BL	
Terek sandpiper	*Xenus cinereus*	-	W	L	RK	
Whimbrel	*Numenius phaeopus*	-	W	L	RK	
White-bellied sea-eagle	*Haliaeetus leucogaster*	-	-	L	BK	
White-throated needletail	*Hirundapus caudacutus*	V	T	L	SHK	SHK
Yellow wagtail	*Motacilla flava*	-	T	L	SHK	SHM

Listed Threatened
CE: Critically Endangered
E: Endangered
V: Vulnerable
Listed Migratory
M: Migratory
T: Migratory Terrestrial
W: Migratory Wetlands
Listed Marine
L: Listed

Likely Presence
SHM: Species or species habitat may occur within area.
SHL: Species or species habitat likely to occur within area.
SHK: Species or species habitat known to occur within area.
FL: Foraging, feeding or related behaviour likely to occur within area.
RK: Roosting known to occur within area.
ML: Migratory route likely to occur in area.
BK: Breeding known to occur within area.

^ The type of presence may vary between the different areas, e.g. an important behaviour (e.g. foraging, breeding) may be present in the planning area, but not present in the operational area.

Albatross and petrels

Albatrosses and giant-petrels are among the most dispersive and oceanic of all birds, spending more than 95% of their time foraging at sea in search of prey and usually only returning to land (remote islands) to breed. Only seven species of albatross and the southern and northern giant petrel are known to breed within Australia, which are protected under the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). Breeding within Australian territory occurs on the isolated islands of Antarctica (Giganteus Island, Hawker Island and Frazier islands) and the Southern Ocean (Heard Island, McDonald Island, Macquarie Island, Bishop and Clerk Islands), as well as islands off the south coast of Tasmania and Albatross Island off the north-west coast of Tasmania in Bass Strait (DSEWPaC, 2011b). There are no islands with colonies of threatened marine seabirds within the operational and planning areas. Albatross Island, supporting a breeding population of approximately 5,000 shy albatross (*Thallassarche cauta*), is the closest breeding colony of threatened seabirds to the planning area.

Albatross and giant petrel species exhibit a broad range of diets and foraging behaviours, hence their 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 degrees where most species spend most of their foraging time. The Antipodean albatross, black-browed albatross, Buller's albatross, Campbell albatross, Indian yellow-nosed albatross, shy albatross and wandering albatross, have BIAs for foraging that overlap the operational area or planning area (Figure 4-28, Figure 4-29 and Figure 4-30). These BIAs cover either most or all the SEMR (Commonwealth of Australia, 2015c). Therefore, it is likely that these will be present and forage in the planning area.

Both the common diving-petrel and the white-faced storm petrel are not listed as threatened species under the EPBC Act, and have large populations within Australia, accounting for 5% and 25% respectively of the global population (DoE, 2015b). The common diving-petrel breeds on islands off south-east Australia and Tasmania; there are 30 sites with significant breeding colonies (defined as more than 1,000 breeding pairs) known in Tasmania, and 12 sites in Victoria (including Seal Island, Wilson's Promontory and Lady Julia Percy Island) (DoE, 2015e). There are 15 sites with significant breeding colonies in Tasmania, and three sites with Victoria, for the white-faced storm petrel (DoE, 2015e). A BIA for foraging has been identified for the common diving-petrel that overlaps with the operational and planning areas. The common-diving petrel also has a breeding BIA that overlaps the planning area. The white-faced storm petrel has a foraging BIA and a breeding BIA that overlaps the planning area.

The grey-headed Albatross breed on the southern and western flanks of Petrel Peak, Macquarie Island and this specie has bred in this same restricted area on Macquarie Island for at least the past 30 years (Terauds et al. 2005). The northern royal albatross is regularly recorded throughout the year around Tasmania and South Australia at the continental shelf edge and feeds frequently in these waters. The Pacific albatross (equivalent to the northern Buller's albatross) is a non-breeding visitor to Australian waters mostly limited to the Tasman Sea and Pacific Ocean, occurring over inshore, offshore and pelagic waters and off the east-coast of Tasmania (DSEWPaC, 2011b). During the non-breeding season, the Salvin's albatross occur over continental shelves around continents with a small number of non-breeding adults flying regularly across the Tasman Sea to south-east Australian waters (DSEWPaC, 2011b). Sooty albatrosses although rare are likely regular migrants to Australian waters mostly in the autumn to winter months and have been observed foraging in southern Australia (Thiele, 1977; Pizzey & Knight, 1999). Southern royal albatross forage from 36° to 63°. They range over the waters off southern Australia at all times of the year but especially from July to October (DSEWPaC, 2011b). Despite breeding colonies in New Zealand, the white capped albatross is common off the coast of south-east Australia throughout the year. Gibson's albatross has breeding colonies in New Zealand but has been known to forage in the Tasman Sea and South Pacific Ocean with individuals occurring offshore from Coffs harbour in the north to Wilson's Promontory in the south (EA, 2001; Marchant & Higgins 1990). Therefore, it is likely that these along with the Tasmanian shy albatross will be present and forage in the planning area and potentially the operational area.

The blue petrel (*Halobaena caerulea*) is listed as vulnerable under the EPBC Act. It breeds in dense but discrete colonies on offshore stacks near Macquarie island (Marchant & Higgins 1990). The Gould's petrel breeds in NSW on Cabbage Tree Island and nearby Boondelbah Island, near Port Stephens (Fullagar 1976). The Northern giant petrel breeds in the sub-Antarctic, and visits areas off the Australian mainland mainly during the winter months (May-October). Immature and some adult birds are commonly seen during this period in offshore and inshore waters from around Frenamtle (WA) to around Sydney (NSW) (Pizzey & Knight 1999).

The soft-plumaged petrel is a regular and quite common visitor to southern Australian seas but is more common on the west than in the south and southeast, breeding occurring on south Australian islands (Marchant & Higgins, 1990). The southern giant petrel is widespread distributed through the Southern Ocean from the Antarctic to subtropical waters and this species may transit the planning area from time-to-time, foraging for food. The white-bellied storm petrel breed on small offshore islets and rocks in Lord Howe Island and has been recorded over near-shore waters off Tasmania (Baker et al. 2002).

Terns and shearwaters

The flesh-footed shearwater 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. Thirty-nine of the 41 islands on which the species breeds lie off the coast of southern Western Australia, with the remaining two islands 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). This species is likely to visit the operational and planning areas foraging for food.

The short-tailed shearwater has foraging and breeding BIAs within the planning area (Figure 4-30). The short-tailed shearwater is migratory, and breeding is restricted to southern Australia being most abundant in Victoria and Tasmania (Skira et al., 1996). Huge numbers arrive along the south and south-east coast of Australia from wintering grounds in the North Pacific and are observed in large numbers foraging the surrounding coastal and offshore waters (Marchant & Higgins, 1990). Short-tailed shearwaters have been identified as a conservation value in the temperate east and south-west marine areas.

The sooty shearwater breeds around New Zealand, southern Australia and southern South America and, in winter, these birds move to the North Pacific Ocean, but some move into the North Atlantic Ocean, or remain in the southern hemisphere (DAWE, 2021).

Caspian tern is the largest turn in Australia, they inhabit both coastal and inland regions and breeding occurs widespread throughout Australia. In Victoria breeding sites are mostly along coastal regions with three significant regular breeding colonies, Corner Inlet, Mud Island and Mallacoota (Minton & Deleyev, 2001). Breeding occurs between September to December are resident and occur throughout the year at breeding sites. The Caspian tern usually forages in open wetlands and prefers shallow waters but is also found in open coastal waters, title channels and mud flaps. They can forage 60 km from their nesting site (Higgins & Davis, 1996). The little tern species is also widespread in Australia with three major sub populations, the northern population that breeds from Broome to Northern Territory. The eastern subpopulation breeds on the eastern and south eastern coast extending as far as western Victoria and the south-eastern parts of South Australia, to the northern and eastern coast of Tasmania. The third population migrate from breeding grounds in Asia to spend the spring and summer in Australia. The little tern has a naturally high rate of breeding failure due to the ground nets being exposed to adverse weather conditions, and native predators. The Australian fairy tern occurs along the coastline of Victoria, South Australia, Western Australia and Tasmania. Breeding habitat for the Caspian, little tern and Australian fairy tern vary from terrestrial wetlands, rocky islets or banks, low islands, beaches, cays and spits. Nests are present in the open sparse vegetation such as tussocks and other sand binding plants to sometimes near bushes and driftwood. Their diet also consists primarily of fish along with aquatic invertebrates, insects and eggs and the young of other birds (Higgins & Davis, 1996; Taylor & Roe, 2004; Van de Kam et al., 2004).

The sooty tern has a much larger foraging range, encompassing open shelf waters, shelf edge and deep water (DSEWPaC, 2012b). Main breeding colonies occur off Australia's west and east coast. Like the crested tern where distribution is widespread in Australia, but breeding occurs off islands in large colonies off Queensland and New South Wales (Higgins & Davis, 1996). Foraging diet consists of pelagic fish, cephalopods, crustaceans and insects. Terns were observed amongst mixed flocks of seabirds (such as albatross and shearwaters) during the drilling of Geographe-4 in April 2021.

Osprey and white bellied sea eagle

The white-bellied sea eagle is a large raptor generally seen singly or in pairs, distributed along the coastline of mainland Australia and Tasmania. Breeding records are patchily distributed mainly along the coastline especially the eastern coast extending from Victoria and Tasmania to Queensland. There are recorded breeding sites as far inland as the Murray, Murrumbidgee and Lachlan River in norther Victoria (Marchant & Higgins, 1993). There is no quantitative data available on area of occupancy, but it is believed that there could be a decline due to increased development of coastal areas. Estimations of 500 or more pairs in Australia account for 10-20% of the global population (Marchant & Higgins, 1993). Recorded decline in numbers have been recorded across Australia, with a decline numbers in Victoria recorded in Gippsland Lakes, Phillip Island and the Sunraysia district (Bilney & Emison, 1983; Quinn, 1969). White-bellied sea eagles feed on a variety of fish, birds, reptiles, mammals and crustaceans. They hunt from a perch and while in flight (circling slowly). Described as a breeding resident throughout much of its range in Australia, breeding is generally sedentary, and the home range can be up to 100 km^2 (Marchant & Higgins, 1993). White-bellied sea eagles are sensitive to disturbance particularly in the early stages of nesting, human activity may cause nests and young to be abandoned (Debus et al, 2014). Breeding is known to occur within the planning area, so they are likely to be common visitor.

The osprey is a medium sized raptor extending around the northern coast of Australia from Albany, Western Australia to Lake Macquarie in New South Wales with an isolated breeding population on the coast of South Australia. Listed as migratory under the EPBC Act they are resident around breeding territories. They are found along coastal habitats and terrestrial wetlands and require open fresh or saltwater for foraging (Marchant & Higgins, 1993). Osprey feed mainly on fish, occasionally molluscs, crustaceans, mammals, birds, reptiles and insects. Generally, they search or prey by soaring, circling and quartering above water and dive directly into the water at their target prey (Clancy, 2005). This species is likely to be an uncommon visitor to the operational or planning areas.

Australasian gannet

The Australasian gannet generally feeds over the continental shelf or inshore waters. Their diet is comprised mainly of pelagic fish, but also squid and garfish. Prey is caught mainly by plunge-diving, but it is also seen regularly attending trawlers. Breeding is highly seasonal (October–May), nesting on the ground in small but dense colonies (DoE, 2015a). Important breeding locations for the Australasian gannet within the Environment Sectors include Pedra Branca, Eddystone Rocks, Sidmouth Rocks, and Black Pyramid (Tasmania) and Lawrence Rocks (Victoria). BIAs for foraging and aggregation occur within the planning area with substantial foraging sites within Port Philip Bay and Port Fairy (Figure 4-28).

Little penguin

The little penguin is the smallest species of penguin in the world and are permanent residents on a number of inshore and offshore islands. The Australian population is large but not thought to exceed one million birds (DoE, 2015a). Bass Strait has the largest proportion (approximately 60%) of the known breeding colonies in Australia; however, breeding populations are also found on the New South Wales coast. Individuals exhibit strong site fidelity, returning to the same breeding colony each year to breed in the winter and spring months (Gillanders et al., 2013). The diet of a little penguin includes small school fish, squid and krill. Prey is typically caught with rapid jabs of the beak and swallowed whole. A BIA for breeding and foraging, has been identified for the little penguin within the planning area (Figure 4-29). Their main breeding site within the planning area is in Western Port Bay. Little penguins are also an important component of the Australian and New Zealand fur-seals' diet (Parliament of South Australia, 2011).

Orange-bellied parrot

The orange-bellied parrot (*Neophema chrysogaster*) (listed as critically endangered under the EPBC Act) breeds in Tasmania during summer, migrates north across Bass Strait in autumn and spends winters on the mainland. The migration route includes the west coast of Tasmania and King Island (Figure 4-31). Birds depart the mainland for Tasmania from September to November (Green, 1969). The southward migration is rapid (Stephenson, 1991), so there are few migration records. The northward migration across western Bass Strait is more prolonged (Higgins & Davies, 1996). The orange-bellied parrot is protected under the National Recovery Plan for the Orange-bellied Parrot (DELWP, 2016a). The parrot's breeding habitat is restricted to south-west Tasmania, where breeding occurs from November to mid-January mainly within 30 km of the coast. The species forage on the ground or in low vegetation (Loyn et al., 1986). During winter, on mainland Australia, orange-bellied parrots are found mostly within 3 km of the coast. In Victoria, they mostly occur in sheltered coastal habitats, such as bays, lagoons and estuaries. They are also found in low samphire herbland dominated by beaded glasswort (*Sarcocornia quinqueflora*), sea heath (*Frankenia pauciflora*) or sea-blite (*Suaeda australis*), and in taller shrubland dominated by shrubby glasswort (*Sclerostegia arbuscula*) (DotEE, 2019a). There are also non-breeding orange-bellied parrots on mainland Australia, between Goolwa in Australia and Corner Inlet in Victoria. The orange bellied parrot may overfly the coastal waters of the operational and planning area (Figure 4-31 and Figure 4-31). However, parrots rarely land or forage out at sea.

Other shorebirds

A number of species listed in Table 4-11 use coastal shoreline habitats such as Australian fairy tern, Australasian bittern, curlew sandpiper, eastern curlew, fairy prion, fork-tailed swift, little curlew, pectoral sandpiper, red knot, sharp-tailed sandpiper, yellow wagtail, and species of plover. These species are commonly found on coastal shores including beaches and rocky shores and either feed at low tide on worms, crustaceans and molluscs or fish species or feed on aquatic biota (Parks Victoria, 2016). These species may be present on coastal areas of the operational or planning areas.

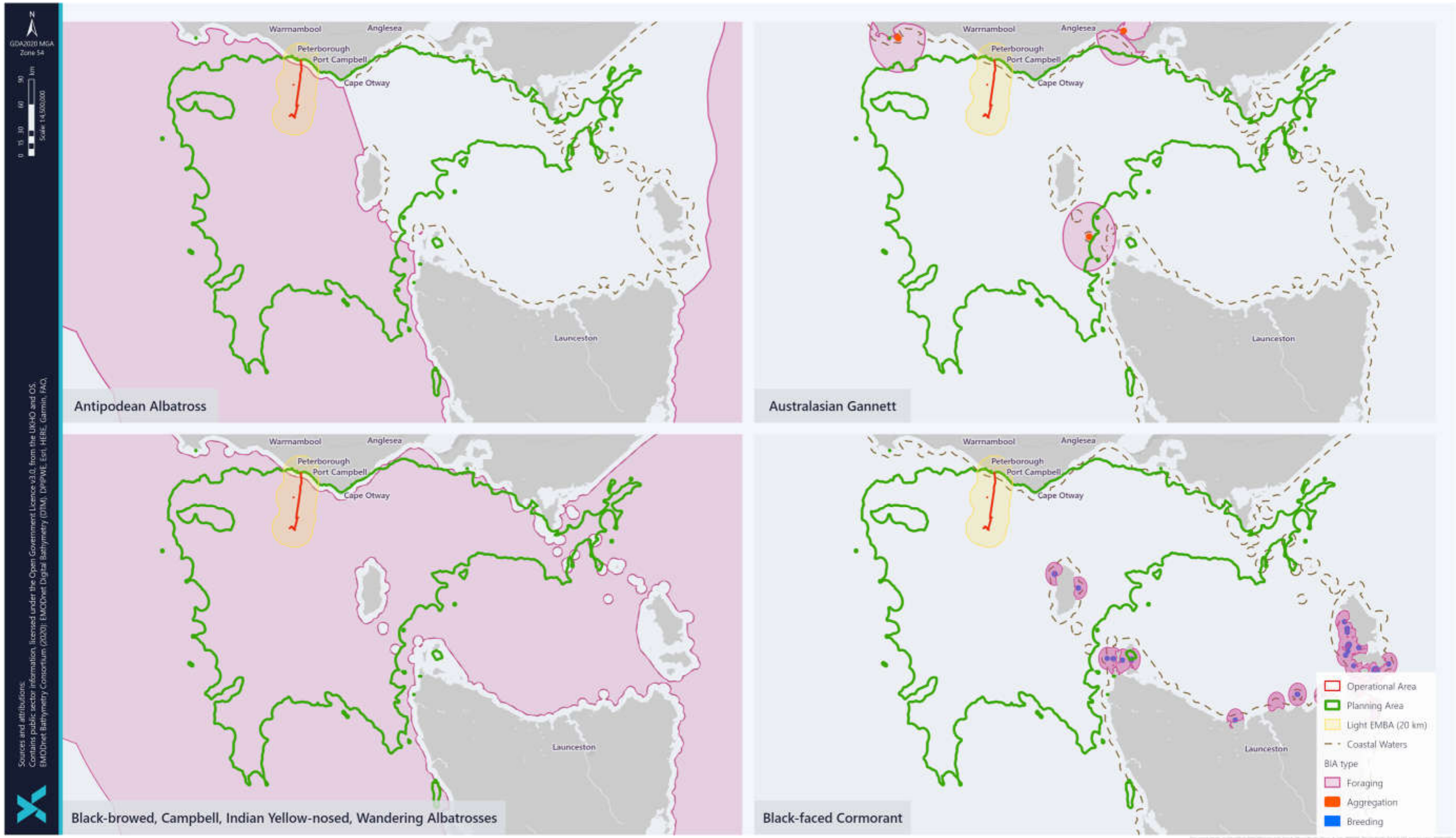
Many sandpipers including the common, marsh, terek and the broad-billed sandpiper are widespread through Australia’s coastline inhabiting saltwater and freshwater ecosystems. They migrate from the Northern Hemisphere in non-breeding months, favouring estuaries, saltmarshes, intertidal mudflats, swamps and lagoons and foraging on worms, molluscs, crustaceans, insects, seeds and occasionally rootlets and other vegetation (Marchant & Higgins, 1993; Higgins & Davies, 1996).

The Australian painted snipe is a stocky wading bird most commonly in eastern Australian wetlands. Feeding on vegetation, insects, worms, molluscs, crustaceans and other invertebrates. Latham’s, Swinhoe’s and pin-tailed snipe are non-breeding visitors to Australia occurring at the edges of wetlands, shallow swamps, ponds and lakes (Marchant & Higgins, 1993). The grey-tailed tattler migrates from the Northern hemisphere and inhabit rocky coasts with reefs and platforms, offshore islands and intertidal mudflats. Foraging on polychaete worms, molluscs and crustaceans and roosting on branches of mangroves and rocks and boulders close to water. The bar-tailed godwit and black-tailed godwit are large waders, migrating from the Northern hemisphere in the noon-breeding months to coastal habitat in Australia. The large waders are commonly found in sheltered bays, estuaries, intertidal mudflats, and occasionally on rocky coasts (Higgins & Davies, 1996).

Hooded and eastern hooded plovers are small beach nesting birds. They predominantly occur on wide beaches and are easily disturbed by human activity. The lesser sand and greater sand plover are migratory and inhabits intertidal sand and mudflats, forage on invertebrates and breed in areas characterised by high elevation. Breeding occurs outside Australia, but roosting occurs near foraging areas on beaches, banks, spits and banks (Pegler, 1983). The pacific golden and grey plover are widespread in coastal regions foraging on sandy beaches, spits, rocky points, exposed reef and occasional low saltmarsh and mangroves. Roosting usually occurs near foraging areas while breeding occurs in dry tundra areas away from the coast (Bransbury, 1985; Pegler, 1983; Marchant & Higgins, 1993). The double-banded plover is found in both coastal and inland areas with greatest numbers in Tasmania and Victoria. It breeds only in New Zealand and migrates to Australia.

Other waders including black-faced cormorant, common greenshank, pied stilt, red-necked stint, ruddy turnstone, ruff, rufous fantail, sanderling and white-throated needletail and are common along Australia's coastline. The black-faced cormorant has a breeding and foraging BIA off King Island within the planning area. Many of these waders are migratory travelling from the Northern Hemisphere in non-breeding months. Most inhabit intertidal mudflats, rocky islets, sand beaches, mangroves, rocky coastline and coral reefs. Roosting occurs in similar habitats and species are found feeding on fish, crustaceans, aquatic insects, as well as plants and seeds (Higgins & Davies, 1996). These species are unlikely to be present in the operational and planning areas due to the distance offshore. The plains wanderer is a unique bird that lives predominantly in grasslands in Victoria, South Australia, New South Wales and Queensland.

The swift parrot is a small parrot breeding in colonies in Tasmania. The entire population migrates to the mainland during winter. The great knot is critically endangered migratory arriving in large numbers in Australia occurring in sheltered coastal habitats with large intertidal mudflats. Typically, they roost in large open areas at the water's edge to in shallow water close to foraging grounds (Higgins & Davies 1996). These species are critically endangered and may occur within the planning area.



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EMODnet Bathymetry Consortium (2020): EMODnet Digital Bathymetry (DTM). DPIPWE, Esri, HERE, Garmin, FAO.

Figure 4-28: BIAs for Antipodean Albatross, Australasian Gannet, Black-browed Albatross, Campbell Albatross, Indian Yellow-nosed, Wandering Albatross and Black-faced Cormorant within the Operational and Planning Area

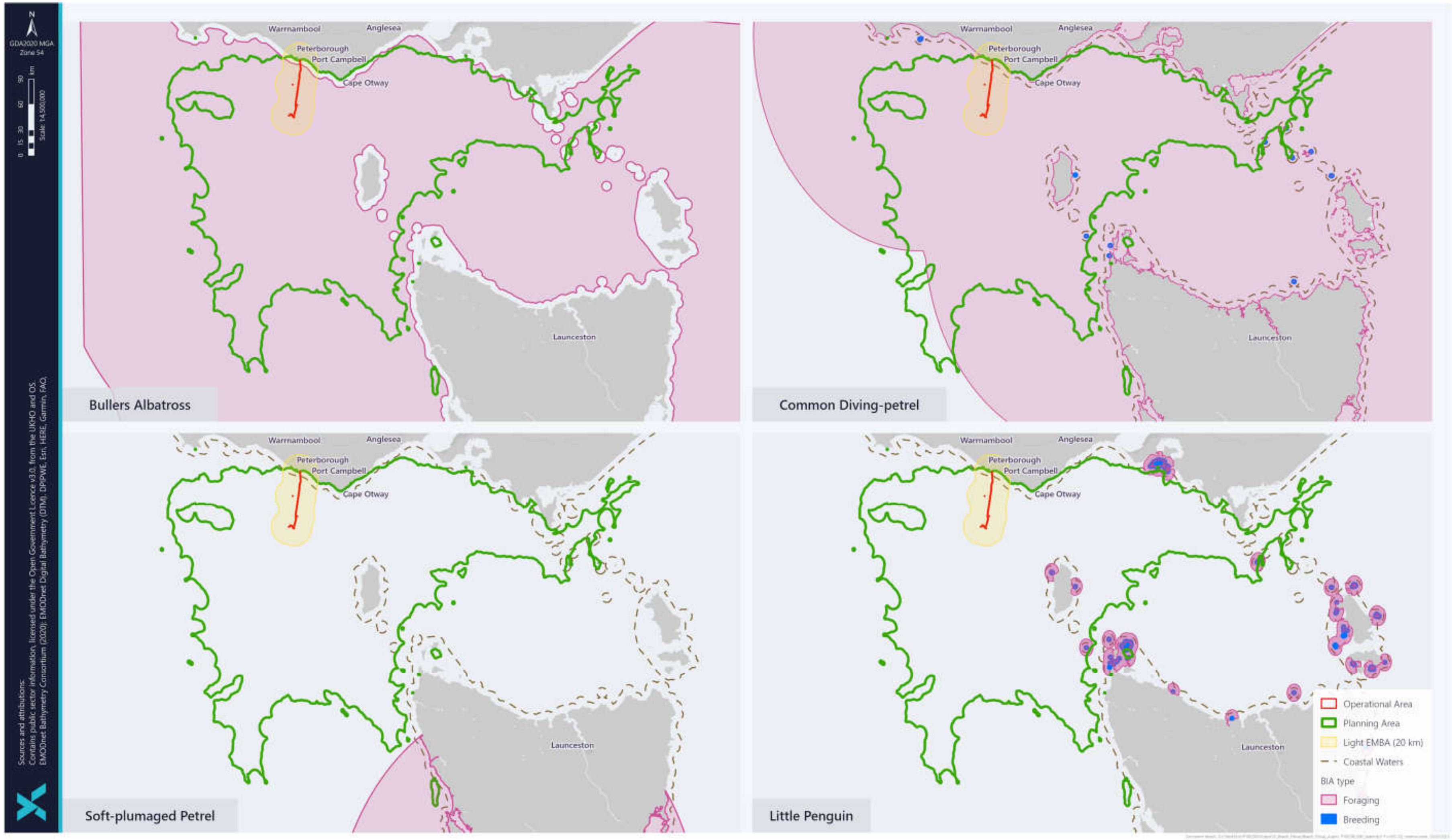
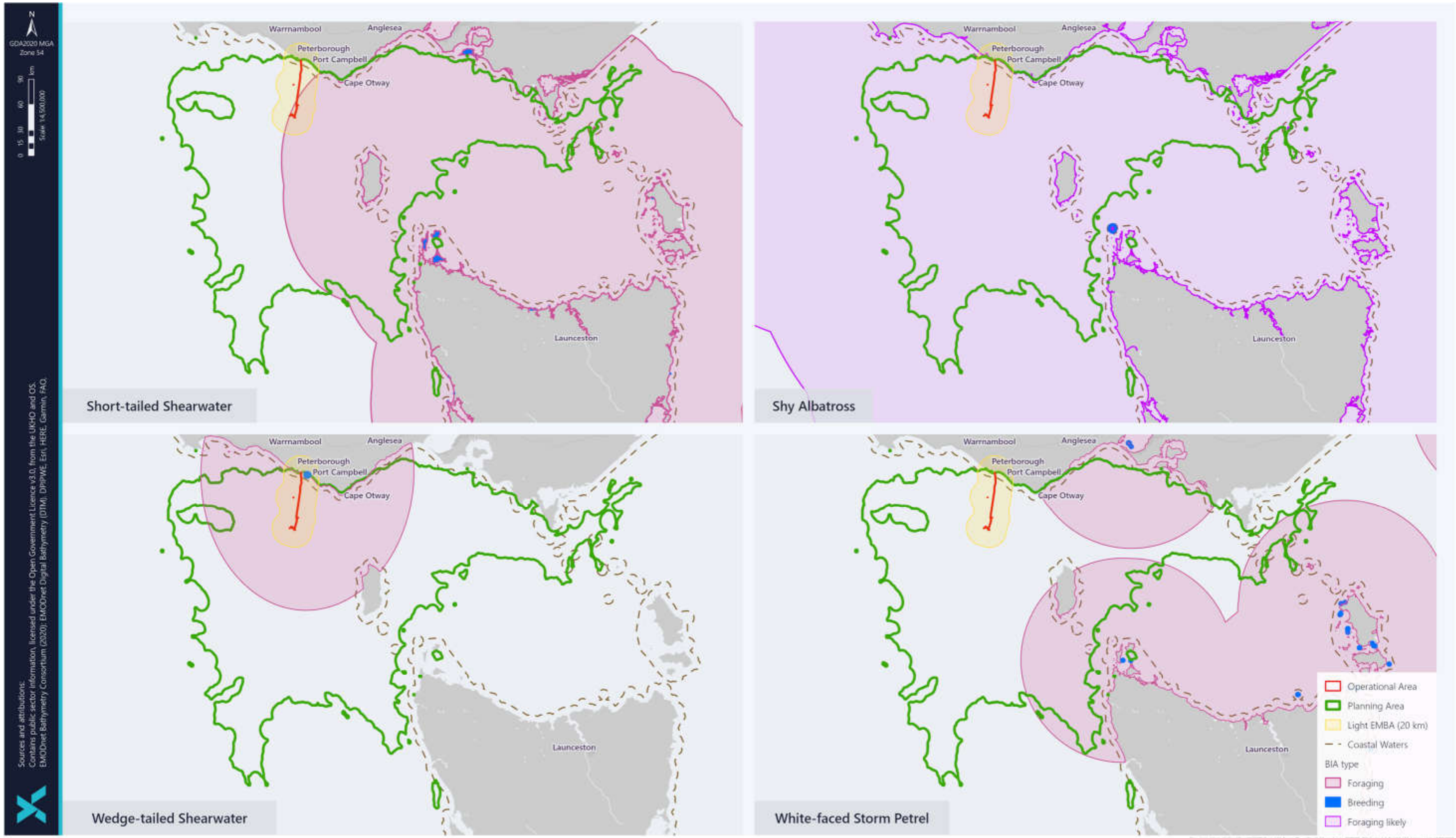


Figure 4-29: BIAs for the Buller's Albatross, Common Diving-petrel, Soft-plumaged Petrel and Little Penguin within the Operational and Planning Area



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EMODnet Bathymetry Consortium (2020): EMODnet Digital Bathymetry (DTM). DPIPWE, Esri, HERE, Garmin, FAO.

Figure 4-30: BIAs for Short-tailed Shearwater, Shy Albatross, Wedge-tailed Shearwater and White-faced Storm Petrel within the Operational and Planning Area

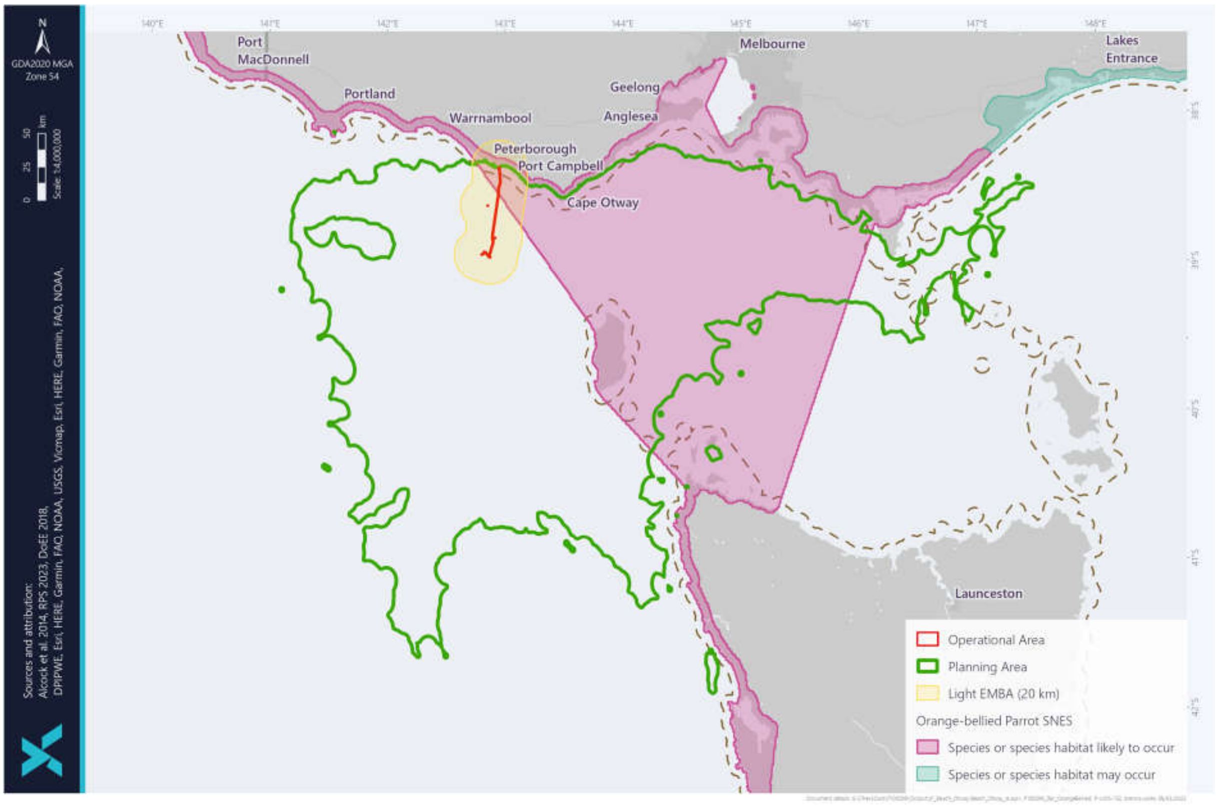


Figure 4-31: Distribution of the Orange-bellied Parrot within the Operational and Planning Area

4.4.7.5 Marine Reptiles

The PMST Reports for the operational and planning areas identified three marine turtle species likely to occur (Table 4-12, Appendix A). All three species of marine turtles are protected by the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). The planning area PMST report identifies that feeding is known to occur in the planning area for all species. There are no identified BIAs for marine reptiles in the operational area or planning area.

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) details that the long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles. Threats identified relevant to the activity are:

- Chemical and terrestrial discharge
- Marine debris
- Light pollution
- Habitat modification
- Vessel strike
- Noise interference
- Vessel disturbance

Table 4-12: Listed Turtle Species identified in the PMST

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed threatened	Listed migratory	Listed marine		
Green turtle	*Chelonia mydas*	V	M	L	SHM	SHM
Leatherback turtle	*Dermochelys coriacea*	E	M	L	FK	BL
		Approved Conservation Advice for *Dermochelys coriacea* (leatherback turtle) (DEWHA, 2008). Threats identified relevant to the activity are as per the recovery plan.				
Loggerhead turtle	*Caretta caretta*	E	M	L	FK	BL
Listed Threatened		Likely Presence				
E: Endangered		FK: Foraging, feeding or related behaviour likely to occur within area				
V: Vulnerable		SHL: Species or species habitat likely to occur within area				
Listed Migratory						
M: Migratory						
Listed Marine						
L: Listed						

Green turtle

Green turtles (*Chelonia mydas*) nest, forage and migrate across tropical northern Australia. They usually occur between the 20°C isotherms, although individuals can stray into temperate waters as vagrant visitors. Green turtles spend their first 5-10 years drifting on ocean currents. During this pelagic (ocean-going) phase, they are often found in association with drift lines and floating rafts of sargassum. Green turtles are predominantly found in Australian waters off the Northern Territory, Queensland and Western Australian coastlines, with limited numbers in NSW, Victoria and South Australia. There are no known nesting or foraging grounds for green turtles offshore Victoria; they occur only as rare vagrants in these waters (DotEE, 2019m), therefore it is expected they would only be occasional visitors in the planning area.

Leatherback turtle

The leatherback turtle (*Dermochelys coriacea*) is a pelagic feeder found in tropical, sub-tropical and temperate waters throughout the world. Unlike other marine turtles, the leatherback turtle utilises cold water foraging areas, with the species most commonly reported foraging in coastal waters between southern Queensland and central NSW, southeast Australia (Tasmania, Victoria and eastern SA), and southern WA (Commonwealth of Australia, 2017b). This species is an occasional visitor to the Otway shelf and has been sighted on a number of occasions during aerial surveys undertaken by the Blue Whale Study Group, particularly to the southwest of Cape Otway. It is mostly a pelagic species, and away from its feeding grounds is rarely found inshore (Commonwealth of Australia, 2017b). Adults feed mainly on soft-bodied organisms such as jellyfish, which occur in concentrations at the surface in areas of convergence and upwelling (Bone, 1998; Cogger, 1992). Bass Strait is one of three of the largest concentrations of feeding leatherbacks (DSE, 2009). The major threat to leatherback turtles is by-catch and habitat pollution. In the Bass Strait, leatherbacks are at risk of entanglement from crayfish and pot float lines, ingestion of marine debris as ocean currents and wind can accumulate floating debris where turtles feed (DSE, 2009).

No major nesting has been recorded in Australia, with isolated nesting recorded in Queensland and the Northern Territory. The leatherback turtle is expected to be only an occasional visitor in the planning area.

Loggerhead turtle

The loggerhead turtle (*Caretta caretta*) is globally distributed in tropical, sub-tropical waters and temperate waters. The loggerhead is a carnivorous turtle, feeding primarily on benthic invertebrates in habitat ranging from nearshore to 55 m depth (Plotkin et al., 1993).

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, 2008). Loggerhead turtles forage in all coastal states and the Northern Territory, but are uncommon in South Australia, Victoria and Tasmania (Commonwealth of Australia, 2017b). Due to waters depths it is unlikely loggerhead turtles would be present in the planning area.

4.4.7.6 Cetaceans

The PMST Reports identify several cetaceans that potentially occur in the operational and planning areas (Appendix A). Table 4-13 details cetaceans identified in the PMST Reports. Threatened or migratory species that are likely or known to occur in the area or have an intercepting BIA with the operational and planning areas are discussed in more detail in the following sections.

The Bass Strait and the Otway Basin is considered an important migratory path for humpback, blue, southern right, and to some extent the fin and sei whales. The whales use the Otway region to migrate to and from the north-eastern Australian coast and the sub-Antarctic. Of environmental importance in the Otway is the Bonney coast upwelling, the eastward flow of cool nutrient rich water across the continental shelf of the southern coast of Australia that promotes blooms of krill and attracts baleen whales during the summer months.

Cultural significance

First nation’s people around Australia have long had a strong connection to whales, which has significance as totemic ancestors to some groups. The arrival of whales along Australia's coastline marked the arrival of the "elders of the sea", which follows a songline or ancient memory code, that traces the journeys of ancestral spirits as they created the land, animals, and lore.

Indigenous Australians have a long tradition of utilising beached (or stranded) whales as a food source and whale stranding’s were occasions for feasting (Clarke 2001). For example, Ngarrindjeri had gathered to harvest the bodies of stranded whales well before Kringkari (pink-skinned men) arrived in their lands. Runners were sent inland telling others of the arrival of Kondoli, which was a time for ceremony and trade (Paterson & Wilson 2019).

Otway Whale Surveys

Gill et al. (2015) summarised cetacean sightings from 123 systematic aerial surveys undertaken over western Bass Strait and the eastern Great Australian Bight between 2002 and 2013. This paper does not include sighting data for blue whales, which has previously been reported in Gill et al. (2011) (See Section on blue whales).

These surveys recorded 133 sightings of 15 identified cetacean species consisting of seven mysticete (baleen) whale species, eight odontocete (toothed) species and 384 sightings of dolphins (Table 4-14 and Table 4-15). Survey effort was biased toward coverage of upwelling seasons, corresponding with pygmy blue whales' seasonal occurrence (November to April; 103 of 123 surveys), and relatively little survey effort occurred during 2008–2011. Cetacean species sighted within the region are described in the following sections.

Gill et al. (2015) encountered southern right and humpback whales most often from May to September, despite low survey effort in those months. Southern right whales were not recorded between October and May. Fin, Sei, and Pilot whales were sighted only from November to May (upwelling season), although this may be an artefact of their relative scarcity overall and low survey effort at other times of year. Dolphins were sighted most consistently across years. The authors caution that few conclusions about temporal occurrence can be drawn because of unequal effort distribution across seasons and the rarity of most species.

Species of cetacean sighted in the period 31 October to 19 December 2010 during the Speculant 3D Transitions Zone Seismic Survey (3DTZSS) undertaken by Origin Energy, recorded species of common dolphin (*Delphinus spp*.), bottlenose dolphin (*Tursiops spp*.), unidentified small cetaceans and fur-seals.

Origin Energy conducted a survey for cetaceans focused on Origin operations and permit in the Otway basin from June 2012 through to March of 2013. Table 4-15 lists the species present in the area Origin surveyed.

As part of Beach's Otway Drilling Campaign, marine fauna observations occurred through most of 2021 (2 February to 31 December 2021) from the drill rig and support vessels at the Artisan-1, Geographe-4, Geographe-5, Thylacine North-1 and West-1 drilling locations. Table 4-17 provides this cetacean sighting data. For whales, the highest number of detections was for blue whales (198), while for dolphins, it was the common dolphin (519). Further detail on marine fauna observations of blue whales through to 30 April 2022 is provided in the section on blue whales).

Table 4-13: Listed cetacean species identified in the PMST report

Common name	**Species name**	**EPBC Act status**			**Planning area**	**Operational area**
		Listed threatened	**Listed migratory**	**Listed marine**		
Whales						
Andrew's beaked whale	*Mesoplodon bowdoini*	-	-	L	SHM	SHM
Antarctic minke whale	*Balaenoptera bonaerensis*	-	M	L	SHL	SHL
Arnoux's beaked whale	*Berardius arnuxii*	-	-	L	SHM	SHM
Blainville's beaked whale	*Mesoplodon desirostris*	-	-	L	SHM	SHM
Blue whale	*Balaenoptera musculus brevicauda and intermedia*	E	M	L	FK	FK
		Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b). The long-term recovery plan objective for blue whales is to minimise anthropogenic threats to allow for their conservation status to improve. Threats relevant to the activity are: • Noise interference -Evaluate risk of noise impacts and, if required, appropriate mitigation measures are implemented. • Vessel disturbance - Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.				
Curvier's beaked whale	*Ziphius cavirostris*	-	-	L	SHM	SHM
Dwarf sperm whale	*Kogia simus*	-	-	L	SHM	SHM
False killer whale	*Pseudorca crassidens*	-	-	L	SHL	SHM
Fin whale	*Balaenoptera physalus*	V	M	L	FK	FL
		Approved Conservation Advice for *Balaenoptera physalus* (fin whale) (TSSC, 2015f). Threats relevant to the activity are: • Noise interference - Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. • Vessel disturbance - Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.				
Gray's beaked whale	*Mesoplodon grayi*	-	-	L	SHM	

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed threatened	**Listed migratory**	**Listed marine**		
Hector's beaked whale	*Mesoplodon hectori*	-	-	L	SHM	SHM
Humpback whale	*Megaptera novaeangliae*	-	M	-	SHK	SHL
		Approved Listing Advice for *Megaptera novaeangliae* (humpback whale) (TSSC, 2022). Listing advice details that the humpback is no longer listed as vulnerable and has been removed from the threatened species list. It will remain a matter of national environmental significance under the EPBC Act as a listed Migratory Species. Threats identified relevant to the activity: • Marine debri • Noise interference • Pollution • Vessel disturbance and strike No explicit relevant management actions.				
Killer whale, orca	*Orcinus orca*	-	M	L	SHL	SHL
Long-finned pilot whale	*Globicephala melas*	-	-	L	SHM	SHM
Minke whale	*Balaenoptera acutorostrata*	-	-	L	SHM	SHM
Pygmy right whale	*Caperea marginata*	-	M	L	FL	FM
Pygmy sperm whale	*Kogia breviceps*	-	-	L	SHM	SHM
Sei whale	*Balaenoptera borealis*	V	M	L	FK	FL
		Approved Conservation Advice for *Balaenoptera borealis* (sei whale) (TSSC, 2015g). Threats identified relevant to the activity: • Noise interference -Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. • Vessel disturbance -Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.				
Shepherd's beaked whale	*Tasmacetus shepherdi*	-	-	L	SHM	
Short-finned pilot whale	*Globicephala macrorhynchus*	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed threatened	Listed migratory	Listed marine		
Southern bottlenose whale	*Hyperoodon planifrons*	-	-	L	SHM	
Southern right whale	*Eubalaena australis*	E	M	L	BK	SHK
	Balaena glacialis australis	Conservation Management Plan for the Southern Right Whale 2011-2021 (DSEWPaC, 2012a). Threats identified relevant to the activity: • Noise interference - Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented. • Vessel disturbance - Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.				
Sperm whale	*Physeter macrocephalus*	-	M	L	SHM	SHM
Strap-toothed beaked whale	*Mesoplodon layardii*	-	-	L	SHM	SHM
True's beaked whale	*Mesoplodon mirus*	-	-	L	SHM	SHM
Dolphins						
Bottlenose dolphin	*Tursiops truncates*	-	-	L	SHM	SHM
Common dolphin	*Delphinus delphis*	-	-	L	SHM	SHM
Dusky dolphin	*Lagenorhynchus obscures*	-	M	L	SHL	SHL
Indian ocean bottlenose dolphin	*Tursiops aduncus*	-	-	L	SHL	SHL
Risso's dolphin	*Grampus griseus*	-	-	L	SHM	SHM
Southern right whale dolphin	*Lissodelphis peronii*	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Planning area	Operational area
		Listed threatened	**Listed migratory**	**Listed marine**		
Listed Threatened E: Endangered V: Vulnerable Listed Migratory M: Migratory Listed Marine L: Listed		Likely Presence SHM: Species or species habitat may occur within area. SHL: Species or species habitat likely to occur within area. SHK: Species or species habitat known to occur within area. FK: Foraging, feeding or related behaviour known to occur within area. FL: Foraging, feeding or related behaviour likely to occur within area FM: Foraging, feeding or related behaviour may to occur within area.				

^ The type of presence may vary between the different areas, e.g. an important behaviour (e.g. foraging, breeding) may be present in the planning are, but not present in the operational area.

Table 4-14: Cetacean Species Recorded during Aerial Surveys 2002–2013 in Southern Australia

Taxon	Common name	Species group*	Sightings	Individual	Mean group size (+/- SD)
Baleen whales					
Eubalaena australis	Southern right whale	SRW	12	52	4.2 +/- 4.2
Caperea marginata	Pygmy right whale		1	100	100
Balaenoptera physalus	Fin and like fin whale	ROR	7	8	1.1 +/- 0.4
B. borealis	Sei and like sei whale	ROR	12	14	1.3 +/- 0.5
B. acutorostrata	Dwarf minke whale	ROR	1	1	1
B. bonaerensis	like Antarctic minke whale	ROR	1	1	1
Megaptera novaeangliae	Humpback whale	ROR	10	18	1.8 +/- 1.0
Toothed whales					
Physeter macrocephalus	Sperm whale	ODO	34	66	1.9 +/- 2.2
Mesoplodon spp.	Unidentified beaked whales	ODO	1	20	20
Orcinus orca	Killer whale	ODO	6	21	3.5 +/- 2.8
Globicephala melas	Long-finned pilot	ODO	40	1853	46.3 +/- 46.7
Grampus griseus	Risso's dolphin	ODO	1	40	40
Lissodelphis peronii	Southern right whale dolphin	ODO	1	120	120
Tursiops spp.	Bottlenose dolphin	DOL	4	363	90.8 +/- 140.1
	Dolphins	DOL	384	22169	58 +/- 129.6
Unidentified large whales			3	3	1
Unidentified small whales			2	2	1

SRW = southern right whales; ROR = rorquals; ODO = other odontocetes; DOL = dolphins.

Table 4-15: Temporal Occurrence of Cetaceans Sighted during Aerial Surveys from November 2002 to March 2013 in Southern Australia

Species	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
Southern right whale	0	0	0	0	0	0	0	0	0.8	3.1	6.8	8.8
Pygmy right whale*	0	0	0	0	0	0	0	0	19.8	0	0	0
Fin whale	0	0.10	0.14	0.07	0.08	0	0	0	0	0	0	0
Sei whale	0	0.25	0.07	0.04	0.08	0.19	0	0.21	0	0	0	0
Minke whale*	0	0	0.02	0	0	0	0.12	0	0	0	0	0
Humpback whale	0	0.05	0.07	0	0	0	0	0.11	0.99	1.0	0	0.35
Sperm whale	1.7	1.2	0.23	0.53	0.08	0.13	0.75	0.85	0	0	0	0
Unidentified beaked whale*	0	0	0.47	0	0	0	0	0	0	0	0	0
Killer whale	0	0	0.19	0	0	5.0	0	6.0	0	0.68	0	0
Pilot whale	0	59.6	7.0	19.3	4.0	39.5	0	26.3	0	0	0	0
Southern right whale dolphin*	0	59.6	0	0	0	0	0	0	0	0	0	0
Risso's dolphin*	0	0	0	0	1.7	0	0	0	0	0	0	0
Bottlenose dolphin	0	1.5	7.7	0	0	0	0	0	0	0	0	1.1
Dolphins	545.1	120.3	105.0	151.8	105.6	233.4	26.9	257.6	155.8	2.7	0	0

*Species sighted 2 or fewer times.

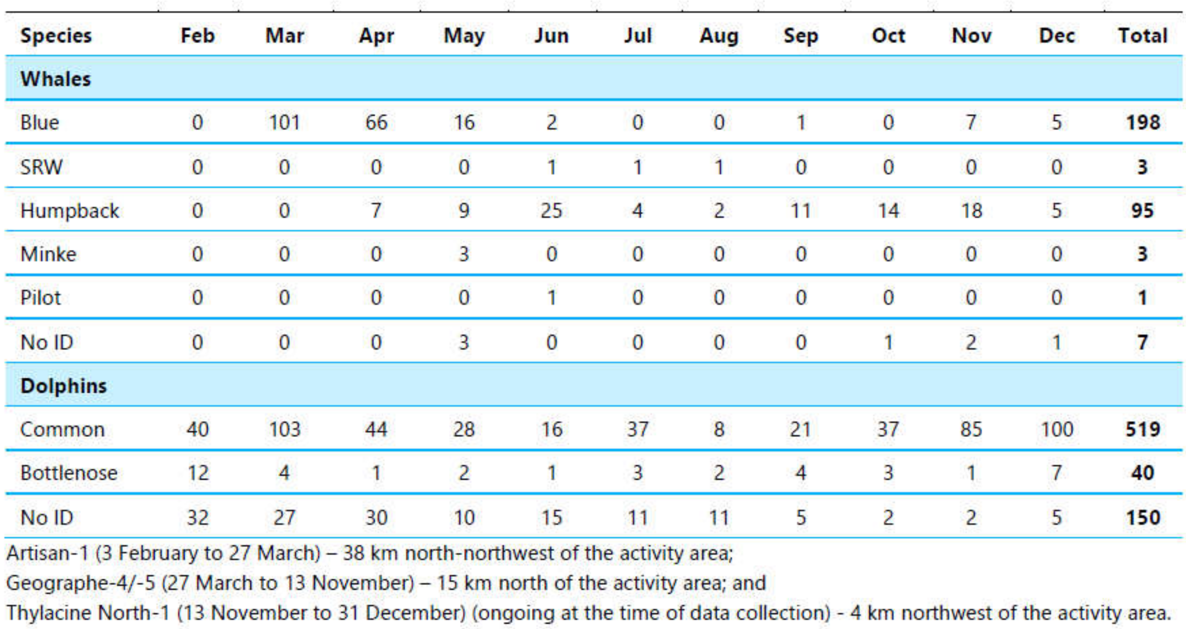
Note: Numbers denote animals sighted per 1,000 km survey distance for each month, pooled for all years (i.e. the 12-month period from Oct–Sep).

Table 4-16: Observed Cetaceans in the Otway Basin

Species	**Jun**	**Jul**	**Aug**	**Sep ***	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Total**
Blue whale	0	0	0	0	0	23	70	17	8	2	120
Southern right whale	2	0	12	13	0	0	0	0	0	0	39*
Humpback whale	3	2	0	1	0	1	0	0	0	0	7
Sperm whale	2	0	0	0	4	0	0	3	1	0	10
Pilot whale	0	0	0	0	0	70	0	0	55	0	125
Dolphins	13	298	0	33	54	620	80	672	1526	21	3317
Southern right whale	0	0	0	0	0	120	0	0	0	0	120

*September values averaged over two surveys on 1 and 11 September 2012. Totals include individuals from both September surveys

Table 4-17: Marine fauna observations at project locations during the Otway drilling project in 2021



Species	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Whales												
Blue	0	101	66	16	2	0	0	1	0	7	5	**198**
SRW	0	0	0	0	1	1	1	0	0	0	0	**3**
Humpback	0	0	7	9	25	4	2	11	14	18	5	**95**
Minke	0	0	0	3	0	0	0	0	0	0	0	**3**
Pilot	0	0	0	0	1	0	0	0	0	0	0	**1**
No ID	0	0	0	3	0	0	0	0	1	2	1	**7**
Dolphins												
Common	40	103	44	28	16	37	8	21	37	85	100	**519**
Bottlenose	12	4	1	2	1	3	2	4	3	1	7	**40**
No ID	32	27	30	10	15	11	11	5	2	2	5	**150**

Artisan-1 (3 February to 27 March) – 38 km north-northwest of the activity area;
Geographe-4/-5 (27 March to 13 November) – 15 km north of the activity area; and
Thylacine North-1 (13 November to 31 December) (ongoing at the time of data collection) - 4 km northwest of the activity area.

Antarctic minke whale

The Antarctic minke whale (*Balaenoptera bonaerensis*) has been found in all Australian states except the Northern Territory and occupies cold temperate to Antarctic offshore and pelagic habitats between 21°S and 65°S (Bannister et al., 1996). In summer the species is found in pelagic waters from 55°S to the Antarctic ice edge. During winter the species retreat to breeding grounds between 10-30°S, occupying oceanic waters exceeding 600 m depth and beyond the continental shelf break (DotEE, 2019e). Mating occurs from June through December, with a peak in August and September and calving occurs during late May and early June in warmer waters north of the Antarctic Convergence (DotEE, 2019e). The species primarily feeds in the Antarctic during summer on Antarctic krill and does not appear to feed much while in the breeding grounds of lower latitudes (DotEE, 2019e).

The Antarctic minke whale has been observed within the region however there are no BIAs in the operational and planning areas. Therefore, it is likely that they would be uncommon visitors in the planning area.

Blue whale

The pygmy blue whale has a foraging (annual high use area) BIA within the operational and planning areas (Figure 4-32).

Data, as detailed in this section, suggests that blue whales are most likely to first appear during December/January and reach peak number during February/March. The likelihood and extent of the interaction is dependent on broad scale environmental factors affecting the abundance and distribution of blue whale feeding resources.

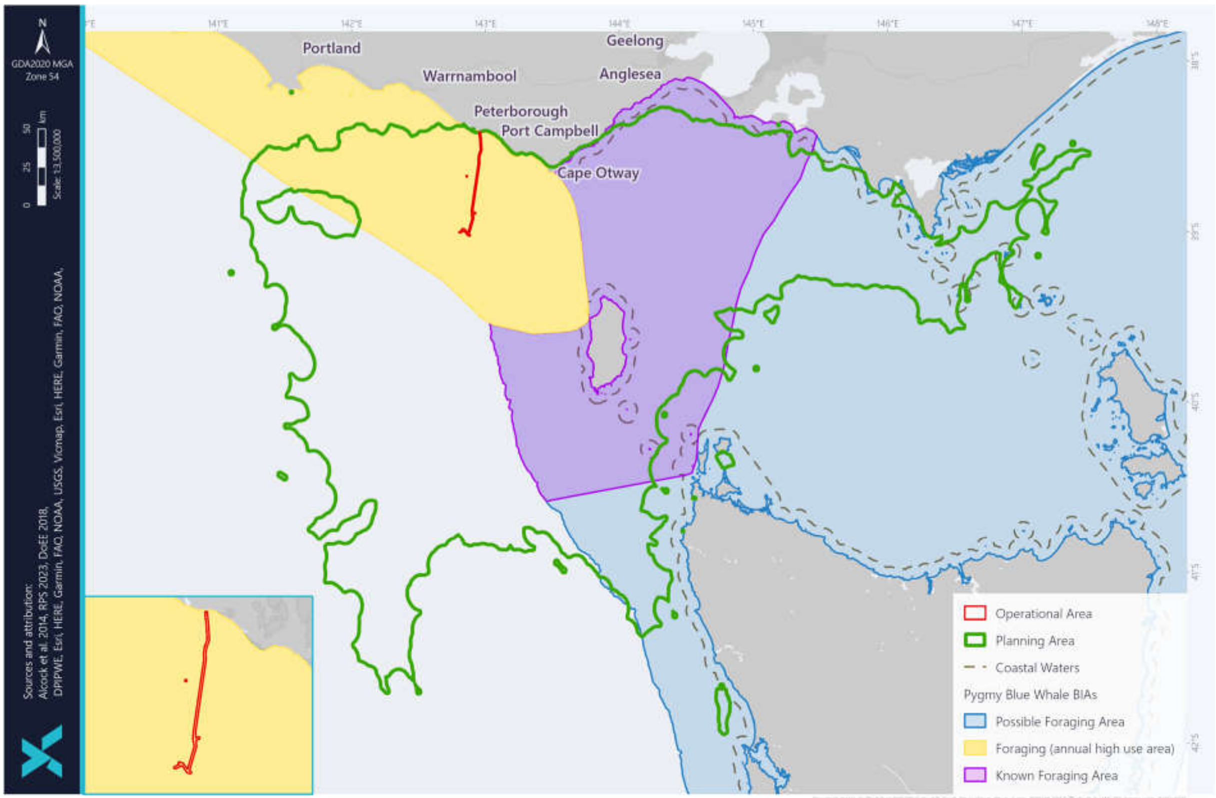


Figure 4-32: Pygmy Blue Whale BIAs within the Operational and Planning Areas

Status

The blue whale (*Balaenoptera musculus*) is listed as an endangered species under the Australian Government EPBC Act (1999) and the IUCN Red List. There are two subspecies of blue whales that use Australian waters (including Australian Antarctic waters), the pygmy blue whale (*B. m. brevicauda*) and the Antarctic blue whale (*B. m. intermedia*). Reference to blue whale unless otherwise specified is generally synonymous to both species. The blue whale has a recovery plan that identifies threats and establishes actions for assisting the recovery of blue whale populations using Australian waters (Commonwealth of Australia, 2015b).

Population

The Antarctic blue whale was extremely abundant until the early 20th century when they were hunted to near extinction. Approximately 341,830 blue whale takes were recorded by commercial whaling in the Antarctic and sub-Antarctic in the 20th century, of which 12,618 were identified as pygmy blue whales (Branch et al., 2004). The current global population of blue whales is uncertain but is plausibly in the range of 10,000 to 25,000, corresponding to about 3-11% of the 1911 estimated population size (Reilly et al., 2008). The Antarctic blue whale subspecies remains severely depleted from historic whaling and its numbers are recovering slowly. The Antarctic blue whale population is growing at an estimated rate of 7.3% per year, but it was hunted to such a low level that it remains at a tiny fraction of pre-whaling numbers (Branch et al., 2004). Recent studies suggest an updated rate of increase in population growth of 12.6 %, consistent with growth rates in waters off the south of Australia (McCauley et al., 2018). The updated abundance estimate uses acoustic chorus squared pressure levels to estimate growth rate off Portland (McCauley et al., 2018). This growth rate considers the number of whales calling assuming the range distribution of whales, source levels, sound propagation and calling behaviour were all similar between years.

Genetic analysis has shown that pygmy blue whales which feed off the Perth Canyon, WA and the Bonney Upwelling, SA and Victoria constitute the same population (Attard et al. 2010, in Commonwealth of Australia, 2015b). Photo identification and genomic studies suggest population exchange between the two feeding grounds of the Bonney coast upwelling and the Perth Canyon (Attard et al. 2018).

Global pygmy blue whale abundance estimates range from 2,000 to 5,000 individuals (Reilly et al. 2018). Abundance estimates based on photo-identification mark-recapture from 1999/2000 to 2004/2005 for blue whales in the Perth Canyon were between 532 and 1,754 individuals, which generally agree with acoustic abundance estimates of 662 to 1,559 calling blue whales migrating south in 2004 past Exmouth in Western Australia and a 1992/1993 season cruise which estimated 671 (95% interval 289–1,557) individuals offshore of southern Western Australia (35–45^0 South, 115–125^0 East) (Commonwealth of Australia, 2015b).

Distribution

The blue whale is a cosmopolitan species, found in all oceans except the Arctic, but absent from some regional seas such as the Mediterranean, Okhotsk and Bering seas. Little is known about mating behaviour or breeding grounds. The pygmy blue whale is mostly found north of 55°S, while Antarctic blue whales are mainly sighted south of 60°S in Antarctic waters. Pygmy blue whales are most abundant in the southern Indian Ocean on the Madagascar plateau, and off South Australia and Western Australia, where they form part of a more or less continuous distribution from Tasmania to Indonesia. The Otway region is an important migratory and foraging area for blue whales, as shown by passive acoustic monitoring and aerial surveys (Gavrilov, 2012; McCauley et al., 2018; Gill et al., 2011).

Underwater acoustic monitoring programs have detected Antarctic and pygmy blue whale calls in the Otway Region. Acoustic detection of Antarctic blue whales indicates that they occur along the entire southern coastline of Australia (McCauley et al., 2018). Pygmy and Antarctic blue whales were acoustically detected by Origin Energy between February and October 2011 in the Otway Basin, east of the Thylacine-A wellhead platform. The presence of Antarctic blue whales in the area is considered rare (Gavrilov, 2012). However, recent acoustic studies have estimated an increase in the abundance of blue whales off Portland, Victoria (McCauley et al., 2018). From 2009-2016 Antarctic blue whale calls were received via deep sound channel propagation south of Portland and the maximum chorus levels occurred from late February to late June with yearly increases in chorus levels (McCauley et al., 2018).

Important foraging grounds for blue whales include the Great Australian Bight, South Australia and off Portland Victoria where blue whales visit between December and June to forage on the inshore shelf break (Figure 4-33). The time and location of the appearance of blue whales in the east generally coincides with the upwelling of cold water in summer and autumn along this coast (the Bonney Upwelling) and the associated aggregations of krill that they feed on (Gill and Morrice, 2003). The Bonney Upwelling generally starts in the eastern part of the Great Australian Bight in November or December and spreads eastwards to the Otway Basin around February as southward migration of the subtropical high-pressure cell creates upwelling favourable winds. Sighting data indicates that blue whales are seasonally distributed (Gill et al. 2011, McCauley et al., 2018.

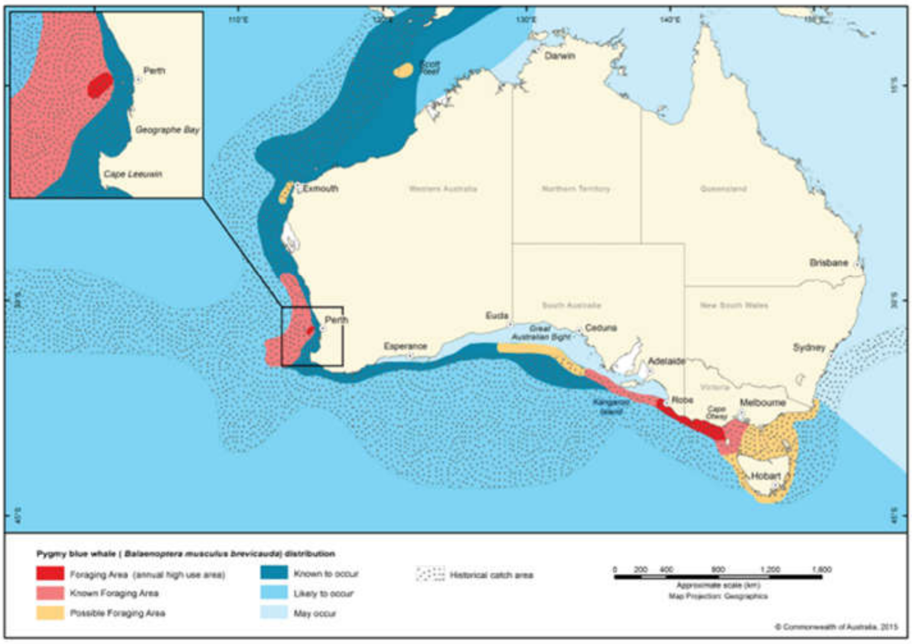
The seasonal distribution and abundance of blue whales are variable across years and influenced by climate variables. The time and location of the appearance of blue whales in the east generally coincides with the upwelling of cold water in summer and autumn along the coast (the Bonney coast upwelling) and the associated aggregations of krill that they feed on (Gill and Morrice, 2003). The Bonney coast upwelling generally starts in the eastern part of the Great Australian Bight in November or December and spreads eastwards to the Otway Basin around February as southward migration of the subtropical high-pressure cell creates upwelling favourable winds.

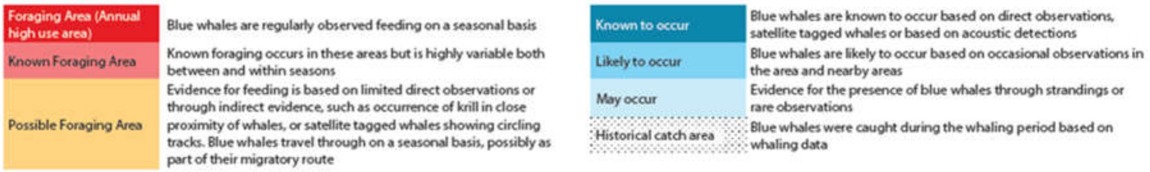
There are two known seasonal feeding aggregations areas in Australia, the Bonney Coast Upwelling KEF and adjacent waters off South Australia and Victoria (Figure 4-39), and the Perth Canyon KEF and adjacent waters in Western Australia. The abundance of pygmy blue whales varies within and between seasons, but they typically forage in the Otway region between January and April. Foraging of pygmy blue whales is known to occur in Bass Strait and the west coast of Tasmania where they have been recorded diving at depth presumably feeding (Commonwealth of Australia. 2015). McCauley et al. (2018) suggests that acoustic detection of pygmy blue whales indicate they predominantly occur west of Bass Strait (Figure 4-40). Acoustic detections of pygmy blue whales off Portland Victoria correlated with upwelling indicators in the Bonney coast upwelling in late summer to autumn (February-April) (McCauley et al., 2018). The two pygmy blue whale call types and the Antarctic blue whale call have been detected in central Bass Strait. One occasion all three types were detected between April and June with more commonly two calls present over this period during other years (Figure 4-40).

Pygmy blue whales have three migratory stages around Australia; the “southbound migration stage” where predominantly between October to December (sometimes into January) whales travel from Indonesian waters down to the WA coast, the “southern Australian stage” where between January and June whales spread across the southern Australian waters, and the “northbound migration stage” where whales travel back up to Indonesia between April and August. The “southern stage” involves animals searching for prey. The Bonney coast upwelling is a strong predicator of pygmy blue whale presence at Portland where whale presence in the area is linked to prey availability (McCauley et al., 2018). Passive acoustic monitoring in southern Australia during 2000-2017 focused on the distribution and population parameters of both subspecies of blue whales in southern and western Australia. In Portland sea noise data was available from 2009 to early 2017. In 2009 and 2011 pygmy blue whales arrived in November or December whereas in the other years, calls were not detected until January or February. There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year. Acoustic loggers located east of the Thylacine platform from February to October 2011 detected pygmy blue whales between February and early June, with the greatest abundance from March to mid-May.

It is difficult to predict numbers within a season but when correlated across seasons the strength and persistence of the Bonney coast upwelling, given by time integrated water temperature, significantly correlates with time integrated number of individual whales calling from the same site. The upwelling index explains 83% of the variability in blue whale calling presence across seasons when using seasonal whale counts (not corrected for population growth). When a growth rate of 4.3% is applied a correlation of 90% of the variance in seasonal occurrence is predicted by the upwelling index. The number of pygmy blue whale calling in Portland could be expected in increase yearly with whale population growth (McCauley et al., 2018).

Photo identification, genetics and telemetry studies provide information on whale movements and connectivity. Photo identification and genomic studies suggest population exchange between the two feeding grounds of the Bonney coast upwelling and the Perth Canyon (Attard et al., 2018). A pygmy blue whale was tagged in 2014 north of the Perth Canyon and travelled a total distance of 506.3 km in 7.6 days, indicating the vast distances that the large marine mammals can travel in a short amount of time (Owen et al., 2016). While migrating the whale made dives at depths just below the surface which likely reduces energy expenditure but also increases the risk of ship strike greatly for longer periods than previously thought.





Foraging Area (Annual high use area)	Blue whales are regularly observed feeding on a seasonal basis	Known to occur	Blue whales are known to occur based on direct observations, satellite tagged whales or based on acoustic detections
Known Foraging Area	Known foraging occurs in these areas but is highly variable both between and within seasons	Likely to occur	Blue whales are likely to occur based on occasional observations in the area and nearby areas
Possible Foraging Area	Evidence for feeding is based on limited direct observations or through indirect evidence, such as occurrence of krill in close proximity of whales, or satellite tagged whales showing circling tracks. Blue whales travel through on a seasonal basis, possibly as part of their migratory route	May occur	Evidence for the presence of blue whales through strandings or rare observations
		Historical catch area	Blue whales were caught during the whaling period based on whaling data

Figure 4-33: Pygmy Blue Whale Foraging Areas around Australia (Commonwealth of Australia, 2015b)

Foraging

There are two known seasonal feeding aggregations areas in Australia, the Bonney Coast Upwelling KEF and adjacent waters off South Australia and Victoria and the Perth Canyon KEF and adjacent waters in Western Australia (Figure 4-33). Foraging of pygmy blue whales is known to occur in Bass Strait and the west coast of Tasmania where they have been recorded diving at depth presumably feeding (DoE, 2015d). Blue whales are known as 'constant foragers'; their ecology in feeding grounds consists of constantly searching for patchily distributed krill resources, preferably those that reward the effort involved in consuming them (Torres et al., 2020). They are physically well-adapted for rapid movement between widely separated foraging areas (Woodward et al., 2006), but when they enter areas where krill may occur, they carry out zig-zagging 'area-restricted searches' (ARS) patterns until either they find prey, or exhaust local possibilities, and move on to another possible foraging ground based on past experience (Abrahms et al., 2019). Based on this it is assumed that once the blues have finished feeding, they will move from the feeding area to commence searching for another area.

Diving behaviour of blue whales associated with feeding at depth was observed by Gill & Morris (2003) in the Otway region, who note that blue whales dived steeply, submerging for 1 – 4 minutes, then returned to the surface. Tagging of a pygmy blue whale at the Perth Canyon identified 1677 dives over the tag duration (7.6 days) (Owen et al., 2016). The duration of dives was:

- Feeding - mean of 7.6 minutes, maximum of 17.5 minutes.
- Migratory – mean of 5.2 minutes, maximum of 26.7 minutes.
- Exploratory – mean of 8.6 minutes, maximum of 22.05 minutes.

Tagging of 13 pygmy blue whales (five of which had tags that monitored dive depth and duration) in the Bonney upwelling identified (Möller et al., 2015):

- Whales predominantly carried out area-restricted search (presumably foraging) with generally shallow and short dives. However, dives were generally deeper at night compared to during the day.
- Whales performed mostly square shaped dives that were shallow in depth and short in duration.
- Dives recorded to a maximum of 492 m (mean = 59.5 m ± 94.3), and for a maximum duration of 112 minutes (mean = 6.1 minutes ± 5.2).

Although the maximum recorded dive time was 112 minutes, the mean dive time of 6.1 minutes ± 5.2 provides confidence that the typical dive time is less than 30 minutes (Möller et al., 2015). Tagging of eight blue whales off California (Irvine et al., 2019) identified that dive durations were as long as 30.7 minutes, and no feeding lunges were recorded during dives >20 minutes in duration.

Surveys

Several aerial and noise studies of blue whales within the Otway Basin have been conducted and are summarised below.

<u>Aerial Surveys (2001-02 to 2006-07)</u>

Gill et al. (2011) undertook 69 seasonal aerial surveys for blue whales between Cape Jaffa and Cape Otway over six seasons (2001-02 to 2006-07). This study found that the general pattern of seasonal movement of blue whales is from west to east, with whales foraging in between the Great Australian Bight and Cape Nelson in November and spreading further east in December. Whales are typically widely distributed throughout Otway shelf waters from January through to April (Gill et al., 2011) (Figure 4-35 and Figure 4-36).

Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month is shown in Figure 4-34 with sighting and effort data presented geographically in Figure 4-35 and Figure 4-36. Data is pooled for all seasons, for central and eastern areas, overlaid on gridded aerial survey effort (10 km x 10 km squares), represented as minutes flown per grid square (key, upper right). Thick solid lines represent 50% and 95% probability contours for blue whale distribution from density kernel analysis. Dashed lines are central and eastern boundaries (Gill et al., 2011). The planning area is within the central and eastern areas and the operational area on the outer edge of the eastern area.

There had been fewer than 50 sightings of blue whales in Bass Strait up to the year 1999, but since that time feeding blue whales have been more regularly observed in the Discovery Bay area and more generally along the Bonney coast from Robe to Cape Otway. Gill et al., (2011) found that across the eastern zone (Cape Nelson to Cape Otway), there were no blue whale sightings in November (2001-2007) despite significant effort (Figure 4-35).

Based on the pooled aerial survey data (2001-2007), encounter rates increased from 1.6 whales per 1,000 km in December, to 9.8 whales per 1,000 km in February, decreased slightly to 8.8 whales per 1,000 km in March, then declined sharply to a single sighting for May (0.4 whales per 1,000 km) (Gill et al., 2011). A mean blue whale group size of 1.3±0.6 was observed per sighting with cow-calf pairs observed in 2.5% of the sightings. Gill et al. (2011) also identified that 80% of blue whale sightings are encountered in water depths between 50 and 150 m; 93% of sightings occurred in water depths <200 m and 10% of sightings occurred within 5 km of the 200 m isobath in the eastern and central zones.

The data from Gill et al. (2011) shows:

- Blue whales are typically widely distributed throughout central and eastern areas shelf waters from January through to April.
- Blue whale numbers are significantly lower in November, December and January in the eastern area compared to the central area.
- No blue whales were sighted in the eastern area during November for any season despite significant effort. Pooled monthly encounter rates increased from 1.6 whales 1,000 km–1 in December, 5 whales 1,000 km–1 in January, peaked at 9.8 whales 1,000 km–1 in February, dropped slightly to 8.8 whales 1,000 km–1 in March, then declined sharply to a single sighting for May (0.4 whales 1,000 km–1).
- Encounter rates in central and eastern zones peaked in February, coinciding with peak upwelling intensity and primary productivity.

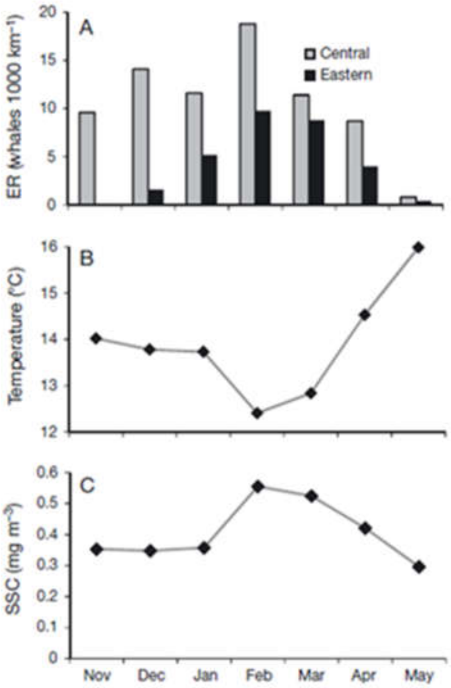


Figure 4-34: Blue Whale Encounter Rates in the Central and Eastern Study (Cape Nelson to Cape Otway) Area by Month (Gill et al., 2011)

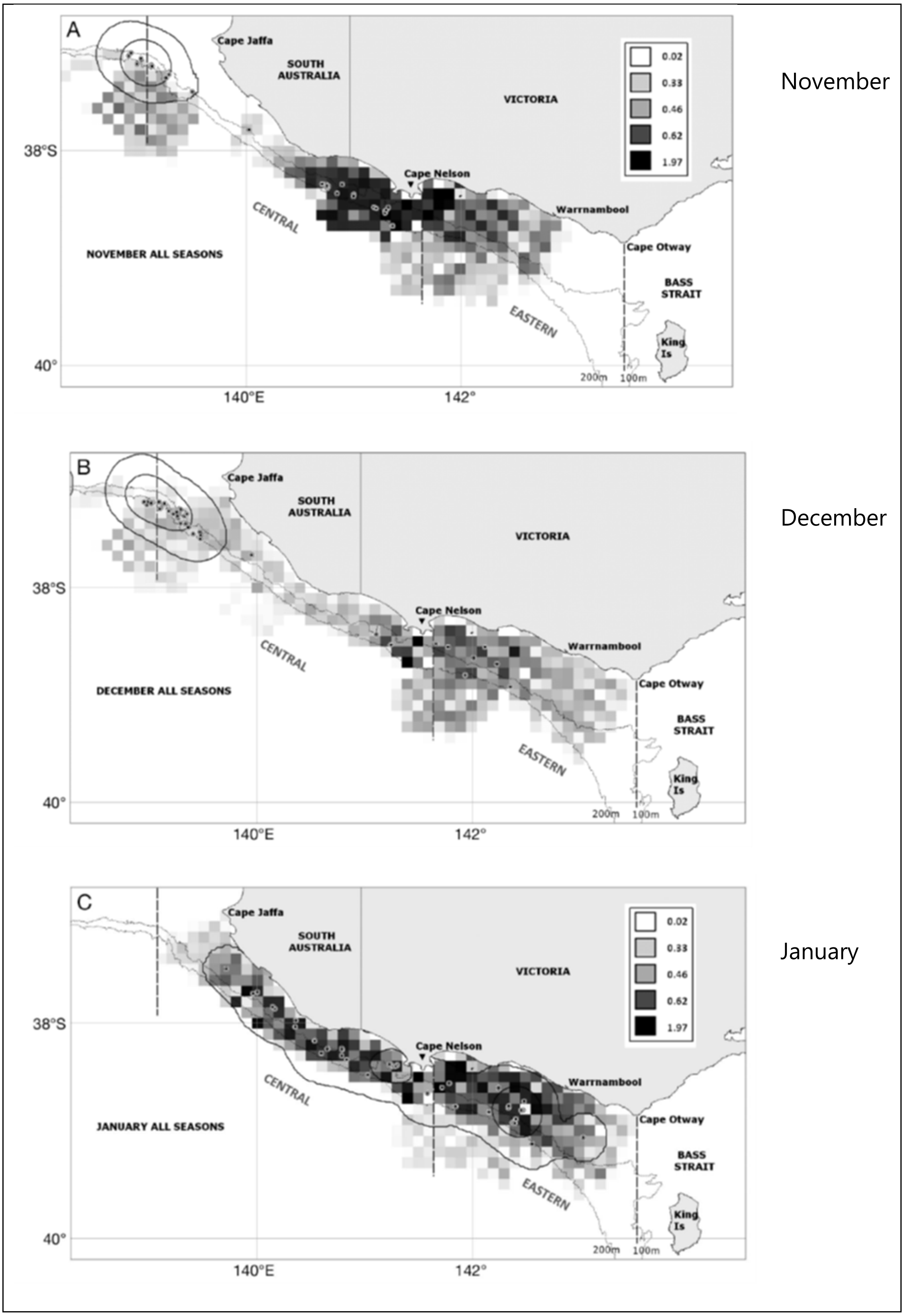


Figure 4-35: Blue Whale Sightings in the Otway Basin (Nov, Dec, Jan) (Gill et al., 2011)

Note: Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square (key, upper right corner of the November and January figures).

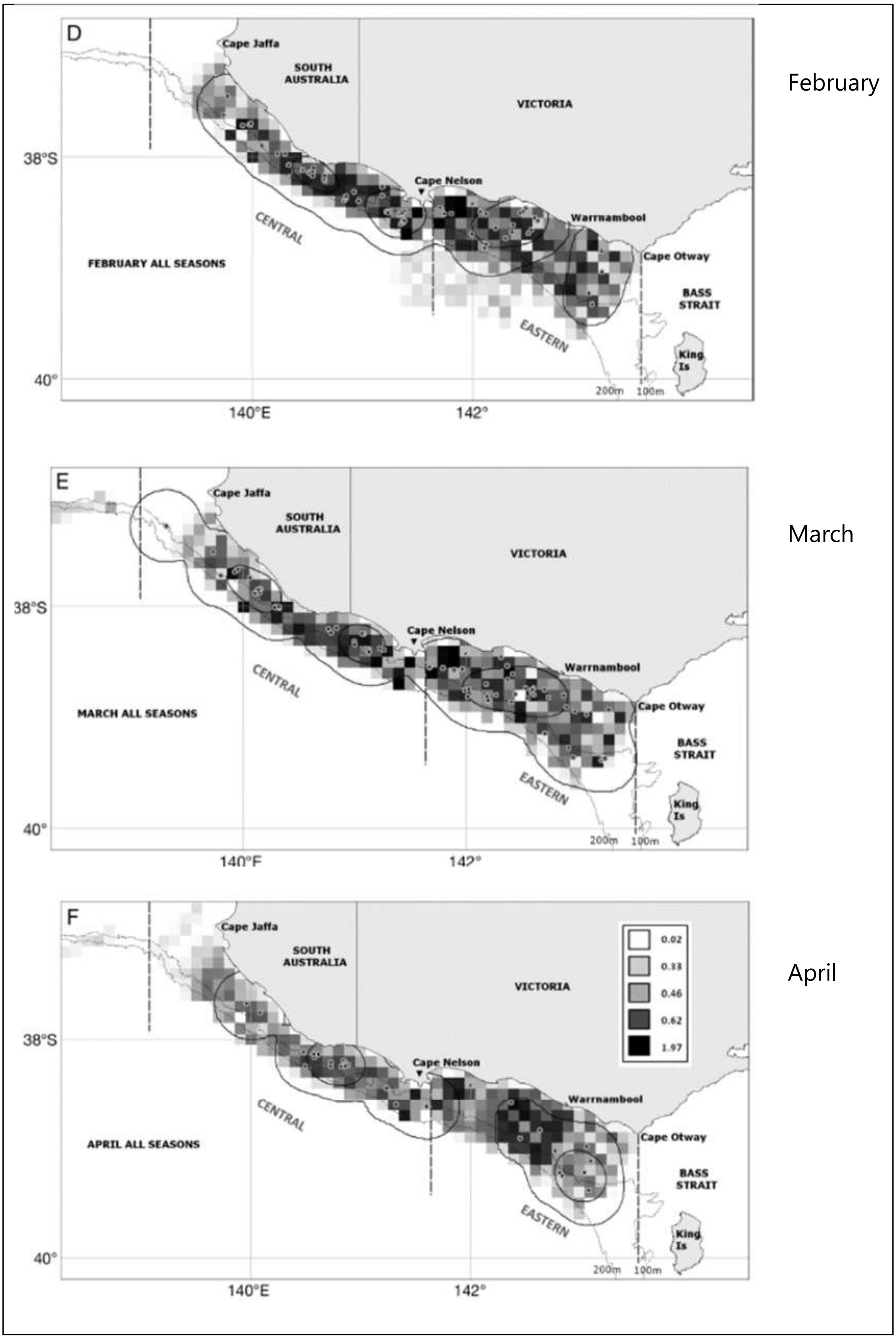


Figure 4-36: Blue Whale Sightings in the Otway Basin (Feb, Mar, Apr) (Gill et al., 2011)

Note: Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square (key, upper right corner of the April figure).

Origin Energy Surveys (2010-2014)

There were no confirmed sightings of blue whales during Origin's Speculant 3D Transition Zone marine seismic survey in November and December 2010, the Astrolabe 3D seismic survey undertaken in early November 2013 (RPS, 2014) or during the Enterprise 3D seismic survey undertaken in late October and early November 2014 (RPS, 2014).

From February to October 2011 Origin located an array of marine loggers east of the Thylacine platform to document nearby ambient marine noise, detect cetaceans and measure acoustics associated with the Origin 3D Bellerive Marine Seismic Survey. Pygmy and Antarctic blue whales were acoustically detected in the monitored area. Pygmy blue whales were observed from early February to early June being abundant from March to mid-May. Rare calls from Antarctic blue whales were observed in June.

Aerial surveys were commissioned by Origin and undertaken during 2011 and 2012 by the Blue Whale Study. During five aerial surveys between 8 and 25 February 2011, 56 blue whales were sighted. Most of the sightings were at inshore areas between Moonlight Head to Port Fairy with whales apparently aggregating along and offshore of the boundary between the runoff plume from major flooding prevalent at the time and adjacent seawater. Figure 4-37 shows sightings from 14 February 2011 (Gill 2020).

The 2012 aerial surveys found that blue whales were common in the eastern upwelling zone during November and December 2012 (Figure 4-37 and Figure 4-38). In November, an estimated 21 individual blue whales were sighted, with most sightings near the 100 m isobath or deeper. December 2012 surveys identified 70 blue whales foraging along the edge of the continental shelf west of King Island. This was the largest recorded aggregation of blue whales during any aerial surveys of the Bonney coast upwelling since 1999 (Gill 2020).

The large numbers of whales found in this area during November and December indicated high productivity, although the krill was too deep to be seen from the air. Subsequent surveys in the same area for Origin Energy in early 2013 resulted in 17 blue whales sighted in January, eight in February, and two (a cow and calf) in March 2013, despite the extremely warm surface conditions. The high productivity of this area seen in November-December 2012 evidently tailed off during the next few months (Gill 2020)

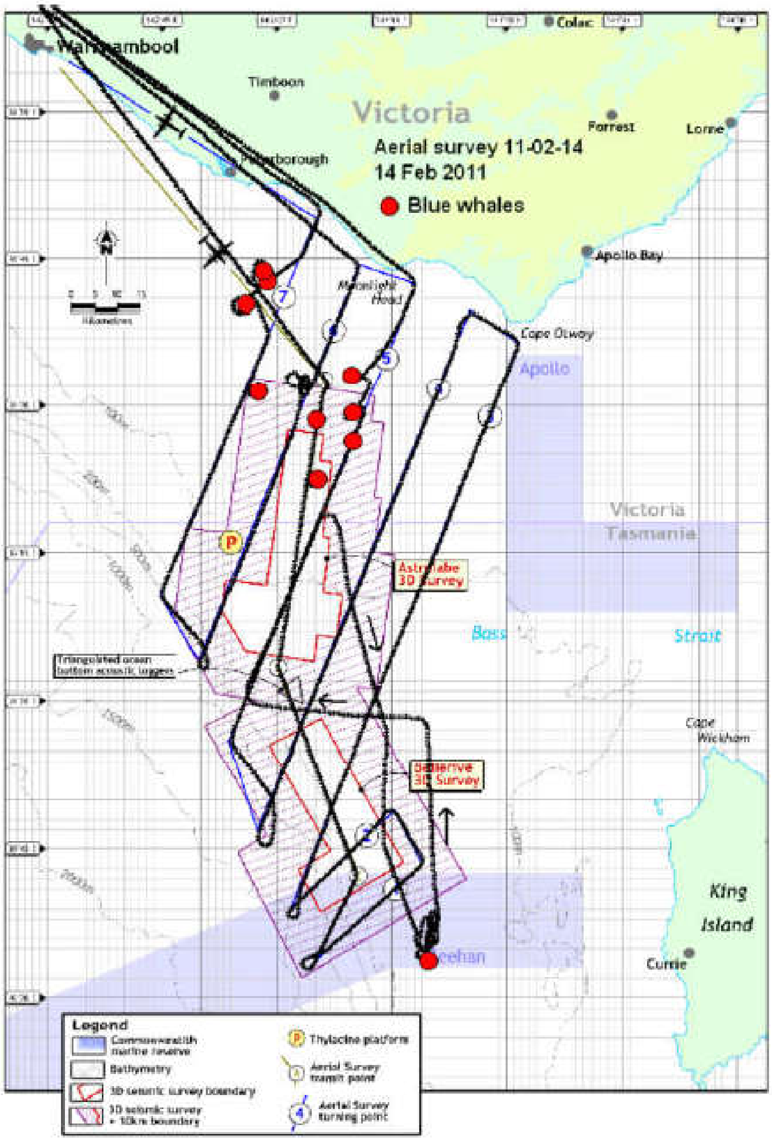


Figure 4-37: Blue Whale Sightings during an Aerial Survey for Origin Energy in February 2011 (Gill 2020)

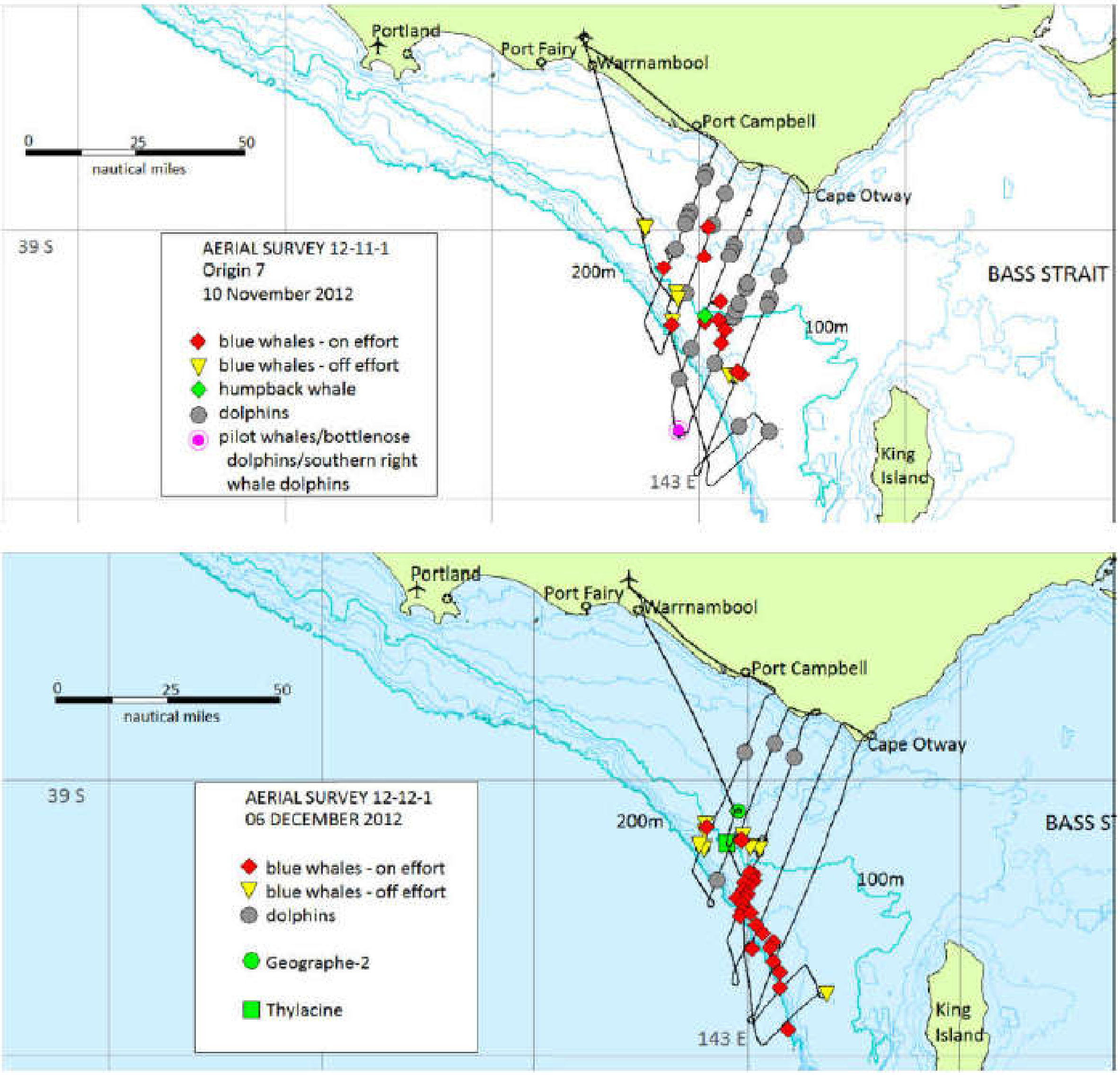


Figure 4-38: Blue Whale Sightings during an Serial Survey for Origin Energy in November and December 2012 (Gill 2020)

<u>Tagging Study (2015-2016)</u>

Möller et al. 2020 analysis data from the tags of 13 pygmy blue whales who were tagged in the Bonney upwelling region in January 2015 with tags transmitting up to March 2016. In summary:

- Whale movements in the Great Southern Australian Coastal Upwelling System (GSACUS) ranged mostly from eastern South Australia, over the continental shelf south of Kangaroo Island, to between mainland Australia and Tasmania), with a few whales performing some movements to the continental slope and the deep-sea (Figure 4-39).
- In the GSACUS, most tagged whales remained over the continental shelf, utilising this region from at least January to July. This was the area of highest occupancy by the whales, with one whale returning to the Bonney Upwelling in January the year after and remaining there for at least three

months. This timing coincides with the upwelling season, which generally occurs from November to March each year.

- A low probability of area restricted search (ARS) behaviour (i.e. high probability of transiting behaviour) was mainly observed between April and June, and then between November and December, suggesting that the pygmy blue whales were mainly migrating during those times.
- Seascape correlates of ARS behaviour for these whales suggested the importance of sea surface temperature, sea surface height anomaly, wind speed and chlorophyll a concentration as proxies of upwelling productivity and presence of krill patches.

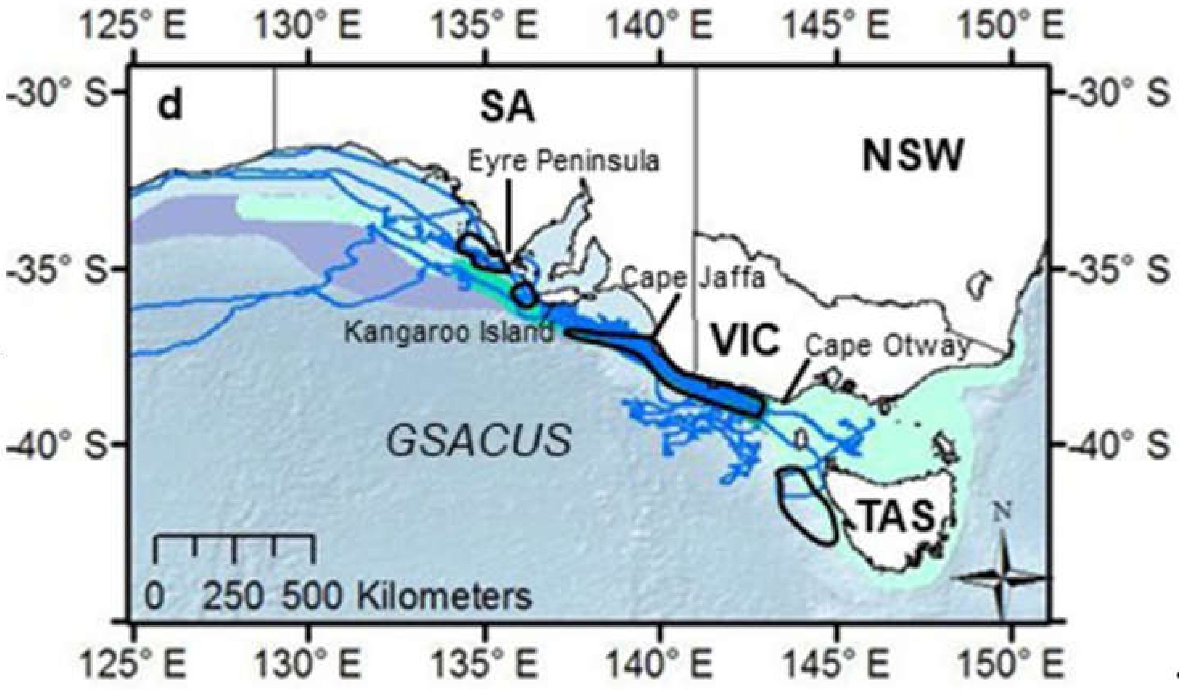


Figure 4-39: Tracks of 13 Pygmy Blue Whales in the GSACUS (Möller et al. 2020)

<u>Passive Acoustic Recorders (2009-2017)</u>

Between 2009 and 2016 the Integrated Marine Observing System (IMOS) has been recording underwater sound south of Portland, Victoria. McCauley et al. (2018) analysed the data from to look at blue whale presence, distribution, and population parameters.

McCauley et al. (2018) analysed data from passive acoustic recorders that were located around Australia to look at blue whale presence, distribution and population parameters. The primary sites comprised central Bass Strait, western Tasmania, the southeast Australian coast and the Great Australian Bight area. Each study area had multiple receivers and may have had several sites sampled within the area. Temporal sampling focussed on the southern Australian site south west of Portland, Victoria. Data was used from 2004 to 2016. The study concluded:

- Antarctic blue whale calls were received via deep sound channel propagation south of Portland and the maximum chorus levels occurred from late February to late June with yearly increases in chorus levels (McCauley et al., 2018). McCauley et al. (2018) suggests that acoustic detection of Antarctic blue whales indicate they predominantly occur along the entire southern coastline.

- Pygmy blue whales have three migratory stages around Australia; the "southbound migration stage" were predominantly between October to December (sometimes into January) whales travel from Indonesian waters down to the WA coast, the "southern Australian stage" where between January and June whales spread across the southern Australian waters, and the "northbound migration stage" where whales travel back up to Indonesia between April and August.

- The "southern stage" involves animals searching for feeding sites, feeding and then marking their way north towards June.

- Along the southern Australian coastline pygmy blue whales are most frequently detected towards the east along the Bonney coast over late February to early June, utilising secondary productivity produced by a seasonal upwelling event.

- Within a season it is difficult to predict whale numbers and their specific locations, but when correlated across seasons the strength and persistence of this upwelling event as given by time integrated water temperature south of Portland, significantly correlates with time integrated number of individual whales calling from the same site.

- The Bonney coast upwelling is a strong predicator of pygmy blue whale presence at Portland where whale presence in the area is linked to prey availability

- Sea noise data was available from the Portland site from 2009 to early 2017 detailed:

  - In 2009 and 2011 pygmy blue whales arrived in November or December whereas in the other years, calls were not detected until January or February (Figure 4-40). There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year.

  - There was considerable variability in whale persistence and presence within a season (Figure 4-40) with no consistent trend other than a peak in presence somewhere over February to June.

- It is difficult to predict numbers within a season but when correlated across seasons the strength and persistence of the Bonney coast upwelling, given by time integrated water temperature, significantly correlates with time integrated number of individual whales calling from the same site. The upwelling index explains 83% of the variability in blue whale calling presence across seasons when using seasonal whale counts (not corrected for population growth). When a growth rate of 4.3% is applied a correlation of 90% of the variance in seasonal occurrence is predicted by the upwelling index.

- The number of pygmy blue whale calling in Portland could be expected in increase yearly with whale population growth.

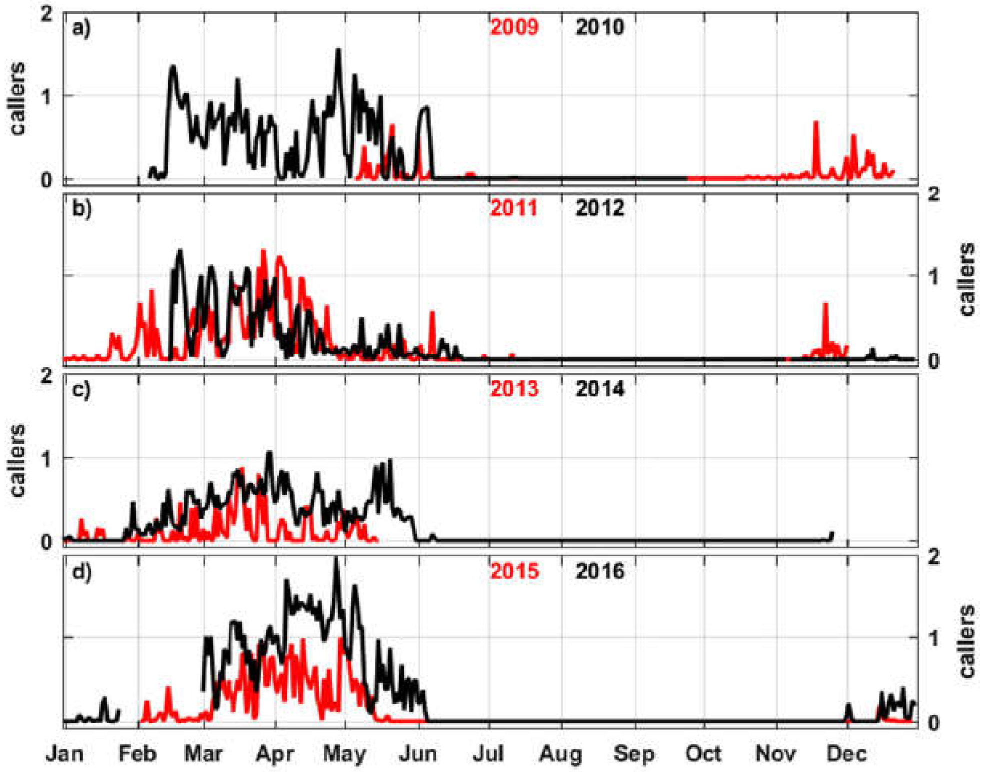


Figure 4-40: Mean Number of Individual Pygmy Blue Whales Calling (McCauley et al. 2018)

Beach Surveys (2019-2022)

During the Beach Otway Development Seabed Survey (November 2019 to January 2020) there were four sightings of blue whales within 3.5 km of the Thylacine Platform in November 2019 and one sighting in January 2020 about 1 km from the Artisan well location. The whales were identified as swimming.

As detailed in Section 4.3.5, JASCO completed a monitoring study for Beach in relation to exploration drilling activities at the Artisan-1 well from the 1 Feb to 6 April 2021 (McPherson et al., 2021). Songs of pygmy blue whales were detected sporadically through February and the first half of March. By the end of March, the signals were present in almost every hour of recording. This pattern of occurrence was reflected across all recording stations. The data were too sparse to confirm anything about animal movements.

Beach commenced its Otway drilling program in February 2021 in the Otway Development Area, including:

- Exploration drilling at the Artisan-1 location (2 February 2021 – 27 March 2021).
- Development drilling, well abandonment, subsea installation, and commissioning activities in the Geographe field (27 March 2021 – 13 November 2021).
- Development drilling of the Thylacine North-1 well (16 November 2021 – 11 January 2022).
- Development drilling of the Thylacine West wells (23 January 2022 – 30 April 2022).

Drilling was undertaken by a mobile offshore drilling unit (MODU), the *Ocean Onyx*. The Blue Whale Study was engaged to undertaken aerial surveys from February to May 2021 to identify blue whale and krill surface swarms within the Otway Development Area and outside of this area. A preliminary data summary provided to Beach detailed:

- Nine aerial surveys were undertaken from 25 February to 21 May 2021.
- There were 34 blue whale sightings consisting of 43 individuals.
- The highest number of blue whale sightings was on 7 April with 19 blue whales sighted.
- The first blue whale was sighted 25 February and final blue whale sighted 7 April.
- Blue whales and krill surface swarms were distributed throughout the area surveyed.

Throughout the drilling campaign marine fauna observers (MFOs) were employed (January 2021 to April 2022). to ensure activities complied with Beach's Whale Management Standard Operating Procedure (WMSOP) (Document No.: S4000AF726092). The data collected includes the numbers of blue whales observed at varying distances from the MODU, based on the WMSOP management zones, during different drilling activities, along with information on whether the whale was observed to be approaching the MODU or moving away from it. They also collect additional data whilst in transit, or at distances outside of the zones specified in the WMSOP. Observations are based on distances of:

- 0 – 500 m
- 501 – 1,500 m
- 1,501 – 2,000 m
- 2,001 – 3,000 m
- 3,000 m

The total number of blue whales sighted by the aerial surveys and by MFOs was 324 individuals (Figure 4-41), with a peak of 102 whales in March 2021 (note that the period February-May 2021 includes aerial survey data). Over this period, whales were observed in most months apart from July, August, and October.

Figure 4-42 shows all whale sightings by MFOs between 2 February 2021 and 31 March 2022 across all well locations. Note that many observations were made whilst in transit.

The Lead MFO provided summary data collected under the WMSOP for the period between 2 February 2021 and 31 March 2022. This was reviewed and a brief analysis undertaken.

During this period, 127 blue whales were observed within 3 km of the MODU (Table 4-18). Thirty-two whales were first detected within 1,500 m of the MODU. Sixty-two were first detected at 1,501 to 3,000 m. Thirty-three were first observed to be further than 3 km from the MODU before moving towards it. The total number of blue whales observed to move towards the MODU (following first detection) was 70 (55%); 57 were observed to move away from the MODU (45%).

Of the 94 whales first detected within 3,000 m of the MODU, 32 were observed within 1,500 m and 62 observed between 1,501 and 3,000 m. The number of blue whales/km^2 observed was 2.7x higher in the 0-1,500 m zone (7.8 whales/km^2) than in the 1,501 to 3,000 m zone (2.9 whales/km^2) (Table 4-18).

It would be expected that the number of blue whales/km^2 would be the same in all zones if underwater noise was not displacing blue whales from the area. Alternatively, if whales are being displaced then it would be expected that the number of blue whales/km^2 would increase with increasing distance from the MODU. The apparent increased density of whales within 1,500 m of the MODU in Table 4-18 can be explained by the fact that it is harder to detect whales at greater distances (i.e., the probability of detection is inversely related to distance). To correct for this a detection function is needed. The data collection methods employed by the MFOs were not designed to enable detection functions to be generated so surrogate detection functions were applied.

Williams et al. (2016) collected 3,262 vessel-based observations from 2008 to 2015 of humpback whales in and near Glacier Bay National Park, Alaska, which is a site of a regionally important feeding aggregation of humpback whales. They analysed this data (85% truncated at 4,565 m) to generate detection functions to understand the probability of whale detection and how it varies with distance under different environmental and biological characteristics. Figure 4-43 shows the detection function for all data; Figure 4-44 shows the detection functions under different visibility conditions; Figure 4-45 shows the detection functions for different group sizes. Shaded areas show 95% confidence intervals. Arrows identify detection probability at 1,000 m reference distance.

Detection probability of surfacing whales decreased markedly with increasing distance from the ship. They found visibility and group size to be the most important variables influencing detection. The worst visibility conditions reduced detection probability to near 0 at 1000 m. Compared to detecting a single whale, a group of 2 or 3 whales almost doubled detection probability at 1000 m. Surface active behaviour increased detection compared to spouting while showing no flukes. In southeastern Alaska, single whales that spouted during excellent visibility conditions were most commonly encountered and had a detection probability of 0.569 at 1000 m (Williams et al. 2016).

The Lead MFO for the Otway drilling program advised that they were only able to detect whales further than 3 km on 25% of occasions. The detection function from Williams et al. (2016) which best matches the MFOs advice was the curve showing '4+ group size' in Figure 4-45. Detection probabilities for this case, along with those for 'excellent visibility' conditions (Figure 4-44) and 'all' data (Figure 4-43) were extracted to provide probabilities in 500 m increments (Table 4-19). To allow these probabilities to be applied to the management zones shown in Table 4-18, the average probability for each management zone was calculated and expected numbers and densities calculated for the three scenarios (Table 4-20).

The total expected number of blue whales is 158.6 for the '4+ group size' scenario, 437.9 for the 'excellent visibility' scenario and 530.7 for the 'all data' scenario. The total observed blue whales was 127.

The expected densities for each management zone for the three scenarios are shown in Figure 4-46. The data shows that for the '4+ group size' there is no significant difference in expected blue whale densities between any of the four management zones, with highest expected densities in the 0 – 500 m zone. The 'excellent visibility' and 'all data' scenarios show significant expected differences between the 0 to 1,500 m and 1,501 to 3, 000 m management zones, however no significant differences between the 0 – 500 and 501 – 1,500 m zones.

All the scenarios presented show similar expected densities for the 0 to 1,500 m zone. All three scenarios show that there is no increase in expected densities between the 0 – 500 and 501 – 1,500 m zones which implies that blue whales are not being displaced within 1,500 m. The '4+ group size' scenario (which most closely matches the Lead MFOs advice) implies that there is no displacement of blue whales within 3,000 m.

The '4+ group size' scenario has a mean expected density of 6.21 blue whales/km^2 across all zones, which (if correct) should apply to the wider area beyond observations. If whales are being displaced beyond 1,500 m as implied by the 'excellent visibility' and 'all data' scenarios, then the minimum mean expected densities for the wider area should be calculated using the observations between 1,501 and 3,000 m. These expected minimum mean densities are 18.70 blue whales/km^2 and 22.91 blue whales/km^2 for the 'excellent visibility' and 'all data' scenarios, respectively.

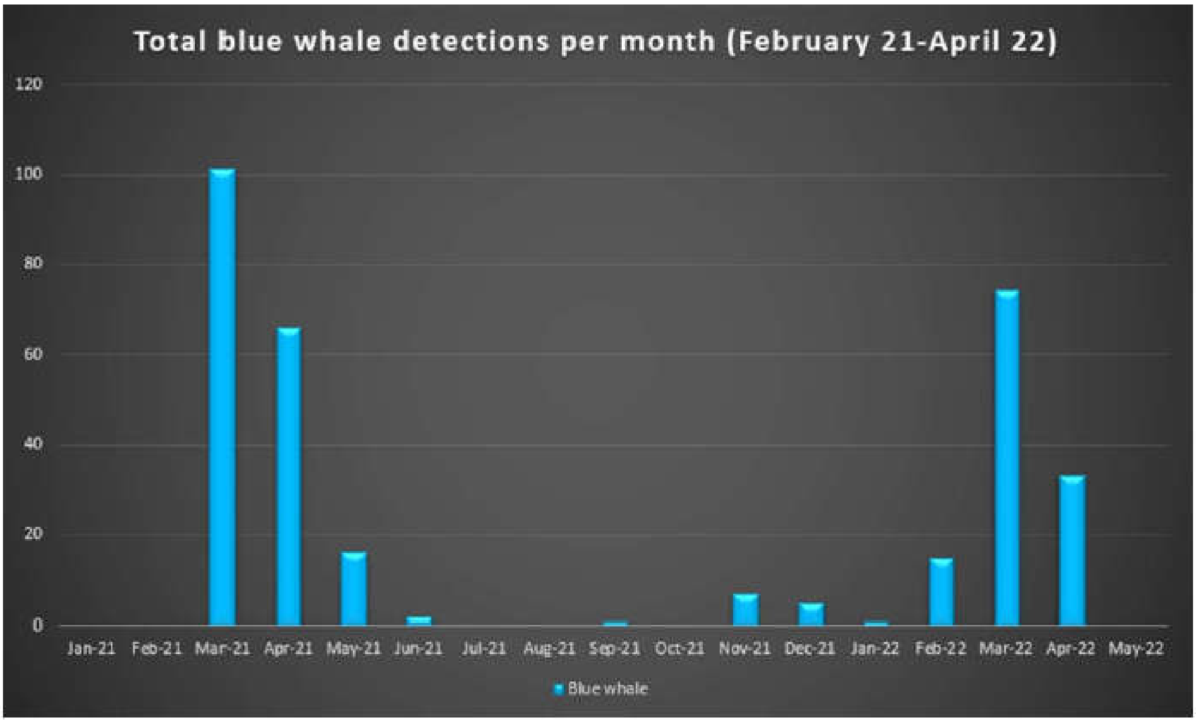
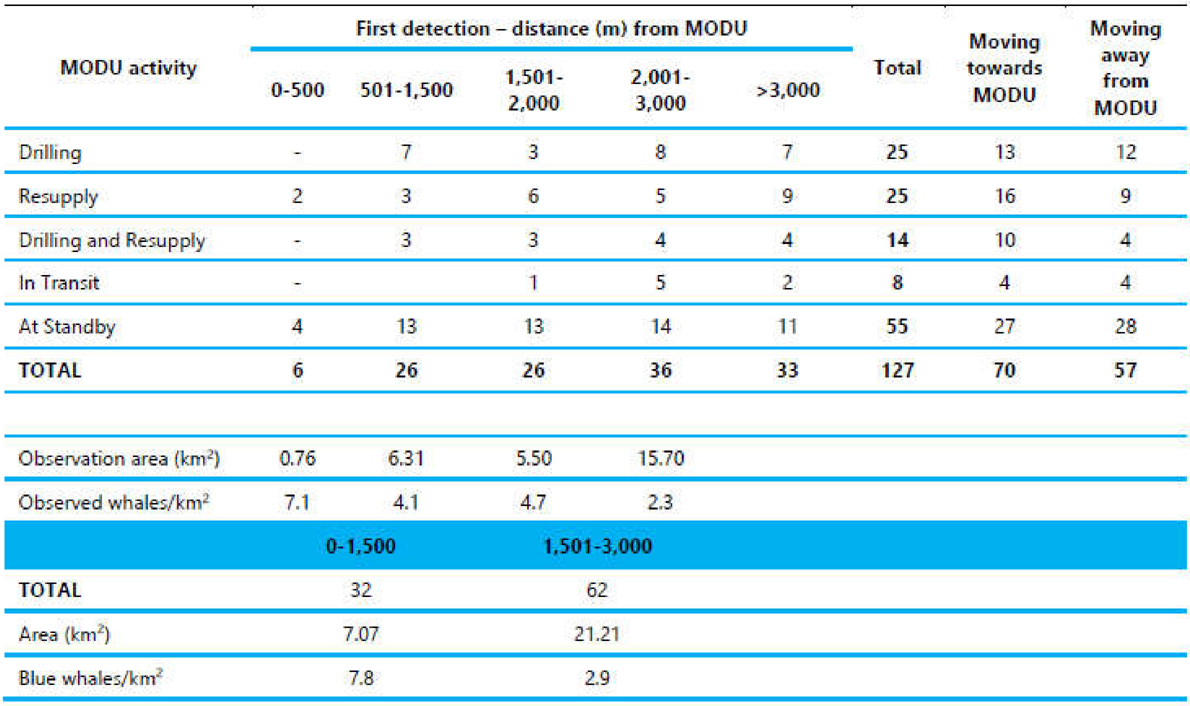


Figure 4-41: Blue Whale Sightings for the Otway Drilling Campaign

Table 4-18: Blue Whale Observations within 3,000 m of the MODU (2 February 2021 and 31 March 2022)



MODU activity	First detection – distance (m) from MODU					Total	Moving towards MODU	Moving away from MODU
	0-500	501-1,500	1,501-2,000	2,001-3,000	>3,000			
Drilling	-	7	3	8	7	**25**	13	12
Resupply	2	3	6	5	9	**25**	16	9
Drilling and Resupply	-	3	3	4	4	**14**	10	4
In Transit	-		1	5	2	**8**	4	4
At Standby	4	13	13	14	11	**55**	27	28
TOTAL	**6**	**26**	**26**	**36**	**33**	**127**	**70**	**57**
Observation area (km²)	0.76	6.31	5.50	15.70				
Observed whales/km²	7.1	4.1	4.7	2.3				
	0-1,500		**1,501-3,000**					
TOTAL	32		62					
Area (km²)	7.07		21.21					
Blue whales/km²	7.8		2.9					

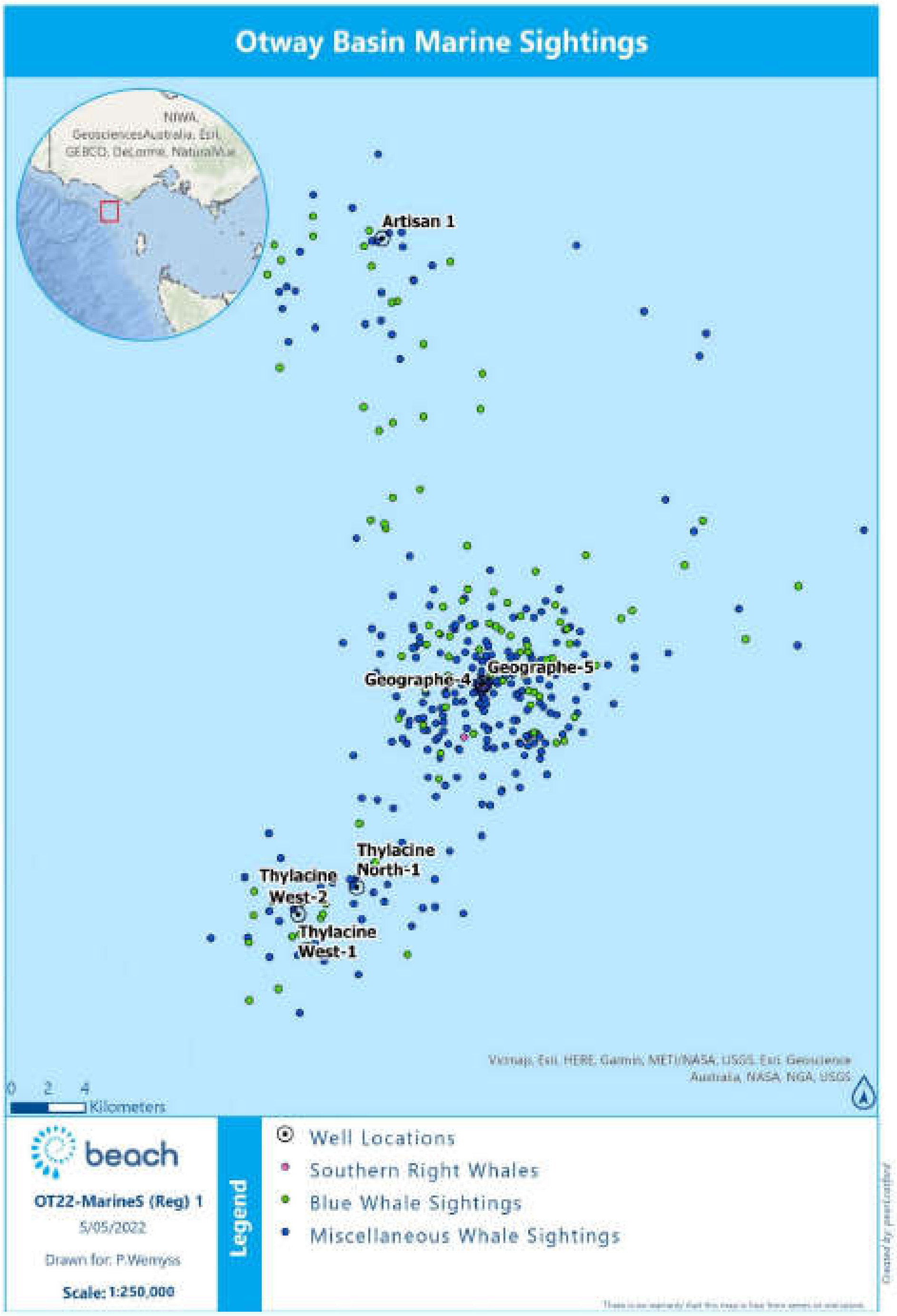


Figure 4-42: Whale Sightings between 2 February 21 – 31 March 2022

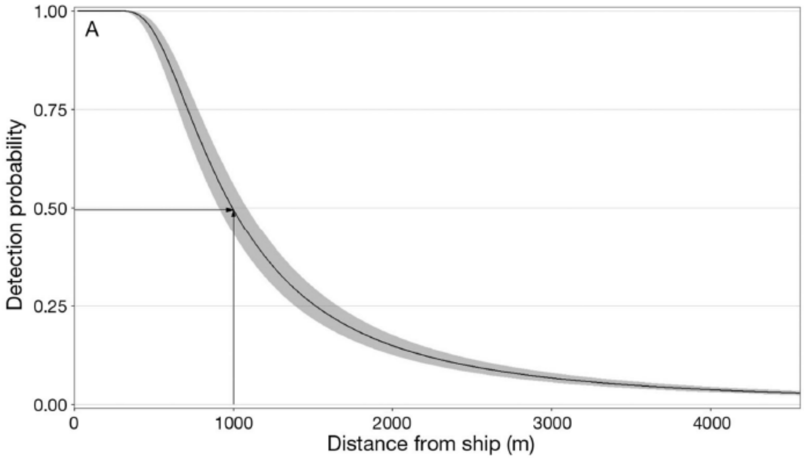


Figure 4-43: Detection Probability as it Varies with Distance between Ships and Whales in and near Glacier Bay National Park from 2008 to 2015 (Williams et al. 2016)

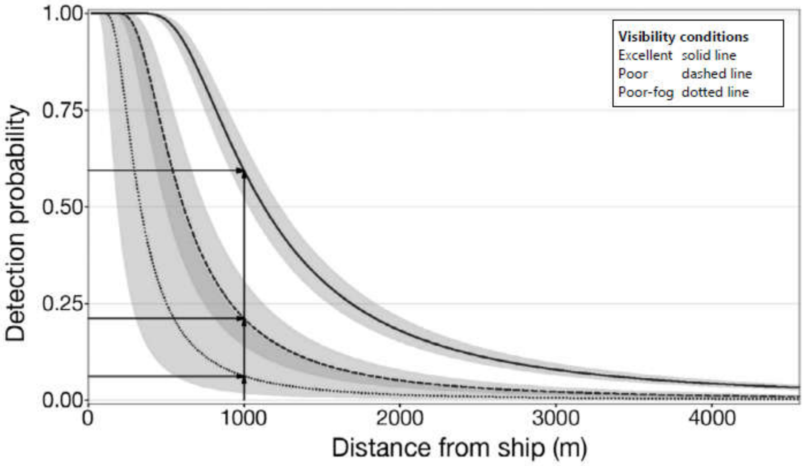


Figure 4-44: Detection Probability of Humpback Whales under Different Visibility Conditions (Williams et al. 2016)

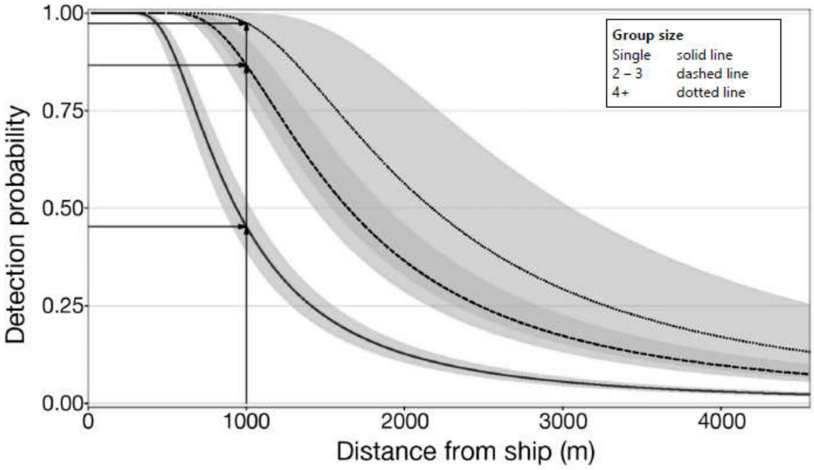
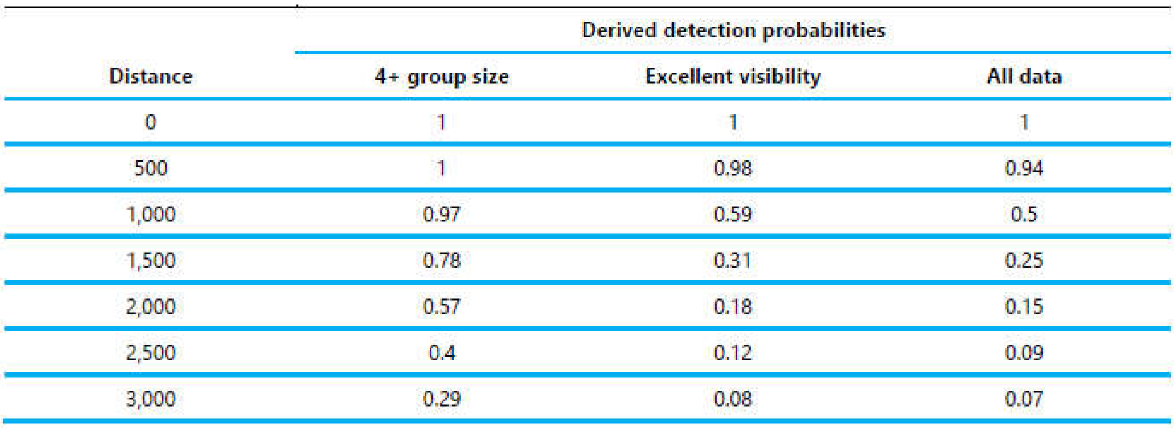


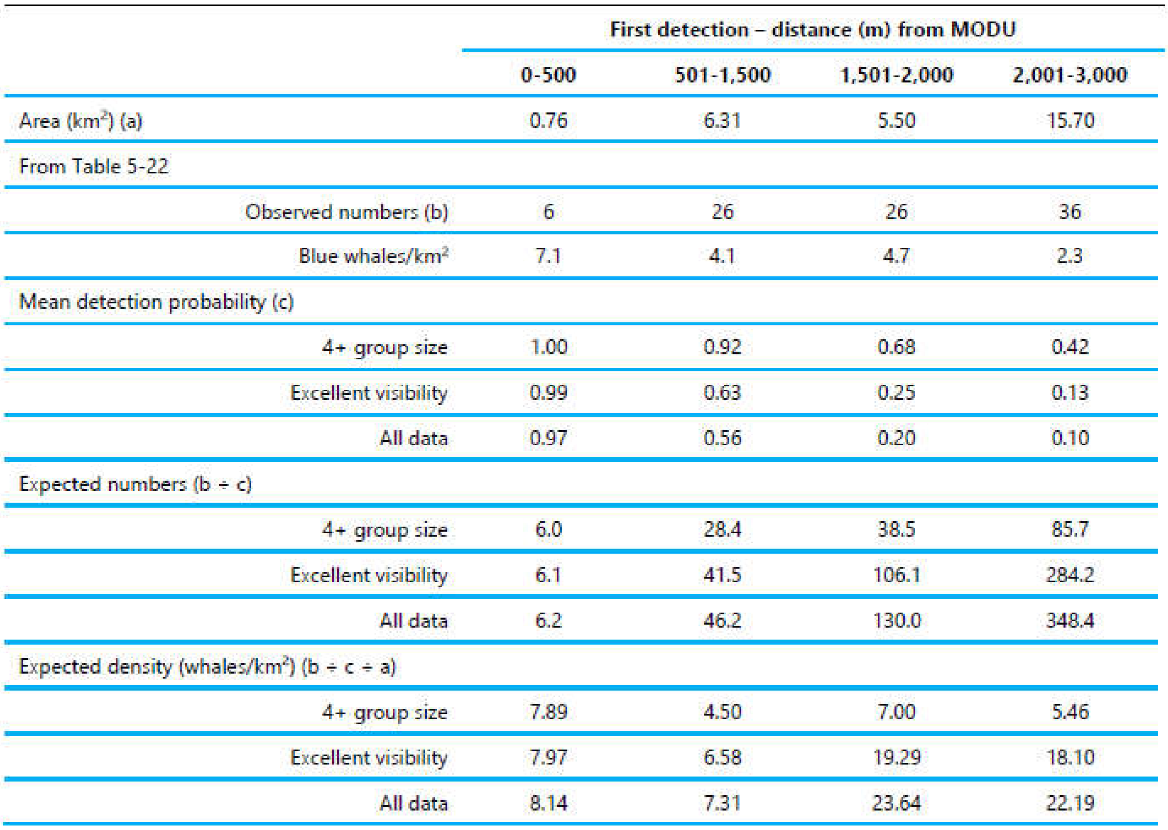
Figure 4-45: Probability of Detecting Whale Groups of Different Sizes of Humpback Whales (Williams et al. 2016)

Table 4-19: Detection Probabilities derived from Williams et al. (2016)



Distance	Derived detection probabilities		
	4+ group size	Excellent visibility	All data
0	1	1	1
500	1	0.98	0.94
1,000	0.97	0.59	0.5
1,500	0.78	0.31	0.25
2,000	0.57	0.18	0.15
2,500	0.4	0.12	0.09
3,000	0.29	0.08	0.07

Table 4-20: Estimated Blue Whale Abundance and Density based on MFO data from 2 Feb. 2021 and 31 Mar. 2022. Note that the reference to Table 5-22 is Table 4-18 in this EP.



	First detection – distance (m) from MODU			
	0-500	501-1,500	1,501-2,000	2,001-3,000
Area (km^2) (a)	0.76	6.31	5.50	15.70
From Table 5-22				
Observed numbers (b)	6	26	26	36
Blue whales/km^2	7.1	4.1	4.7	2.3
Mean detection probability (c)				
4+ group size	1.00	0.92	0.68	0.42
Excellent visibility	0.99	0.63	0.25	0.13
All data	0.97	0.56	0.20	0.10
Expected numbers (b ÷ c)				
4+ group size	6.0	28.4	38.5	85.7
Excellent visibility	6.1	41.5	106.1	284.2
All data	6.2	46.2	130.0	348.4
Expected density (whales/km^2) (b ÷ c ÷ a)				
4+ group size	7.89	4.50	7.00	5.46
Excellent visibility	7.97	6.58	19.29	18.10
All data	8.14	7.31	23.64	22.19

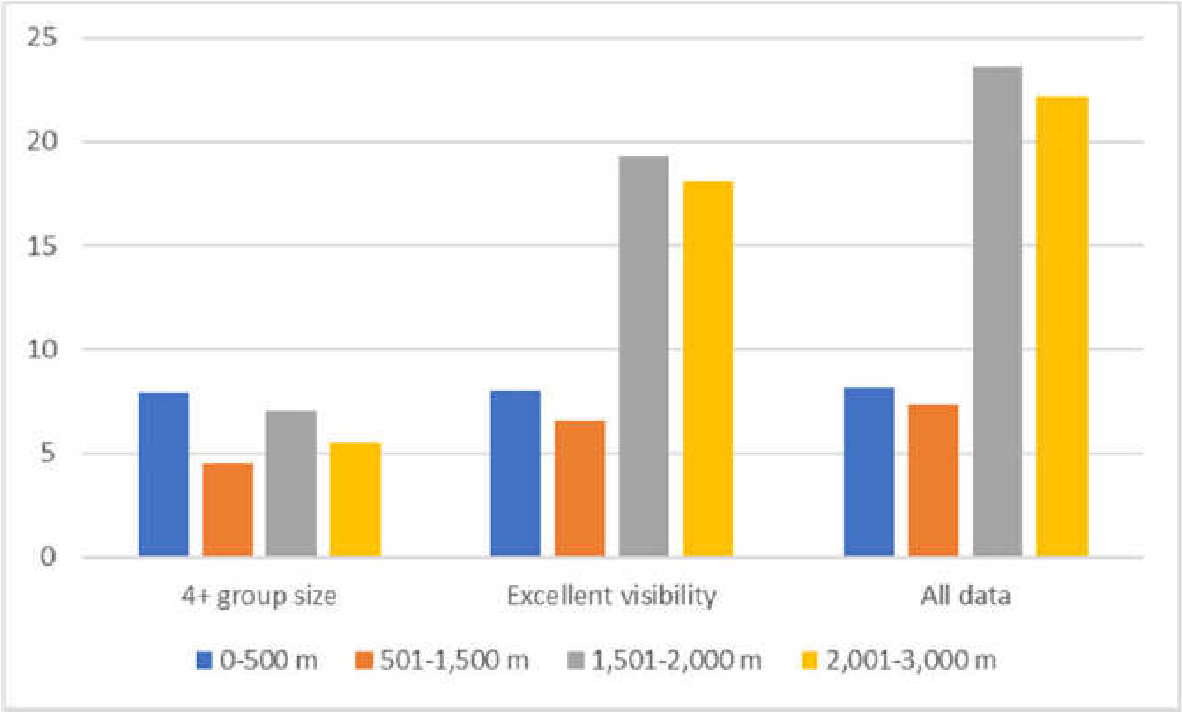


Figure 4-46: Expected Density (blue whales/km2) for each Management Zone

Fin whale

Fin whales are considered a cosmopolitan species and occur from polar to tropical waters and are rarely in inshore waters. They show well defined migratory movements between polar, temperate and tropical waters. Migratory movements are essentially north–south with little longitudinal dispersion. Fin whales regularly enter polar waters. Unlike blue whales and minke whales, fin whales are rarely seen close to ice, although recent sightings have occurred near the ice edge of Antarctica.

There are stranding records of this species from most Australian states, but they are considered rare in Australian waters (Bannister et al., 1996). The fin whale has been infrequently recorded between November and February during aerial surveys in the region (Gill et al., 2015). Fin whales have been sighted inshore in the proximity of the Bonney coast upwelling, Victoria, along the continental shelf in summer and autumn months (Gill, 2002). Fin whales in the Bonney coast upwelling are sometimes seen in the vicinity of blue whales and sei whales.

Fin whales were sighted, and feeding was observed between November-May (upwelling season) during aerial surveys conducted between 2002-2013 in South Australia (Gill et al., 2015). This is one of the first documented records these whales feeding in Australian waters, suggesting that the region may be used for opportunistic baleen whale feeding (Gill et al., 2015). Fin whales have also been acoustically detected south of Portland, Victoria (Erbe et al., 2016). Aulich et al. (2019) recorded infrequent presence of fin whales in Portland between 2009 to 2016. This suggests that the area may not be a define migratory route however, calls recorded in July may be from whales migrating northward towards the east coast of NSW. Calls detected in late August and September may be indication of the presence of whales on their migration route back to Antarctica waters.

The sighting of a cow and calf in the Bonney coast upwelling in April 2000 and the stranding of two fin whale calves in South Australia suggest that this area may be important to the species' reproduction, perhaps as a provisioning area for cows with calves (Morrice et al., 2004). However, there are no defined mating or calving areas in Australia waters.

As there are no BIAs for the fin whale in the operational area or Planning area, they are likely to be uncommon visitors.

Humpback whale

Humpback whales (*Megaptera novaeangliae*) are present around the Australian coast in winter and spring. Humpbacks undertake an annual migration between the summer feeding grounds in Antarctica to their winter breeding and calving grounds in northern tropical waters. Along the southeast coast of Australia, the northern migration starts in April and May while the southern migration peaks around November and December (TSSC, 2015a). A discrete population of humpback whales have been observed to migrate along the west coast of Tasmania and through Bass Strait, and these animals may pass through the operational area. The exact timing of the migration period varies between years in accordance with variations in water temperature, extent of sea ice, abundance of prey, and location of feeding grounds (TSSC, 2015a). Feeding occurs where there is a high krill density, and during the migration this primarily occurs in Southern Ocean waters south of 55°S (TSSC, 2015a).

Humpback whales satellite-tagged off Australia's east coast were tracked during three austral summers in 2008/2009, 2009/2010 and 2010/2011 (Andrews-Goff et al., 2018). Of the thirty tagged humpbacks, 21 migrated south along the coastline across into Bass Strait during October. In November the whales then migrated along the east coast (12 whales) and west coast (1 whale) of Tasmania to Antarctic feeding grounds. The state space model used shows both search and transit behaviour revealing new temperate feeding grounds in Bass Strait, the east coast of Tasmania and in the eastern Tasman Sea.

There are no known feeding, resting or calving grounds for humpback whales in the operational area or planning area, although feeding may occur opportunistically where sufficient krill density is present (Commonwealth of Australia, 2015). The nearest BIA which is important habitat for migrating humpback whales is Twofold Bay, a resting area off the NSW coast (DAWE, 2021).

During Origin's Enterprise 3D seismic survey undertaken during early November 2014, 16 humpback whales were sighted (RPS, 2014). During Beach's Otway drilling campaign in 2021, which includes the operational area, 95 humpback whale detections were made, with the highest numbers being during June, September, October and November.

The recovery of humpback whale populations following whaling has been rapid. The Australian east coast humpback whale population, which was hunted to near-extinction in the 1950s and early 1960s, had increased to 7,090±660 (95% CI) whales by 2004 with an annual rate of increase of 10.6±0.5% (95% CI) between 1987–2004 (Noad et al., 2011). The available estimates for the global population total more than 60,000 animals, and global population is categorised on the IUCN Red List as Least Concern.

Killer whale

Killer whales (*Orcinus orca*) are thought to be the most cosmopolitan of all cetaceans and appear to be more common in cold, deep waters; however, they have often been observed along the continental slope and shelf particularly near seal colonies (Bannister et al., 1996). The killer whale is widely distributed from polar to equatorial regions and has been recorded in all Australian waters with concentrations around Tasmania. The only recognised key locality in Australia is Macquarie Island and Heard Island in the Southern Ocean (Bannister et al., 1996). The habitat of killer whales includes oceanic, pelagic and neritic (relatively shallow waters over the continental shelf) regions, in both warm and cold waters (DotEE, 2019d).

Killer whales are top-level carnivores. Their diet varies seasonally and regionally. The specific diet of Australian killer whales is not known, but there are reports of attacks on dolphins, young humpback whales, blue whales, sperm whales, dugongs and Australian sea lions (Bannister et al., 1996). In Victoria, sightings peak in June/July, where they have been observed feeding on sharks, sunfish, and Australian fur seals (Morrice et al., 2004; Mustoe, 2008).

The breeding season is variable, and the species moves seasonally to areas of food supply (Bannister et al., 1996; Morrice et al., 2004). Killer whales are frequently present in Victorian waters with sightings recorded along most of Victoria's coastline. Mustoe (2008) describes between 2002 and 2008 web-based casual sightings had an average of 13 killer whales sighted per year in Victoria and NSW, more than half in Victorian waters. This combined with the Atlas of Victorian Wildlife indicates a peak in killer whale sightings in June to July and September to November (Mustoe, 2008).

The killer whale has been observed within the region however there are no BIAs in the operational or planning areas. No killer whales were detected during Beach's Otway drilling campaign, which includes the operational area location. Therefore, it is likely that they would be uncommon visitors in the operational or planning area.

Long-finned pilot whale

The long-finned pilot whale (*Globicephala melas*) is distributed throughout the northern and southern hemispheres in circumpolar oceanic temperate and subantarctic waters containing zones of higher productivity along the continental slope. They sometimes venture into the shallower waters of the shelf (<200 m) in pursuit of prey species. Stomach contents confirm that squid are the main prey of long-finned pilot whales in Australian waters, although some fish are also taken (DotEE, 2019f). No key localities have been identified in Australia (Bannister et al., 1996) however they are considered reasonably abundant (DotEE, 2019f).

There is some (inconclusive) evidence that suggests the species moves along the edge of the continental shelf in southern Australian waters (Bannister et al., 1996) in response to prey abundance at bathymetric upper slopes and canyons (DoE, 2016g). Records from Tasmania indicate mating occurs in spring and summer with 85% of calves born between September and March although births do occur throughout the year.

No calving areas are known in Australian waters (DotEE, 2019f).

The long-finned pilot whale has been identified in surveys over the Bass Strait and eastern Great Australian Bight; however, there are no BIAs in the operational area or planning area. During works undertaken by Origin Energy, long-finned pilot whales have been seen sporadically, such as, a sighting of approximately 30 whales occurred during the 2014 Enterprise MSS. No long-finned pilot whales were detected during Beach's Otway drilling campaign, which includes the operatonal area.It is likely that they would be uncommon visitors to the operational or planning areas.

Minke whale

The minke whale (*Balaenoptera acutorostrata*) is a widely distributed baleen whale that has been recorded in all Australian waters except the Northern Territory. The whales can be found inshore although they generally prefer deeper waters. In summer they are abundant feeding throughout the Antarctic south of 60°S but appear to migrate to tropical breeding grounds between 10°S and 20°S during the Southern Hemisphere winter (Kasamatru, 1998; Reilly et al., 2008). Although the exact location of breeding grounds is unknown, mating occurs between August to September with calving between May and July (Bannister et al., 1996).

A few animals have been sighted during aerial surveys of the Bonney coast upwelling. The minke whale has been observed within the region, however, there are no BIAs in the operational area or planning area. During Beach's Otway drilling campaign in 2021, which included the operational area, three minke whale detections were made during May. Therefore, it is likely that they would be uncommon visitors in the operational or planning areas.

Pygmy right whale

The pygmy right whale (*Caperea marginata*) is a little-studied baleen whale species that is found in temperate and sub-Antarctic waters in oceanic and inshore locations. The species, which has never been hunted commercially, is thought to have a circumpolar distribution in the Southern Hemisphere between about 30°S and 55°S. Distribution appears limited by the surface water temperature as they are almost always found in waters with temperatures ranging from 5° to 20°C (Baker, 1985) and staying north of the Antarctic Convergence. There are few confirmed sightings of pygmy right whales at sea (Reilly et al., 2008). The largest reported group was sighted (100+) just south-west of Portland in June 2007 (Gill et al., 2008).

Species distribution in Australia is found close to coastal upwellings and further offshore it appears that the Subtropical Convergence may be important for regulating distribution (Bannister et al., 1996). Key locations include south-east Tasmania, Kangaroo Island (SA) and southern Eyre Peninsula (SA) close to upwelling habitats rich in marine life and zooplankton upon which it feeds (Bannister et al., 1996).

The pygmy right whale has been observed in surveys in the region, however, Origin Energy did not observe it during the 2010 Speculant MSS and 2014 Enterprise MSS. Also, there are no BIAs identified in the operational or planning areas. No pygmy right whales were detected during Beach's Otway drilling campaign, which includes the operational area. Therefore, it is likely to be an uncommon visitor in the operational or planning areas.

Sei whale

Sei whales are considered a cosmopolitan species, ranging from polar to tropical waters, but tend to be found more offshore than other species of large whales. They show well defined migratory movements between polar, temperate and tropical waters. Migratory movements are essentially north-south with little longitudinal dispersion. Sei whales do not penetrate the polar waters as far as the blue, fin, humpback and minke whales (Horwood, 1987), although they have been observed very close to the Antarctic continent.

Sei whales move between Australian waters and Antarctic feeding areas; subantarctic feeding areas (e.g. Subtropical Front); and tropical and subtropical breeding areas. The proportion of the global population in Australian waters is unknown as there are no estimates for sei whales in Australian waters.

Sei whales feed intensively between the Antarctic and subtropical convergences and mature animals may also feed in higher latitudes. Sei whales feed on planktonic crustaceans, in particular copepods and amphipods. Below the Antarctic convergence sei whales feed exclusively upon Antarctic krill (*Euphausia superba*).

In the Australian region, sei whales occur within Australian Antarctic Territory waters and Commonwealth waters, and have been infrequently recorded off Tasmania, NSW, Queensland, the Great Australian Bight, Northern Territory and Western Australia (Parker 1978; Bannister et al., 1996; Thiele et al., 2000; Chatto and Warneke 2000; Bannister 2008a).

Sightings of sei whales within Australian waters includes areas such as the Bonney coast upwelling off South Australia (Miller et al., 2012), where opportunistic feeding has been observed between November and May (Gill et al., 2015).).

There are no known mating or calving areas in Australian waters. No sei whales were detected during Beach's Otway drilling campaign, which includes the operational area. Thus, the sei whale is likely to be an uncommon visitor to the operational or planning areas.

Southern right whale

The southern right whale is listed as endangered under the EPBC Act in Australia and as critically endangered on the Victorian Threatened Species Advisory List.

The operational area overlaps the southern right whale (*Eubalaena australis*) known core range, migration and resting on migration BIA and Port Campbell emerging aggregation area (Figure 4-48 and Figure 4-49). The operational area is ~22 km from the aggregation BIA and ~90 km from the connecting habitat BIA (Figure 4-48)

The planning area overlaps the southern right whale known core range, migration and resting on migration, and connecting habitat and migration BIAs and Port Campbell emerging aggregation area (Figure 4-48 and Figure 4-49).

The Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) provides an update to BIAs and emerging aggregation areas. The proposed changes are:

- Reproductive areas - Areas where mating, calving, nursing and/or presence of neonates are known, or likely, to occur. For Victoria this is the nearshore area between Portland and Port Campbell (Figure 4-50). As these areas are not yet final and GIS data is not available for them, the existing BIAs and emerging aggregation areas are used for the impact assessment.
- Migration areas - Areas southern right whales are known, or likely, to use for movement between regions that support biologically important behaviour (e.g., coastal movement between reproductive areas). The recovery plan does not show the location of these area and refers to the National Conservation Values Atlas which has not been updated so still aligns with the BIAs in Figure 4-48.

In addition, no 'Critical Habitat' as defined under section 207A of the EPBC Act have been identified, or included, in the Register of Critical Habitat.

Population

Southern right whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al., 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because southern right whales have a slow rate of increase compared to other marine mammals, their numbers remain low (IWC, 2013). Global abundance estimates are 13,000 for the species, across key wintering grounds in South Africa, Argentina, Australia and New Zealand.

The Australian population of southern right whales is divided into two sub-populations due to genetic diversity (Carroll et al., 2011; Baker et al., 1999) and different rates of increase (DSEWPaC, 2012a). The western sub-population occurs predominantly between Cape Leeuwin, Western Australia (WA) and Ceduna, South Australia (SA) This sub-population comprises most of the Australian population and is estimated at 3,200 individuals increasing at an annual rate of approximately 6% p.a. (Smith et al., 2019). The eastern sub-population can be found along the south-eastern coast, including the region from Tasmania to Sydney, with key aggregation areas in Portland and Warrnambool in Victoria. The eastern sub-population is estimated at less than 300 individuals and is showing no signs of increase (Bannister, 2017). A rate of around 7% p.a. is considered the maximum biological rate of increase for southern right whales (IWC, 2013). Connectivity between the two populations is unknown however, some limited movement between the two areas has been recorded (Burnell, 2001; Charlton, 2017; Pirzl et al., 2009).

Distribution

Southern right whales are distributed in the Southern Hemisphere with a circumpolar distribution between latitudes of 16°S and at least 65°S. They migrate from southern feeding grounds in sub-Antarctic waters to Australia in between May and November to calve, mate and rest (Bannister et al., 1996; DCCEEW 2022). They are distributed across thirteen primary aggregation areas along the southern coast of Australia (Figure 4-49) (DSEWPaC, 2012a). In Australian coastal waters, they occur along the southern coastline of the mainland and Tasmania and generally extend as far north as Sydney on the east coast and Perth on the west coast (DSEWPaC, 2012a). There are occasional sightings further north, with the extremities of their range recorded at Hervey Bay and Exmouth (DSEWPaC, 2012a).

The largest established calving areas in Australia include Head of Bight in SA, and Doubtful Island Bay and Israelite Bay in WA. Smaller but established aggregation areas regularly occupied by southern right whales include Yokinup Bay in WA, Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Emerging aggregation areas include Flinders Bay, Hassell Beach, Cheyne/Wray Bays, and Twilight Cove in WA, and sporadically occupied areas include Encounter Bay in SA (DSEWPaC, 2012a) (Figure 4-49). Southern right whales generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m (Charlton et al., 2019). A number of additional areas for southern right whales are emerging that might be of importance, particularly to the south-eastern population. In these areas, small but growing numbers of non-calving whales regularly aggregate for short periods of time. These areas include coastal waters off Peterborough, Port Campbell, Port Fairy and Portland in Victoria (DSEWPaC, 2012a) (Figure 4-49).

Coastal connecting habitat, which may also serve a migratory function or encompass locations that will emerge as calving habitat as recovery progresses (some locations within connecting habitat are occupied intermittently but do not yet meet criteria for aggregation areas) (DSEWPaC, 2012a). A portion of the King Island connecting habitat BIA is within the planning area.

There is variation in annual abundance on the coast of Australia due to the 3-year calving cycles (Charlton 2017). Female and calf pairs generally stay within the calving ground for 2–3 months (Burnell, 2001). Peak periods for mating in Australian coastal waters are from mid-July through August (DSEWPaC, 2012a). Pregnant females generally arrive during late May/early June and calving/nursery grounds are generally occupied until October (occasionally as early as April and as late as December) (Charlton et al., 2019). A study conducted by Stamation et al, (2020) shows that despite an increase in breeding females sighted in south-eastern Australian between 1985 and 2017, there is no evidence of an increase in annual numbers of mother-calf pairs.

As a highly mobile migratory species, southern right whales travel thousands of kilometres between habitats used for essential life functions. Movements along the Australian coast are reasonably well understood, but little is known of migration travel, non-coastal movements and offshore habitat use. Exactly where southern right whales approach and leave the Australian coast from, and to, offshore areas remain unknown (DSEWPaC, 2012a). 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). A predominance of westward movements amongst long-range photo-identification re-sightings may indicate a seasonal westward movement in coastal habitat (Burnell, 2001). Direct approaches and departures to the coast have also been recorded through satellite telemetry studies (Mackay et al. 2015).

Aerial surveys of western Bass Strait and eastern Great Australian Bight undertaken by Gill et al., (2015) detected southern right whales between May and September. A survey in early November 2010 did not observe any whales in the Warrnambool area and it was assumed that cows and calves had already left the calving and aggregation areas (M. Watson, pers. comm., 2010). No southern right whales were encountered during Origin's Enterprise 3D seismic survey undertaken during November 2014 (RPS, 2014), or during spotter flights of the coastline undertaken prior to the survey in late October 2014. Aerial surveys between Ceduna, SA and Sydney NSW (and included Tasmania) were undertaken in August of 2013 and 2014 and recorded a total of 34 southern right whale individuals (17 breeding females) in 2013 and 39 (11 breeding females) in 2014, respectively (Watson et al., 2015).

Marine mammal observer data from January 2021 to April 2022 for the drilling program in the Otway Development Area identified three southern right whales (Table 4-17) consisting of a single individual in each month of June, July and August.

The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) reports that known and potential threats that may have individual or population level impacts to southern right whales include: entanglement in fishing gear, vessel disturbance, climate variability and change, noise interference, habitat modification and overharvesting of prey.

Cultural significance

The Draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022) provides information on the cultural significance of southern right whales to Indigenous Australians. The plan details:

At the Great Australian Bight in South Australia, the Mirning people are whale people and the white whale Jeedara is their totem and part of the Dreaming, which tells how the Mirning and Southern Right Whales are connected (Burgoyne 2000). Mirning Country is the sacred place of the Mirning People, and the Yinyila Nation of Mirning clans forms a huge yerrambai, or rainbow arch, spanning the length of the coastal area of the Great Australian Bight from Point Culver in Western Australia to near Streaky Bay in South Australia (Burgoyne 2000). The Far West Coast Aboriginal Corporation (FWCAC) manages the Far West Coast land, which belongs to the Far West Coast Aboriginal Peoples. FWCAC represents six distinct cultural groups of Aboriginal people: Mirning Peoples, The descendants of Edward Roberts, Wirangu Peoples, Yalata Peoples, Kokatha Peoples and Maralinga Tjaratja (Oak Valley) Peoples.

In Victoria, Koontapool (southern right whales) occur along the coastlines of south-west Victoria in Gunditjmara Sea Country to feed and birth. These Koontapool Woorrkngan Yakeen (Whale Birthing Dreaming Sites), are in coastal bay areas from Port Campbell to Portland, including Warrnambool. These places on Gunditjmara Country are known resting and feeding sites for mothers and calves and are directly related to Gunditjmara Neeyn (midwives), explaining why Gunditjmara is a Matrilineal Nation.

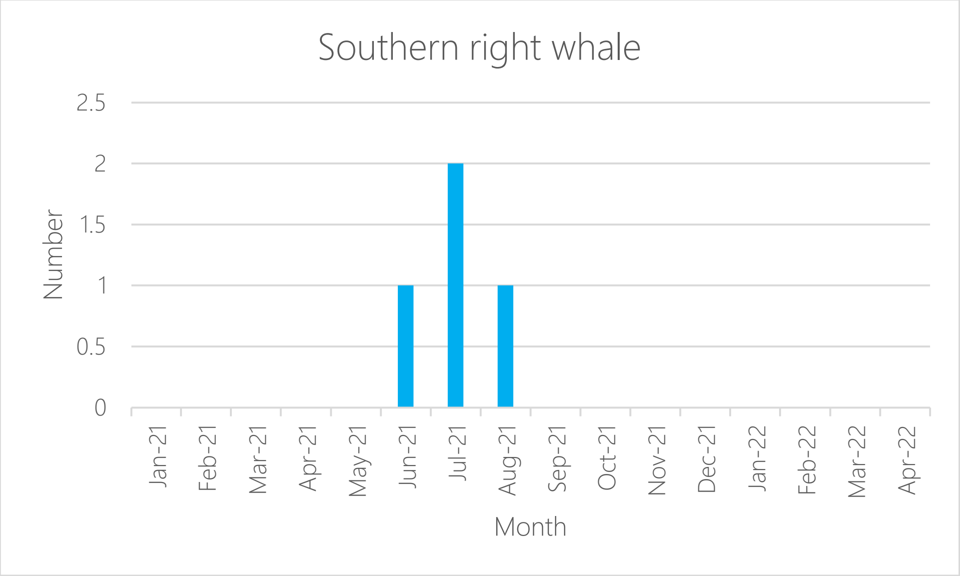


Figure 4-47: Southern Right Whale Sightings for the Otway Drilling Campaign

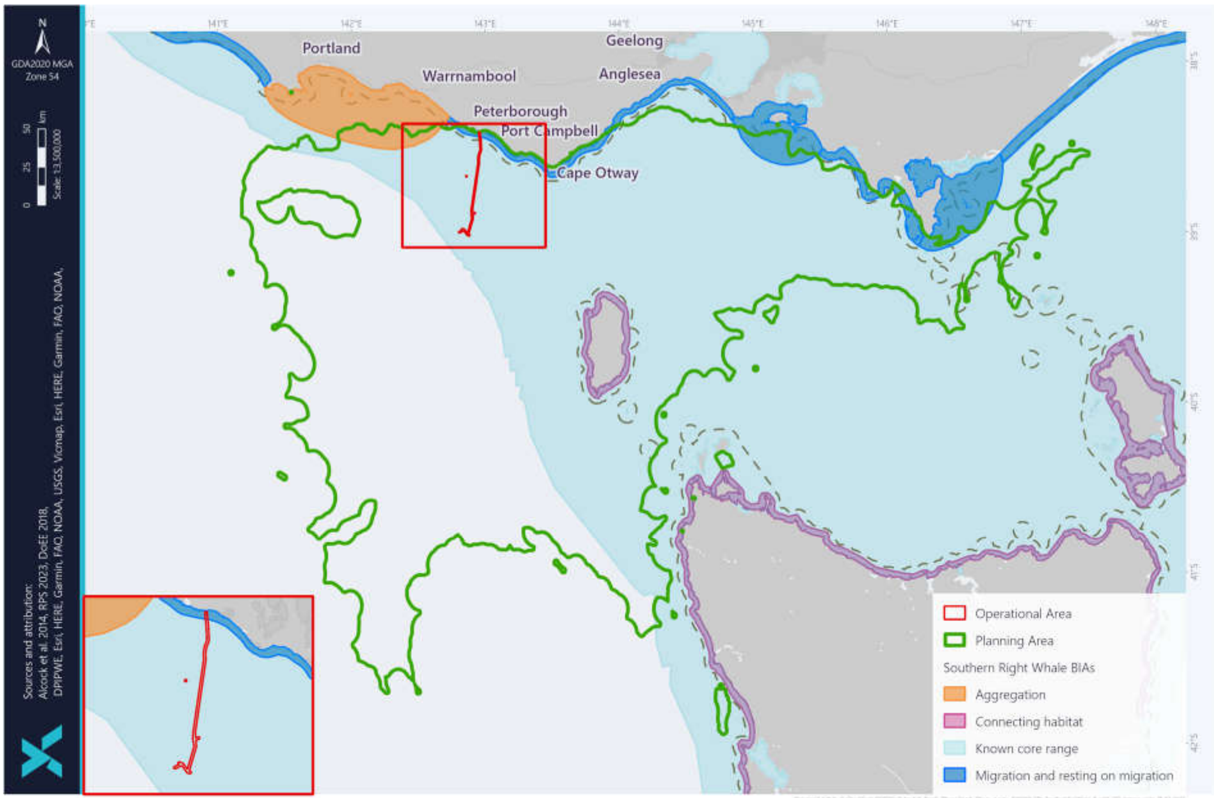


Figure 4-48: Southern Right Whale BIAs within the Planning Area

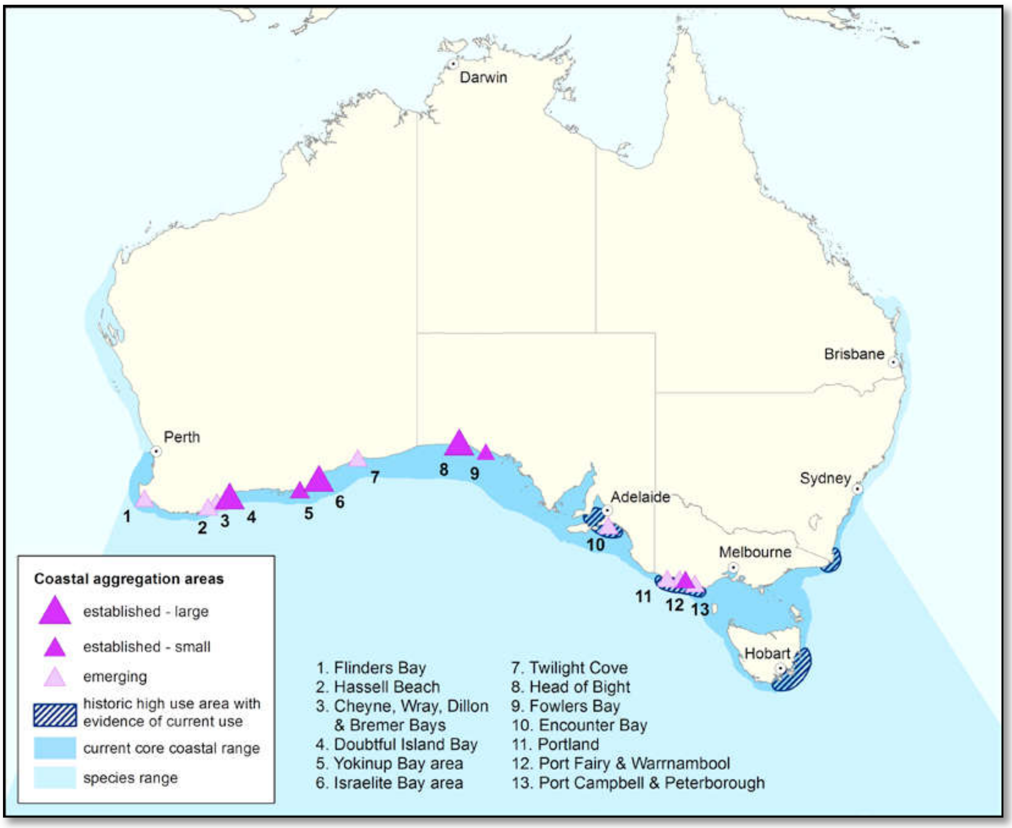


Figure 4-49: Aggregation Areas for Southern Right Whales (DSEWPaC, 2012a)

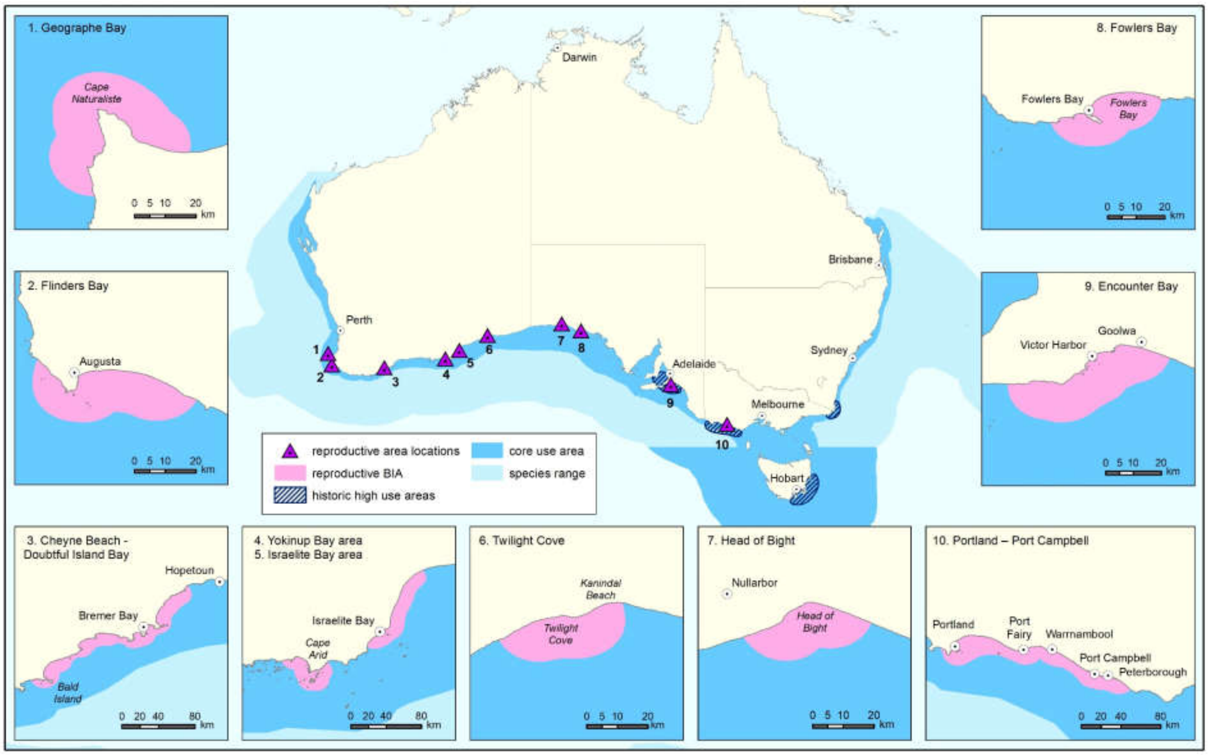


Figure 4-50: Proposed Southern Right Whale Reproductive BIAs and Reproductive Areas

Sperm whale

The sperm whale (*Physeter macrocephalus*) has a worldwide distribution and has been recorded in all Australian states. Sperm whales tend to inhabit offshore areas with a water depth of 600 m or greater and are uncommon in waters less than 300 m deep (DotEE, 2019f). Key locations for the species include the area between Cape Leeuwin to Esperance (WA); southwest of Kangaroo Island (SA), deep waters of the Tasmanian west and south coasts, areas off southern NSW (e.g., Wollongong) and Stradbroke Island (Qld) (DotEE, 2019f). Concentrations of sperm whales are generally found where seabeds rise steeply from a great depth (i.e., submarine canyons at the edge of the continental shelf) associated with concentrations of food such as cephalopods (DotEE, 2019f).

Females and young males are restricted to warmer waters (i.e., north of 45ºS) and are likely to be resident in tropical and sub-tropical waters year-round. Adult males are found in colder waters and to the edge of the Antarctic pack ice. In southern Western Australian waters sperm whales move westward during the year. For species in oceanic waters, there is a more generalised movement of sperm whales' southwards in summer and northwards in winter (DotEE, 2019f).

Sperm whales are prolonged and deep divers often diving for over 60 minutes (Bannister et al., 1996) however studies have observed sperm whales do rest at, or just below, surface for extended periods (>1 hr) (Gannier et al., 2002). In addition, female and juvenile sperm whales in temperate waters have been observed to spend several hours a day at surface resting or socialising (Hastie et al., 2003).

The sperm whale has been observed in the region, however the closest recognised BIA for foraging is further east near Kangaroo Island in South Australia. Therefore, it is likely they would be uncommon visitors in the operational or planning areas.

Bottlenose dolphin

The bottlenose dolphin (*Tursiops truncates*) has a worldwide distribution from tropical to temperate waters. While the species is primarily coastal, they are also found inshore, on the shelf and open oceans.

They are associated with many types of substrate and habitats, including mud, sand, seagrasses, mangroves and reefs (DotEE, 2019j). Bottlenose dolphins are known to associate with several cetacean species such as pilot whales, white-sided, spotted, rough-toothed and Risso's dolphins, and humpback and right whales (DotEE, 2019j).

There are two forms of bottlenose dolphin, a nearshore form and an offshore form. The nearshore form occurs in Southern Australia including the Otway Basin area, while the offshore form is found north of Perth and Port Macquarie in NSW. Most populations are relatively discrete and reside in particular areas, such as individual resident populations in Port Phillip Bay, Westernport Bay, Spencer Gulf, Jervis Bay and Moreton Bay. There may be some migration and exchange between the populations, but it is likely that most encountered near the Victorian coasts are local residents.

During Beach's Otway drilling campaign in 2021, which included the operational area, 40 bottlenose dolphin detections were made, spread across the year. However, no BIAs for this species have been identified in the operational or planning areas.

Common dolphin

The common dolphin (*Delphinus delphis*) is an abundant species, widely distributed from tropical to cool temperate waters, and generally further offshore than the bottlenose dolphin, although small groups may venture close to the coast and enter bays and inlets. They have been recorded in waters off all Australian states and territories. Stranding statistics indicate that common dolphins are active in Bass Strait at all times of the year, though less so in winter (DotEE, 2019k).

Common dolphins are usually found in areas where surface water temperatures are between 10°C and 20°C, and in habitats also inhabited by small epipelagic fishes such as anchovies and sardines.

In many areas around the world common dolphins show shifts in distribution and abundance, suggesting seasonal migration. The reason for this seasonal migration is unknown however in New Zealand the shift appears to be correlated with sea surface temperature and in South Africa, the species occurrence appears to be correlated with the annual sardine run (DotEE, 2019k). They are abundant in the Bonney coast upwelling during the upwelling season, and very scarce outside the season.

Dusky dolphin

The dusky dolphin (*Lagenorhynchus obscures*) is rare in Australian waters and has been primarily reported across southern Australia from Western Australia to Tasmania with a handful of confirmed sightings near Kangaroo Island and off Tasmania (DotEE, 2019i). Only 13 reports of the dusky dolphin have been made in Australia since 1828, and key locations are yet to be identified (Bannister et al., 1996). The species is primarily found from approximately 55°S to 26°S, though sometimes further north associated with cold currents. They are considered to be primarily an inshore species but can also be oceanic when cold currents are present (DotEE, 2019i).

No dusky dolphins were detected during Beach's Otway drilling campaign, which included the operational area.

Indian Ocean bottlenose dolphin

The Indian Ocean bottlenose dolphins are found in tropical and sub-tropical coastal and shallow offshore waters of the Indian Ocean, Indo-Pacific Region and the western Pacific Ocean bottlenose dolphins are distributed continuously around the Australian mainland, but the taxonomic status of many populations is unknown. Indian Ocean bottlenose dolphins have been confirmed to occur in estuarine and coastal waters of eastern, western and northern Australia and it has also been suggested that the species occurs in southern Australia (Kemper, 2004).

In south-eastern Australia, inshore Indian Ocean bottlenose dolphins show a high degree of site fidelity to some local areas and appear to belong to relatively small communities or populations (Möller et al., 2002).

No Indian Ocean bottlenose dolphins were detected during Beach's Otway drilling campaign, which included the operational area.

Risso's dolphin

The Risso's dolphin (*Grampus griseus*) is a widely distributed species found in deep waters of the continental slop and outer shelf from the tropics to temperate regions. The species prefer warm temperate to tropical waters with depths greater than 1,000 m, although they do sometimes extend their range into cooler latitudes in summer (Bannister et al., 1996). They are thought to feed on cephalopods, molluscs and fish.

Risso's dolphin has been observed in the region, however no BIAs have been identified in the operational area or planning area. No Risso's dolphins were detected during Beach's Otway drilling campaign, which included the operational are. Therefore, it is likely they would be uncommon visitors in the operational area or planning area.

Southern right whale dolphin

The southern right whale dolphin (*Lissodelphis peronnii*) is a pelagic species found in Southern Australian waters but generally well offshore in deep water or on the outer edges of the continental shelf between the subtropical and subantarctic convergence (DotEE, 2019h). No key localities have been identified in Australian waters however preferred water temperatures range from approximately 2-20°C (DotEE, 2019h). Of the limited southern right whale dolphin stomachs examined, myctophids and other mesopelagic fish, squid and crustaceans have been recorded, and euphausiids are also thought to be potential prey (DotEE, 2019h). It is unknown whether the southern right whale dolphin is a surface or deep-layer feeder (Bannister et al., 1996).

Calving areas are not known, however there is evidence that the calving season occurs between November to April (DotEE, 2019h).

The southern right whale dolphin has been observed in the region; however, no BIAs have been identified in the operational area or planning area. No southern right whale dolphins were detected during Beach's Otway drilling campaign, which included the operational area. Therefore, it is likely they would be uncommon visitors in the operational or planning areas.

4.4.7.7 Pinnipeds

The PMST reports identified two pinnipeds that potentially occur in the operational area and three that potentially occur in the planning area (Table 4-21)(Appendix A). The operational and planning areas do not overlap any BIAs for pinnipeds.

Table 4-21: Listed Pinniped Species identified in the PMST Search

Common name	**Species name**	**EPBC Act status**			**Planning Area**	**Operational area**
		Listed threatened	**Listed migratory**	**Listed marine**		
Australian fur-seal	*Arctocephalus pusillus*	-	-	L	BK	SHM
New Zealand fur-seal	*Arctocephalus forsteri*	-	-	L	SHM	SHM
Australian sea lion *Neophoca cinereal*		E	-	L	SHM	-
		Conservation Listing Advice for the *Neophoca cinerea* (Australian sea lion) (TSSC, 2010). Threats relevant to the activity are: • Entanglement in marine debris, disturbance, harassment, displacement, habitat degradation, oil spills, pollution, toxins and climate change. Recovery Plan for the *Neophoca cinerea* (Australian sea lion) (DSEWPaC, 2013b). Threats relevant to the activity are: • Habitat degradation - No explicit relevant management actions • Vessel strike - Collect data on direct killings and confirmed vessel strikes • Pollution (oil spills, toxins) - implement jurisdictional oil spill response strategies as required • Climate change - No explicit relevant management actions				
Listed Threatened E: Endangered Listed Marine L: Listed		Likely Presence SHM: Species or species habitat may occur within area. SHK: Species or species habitat known to occur within area. BK: Breeding known to occur within area				

Australian fur-seal

Australian fur-seals (*A. pusillus*) breed on islands of the Bass Strait but range throughout waters off the coasts of South Australia, Tasmania, Victoria and NSW. Numbers of this species are believed to be increasing as the population recovers from historic hunting (Hofmeyr et al., 2008). The species is endemic to south-eastern Australian waters.

In Victorian State waters they breed on offshore islands, including Lady Julia Percy Island, Seal Rocks in Westernport Bay, Kanowna and Rag Islands off the coast of Wilson's Promontory and The Skerries off Wingan Inlet in Gippsland (Figure 4-51). There are important breeding sites on Lady Julia Percy Island and Seal Rocks, with 25% of the population occurring at each of these islands. Their preferred breeding habitat is a rocky island with boulder or pebble beaches and gradually sloping rocky ledges.

Haul out sites with occasional pup births are located at Cape Bridgewater, at Moonlight Head, on various small islands off Wilsons Promontory and Marengo Reef near Apollo Bay. Australian fur-seals are present in the region all year, with breeding taking place during November and December.

Research being undertaken at Lady Julia Percy Island indicates that adult females feed extensively in the waters between Portland and Cape Otway, out to the 200 m bathymetric contour. Seal numbers on the island reach a maximum during the breeding season in late October to late December. By early December, large numbers of lactating females are leaving for short feeding trips at sea and in late December there is an exodus of adult males. Thereafter, lactating females continue to alternate between feeding trips at sea and periods ashore to suckle their pups. Even after pups begin to venture to sea, the island remains a focus, and at any time during the year groups may be seen ashore resting (Robinson et al., 2008; Hume et al., 2004; Arnould & Kirkwood, 2007).

During the summer months, Australian fur-seals travel between northern Bass Strait islands and southern Tasmania waters following the Tasmanian east coast, however, lactating female fur-seals and some territorial males are restricted to foraging ranges within Bass Strait waters. Lactating female Australian fur-seals forage primarily within the shallow continental shelf of Bass Strait and Otway on the benthos at depths of between 60 – 80 m and generally within 100 – 200 km of the breeding colony for up to five days at a time.

Male Australian fur-seals are bound to colonies during the breeding season from late October to late December, and outside of this they time forage further afield (up to several hundred kilometres) and are away for long periods, even up to nine days (Kirkwood et al., 2009; Hume et al., 2004).

As there are breeding and haul out sites within the planning area it is likely that Australian fur-seal would be present in the planning area. During Beach's Otway drilling campaign in 2021, which included the operational area, 394 Australian fur seal detections were made, spread across the year.

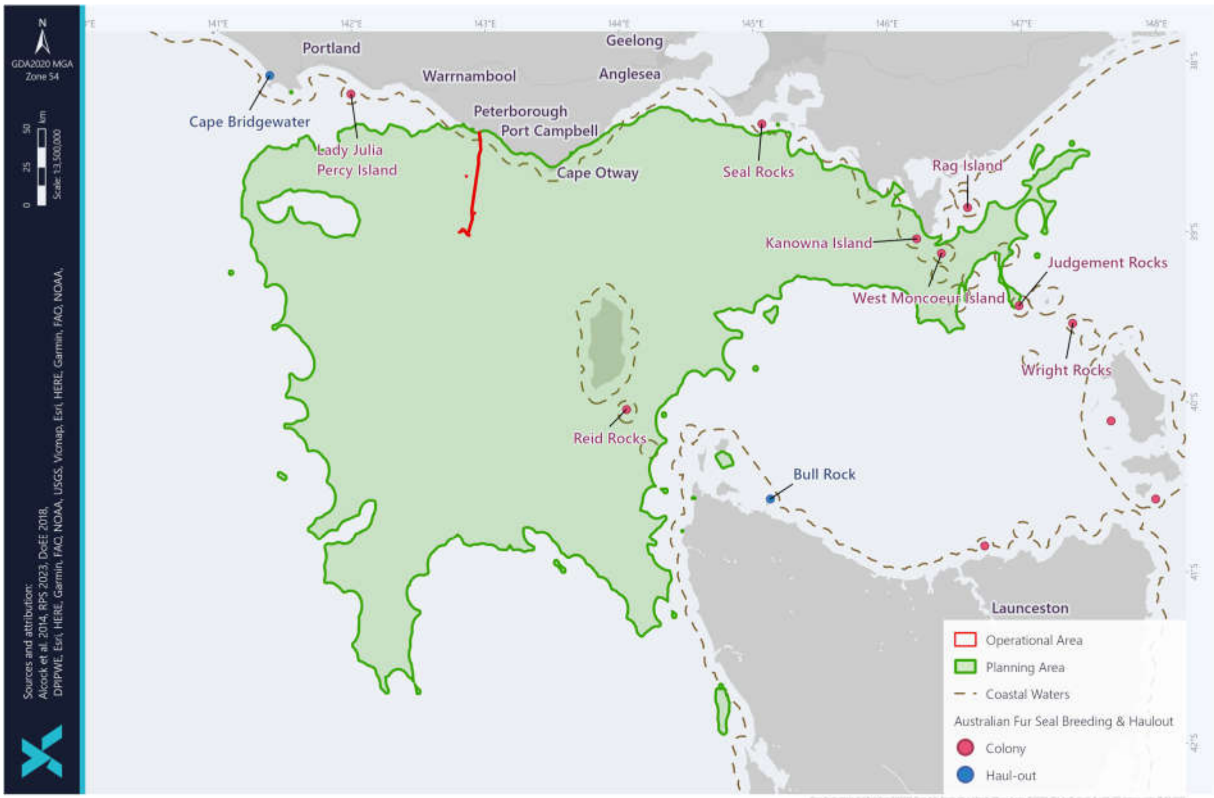


Figure 4-51: Locations of Australian Fur-seal Breeding Colonies and Haul Out Sites (Kirkwood et al., 2010)

New Zealand fur-seal

New Zealand fur-seal (*Arctocephalus forsteri*) are found in the coastal waters and offshore islands of South and Western Australia, Victoria, NSW and New Zealand. Population studies for New Zealand fur-seal in Australia carried out in 1990 estimated an increasing population of about 35,000. The species breeds in southern Australia at the Pages Islands and Kangaroo Island, which produces about 75% of the total pups in Australia. Small populations are established in Victorian coastal waters including at Cape Bridgewater near Portland, Lady Julia Percy Island near Port Fairy and, Kanowna Island (near Wilsons Promontory) and The Skerries in eastern Victoria.

Figure 4-52 illustrates the known breeding colonies of New Zealand fur-seal (Kirkwood et al., 2009). These colonies are typically found in rocky habitat with jumbled boulders. Colonies are typically occupied year-round, with greater activity during breeding seasons. Pups are born from mid-November to January, with most pups born in December (Goldsworthy, 2008). Known sites for New Zealand Fur-seal breeding colonies within the planning area include Seal Rocks (off King Island) and Judgement Rocks (Kent Group Islands) (Figure 4-52).

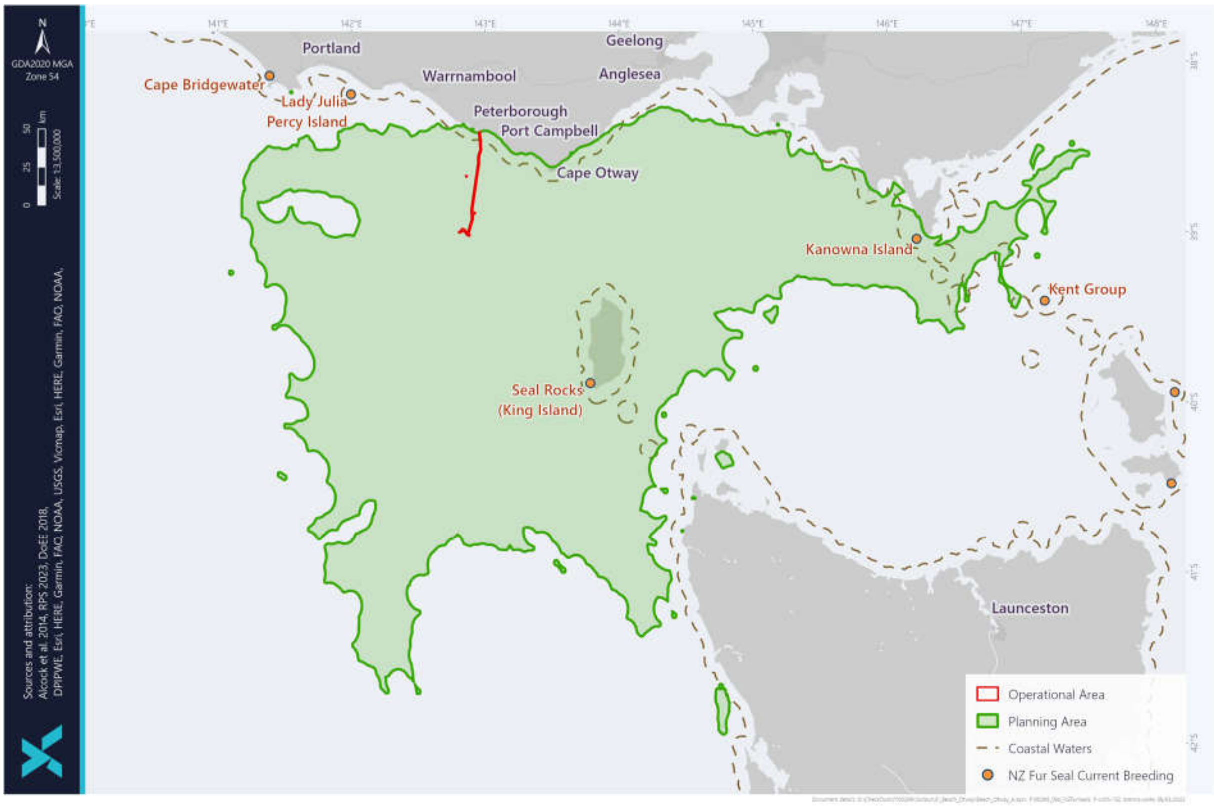


Figure 4-52: Locations of New Zealand Fur-seal Breeding Colonies (Kirkwood et al., 2009).

Australian sea lion

The Australian sea lion is the only endemic, and least abundant, pinniped that breeds in Australia (DoE, 2013b). All current breeding populations are outside of the planning area and are located from the Abrolhos Islands (Western Australia) to the Pages Islands (South Australia). The Australian sea lion uses a variety of shoreline types but prefer the more sheltered side of islands and typically avoid rocky exposed coasts (Shaughnessy, 1999).

The Australian sea lion is a specialised benthic forager; i.e. it feeds primarily on the sea floor (DSEWPaC, 2013). The Australian sea lion feeds on the continental shelf, most commonly in depths of 20–100 m, with adult males foraging further and into deeper waters (DSEWPaC, 2013). They typically feed on a range of prey including fish, cephalopods (squid, cuttlefish and octopus), sharks, rays, rock lobster and penguins (DSEWPC, 2013) They typically forage up to 60 km from their colony but can travel up to 190 km when over shelf waters (Shaughnessy, 1999).

4.4.7.8 Pest Species

Invasive marine species (IMS) are marine plants or animals that have been introduced into a region beyond their natural range and have the ability to survive, reproduce and establish. More than 200 non-indigenous marine species including fish, molluscs, worms and a toxic alga have been detected in Australian coastal waters.

It is widely recognised that IMS can become pests 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 & Grosholz, 2006).

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.

IMS known to occur in Bass Strait, according to Parks Victoria (2020):

- Northern pacific seastar (*Asterias amurensis*) – prefer soft sediment habitat, but also use artificial structures and rocky reefs, living in water depths usually less than 25 m (but up to 200 m water depths). It is thought to have been introduced in 1995 through ballast water from Japan. Well established in Port Phillip but currently not present in other Victorian locations.
- 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.
- 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.
- Dead man's fingers (*Codium fragile ssp. fragile*) – Widespread in Port Phillip and known to inhabit San Remo and Newhaven in Westernport. It grows rapidly to shade out native vegetation and can regenerate from a broken fragment enabling easy transfer from one area to another. Attaches to subtidal rocky reef and other hard surfaces.
- Cord grass (*Spartina anglica* and *Spartina x townsendii sp*) – found at the mouth of Bass River and in drain outlets near Tooradin in Westernport. Widespread in South Gippsland including Anderson's Inlet and Corner Inlet. Invades native saltmarsh, mangroves and mudflats, altering the mud habitat and excluding other species.

The Marine Pests Interactive Map (DotEE, 2019) indicates that Portland where support vessels typically mobilise from, harbours the following marine pests:

- Asian date mussel (*Musculista senhousia*) – prefers soft sediments in waters up to 20 m deep, forming mats and altering food availability for marine fauna.
- European fan worm (*Sabella spallanzanii*) - found at depths down to 30 m and is found in nutrient-rich waters in sheltered locations where there are no strong currents and little wave action. It is a filter feeder and grows on soft sediments or anchors itself to rocks, mollusc shells, jetties, pontoons or other solid surfaces the ports likely to be used for the survey (Warrnambool, Apollo Bay or Port Fairy) do not currently harbour any marine pests.

4.4.7.9 Viruses

A virus, the Abalone Viral Ganglioneuritis (AVG), has been detected in wild abalone populations in southwest Victoria and was confirmed as far east as White Cliffs near Johanna, and west as far as

Discovery Bay Marine Park (DPI, 2012). The virus can be spread through direct contact, through the water column without contact, and in mucus that infected abalone produce before dying. The last confirmation of active disease in Victoria was from Cape Otway lighthouse in December 2009 (Victoria State Government, 2016).

Strict quarantine controls need to be observed with diving or fishing activities in south-west Victoria when the virus has been detected in the area. Given the lack of detected AVG in Victorian State waters, controls outlined in the Biosecurity Control Measures for AVG: A Code of Practice (Gavine et al., 2009) are not active.

4.5 Socio-Economic Environment

This section describes the socio-economic environment within the operational area and planning area.

4.5.1 Coastal Settlements

There are no coastal settlements within the operational area. The nearest settlement to the operational area is Port Campbell. The operational area is within the Corangamite Shire Local Government Area (LGA) and the planning area is within the following (Figure 4-53):

- Circular Head
- Colac Otway
- Corangamite
- Glenelg
- Glennie Group
- King Island
- Moyne
- Phillip Island
- South Gippsland

The larger Victorian coastal settlements within the planning area are described below based on ABS (2021) census data:

- Apollo Bay has a population of 1,790 people and a median age of 52. Of those in the labour force, 40.05% work full-time and 44.2% work part time. Labourers and mangers are the highest occupation making up 33.9% of the workforce. Accommodation and supermarket and grocery stores are the biggest industries, making up 21.1% of employment.
- Peterborough has a population of 322 and a median age of 54. Of those in the labour force, 48.2% work fulltime and 32.3% work part-time. Dairy cattle farming and hospitals employ 16% of the workforce and managers, technicians and trades make up 38.5% of occupations.

- Phillip Island has a population of 13,799 and a median age of 52. Of those in the labour force, 45.1% work fulltime and 40.4% work part-time. Professionals, managers, technicians and trades make up 50.3% of occupations with the accommodation, retail, restaurants, hospitals and education the main employers.

- Port Campbell has a population of 440 and a median age of 40. Of those in the labour force, 44.4% work fulltime and 38.8% work part-time. The accommodation and dairy farming industries employ 22.8% of the workforce and the managers, professionals and labourers make up 58.1% of occupations.

The larger Tasmanian coastal settlements within the planning area are described below based on ABS (2021) census data:

- Currie (King Island) has a population of 659 and a median age of 49. Of those in the labour force, 63.0% work fulltime and 33.3% work part-time. Dairy and beef cattle farming 34.6% of occupations.

- Marrawah has a population of 152 and a median age of 52. Of those in the labour force, 63.5% work fulltime and 30.7% work part-time. Labourers and trades make up 43.3% of occupations with dairy farming, retail, hospitals and rock lobster and crab potting the main employers.

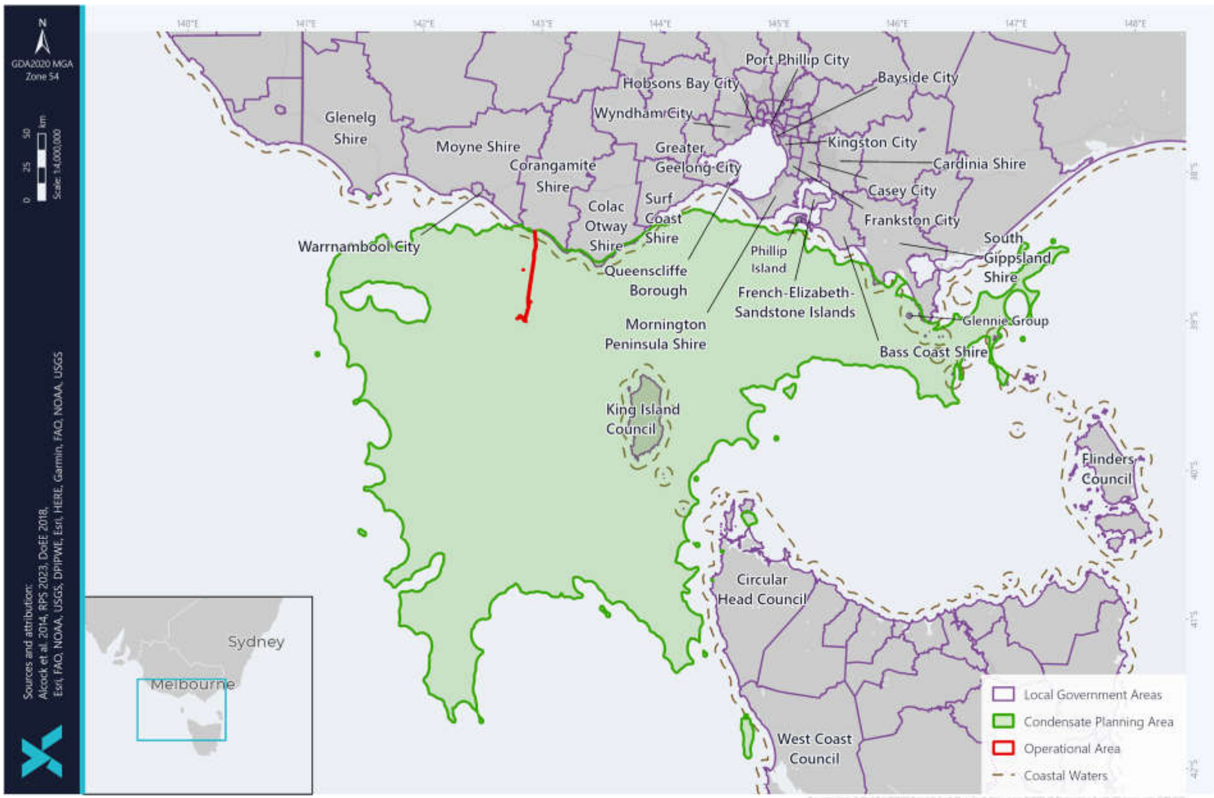


Figure 4-53: Local Government Areas within the Planning Area

4.5.2 Offshore Petroleum Industry

Petroleum exploration has been undertaken within the Otway Basin since the early 1960s. Gas reserves of approximately 2 trillion cubic feet (tcf) have been discovered in the offshore Otway Basin since 1995, with production from five gas fields using 700 km of offshore and onshore pipeline. Up to 2015, the DEDJTR reports that 23 PJ of liquid hydrocarbons (primarily condensate) has been produced from its onshore and offshore basins, with 65 PJ remaining, while 85 PJ of gas has been produced (Victoria and South Australia), with 1,292 PJ remaining.

There is no non-Beach oil and gas infrastructure within the operational area.

The Cooper Energy Casino and Henry gas fields and Casino-Henry pipeline and the Minerva gas field and pipeline are within the northern portion of the planning area.

4.5.3 Other Infrastructure

The Victorian Desalination Plant, located at Wonthaggi, is located 237 km northeast of the operational area and is inshore of the planning area. Operation of the plant commenced in December 2012. The seawater intake and outlet structures are connected to the onshore plant via a 1.2 km and 1.5 km underground tunnel, respectively. The two intake structures are 8 m high, 13 m in diameter, situated 50 m apart and located in a water depth of 20 m. They draw in water at very low speeds (the suction effect is not strong enough to draw fish in).

The Indigo Central telecommunications cable, which connects Perth and Sydney through southern Australia, is located 19 km south of the operational area. There are two Telstra telecommunications cables located in central Bass Strait, with the closest one located 228 km east of the operational area within the planning area.

4.5.4 Defence activities

Unexploded ordnance (UXO) is a by-product of past training activities undertaken by the Australian Defence Force or foreign defence forces.

The interactive Department of Defence database (DoD, 2022a) indicates that the operational area is located within a UXO zone 1052 King Island (Figure 4-54), which is within the 'slight potential' category', meaning there is confirmed history of military activities that may have resulted in numerous residual hazardous munitions, components, or constituents, but where confirmed UXO affected areas cannot be defined (DoD, 2022b). The site was used during 1954 as an Air-to-Air Firing Range (DoD, 2022a).

The operational area is located 45 km away from another UXO zone SDG136 'Sea Dumping - Victorian Coast', which is in the sea dumping category meaning the area has been identified as having been used for historical sea dumping of waste material that may include explosive ordnance (DoD, 2022b).

Beach undertook site surveys ahead of the Otway Drilling Campaign, confirming the absence of UXO within the operational area.

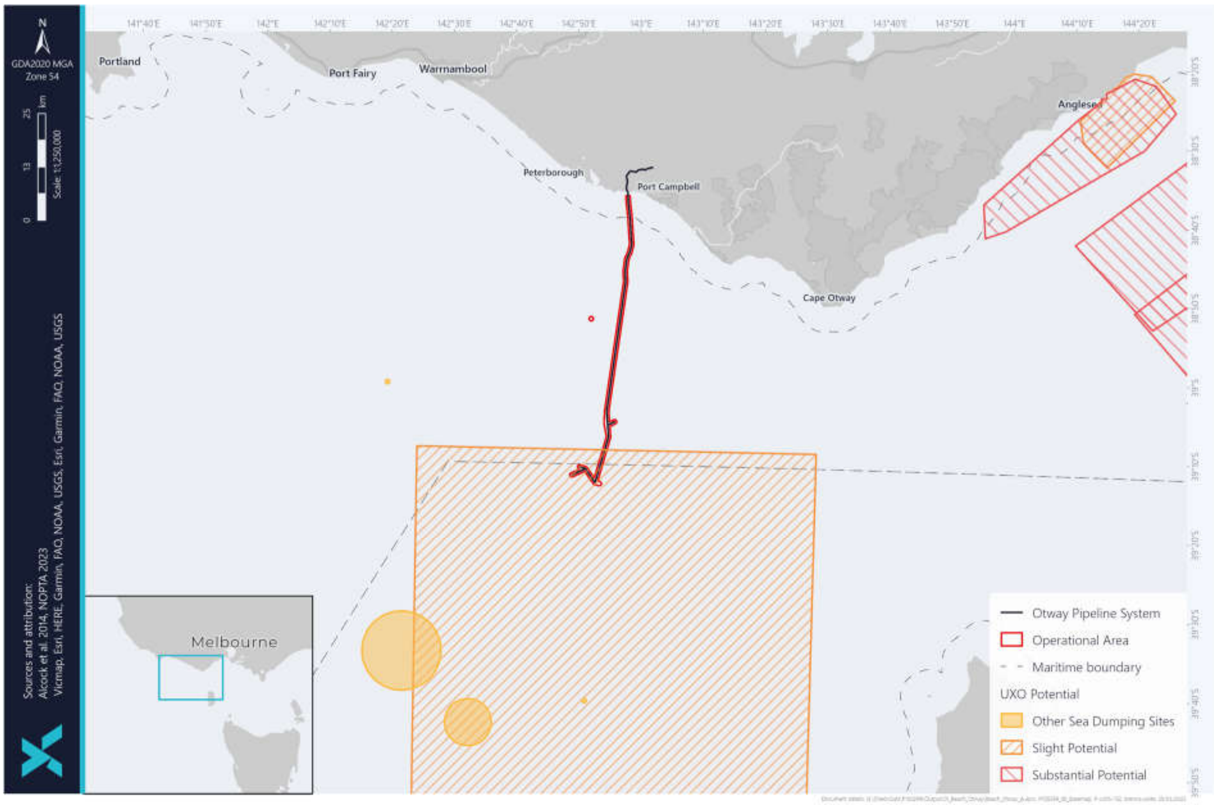


Figure 4-54: UXO within Operational Area

4.5.5 Shipping

The SEMR is one of the busiest shipping regions in Australia and Bass Strait is one of Australia's busiest shipping routes (Figure 4-55). Commercial vessels use the route when transiting between ports on the east, south and west coasts of Australia, and there are regular passenger and cargo services between mainland Australia and Tasmania.

Ports Australia (2019) provide statistics for port operations throughout Australia's main commercial ports. Based on the latest information (2021) the majority of commercial shipping traffic transiting to and from Victorian ports were container (3,682), general cargo (2,663, bulk liquid carriers (2,019),dry bulk (1,715), car carrier (1,342), bulk gas (220), other cargo (47) and livestock (9).

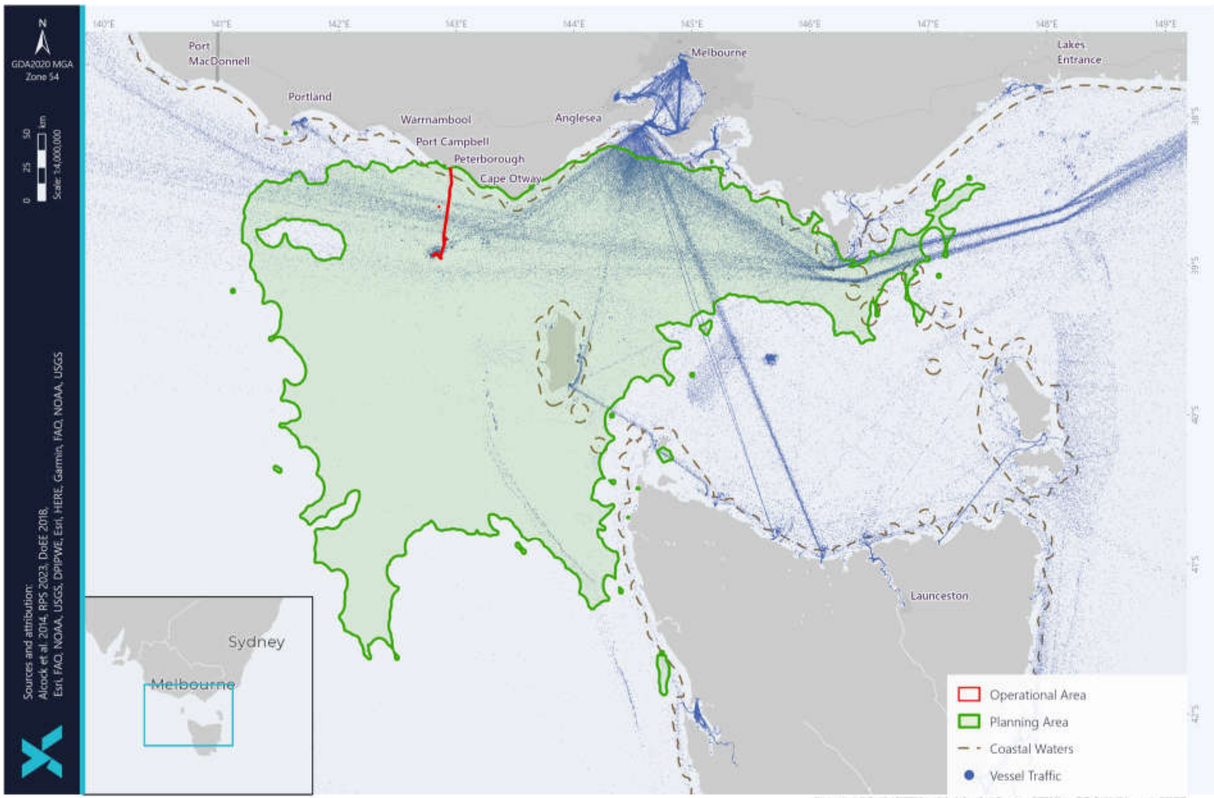


Figure 4-55: Vessel Traffic within the Planning Area

4.5.6 Tourism

Consultation has identified that the key areas of tourism in the region include land-based sightseeing from the Great Ocean Road and lookouts along that road, helicopter sightseeing, private and chartered vessels touring into the Twelve Apostles Marine Park, diving and fishing. Land-based tourism in the region peaks over holiday periods and in 2011, Tourism Victoria reported a total of approximately 8 million visitors to the Great Ocean Road region.

Local vessels accessing the area generally launch from Boat Bay in the Bay of Islands or from Port Campbell. Given the available boat launching facilities in the area (Peterborough and Port Campbell), and the prevailing sea-state of the area, vessel-based tourism is limited.

4.5.7 Recreational Diving

Recreational diving occurs along the Otway coastline. Popular diving sites near Peterborough include several shipwrecks such as the Newfield, which lies in 6 m of water and the Schomberg in 8 m of water. Peterborough provides several good shore dives at Wild Dog Cove, Massacre Bay, Crofts Bay and the Bay of Islands. In addition, there is the wreck of the Falls of Halladale (4-11 m of water) which can be accessed from shore or via boat.

Consultation with local vessel charterers and providers of SCUBA tank fills has confirmed that diving activity is generally concentrated around The Arches Marine Sanctuary and the wreck sites of the Loch Ard and sometimes at the Newfield and Schomberg shipwrecks. Diving activity peaks during the rock lobster season with the bulk of recreational boats accessing the area launching from Boat Bay at the Bay of Islands or Port Campbell.

4.5.8 Recreational Fishing

Recreational fishing is popular in Victoria and is largely centred within Port Phillip Bay and Western Port, although beach- and boat-based fishing occurs along much of the Victorian coastline.

The recreational fisheries that occur within the planning area are:

- Rock lobster
- Finfish (multiple species are targeted, including sharks)
- Abalone
- Scallops
- Squid
- Pipi

Of these, active recreational fishing for rock lobster, abalone, finfish and sharks is likely to occur within the planning area. Recreational scallop and squid fishing primarily occurs within Port Phillip Bay and Western Port and as such fishing for these species is unlikely within the planning area. Pipi harvesting occurs in Venus Bay, inshore of the planning area, but due to high levels of toxins in pipis at that location the public is currently advised that they are unsafe for human consumption.

There is the potential for recreational fishing to occur within the near shore areas of the Otway Pipeline System.

4.5.9 Commonwealth Managed 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)). Commonwealth commercial fisheries with jurisdictions to fish within the planning area are:

- Bass Strait Central Zone Scallop Fishery (Bass Strait CZSF)
- Eastern Tuna and Billfish Fishery (ETBF)
- Skipjack Tuna Fishery
- Small Pelagic Fishery (SPF)
- Southern Bluefin Tuna Fishery (SBTF)
- Southern and Eastern Scalefish and Shark Fishery (SESSF)
- Southern Squid Jig Fishery

Of these fisheries, the Bass Strait CZSF, ETBF, SBTF, SESSF and Southern Squid Jig Fishery have catch effort within the planning area and SESSF and Southern Squid Jig Fishery have catch effort within the operational area based on ABARES reports data for fishing years 2013 – 2021 (Patterson et al. 2022, 2021, 2020, 2019, 2018, 2017, 2016, 2015 and Georgeson et al. 2014).

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in Table 4-22. Detailed mapping is provided where there is overlap between recent fishing intensity and the planning area.

Table 4-22: Commonwealth Managed Fisheries within the Planning Area

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Bass Strait Central Zone Scallop Fishery	Scallops	Fishery operates in the Bass Strait between the Victorian and Tasmanian and starts at 20 nm from their respective coastlines. Commercial scallops in the Bass Strait Central Zone Scallop Fishery are mainly found at depths of 35 - 100 m and are caught using a steel dredge that is towed by the vessel along muddy to coarse sand substrates. Fishing effort is concentrated around King and Flinders Islands. Currently 10 active boats using towed dredges. Fishing season is 1 April to 31 December. Actual catch in 2021 was 2,344 tonnes. The major landing ports are Beauty Point, Devonport and Stanley (Tasmania); Apollo Bay, Lakes Entrance, Melbourne, Port Welshpool, Queenscliff and San Remo (Victoria) Total fishery value in 2021 was A$4.7 million. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the planning area based on ABARES data for 2013 – 2021. There has been no fishing effort in the operational area based on ABARES data for 2013 – 2021. Figure 4-56 shows the total area fished with the highest fishing intensity occurring around King Island.	No	Yes
Eastern Tuna and Billfish Fishery	Albacore tuna Bigeye tuna Yellowfin tuna Swordfish Striped marlin	A longline and minor line fishery that operates in water depths > 200 m from Cape York to Victoria. Fishery effort is typically concentrated along the NSW coast and southern Queensland coast. No Victorian ports are used. In 2017 there was some fishing effort in Victoria at low levels. The number of active vessels has decreased within the fishery from around 152 in 1999 to 35 in 2021. Actual catch in the 2021 season was 5,148 tonnes. Total fishery value in 2021 was A$35.6 million. Fishing mortality: not subject to overfishing. Biomass: Over fished – striped marlin. All other species not overfished. There has been fishing effort within the planning area in 2017 based on ABARES data for 2013 – 2021. There has been no fishing effort in the operational area based on ABARES data for 2013 – 2021.	No	Yes
Skipjack Tuna Fishery (Eastern)	Skipjack tuna	The Skipjack Tuna Fishery is not currently active and the management arrangements for this fishery are under review. There has been no catch effort in this fishery since the 2008 -2009 season.	No	No

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Small Pelagic Fishery (Western sub-area)	Jack mackerel Blue mackerel Redbait Australian sardine	The Small Pelagic Fishery extends from the southern Queensland to southern Western Australia. Fishers use midwater trawls and purse seine nets. Geelong is a major landing port. Total retained catch of the four target species was 18,878 tonnes in the 2021-22 season. Fishery effort generally concentrated in the near-shore Great Australian Bight to the west and south of Port Lincoln. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been no fishing effort in the planning area based on ABARES data for 2013 – 2021/2022. There has been no fishing effort in the operational area based on ABARES data 2013 – 2021/2022.	No	No
Southern Bluefin Tuna Fishery (SBTF)	Southern bluefin tuna	The SBTF covers the entire sea area around Australia, out to 200 nm from the coast. Southern bluefin tuna are also commonly caught off the NSW coastline. In this area, fishers catch these fish using the longline fishing method. A pelagic longline and purse seine fishery that was worth $41.39 million in 2020-21 (actual catch was 5,646 tonnes). The fishery operates year-round. Fishery effort is generally concentrated in the Great Australian Bight and off the southern NSW coast. Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the planning area area based on ABARES data for 2013 – 2021. There has been no fishing effort in the operational area based on ABARES data for 2013 – 2021.	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Southern and Eastern Scalefish and Shark Fishery (SESSF) Shark Gillnet Sector	Elephantfish Gummy shark Sawsharks School shark	The shark gillnet and shark hook sectors (SGSHS) are part of the Gillnet, Hook and Trap Sector (GHTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). Most fishing in the SGSHS using nets occurs in Bass Strait while most fishing using hooks occurs off South Australia. Fishing is generally concentrated east of King Island. Total retained catch of the target species was 2,150 tonnes in the 2021-22 season. No value is provided for 2021-22 season. In 2020-21, the fishery value was A$28.84 million. Fishing mortality: school shark is uncertain. Biomass: school shark is over fished. There has been fishing effort in the planning area based on ABARES data for 2013 – 2021/22. There has been fishing effort in the operational area based on ABARES data for 2013 – 2021/22 (Figure 4-57).	Yes	Yes
Southern and Eastern Scalefish and Shark Fishery (SESSF) Commonwealth Trawl Sector and Scalefish Hook Sector	Blue-eye trevalla Blue grenadier Eastern school whiting Orange roughy Pink ling Ribaldo Tiger flathead	The Southern and Eastern Scalefish and Shark Fishery stretches south from Fraser Island in southern Queensland, around Tasmania, to Cape Leeuwin in southern Western Australia. The planning area is within the Commonwealth Trawl Sector and Scalefish Hook Sector. A multi-sector, multi-species fishery that uses a range of gear year-round. Fishing is generally concentrated along the 200 m bathymetric contour. Total retained catch of the target species was 19,501 tonnes in the 2021-22 season. No value is provided for 2021-22 season. In 2018-19, the fishery value was A$49.47 million. Fishing mortality: some species subject to overfishing. Biomass: some species over fished. There has been fishing effort in the planning area based on ABARES data for 2013 – 2021/22. There has been no fishing effort in the operational area based on ABARES data for 2013 – 2021/22 (Figure 4-57 and Figure 4-59Figure 4-59).	Yes	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Southern Squid Jig Fishery	Gould's squid (arrow squid)	A single species fishery that operates year-round. Portland and Queenscliff are the major Victorian landing ports. Jigging typically occurs midwater at depths between 50 and 100 m at night using large lights that illuminate the waters around a boat. In 2021, the actual catch of 939 tonnes was worth A$3.30 million. In 2021 there were eight active vessels in the fishery with the landing ports being Triabunna (Tasmania); Queenscliff and Apollo Bay (Victoria). Fishing mortality: not subject to overfishing. Biomass: Not over fished. There has been fishing effort in the planning area based on ABARES data for 2013 – 2021. There has been fishing effort in the operational area based on ABARES data for 2013 – 2021. Figure 4-60 shows the total area fished with squid jig in 2021 with the highest fishing intensity occurring near Portland and north of King Island within the planning area.	Yes	Yes

Data/information sources: Australian Fisheries Management Authority (www.afma.gov.au), ABARES Fishery Status Reports 2014 to 2022.

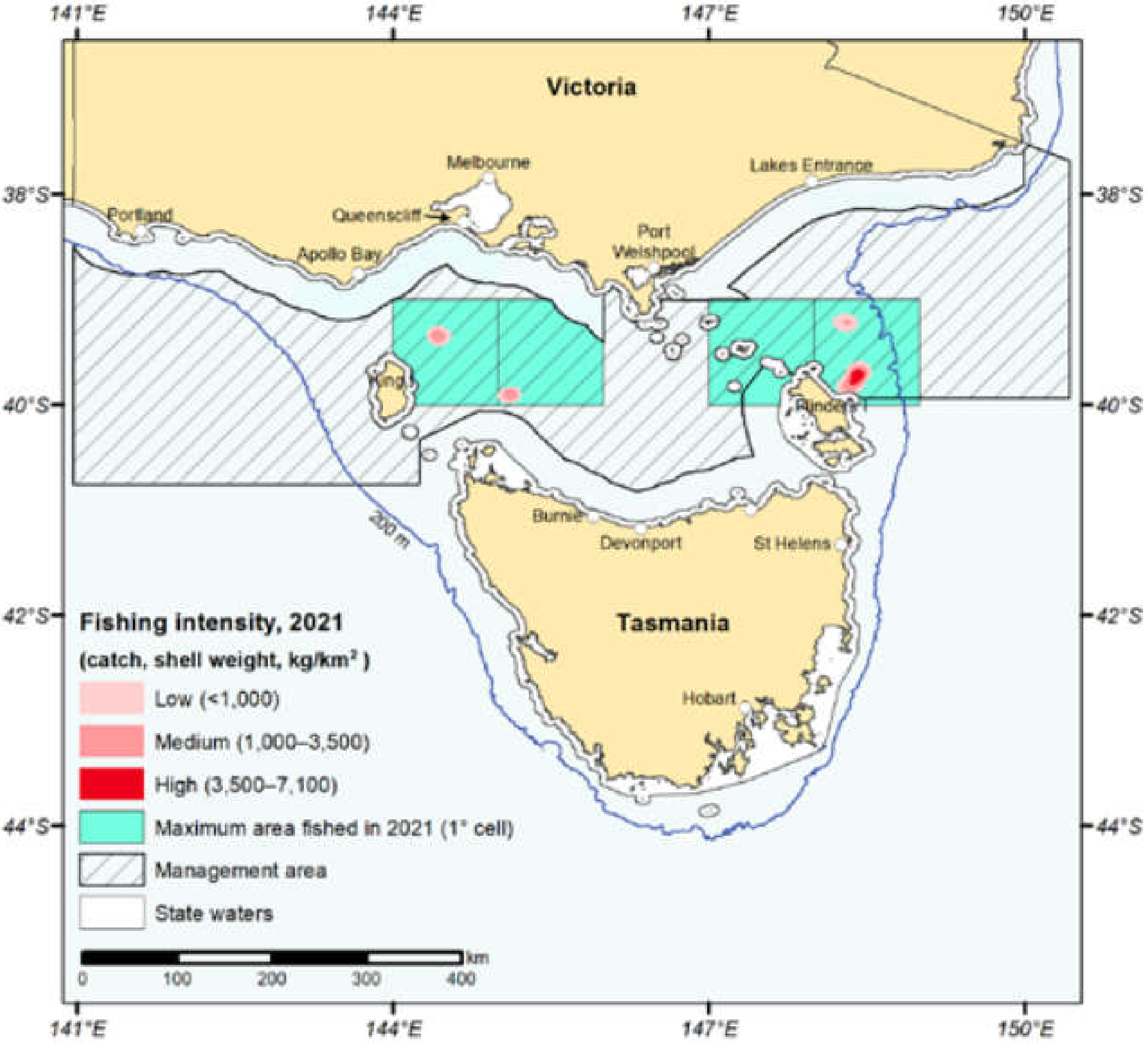


Figure 4-56: Jurisdiction of and Fishing Intensity of the Bass Strait Central Zone Scallop Fishery

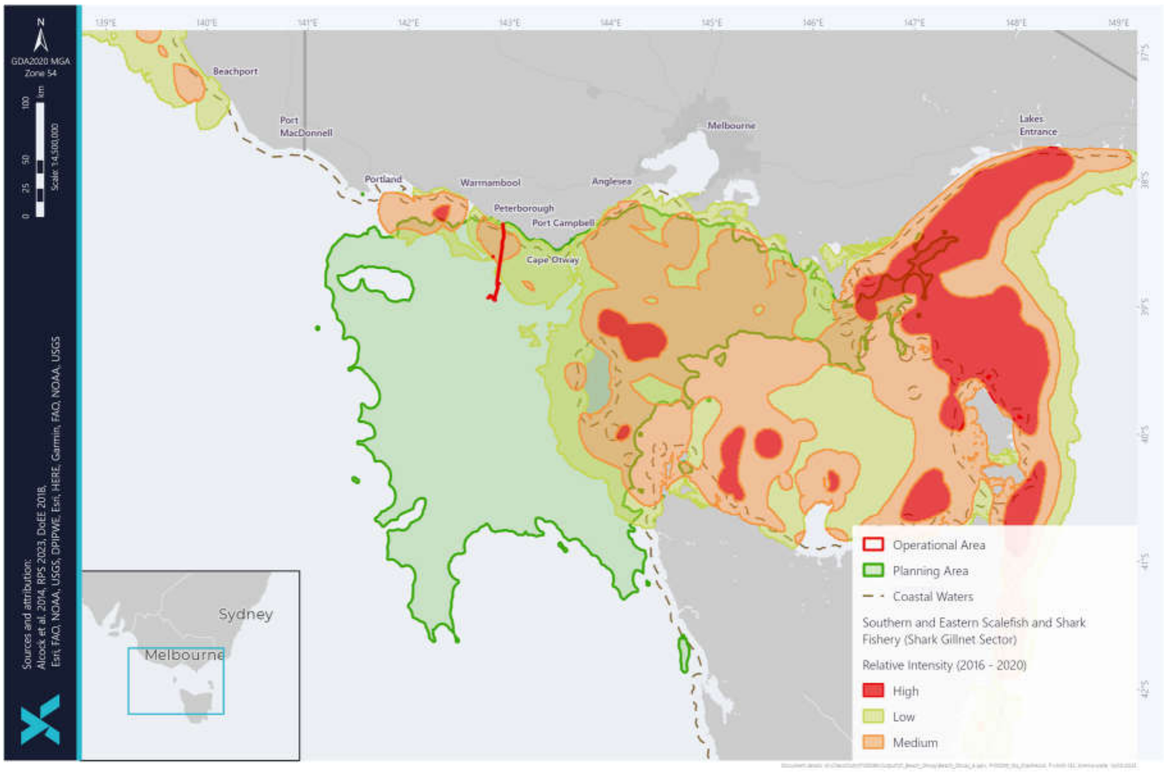


Figure 4-57: Southern and Eastern Scalefish and Shark Fishery (Shark Gillnet Sector) Fishing Intensity (effort, net length, m/km^2)

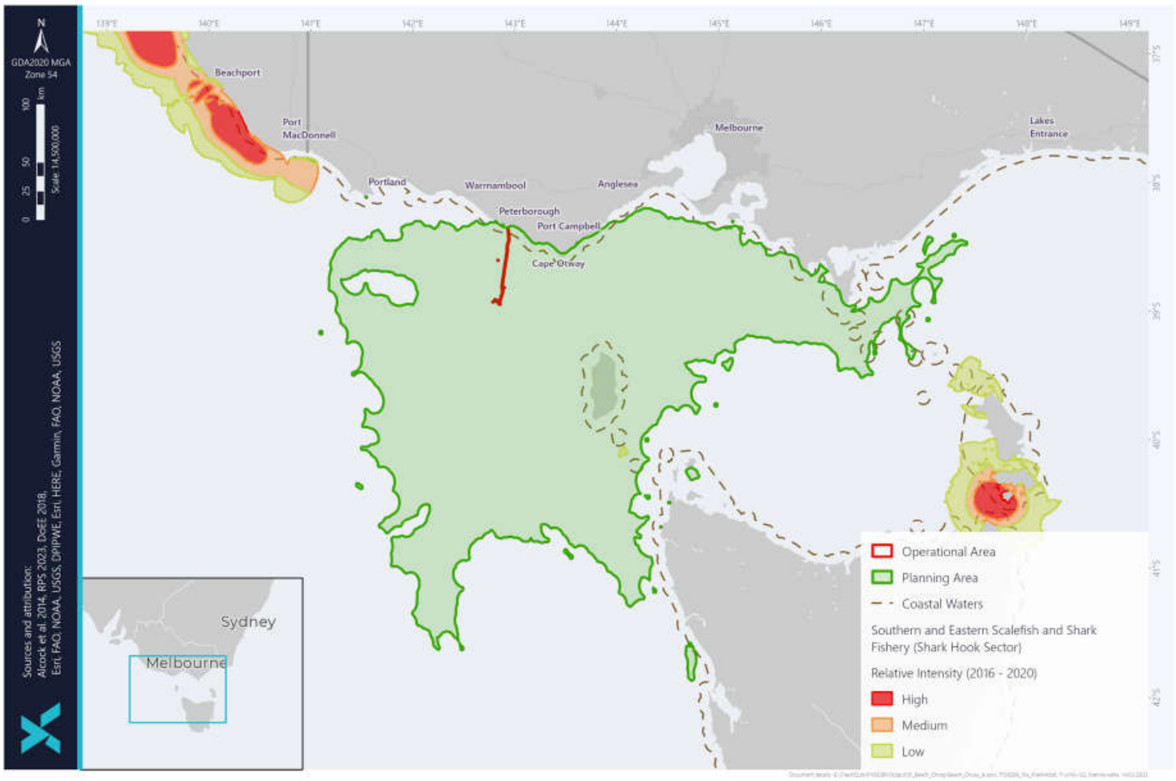


Figure 4-58: Southern and Eastern Scalefish and Shark Fishery (Shark Hook Sector) Fishing Intensity (effort, net length, m/km^2)

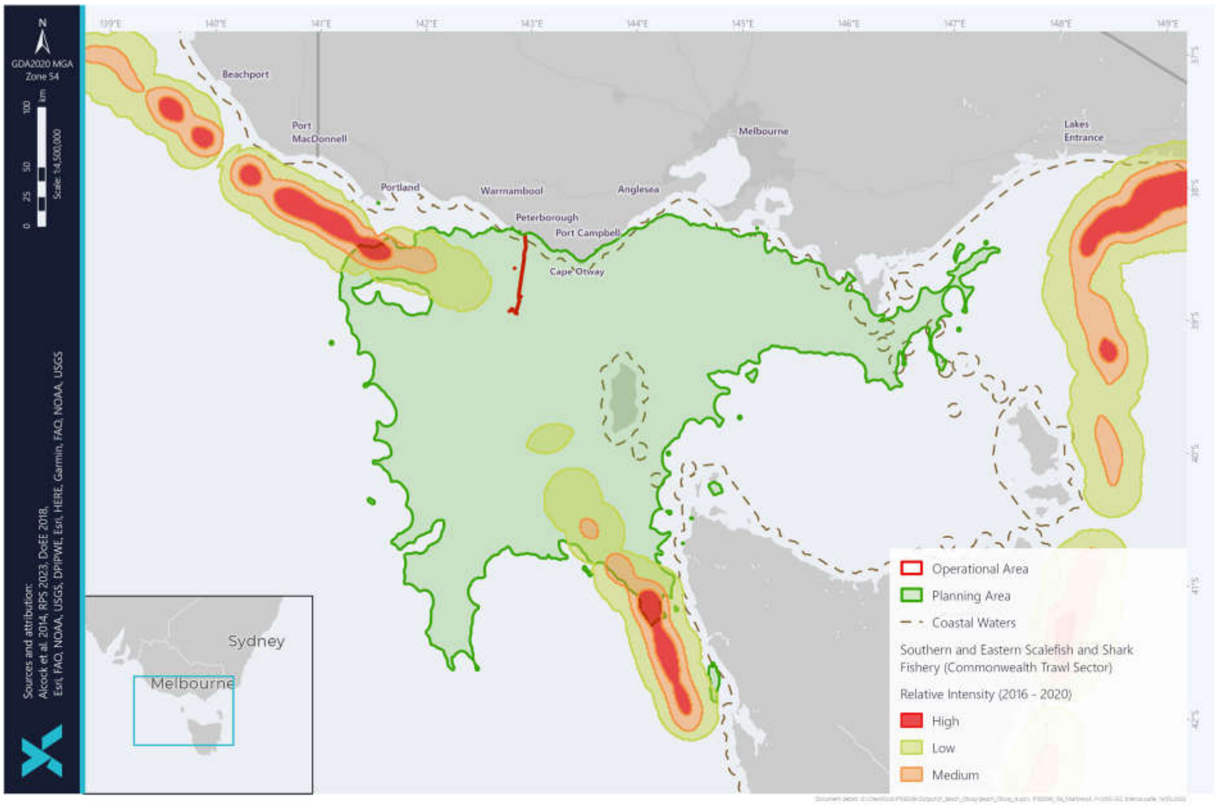


Figure 4-59: Southern and Eastern Scalefish and Shark Fishery (Commonwealth Trawl Sector) Fishing Intensity (effort, net length, m/km^2)

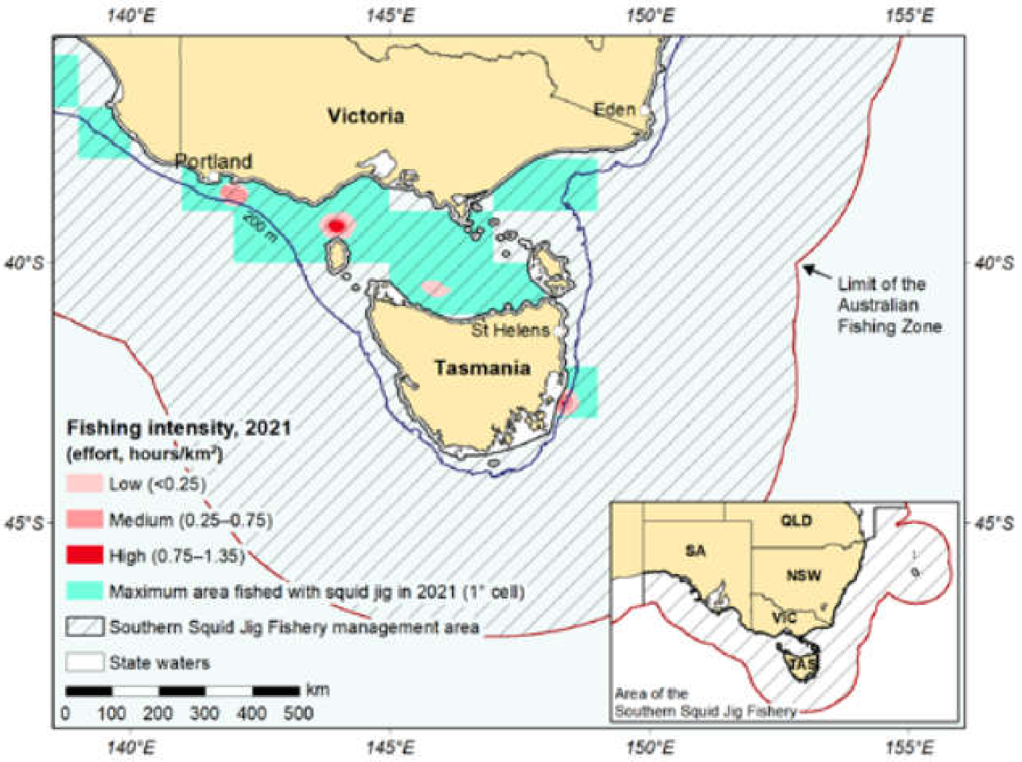


Figure 4-60: Jurisdiction of and Fishing Intensity of the Southern Squid Jig Fishery

4.5.10 Victorian Managed Fisheries

There are ten Victorian state-managed fisheries that overlap the planning area:

- Abalone Fishery
- Bays and Inlet Fisheries
- Eel Fishery
- Giant Crab Fishery
- Multi-species Ocean Fisheries
- Octopus Fishery
- Pipi Fishery
- Rock Lobster Fishery
- Scallop (Ocean) Fishery
- Wrasse (Ocean) Fishery

A description of these fisheries is detailed in Table 4-23.

Table 4-23: Victorian Managed Fisheries in the Planning Area

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Abalone Fishery (western zone)	Blacklip abalone Greenlip abalone	A highly valuable fishery (A$16.8 million in 2020-21) that operates along most of the Victorian shoreline, generally to 30 m depth. Abalone are harvested by divers. Total allowable commercial catch limits of blacklip abalone for the western zone are considerably less than the central and eastern zone (for 2019-20 season, 73.2 tonnes compared with 294.5 and 34.5 tonnes, respectively). There are 14 licences in the western zone. The water depths where abalone are fished are close to shore within the planning area. No fishing effort was identified in the operational area.	No	Yes
Bays and Inlet Fisheries	Multi-species	Multi-species, multi gear fishery utilising octopus, fish and crab traps plus line fishing, seine nets mussel rakes and underwater breathing apparatus. Fisheries within Western Port and Port Phillip Bay are not within the operational or planning area.	No	No
Eel Fishery	Eel	Target species are the short-finned eel (*Anguilla australis*) and long-finned eel (*A. reinhardtii*). Commercial fishers are only permitted to use fyke nets. Total catch for both species in 2020/21 was ~64 tonnes. Species spend the majority of their life cycle in fresh water or estuaries but travel to the ocean to spawn once before dying. Estuaries and migration routes are within the planning area.	No	Yes
Giant Crab Fishery	Giant crab	A small fishery operating in western Victoria and closely linked with the Rock Lobster Fishery. Most vessels are used primarily for rock lobster fishing with giant crab taken as by-product. Fishing effort is concentrated on continental shelf edge (~200 m deep). Giant crabs inhabit the continental slope at approximately 200 m depth and are most abundant along the narrow band of the shelf edge. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) giant crabs. Total landed catch in 2015-16 was 10 tonnes. Data for 2020/21 is not available due to insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data) (VFA 2021). Figure 4-61 shows overlap with the operational and planning areas overlap the giant crab fished areas. Data from VFA shows the number of fishers in the operational has increased from one to two in 2020 and to three in 2021.	Yes	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Planning Area
Multispecies Ocean Fisheries – Ocean General Fishery	Gummy shark School shark Australian salmon Snapper Small flathead bycatch	The wrasse, inshore trawl, southern rock lobster and giant crab fisheries are able to catch gummy shark and school sharks as part of their fishery. Snapper are caught using lines, nets and haul seine. Over 90% of the catch is from Port Phillip Bay, and around 5% from coastal waters. In 2020/21, 45 tonnes were landed but a values could not be provided as there is insufficient data to report because there are less than five licence holders (policy requirement to protect commercial confidentiality of data) (VFA 2021). Figure 4-62 shows the operational area and planning area overlaps areas fished. The nearshore operational area has had up to two fishers with no fishing since 2018.	Yes	yes
Multispecies Ocean Fisheries – Inshore Trawl	Eastern king prawn School prawn Shovelnose lobster/Balmain bug Minor bycatch of school whiting	The fishery operates along the entire Victorian coastline, excluding marine reserves, bays and inlets. Most operators are based at Lakes Entrance. Otter-board trawls with no more than a maximum head- line length of 33 m, or single mesh nets are used. As of June 2019, there were 54 fishery access licences, with only about 15 active to various degrees. Figure 4-63 shows the operational area and planning area overlaps areas fished. The nearshore operational area has had one fisher in 2012.	No	Yes
Octopus Fishery	Pale octopus Maori octopus Gloomy octopus	The octopus fishery (Eastern Zone) is a new fishery harvesting mainly pale octopus (Octopus pallidus) in East Gippsland. The fishery may also catch maori octopus (*Macroctopus maorum*) and gloomy octopus (*Octopus tetricus*). Octopus are caught using purpose-built unbaited traps. The fishery commenced on 1st August 2020. Three fishery locations have been established for this new fishery; Eastern, Central and Western octopus zones. The Eastern zone is where the majority of commercial octopus takes place with the Central and Western zones are less established but are being managed by VFA through exploratory, temporary permits. Figure 4-64 shows that the operational area does not overlap where octopus are fished but the planning area does.	No	Yes
Pipi Fishery	Pipi	Main commercial harvesting area is Discovery Bay with limited activity in Venus Bay. Harvested in the high impact beach zone using traditional dip nets. Figure 4-65 shows that the operational area and planning area do not overlap where pip fishing occurs.	No	No

Fishery	**Target species**	**Description**	**Fishing Effort Operational Area**	**Fishing Effort Planning Area**
Rock Lobster Fishery (western zone)	Southern rock lobster	Victoria's second most valuable fishery with a production value of A$13.6 million in 2020/21. Since 2009/10, annual quotas have been set at between 230 and 260 tonnes and have been fully caught each year. In the western zone, most catch is landed through Portland, Port Fairy, Warrnambool, Port Campbell and Apollo Bay. Closed seasons operate for male (15 September to 15 November) and female (1 June to 15 November) lobsters. Southern rock lobsters are found to depths of 150 m, with most of the catch coming from inshore waters less than 100 m deep. Figure 4-66 shows overlap with the operational and planning areas overlap the southern rock lobster fished areas. Data from VFA the number of fishers in 2021 in the nearshore of the operational was five decreasing to up to two in the offshore operational area.	Yes	Yes
Scallop (Ocean) Fishery	Scallops	Extends the length of the Victorian coastline from high tide mark to 20 nm offshore. Fishers use a scallop dredge. Temporary closures occur when stocks are low to allow scallop beds to recover. Total allowable commercial catch for 2015-16 was set at 135 tonnes. Scallops are mostly fished from Lakes Entrance and Welshpool. Figure 4-67 shows no overlap of the fished areas with the operational and a small overlap at the eastern edge of the planning area.	No	Yes
Wrasse (Ocean) Fishery	Bluethroat wrasse Purple wrasse Small catches of rosy wrasse, senator wrasse and southern Maori wrasse	Extends the length of the Victorian coastline from high tide mark to 20 nm offshore. Fishers mostly use hook and line. Limited entry fishery with 22 current licences. Total annual catch in 2019/20 was 21.5 tonnes. Figure 4-68 shows fishing effort within the planning area and adjacent to the nearshore operational area where there has been one fisher.	Yes	Yes

Data/information sources: Victorian Fisheries Authority (www.vfa.vic.gov.au), DoEE (2015), State Govt of Victoria (2015a, b)

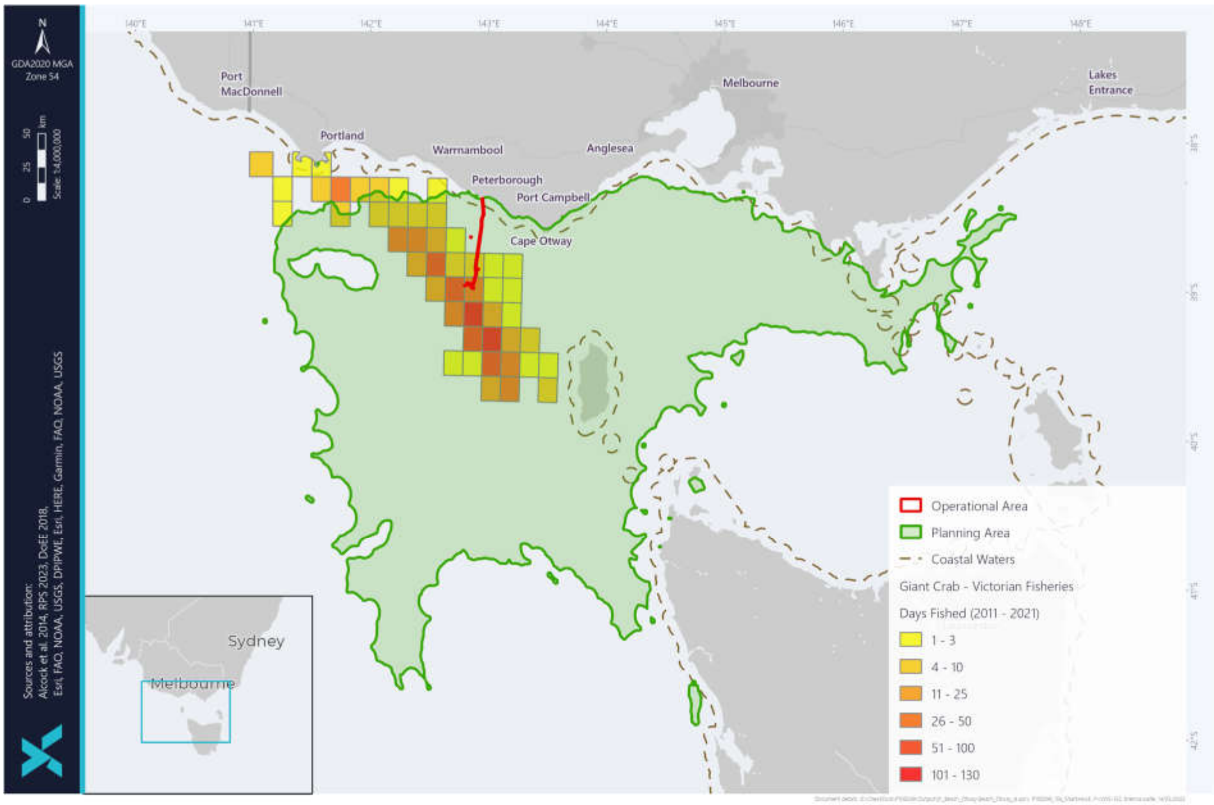


Figure 4-61: Giant Crab Fished Days from 2011-2021. Data obtained from VFA 2022.

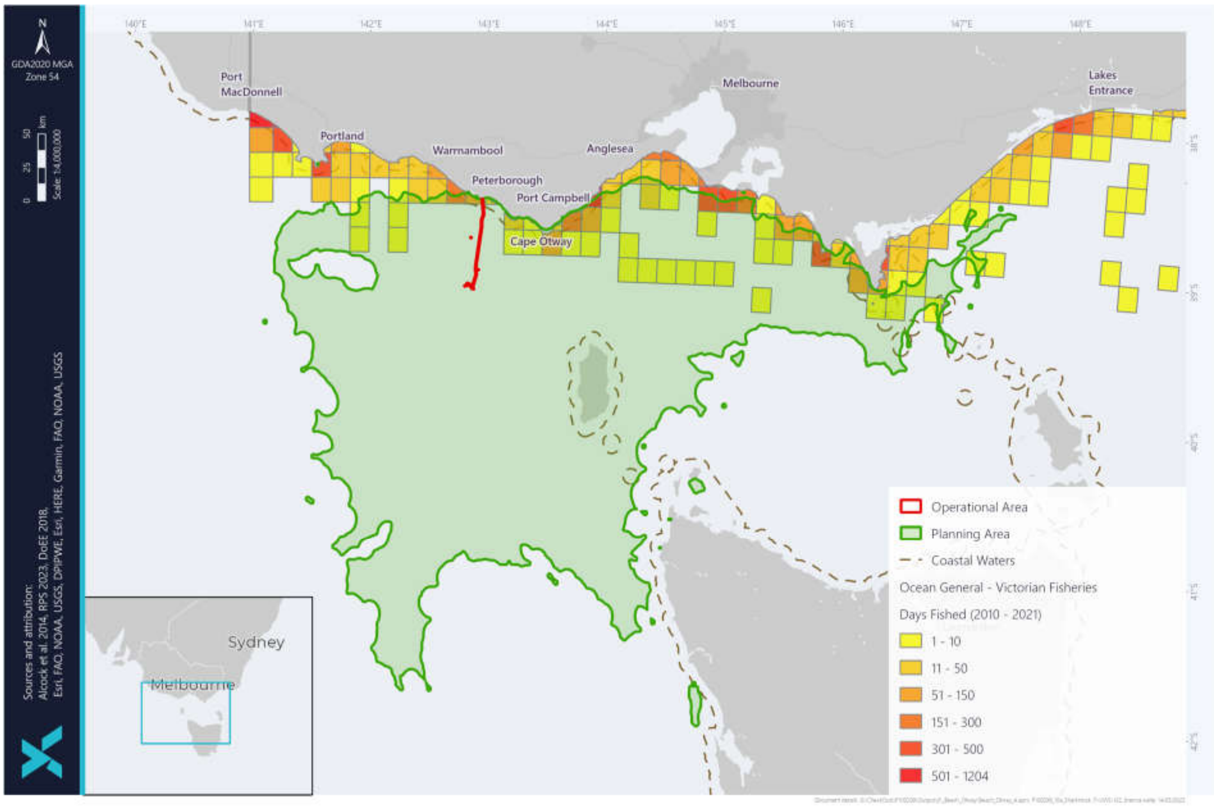


Figure 4-62: Ocean General Fished Days from 2011-2021. Data obtained from VFA 2022.

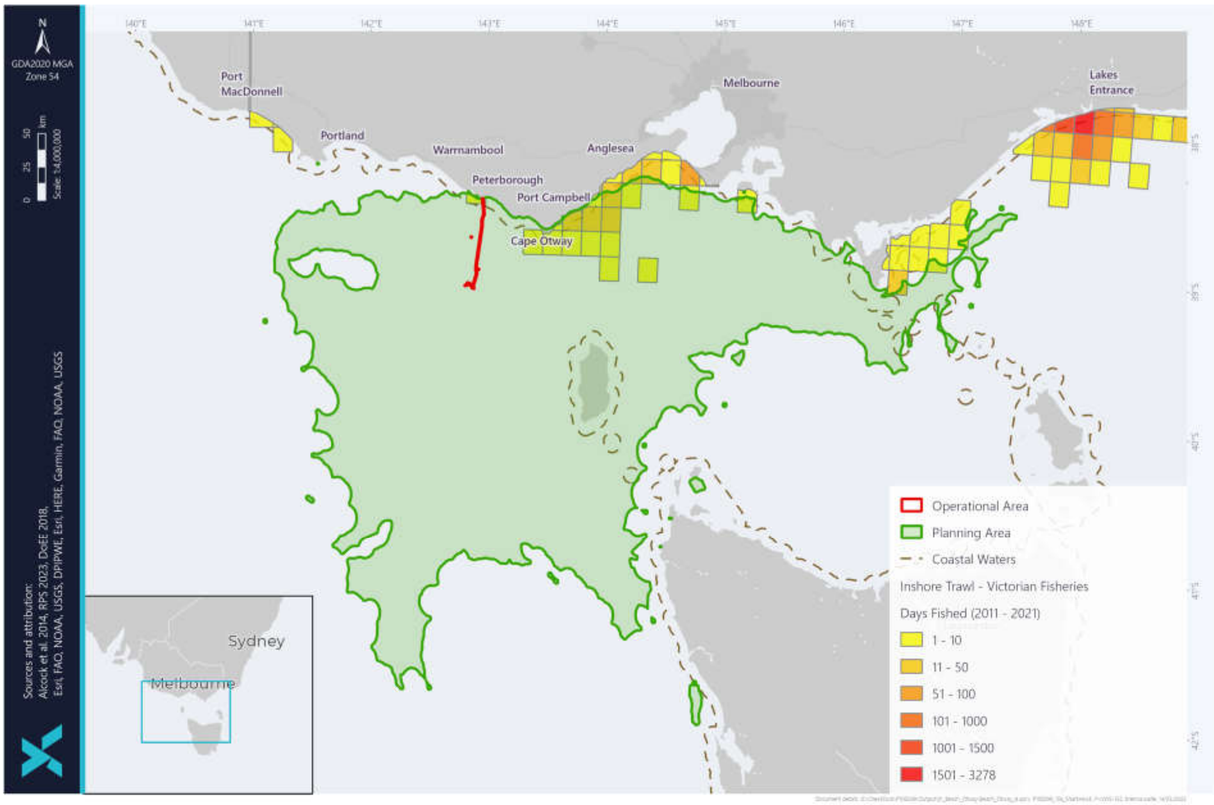


Figure 4-63: Inshore Trawl Fished Days from 2011-2021. Data obtained from VFA 2022.

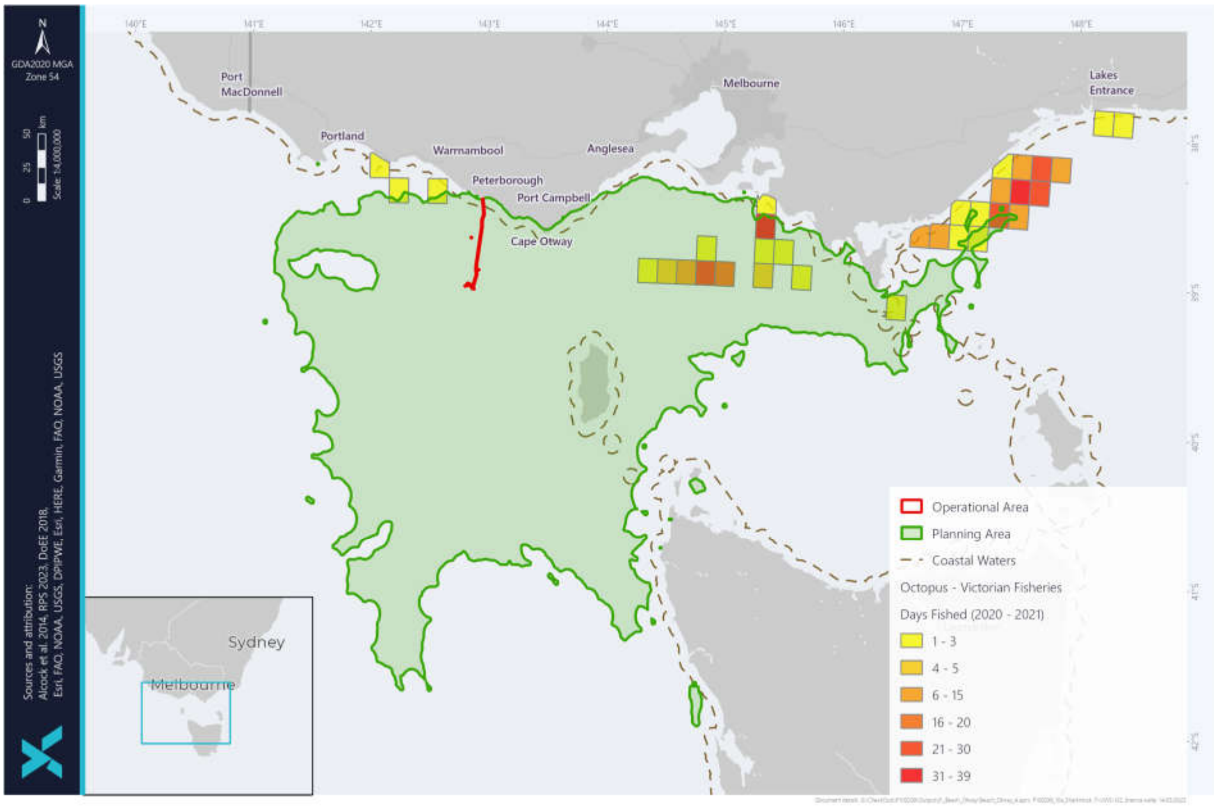


Figure 4-64: Octopus Fished Days from 2011-2021. Data obtained from VFA 2022.

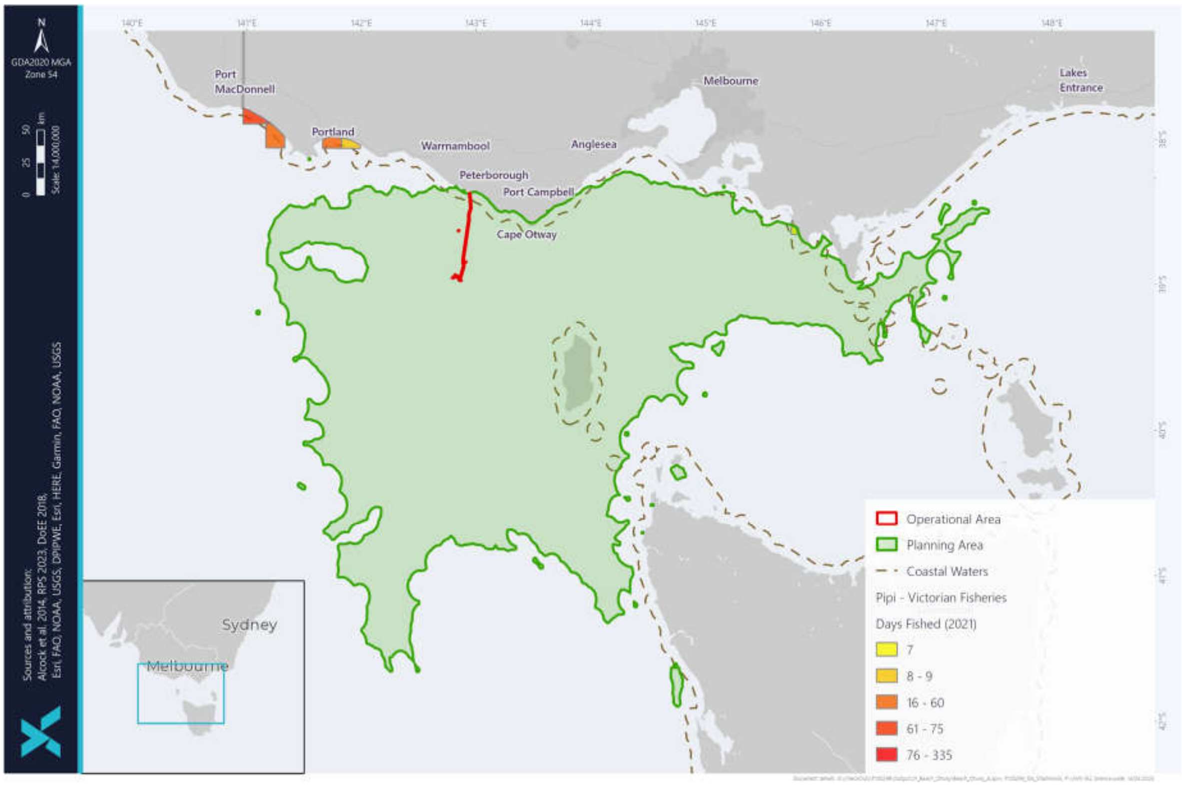


Figure 4-65: Pipi Fished Days from 2011-2021. Data obtained from VFA 2022.

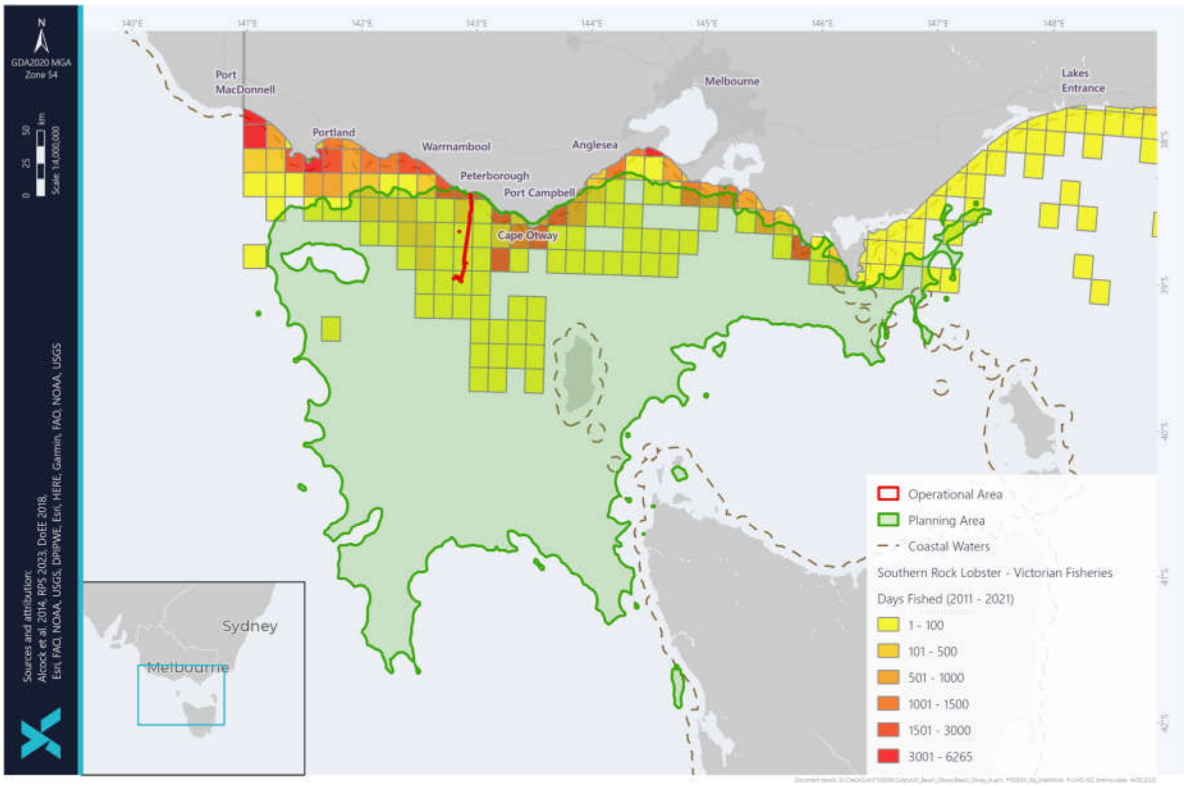


Figure 4-66: Southern Rock Lobster Fished Days 2011-2021. Data obtained from VFA 2022.

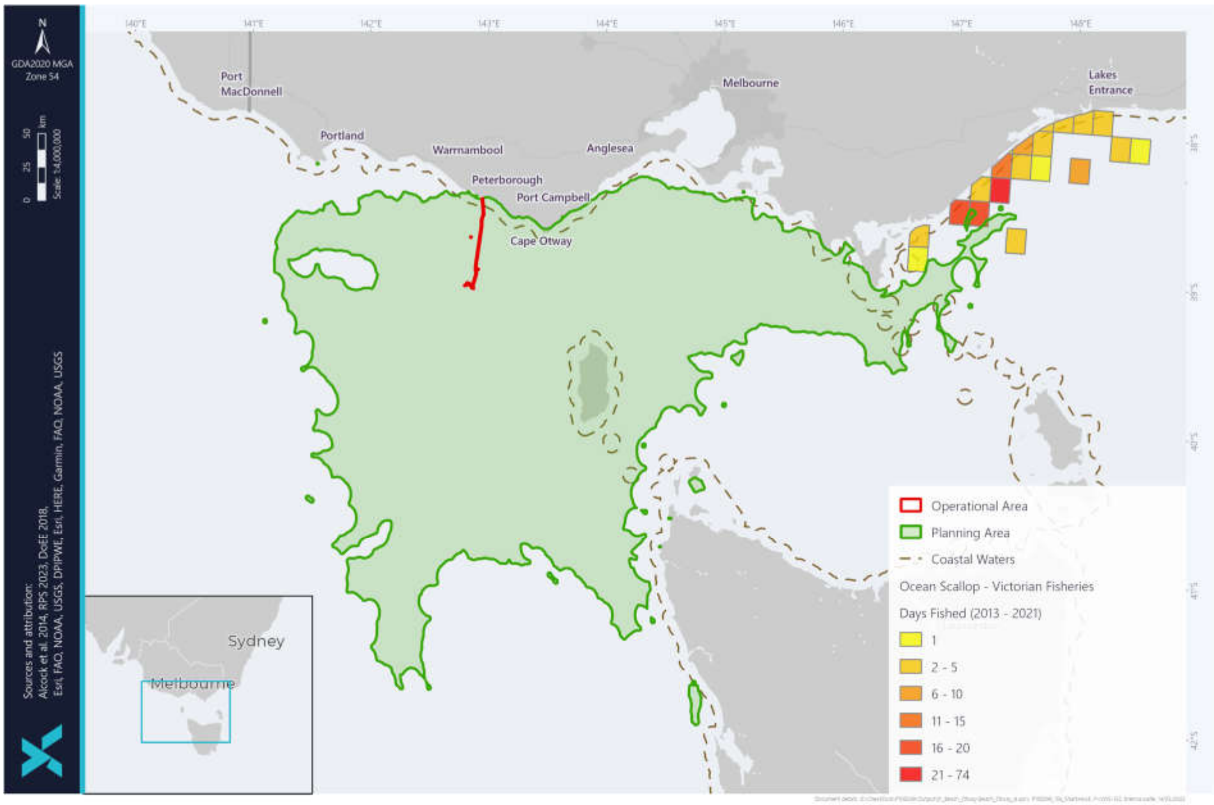


Figure 4-67: Scallop Fished Days 2011-2021. Data obtained from VFA 2022.

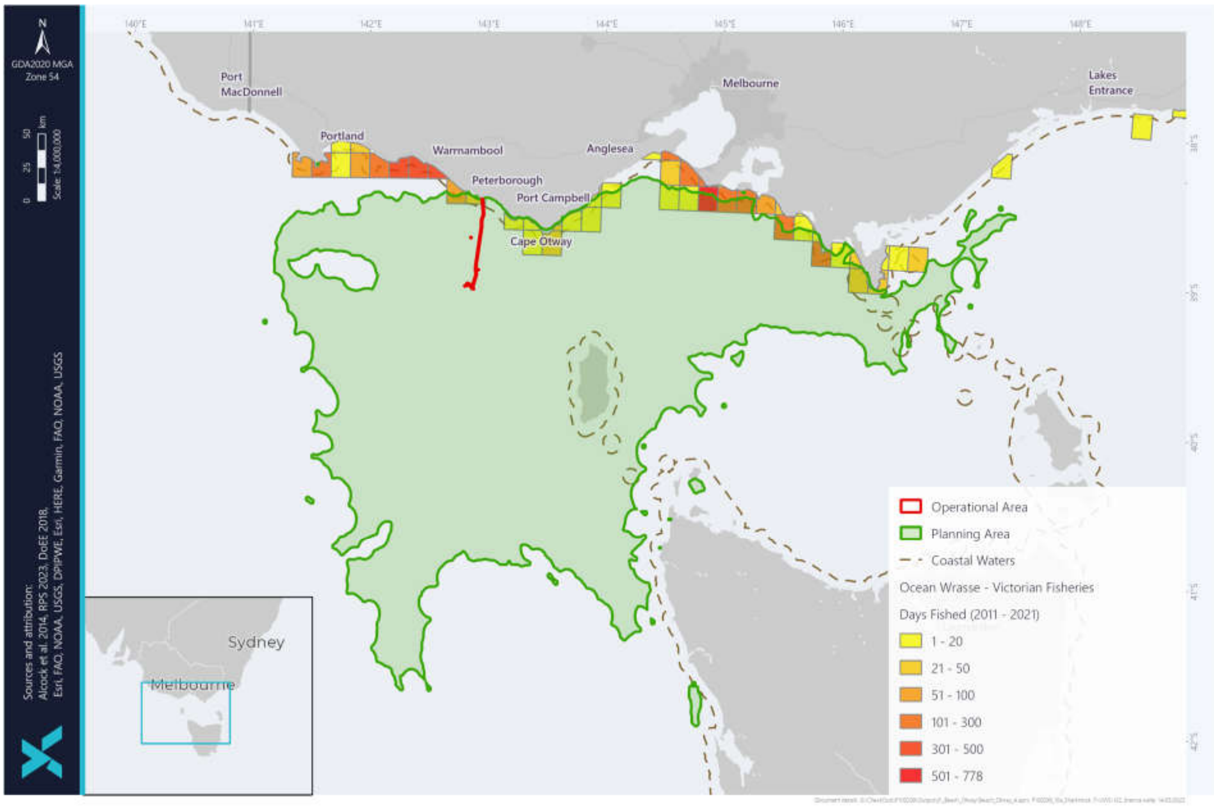


Figure 4-68: Wrasse Fished Days 2011-2021. Data obtained from VFA 2022.

4.5.11 Tasmanian Managed Fisheries

No Tasmanian fisheries occur within the operational area.

There are eight Tasmanian state managed commercial fisheries that potentially occur within the planning area:

- Abalone Fishery
- Commercial Dive Fishery
- Giant Crab Fishery
- Marine Plant Fishery
- Rock Lobster Fishery
- Scalefish Fishery
- Scallop Fishery
- Shellfish Fishery

A description of these fisheries is in Table 4-24.

Historic catch assessments indicate that Commercial Dive, Scallop and Shellfish Fisheries activities are unlikely to occur in the planning area, with fishing effort located in other areas of these fisheries. The Rock Lobster and Abalone Fisheries, which are by far the most productive and economically important Tasmanian fisheries accounting for 95% of the total value, are both expected to be active within the planning area. Giant Crab, Scalefish, Scallop and Seaweed Fisheries are also likely to be active within the planning area to varying degrees.

Table 4-24: Tasmanian Managed Fisheries in the Planning Area

Fishery	Target species	Description	Fishing Effort Planning Area
Abalone Fishery (Northern and Bass Strait Zones)	Black lip (*Haliotis rubra*) and greenlip abalone (*H. laevigata*)	Largest wild abalone fishery in the world (providing ~25% of global production) and a major contributor to the local economy. Abalone are hand-captured by divers in depths between 5-30 m. Blacklip abalone are collected around on rocky substrate around the Tasmanian shoreline and are the main focus of the fishery. Greenlip abalone are distributed along the north coast and around the Bass Strait islands and usually account for around 5% of the total wild harvest. In 2020/21, the gross value of production of the fishery was around $50 million from a total catch of approximately 1,000 tonnes. The jurisdictional area of the Abalone Fishery is Tasmanian State waters. The planning area intersects the Northern Zone (waters around King Island) and Bass Strait Zone (waters in the Northern Bass Strait Region) of the Abalone Fishery.	Yes
Commercial Dive Fishery (Northern Zone)	Shortspined sea urchin (*Heliocidaris erythrogramma*) Wavy periwinkles (*Lunella undulata*) Longspined sea urchin (*Centrostephanus rodgersii*)	Dive capture fishery that targets several different species; the main species collected being sea urchins and periwinkles. In 2020-2021 approximately 180 t of sea urchins and 2.07 t of periwinkles were harvested. Sea urchins and periwinkles accounting for 63% and 37% of the total respectively. Jurisdiction encompasses all Tasmanian State waters (excluding protected and research areas), although licence holders largely operate out of small vessels (<10 m) and effort is concentrated on the south and east costs of Tasmania around ports. The planning area intersects the Northern Zone of the Commercial Dive Fishery at King Island and in the northern Bass Strait. The Northern Zone of the fishery is defined as the area of Tasmanian State waters on the east coast bounded by the line of latitude 42°20'40"S in the south and extending north to the line of latitude 41°00'26"S (from the southern point of Cape Sonnerat to Red Rocks).	Yes

Fishery	Target species	Description	Fishing Effort Planning Area
Giant Crab Fishery	Giant crab (*Pseudocarcinus gigas*)	The giant crab fishery is a comparatively small fishery with the annual harvest set at 20.7 tonnes but with a high landed value of around $2 million. The fishery has been commercially targeted since the early 1990s, moving from open access to limited entry. The area of the fishery includes waters surrounding the state of Tasmania generally south of 39º12 out to 200 nm. Within the area of the fishery, most effort takes place on the edge of the continental slope in water depths between 140 m and 270 m. CPUE has declined continually since the inception of the fishery in the early 1990s indicating that it has been overfished. The TAC has been reduced to 20.7 t for 2019/120 and 2021/2022 to address the issue. The planning area potentially overlaps the area where giant crabs are fished for on the continental slope.	Yes
Rock Lobster Fishery	Southern rock lobster (*Jasus edwardsii*)	Southern rock lobster are the other major wild-caught Tasmanian fishery. For 2022-23 the Total Allowable Catch remains at 1050.7 t. Southern rock lobsters are found to depths of 150 m with most of the catch coming from inshore waters less than 100 m deep throughout state waters. The fishery is a limited entry with 312 licences. The planning area potentially overlaps the Rock Lobster Fishery.	Yes
Scalefish Fishery (northwest coast)	Multi-species and multi-gear fishery	Complex multi-species fishery harvesting a range of scalefish, shark and cephalopod species. Fourteen different fishing methods are used. Highest commercial catches in 2019/20 were reported for Southern Calamari (85.8 t), Wrasse (52.4 t), and Eastern School Whiting (43.7 t). Due to the fishery being under caught by 26.7% in the previous season 2020/21, the Total Allowable Catch for the 2021/22 season has increased to 30 kg quota unit. The planning area potentially overlaps the Scalefish Fishery.	Yes

Fishery	Target species	Description	Fishing Effort Planning Area
Scallop Fishery	Commercial scallop (*Pecten fumatus*)	Fishery area extends 20 nm from the high water mark of Tasmanian state waters into Bass Strait and out to 200 nm offshore from the remainder of the Tasmanian coastline. Eight vessels are active in the fishery. Fishers use a scallop dredge. Scallop beds are generally found along the east coast and Bass Strait in depths between 10-20 m but may occur in water deeper than 40 m in the Bass Strait. Scallop habitat is protected through a ban on dredging in waters less than 20 m and a network of dredge-prohibited areas around the state. There is high variability in abundance, growth, mortality, meat yield and condition of scallop stock in the fishery and recruitment is sporadic and intermittent. Managed using an adaptable strategy where surveys are undertaken to estimate abundance and decision rules are used to open an area (or areas) to fishing. When open the scallop fishery contributes significantly to total fisheries production. In 2015 the scallop fishing season ran from July to October and the catch was 781 t. At present the Tasmanian Commercial Scallop fishery remains closed. The planning area does not overlap the area of effort for the Scallop Fishery.	No
Marine Plant Fishery	Bull kelp (*Durvillea Pototorum*) Japanese kelp (*Undaria pinnatifida*)	Marine plants include kelp, seaweed, seagrasses, and algae which are food and habitat for other marine species. To protect Tasmanian marine ecosystems, no marine plants may be harvested directly from the water, except in the Undaria fishery. The majority of cast bull kelp is collected from King Island. The right to harvest and process kelp on King Island was granted exclusively to Kelp Industries Pty Ltd in the mid-1970s. About 80 to 100 individuals collect cast bull kelp and transport it to the Kelp Industries plant in Currie. An average annual harvest above 3000 t (dried weight) has been produced in recent years, accounting for about 5% of the world production of alginates (i.e. the end product of dried bull kelp). The cast bull kelp harvesting on King Island generates about $2 million annually. Comparatively minor cast bull kelp collection also occurs at two centres of operation on Tasmania's West Coast: around Bluff Hill Point and at Granville Harbour. Japanese kelp is harvested by divers only along Tasmania's east coast where it is already well established. The planning area potentially overlaps the area where bull kelp is collected from King Island.	Yes

Fishery	Target species	Description	Fishing Effort Planning Area
Shellfish Fishery	Katelysia cockles (*Katelysia scalarina*) Venerupis clam (*Venerupis largillierti*) Native oyster (*Ostrea angasi*) Pacific oyster (*Crassostrea gigas*)	Comprises specific shellfish species hand captured by divers in defined locations on the east coast of Tasmania, namely Angasi oysters in Georges Bay, Venerupis clams in Georges Bay and Katelysia cockles in Ansons Bay. The taking of Pacific oysters, an invasive species, is also managed as part of the fishery but no zones apply. Pacific oysters can be collected throughout all State waters (which includes areas within the planning area), as the aim of harvesting these animals is to deplete the wild population. The estimated total value of the shellfish fishery based on landings from 2001-2005 was $345,538. The planning area does not overlap the Shellfish Fishery.	No

Data/information sources: Department of Primary Industries, Water and Environment (DPIPWE, 2021). Australian fisheries and aquaculture statistics 2014-15 (Patterson et al, 2022), Department of the Environment and Energy (DotEE, 2017c), Fish Research and Development Corporation (FRDC, 2017), Fishing Tasmania Webiste 2023.

4.5.12 Seaweed Industry

The Australian seaweed industry is small: currently valued at an estimated GVP of AUD $3 million. Of this, the majority is from one company, Kelp Industries Pty Ltd on King Island in Tasmania, who hand collect plants cast bull kelp (*Durvillea pototorum*) on the beaches from predominantly the west coast of the island, predominantly for export to a large alginate manufacturer and for use in biofertiliser products (Australian Seaweed Institute 2023). Australia Bureau of Statistics (ABS) data shows seaweed exports from Australia are valued at $1.5 million for non-human consumption and it is assumed that this is almost entirely from Kelp Industries exports.

Besides Kelp Industries, other seaweed collectors in Tasmania include Kelpomix and TasKelp. There are also licenses for wild harvest of the invasive species of Undaria in Tasmania (KaiHo Ocean Treasure) and some in Victoria (Australian Seaweed Institute 2023).

The harvesting of native seaweed in Victorian marine waters is prohibited without a permit (s. 112(2) Fisheries Act 1995) and licences enabling seaweed aquaculture are not currently available in Victoria (VFA 2023a).

While there are numerous research projects taking place or being planned, currently there are two projects in Tasmania (Australian Seaweed Institute 2023). The first, is a CRC-P project involving collaboration with Tassal, Spring Bay Seafoods and University of Tasmania (UTAS). This project aims to demonstrate the benefits of Kelps as part of an integrated multitrophic aquaculture approach. The second is a research collaboration between UTAS and Huon Aquaculture in Storm Bay that will also yield its first harvest in late 2020.

4.6 First Nations

First Nations people groups inhabited the southwest Victorian coast as is evident from the terrestrial sites of Aboriginal archaeological significance throughout the area. During recent ice age periods (the last ending approximately 12,000-14,000 years ago), sea levels were significantly lower, and the coastline was a significant distance seaward of its present location, enabling occupation and travel across land that is now submerged.

Figure 4-69 details the Victorian Traditional Owners adjacent to the operational and planning areas.

Coastal Aboriginal heritage sites include mostly shell middens, some stone artefacts, a few staircases cut into the coastal cliffs, and at least one burial site. The various shell middens within the Port Campbell National Park and Bay of Islands Costal Park are close to coastal access points that are, in some cases, now visitor access points (Parks Victoria, 2006b).

First Nations people have inhabited Tasmania for at least 35,000 years. At the end of the last ice age the sea level rose, and Tasmania became isolated from the mainland of Australia. They survived in the changing landscape partly due to their ability to harvest aquatic resources, such as seals and shellfish.

Following conflict between the European colonists and the Tasmanian First Nation peoples, many were relocated to missions on Bruny Island, Flinders Island and other sites, and finally to Oyster Cove. The number of Aboriginal people diminished drastically. The Aboriginal Heritage Register (AHR) lists over 13,000 sites; however, there is no searchable database to identify any sites in the planning area.

The *palawa* (Tasmanian Aboriginal) people as the Traditional Owners of *lutruwita* (Tasmania).

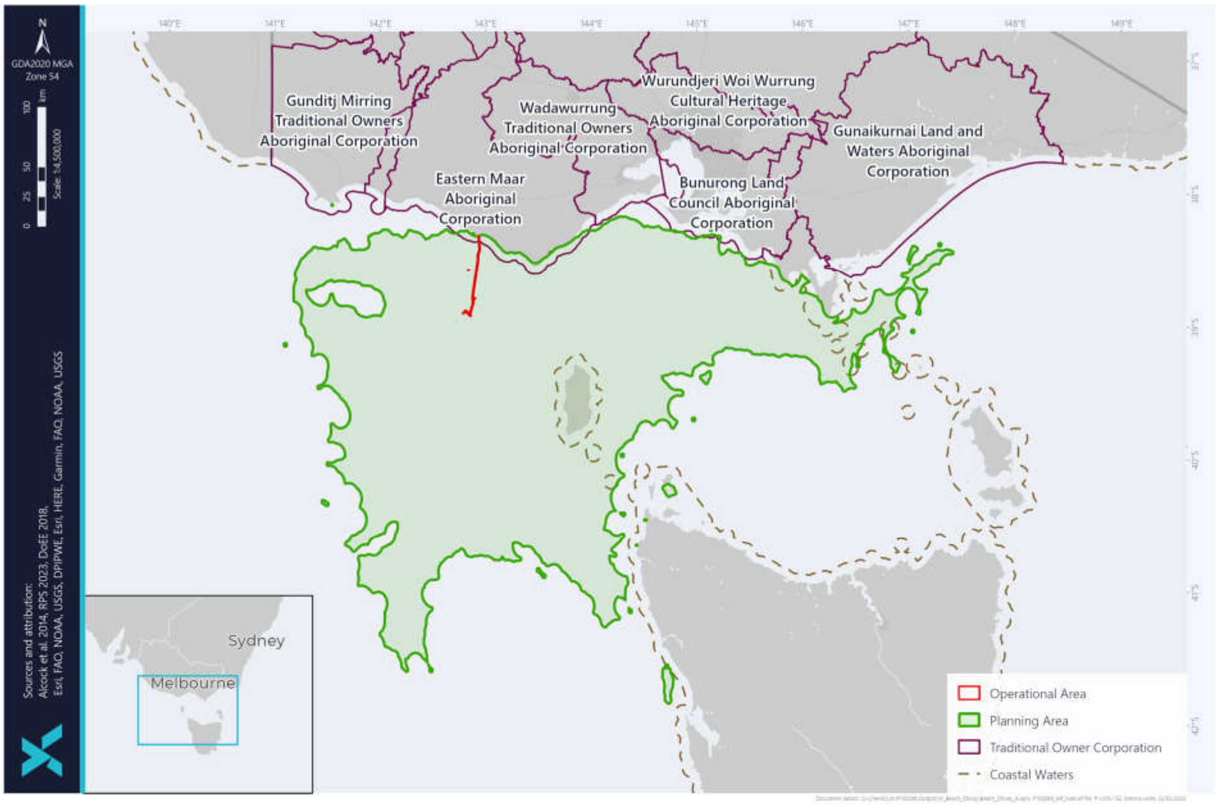


Figure 4-69: Victorian Traditional Owners within the Planning Area

4.6.1 Sea Country

Country is the term often used by First Nations people to describe the lands, waterways, and seas to which they are connected. The term contains complex ideas about law, place, custom, language, spiritual belief, cultural practice, material sustenance, family, and identity (AIATSIS, 2022). Sea Country also known as Saltwater Country may extend into the planning area.

Smyth and Isherwood (2016) describe Sea Country as all estuaries, beaches, bays, and marine areas collectively, within a traditional estate. Sea Country contains evidence of the ancient mystical events by which all geographic features, animals, plants, and people were created. Sea Country contains sacred sites and contains tracks (or song lines) along which mythological beings travelled during the creation period (Smyth and Isherwood, 2016). The sea, like the land, is integral to the identity of First Nations groups. Connection to Sea Country is accompanied by a complexity of cultural rights and responsibilities. Formal recognition of Sea Country rights lags considerably compared to land rights; this could be for a range of reasons including conflicting perspectives and opinions on traditional custodianship of land and how far it extends (Smyth and Isherwood, 2016).

First Nations people see themselves as having responsibilities and rights across the land and sea boundaries that have been put in place over the last 200 years, this includes land that was once inundated by sea, and land that now lies beneath the sea (NOO, 2002a).

Information regarding the cultural significance of whales, where available, is detailed in Section 4.4.7.6.

4.6.2 Sea Country within the South East Marine Region

Contemporary Indigenous interests in the SEMR are diverse and complex. Indigenous people live around the region in major cities, regional centres, small towns and on First Nations land. There are no reliable statistics for the number of First Nations people living in coastal areas of the region in Victoria and Tasmania. But we know that many have been displaced from the coastal areas (NOO, 2002a).

According to the ABS (2021) census data, 2.9% of the population of Currie (King Island, Tasmania) identify as Aboriginal and/or Torres Strait Islander Coastal areas of southeast Australia were amongst the most densely populated regions of pre-colonial Australia. These highly populated areas provided an abundance of marine and other resources. As a result, coastal shell middens and many sacred sites, places and artefacts along the coast exist in the region. At least 17 distinct Aboriginal language groups occupied and used coastal land and seas in this region. The planning area intersects coastal areas associated with the major indigenous language groups of the Giraiwurung and Gadubanud groups (NOO, 2002a).

The Eastern Maar are Traditional Owners of southwest Victoria, and currently occupy a registered Native Title claim on the land adjacent to the operational and planning area and 100 m out to sea. Their land extends as far north as Ararat and encompasses Warrnambool, Port Fairy and other areas along the Great Ocean Road, it also stretches 100 m out to sea from low tide and therefore includes the iconic Twelve Apostles (EMAC, 2020). According to EMAC (2020), one of the services provided by the Eastern Marr group is the involvement/consultation and conducting of fieldwork with Cultural Heritage Management Plans in conjunction with a Heritage Advisor, with this collaboration reflecting the notion of “Working on Country together” (EMAC, 2020). Other services that can be requested are traditional ‘Welcome to Country’, Traditional Smoking Ceremony and Traditional Dance on traditional land.

4.6.3 Historic Use of Sea Country

First Nation peoples’ relationship with offshore waters was based on travel to islands in bark rafts and canoes, and the use and management of coastal species (e.g., migratory eels - Section 4.4.7.3 and bull kelp – Section 4.4.1.3) that are part of ocean ecosystems far from the coast (NOO, 2002a). The extent of pre-colonial Sea Country varied through time and between regions. Aboriginal occupation of Australia extends at least 60,000 years, and possibly considerably longer (NOO, 2002a). During this time, sea levels have risen over 100 metres, resulting in flooding of coastal lands. Following stabilisation of the sea level (about 6,000 years ago), Sea Country use was observed at the time of British colonisation in northern Australia. Observations included extended sea voyages by canoe to gather resources and manage clan, in some places out of sight of the mainland.

4.6.4 Contemporary use of Sea Country

A major issue for Victorian First Nations people is the lack of recognition of access to and equity in the utilisation of marine resources. This is closely related to the forced removal from traditional lands experienced by many Indigenous people. Also of concern is the management and passing on of traditional knowledge of marine management practice that is generations old (NOO, 2002a). Within Victoria, engagement with First Nations people and their connection to Sea Country can be seen in activities such as the collaboration between scientists and the Gunditjmara traditional owners to research and discover more about freshwater eels and their migration patterns (Stevens, 2021).

There has been recent momentum regarding Sea Country in Australia, which can be seen in the Australian Government's $11.6 million commitment to the Sea Country Indigenous Protected Areas (IPA) Program. The program seeks to increase the area of sea in IPAs to strengthen the conservation and protection of Australia's marine and coastal environments, while creating employment and economic opportunities for Indigenous Australians (DCCEW, 2022). In May 2022, 10 Sea Country IPA consultation projects were announced. The projects will support indigenous-led consultation with Traditional Owners and other stakeholders, management planning, and on-sea/on-land management (DCCEW, 2022). Sea Country IPA consultation areas cover over 6.2 million hectares of sea and over 200,000 hectares of land.

The Gunditjmara Sea Country IPA (Gunditj Mirring Traditional Owners Aboriginal Corporation with Eastern Marr Aboriginal Corporation) is located in southwest Victoria from the Convincing Ground (near Portland) in the west to Yambuk Lakes in the east. The area includes volcanic plains, rivers, coast, estuaries and coastal wetlands, and is an important breeding place and nursery for a range of species. The waters within the area encompass sites of national geological and geomorphological importance, and habitat for threatened marine animal species. The area also incorporates important cultural sites such as Deen Maar Island, which has a central role in the creation story of Gunditjmara Country. The project will allow Traditional Owners to further protect the Budj Bim Cultural Landscape. Project activities will include implementation of on land/sea management activities, community employment and capacity building, sharing and documentation of traditional knowledge, and the development and enhancement of regional partnerships. None of the above-mentioned sites are within the planning area.

4.6.5 Native Title

A search of the National Native Title Tribunal (NNTT) database identified one native title claim accepted for registration over coastal areas within the planning area (Figure 4-70). The claim is by the Eastern Maar people (VC2012/001), registered in 2013, and extends seaward 100 m from the mean low-water mark of the coastline (NNTT, 2016). There is currently no determination registered over the area of the claim (still active) in the National Native Title Register.

The following native titles exist outside but adjacent to the planning area (Figure 4-70):

- VCD2007/001 - Gunditjmara - Part A. Gunditj Mirring Traditional Owners Aboriginal Corporation Registered Native Title Body Corporate.
- VCD2011/001 - Gunditjmara Area C. Gunditj Mirring Traditional Owners Aboriginal Corporation Registered Native Title Body Corporate, Eastern Maar Aboriginal Corporation Registered Native Title Body Corporate.
- VCD2010/001 - Gunai/Kurnai People. Gunaikurnai Land & Waters Aboriginal Corporation Registered Native Title Body Corporate.

There are no registered claims in Tasmania.

4.6.6 Indigenous Protected Areas

The Preminghana Indigenous Protect Area (IPA) was identified as being in adjacent to where oil may come ashore within the planning area (Figure 4-70). No IPAs were identified in the operational area (Figure 4-70).

The Preminghana IPA borders Tasmania and the Southern Ocean and was dedicated an IPA in 1999. Covering 524 hectares of land in the north-west, it protects historic Aboriginal engraving sites and the endangered Preminghana daisy.

The Tasmanian Aboriginal Centre Rangers took over the management of Preminghana in 2014. Initial priorities were to understand community aspirations and to improve visitor and worker facilities.

4.6.7 Indigenous Land Use Agreements

No registered Indigenous Land Use Agreements were identified within the operational or planning areas (Figure 4-70).

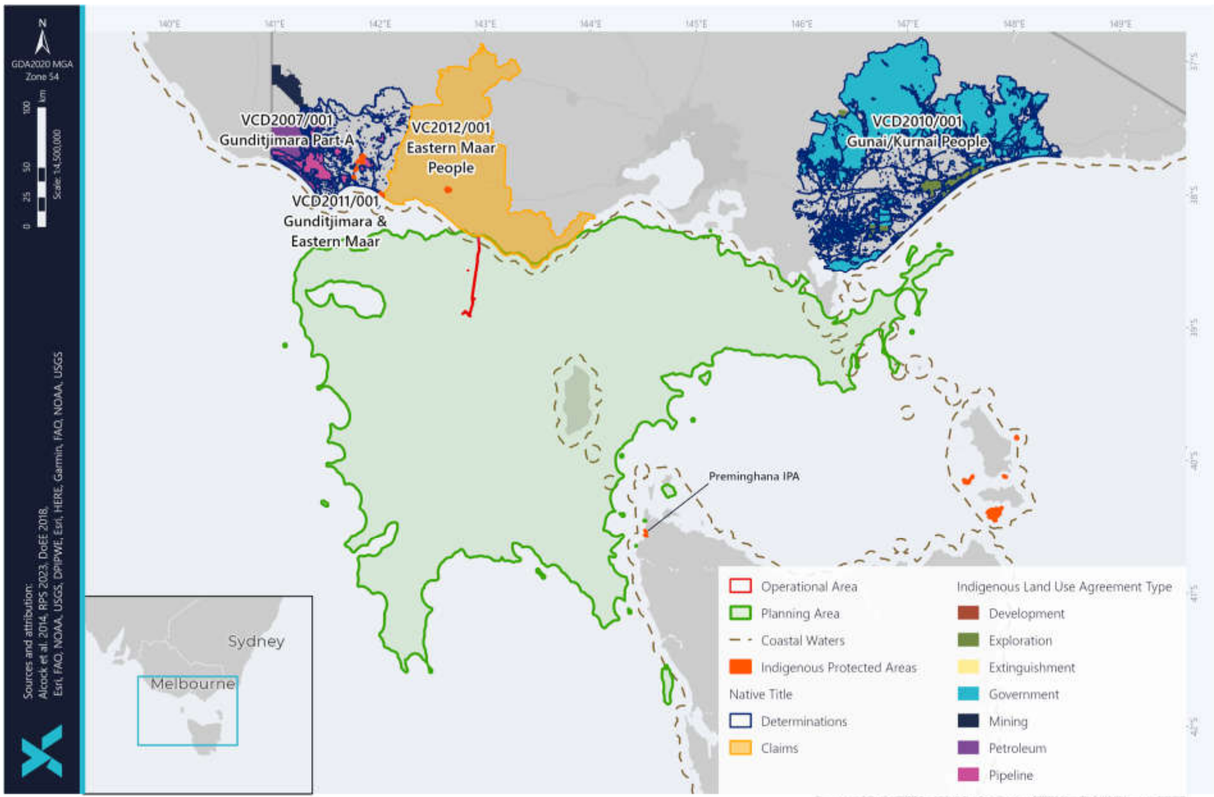


Figure 4-70: Native Title, Indigenous protected Areas and Indigenous Land Use Agreements within Planning Area

5 Environmental Impact and Risk Assessment Methodology

5.1 Overview

This section outlines the environmental impact and risk assessment methodology used for the assessment of the program activities. The methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, *Risk Management – Principles and Guidelines*). Figure 5-1 outlines this risk assessment process.

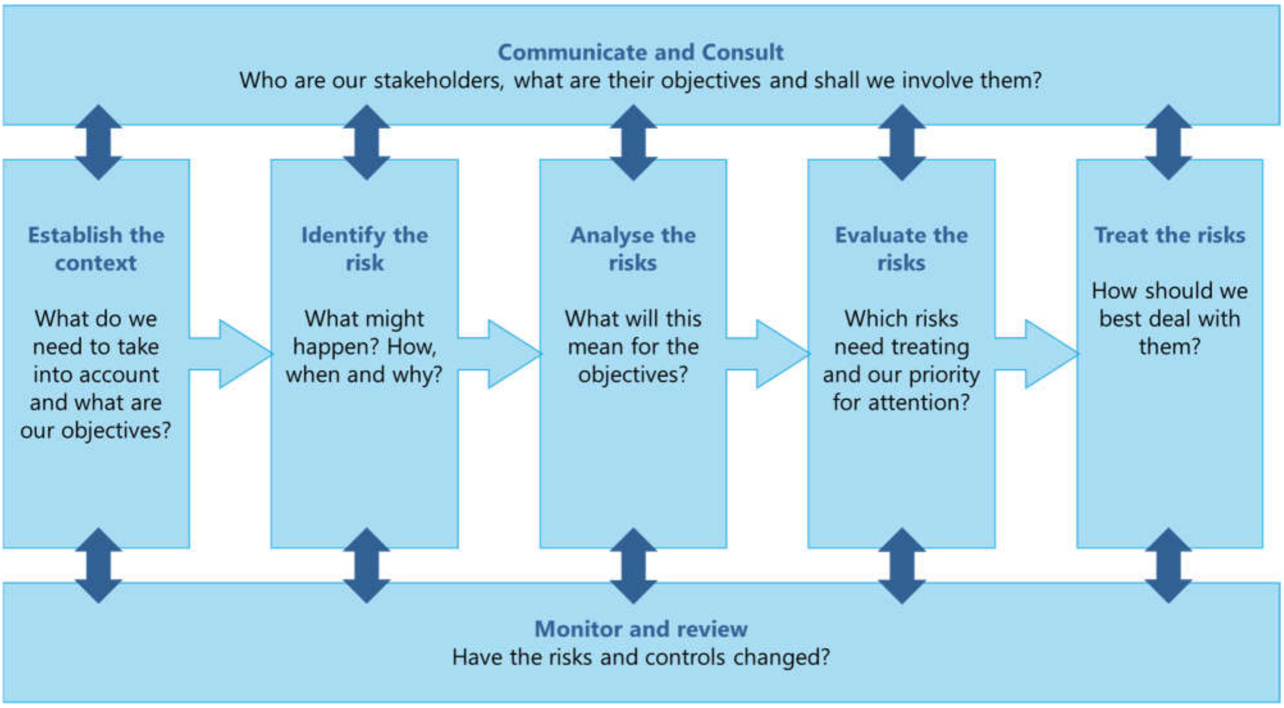


Figure 5-1: Risk Assessment Process

5.1.1 Definitions

Definitions of the term used in the risk assessment process are detailed in Table 5-1.

Table 5-1: Risk Assessment Process Definitions

Term	Definition
Activity	Refers to a 'petroleum activity' as defined under the OPGGS(E)R as: • petroleum activity means operations or works in an offshore area undertaken for the purpose of: a. exercising a right conferred on a petroleum titleholder under the Act by a petroleum title; or, b. discharging an obligation imposed on a petroleum titleholder by the Act or a legislative instrument under the Act.
Consequence	The consequence of an environmental impact is the potential outcome of the event on affected receptors (particular values and sensitivities). Consequence can be positive or negative.
Control measure	Defined under the OPGGS(E)R as a system, an item of equipment, a person or a procedure, that is used as a basis for managing environmental impacts and risks.
Emergency condition	An unplanned event that has the potential to cause significant environmental damage or harm to MNES. An environmental emergency condition may, or may not, correspond with a safety incident considered to be a Major Accident Event.
Environmental aspect	An element or characteristic of an operation, product, or service that interacts or can interact with the environment. Environmental aspects can cause environmental impacts.
Environmental impact	Defined under the OPGGS(E)R as any change to the environment, whether adverse or beneficial, that wholly or partially results from an activity.
Environmental performance outcome	Defined under the OPGGS(E)R as a measurable level of performance required for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level.
Environmental performance standard	Defined under the OPGGS(E)R as a statement of the performance required of a control measure.
Environmental risk	An unplanned environmental impact has the potential to occur, due either directly or indirectly from undertaking the activity.
Likelihood	The chance of an environmental risk occurring.
Measurement criteria	A verifiable mechanism for determining control measures are performing as required.
Residual risk	The risk remaining after control measures have been applied (i.e. after risk treatment).

5.2 Communicate and Consult

In alignment with Regulation 11A(2) of the OPGGS(E)R and 16 (8) and 19 (b) of the OPGGS Regulations (Vic), during the development of this EP, Beach has consulted with relevant person(s) (stakeholders) to obtain information in relation to their activities within the Operational Area and potential impacts to their activities. This information is used to inform the EP and the risk assessment undertaken for the activity. Stakeholder consultation is an iterative process that continues throughout the development of the EP and for the duration of a petroleum activity as detailed in Section 7.12.9.

5.3 Establish the Context

Context for the risk assessment process is established by:

- Understanding the regulatory framework in which the activity takes place (described in Section 2, 'Applicable Requirements').
- Identifying the environmental aspects of the activity (and associated operations) that will or may cause environmental impacts or may present risks to the environment (based upon the 'Activity Description' in Section 3).
- Identifying the environment that may be affected, either directly or indirectly, by the activity (based upon the 'Existing Environment' as described in Section4).
- Understanding the concerns of stakeholders and incorporating those concerns into the design of the activity where appropriate (outlined in Section 8, 'Stakeholder Consultation').

5.4 Identify the Potential Impacts and Risks

Potential impacts (planned) and risks (unplanned) associated with the environmental aspects of the activity are identified in relation to the receptors that may be affected, either directly or indirectly, by one or multiple aspects of the activity i.e., identifying the cause-effect pathway by which environmental and social receptors may be impacted. Table 6-1 details the aspects identified for the activity.

5.5 Analyse the Potential Impacts and Risks

Once impacts and risks have been identified, an analysis of the nature and scale of the impact or risk is undertaken. This involves determining the possible contributing factors associated with the impact or risk. Each possible cause should be identified separately, particularly where controls to manage the risk differ. In this way, the controls can be directly linked to the impact or risk.

5.5.1 Establish Environmental Performance Outcomes

Environmental performance outcomes (EPOs) are developed to provide a measurable level of performance for the management of environmental aspects of an activity to ensure that environmental impacts and risks will be of an acceptable level. EPOs have been developed based on the following:

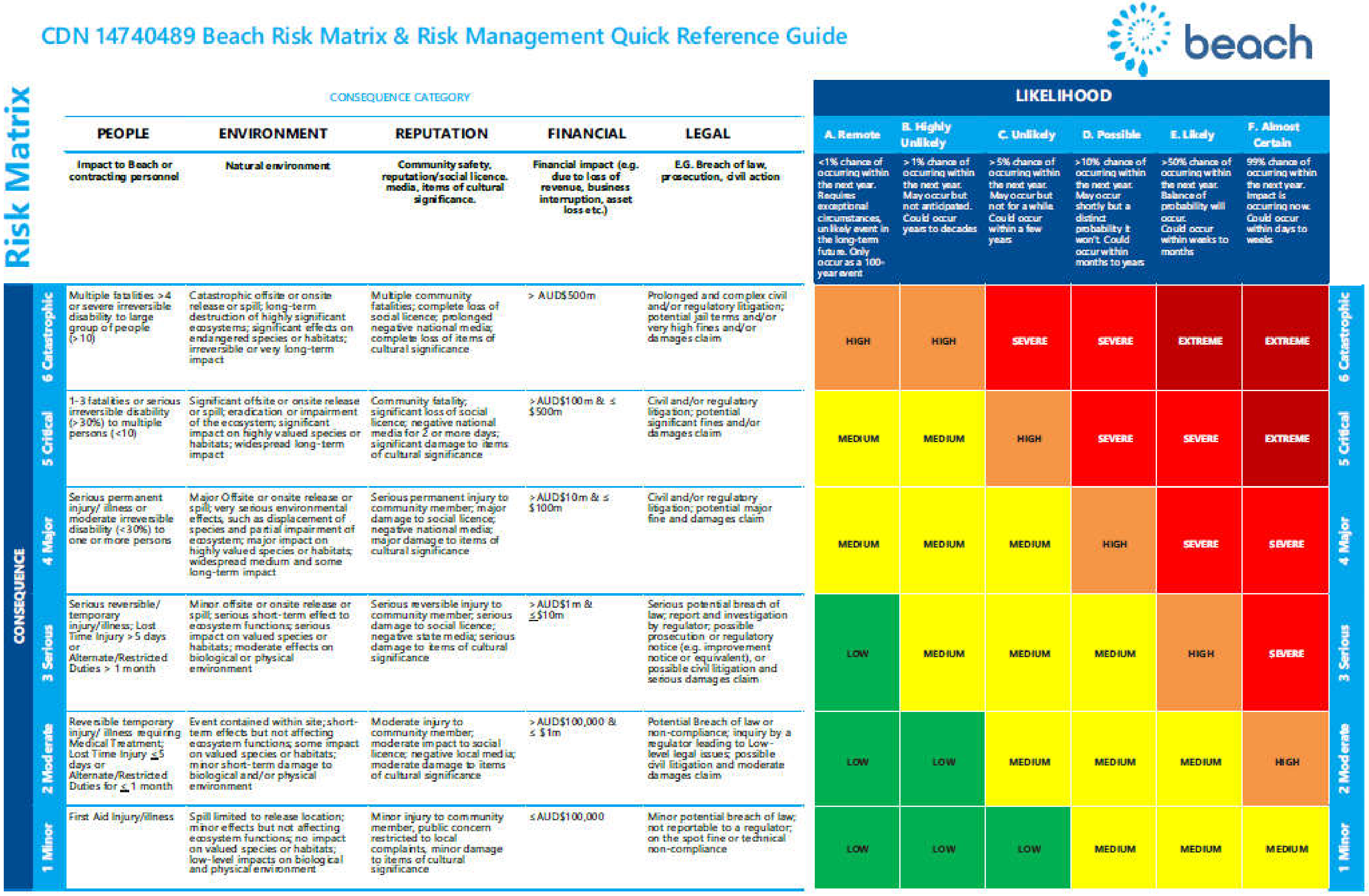
- Ecological receptors: MNES: Significant Guidelines 1.1 to identify the relevant significant impact criteria. The highest category for the listed threatened species or ecological communities likely to be affected is used, for example: endangered over vulnerable. Where appropriate species recovery plan actions and/or outcomes.
- Commercial fisheries: Victorian Fishing Authority core outcome of sustainable fishing and aquaculture (https://vfa.vic.gov.au/about).
- Marine users: OPGGS Act 2006 (Cth) Section 280.

5.6 Evaluate and Treat the Potential Impacts and Risks

The following steps are undertaken using the Beach OEMS Element 8, BSTD 8.1 Risk Management Standard, Risk Matrix (Table 5-2) to evaluate the potential impacts and risks:

- Identify the consequences of each potential environmental impact, corresponding to the maximum credible impact.
- For unplanned events, identify the likelihood (probability) of unplanned environmental impacts occurring.
- For unplanned events, assign a level of risk to each potential environmental impact using the risk matrix.
- Identify control measures to manage potential impacts and risks to as low as reasonably practicable (ALARP) (Section 5.7) and an acceptable level (Section 5.8).
- Establish environmental performance standards for each of the identified control measures.

Table 5-2: Environmental Risk Assessment Matrix



CDN 14740489 Beach Risk Matrix & Risk Management Quick Reference Guide

Risk Matrix

CONSEQUENCE	PEOPLE	ENVIRONMENT	REPUTATION	FINANCIAL	LEGAL	A. Remote	B. Highly Unlikely	C. Unlikely	D. Possible	E. Likely	F. Almost Certain
	Impact to Beach or contracting personnel	Natural environment	Community safety, reputation/social licence. media, items of cultural significance.	Financial impact (e.g. due to loss of revenue, business interruption, asset loss etc.)	E.G. Breach of law, prosecution, civil action	<1% chance of occurring within the next year. Requires exceptional circumstances, unlikely event in the long-term future. Only occur as a 100-year event	>1% chance of occurring within the next year. May occur but not anticipated. Could occur years to decades	>5% chance of occurring within the next year. May occur but not for a while. Could occur within a few years	>10% chance of occurring within the next year. May occur shortly but a distinct probability it won't. Could occur within months to years	>50% chance of occurring within the next year. Balance of probability will occur. Could occur within weeks to months	99% chance of occurring within the next year. Impact is occurring now. Could occur within days to weeks
6 Catastrophic	Multiple fatalities >4 or severe irreversible disability to large group of people (>10)	Catastrophic offsite or onsite release or spill; long-term destruction of highly significant ecosystems; significant effects on endangered species or habitats; irreversible or very long-term impact	Multiple community fatalities; complete loss of social licence; prolonged negative national media; complete loss of items of cultural significance	> AUD$500m	Prolonged and complex civil and/or regulatory litigation; potential jail terms and/or very high fines and/or damages claim	HIGH	HIGH	SEVERE	SEVERE	EXTREME	EXTREME
5 Critical	1-3 fatalities or serious irreversible disability (>30%) to multiple persons (<10)	Significant offsite or onsite release or spill; eradication or impairment of the ecosystem; significant impact on highly valued species or habitats; widespread long-term impact	Community fatality; significant loss of social licence; negative national media for 2 or more days; significant damage to items of cultural significance	>AUD$100m & ≤ $500m	Civil and/or regulatory litigation; potential significant fines and/or damages claim	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE	EXTREME
4 Major	Serious permanent injury/ illness or moderate irreversible disability (<30%) to one or more persons	Major Offsite or onsite release or spill; very serious environmental effects, such as displacement of species and partial impairment of ecosystem; major impact on highly valued species or habitats; widespread medium and some long-term impact	Serious permanent injury to community member; major damage to social licence; negative national media; major damage to items of cultural significance	>AUD$10m & ≤ $100m	Civil and/or regulatory litigation; potential major fine and damages claim	MEDIUM	MEDIUM	MEDIUM	HIGH	SEVERE	SEVERE
3 Serious	Serious reversible/ temporary injury/illness; Lost Time Injury >5 days or Alternate/Restricted Duties > 1 month	Minor offsite or onsite release or spill; serious short-term effect to ecosystem functions; serious impact on valued species or habitats; moderate effects on biological or physical environment	Serious reversible injury to community member; serious damage to social licence; negative state media; serious damage to items of cultural significance	>AUD$1m & ≤$10m	Serious potential breach of law; report and investigation by regulator; possible prosecution or regulatory notice (e.g. improvement notice or equivalent), or possible civil litigation and serious damages claim	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH	SEVERE
2 Moderate	Reversible temporary injury/ illness requiring Medical Treatment; Lost Time Injury ≤5 days or Alternate/Restricted Duties for ≤ 1 month	Event contained within site; short-term effects but not affecting ecosystem functions; some impact on valued species or habitats; minor short-term damage to biological and/or physical environment	Moderate injury to community member; moderate impact to social licence; negative local media; moderate damage to items of cultural significance	>AUD$100,000 & ≤ $1m	Potential Breach of law or non-compliance; inquiry by a regulator leading to Low-level legal issues; possible civil litigation and moderate damages claim	LOW	LOW	MEDIUM	MEDIUM	MEDIUM	HIGH
1 Minor	First Aid Injury/Illness	Spill limited to release location; minor effects but not affecting ecosystem functions; no impact on valued species or habitats; low-level impacts on biological and physical environment	Minor injury to community member, public concern restricted to local complaints, minor damage to items of cultural significance	≤AUD$100,000	Minor potential breach of law; not reportable to a regulator; on the spot fine or technical non-compliance	LOW	LOW	LOW	MEDIUM	MEDIUM	MEDIUM

5.7 Demonstration of ALARP

Beach's approach to demonstration of ALARP includes:

- Systematically identify and assess all potential environmental impacts and risks associated with the activity.
- Where relevant, apply industry 'good practice' controls to manage impacts and risks.
- Assess the effectiveness of the controls in place and determine whether the controls are adequate according to the 'hierarchy of control' principle.
- For higher order impacts and risks undertake a layer of protection analysis and implement further controls if both feasible and reasonably practicable to do so.

NOPSEMA's EP decision making guideline (NOPSEMA, 2019) states that in order to demonstrate ALARP, a titleholder must be able to implement all available control measures where the cost is not grossly disproportionate to the environmental benefit gained from implementing the control measure.

For this EP, the guidance provided in NOPSEMA's EP decision making guideline (NOPSEMA, 2019) has been applied, whereby the level of ALARP assessment is dependent upon the:

- Residual impact and risk level (high versus low).
- The degree of uncertainty associated with the assessed impact or risk.

The following section details how the guidance provided in NOPSEMA's EP decision making guideline (NOPSEMA, 2019).

5.7.1 Residual Impact and Risk Levels

Lower-order Environmental Impacts and Risks

NOPSEMA defines lower-order environmental impacts and risks as those where the environment or receptor is not formally managed, less vulnerable, widely distributed, not protected and/or threatened and there is confidence in the effectiveness of adopted control measures.

Impacts and risks are considered to be lower-order and ALARP when, using the environmental risk assessment matrix, the impact consequence is rated as 'minor' or 'moderate' or risks are rated as 'low', 'medium' or 'high.' In these cases, applying 'good industry practice' (as defined in Section 5.7.2.1) is sufficient to manage the impact or risk to ALARP.

Higher-order Environmental Impacts and Risks

All other impacts and risks are defined by NOPSEMA as higher-order environmental impacts and risks (i.e., where the environment or receptor is formally managed, vulnerable, restricted in distribution, protected or threatened and there is little confidence in the effectiveness of adopted control measures).

Impacts and risks are considered to be higher-order when, using the environmental risk assessment matrix (Table 5-2), the impact consequence is rated as 'serious', 'major', 'critical' or 'catastrophic', or when the risk is rated as ‘severe’ or ‘extreme’. In these cases, further controls must be considered as per Section 5.7.2.

An iterative risk evaluation process is employed until such time as any further reduction in the residual risk ranking is not reasonably practicable to implement. At this point, the impact or risk is reduced to ALARP. The determination of ALARP for the consequence of planned operations and the risks of unplanned events is outlined in Table 5-3.

Table 5-3: ALARP Determination for Consequence (Planned Operations) and Risk (Unplanned Events)

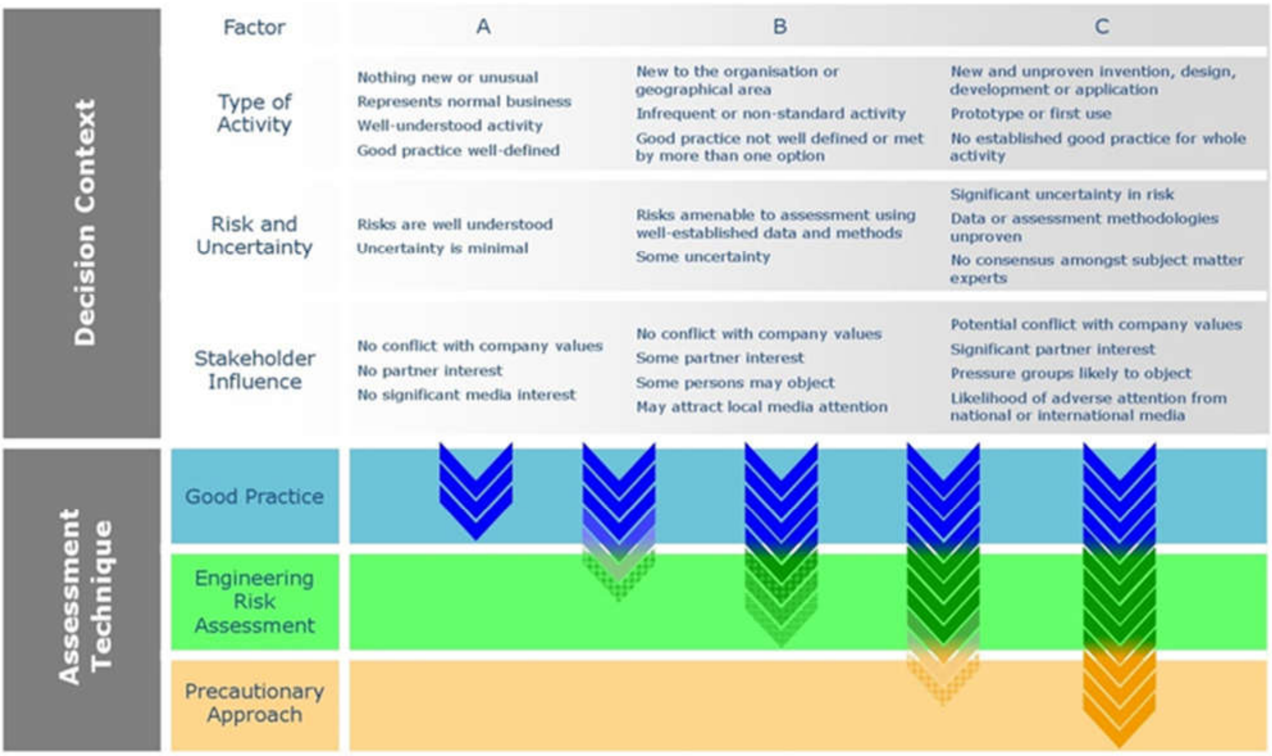
Consequence ranking	Minor	Moderate	Serious	Major	Critical	Catastrophic
Planned operation	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual impact category	Lower order impacts		Higher order impacts			
Risk ranking	Low	Medium	High	Severe	Extreme	
Unplanned event	Broadly acceptable	Tolerable if ALARP		Intolerable		
Residual risk category	Lower order risks			Higher order risks		

5.7.2 Uncertainty of Impacts and Risks

In addition to the evaluation of residual impacts and risks as described above, the relative level of uncertainty associated with the impact or risk is also used to inform whether the application of industry good practice is sufficient to manage impacts and risks to ALARP, or if the evaluation of further controls is required.

In alignment with NOPSEMA’s ALARP Guidance Note (NOPSEMA, 2015), Beach have adapted the approach developed by Oil and Gas UK (OGUK) (OGUK, 2014) for use in an environmental context to determine the assessment technique required to demonstrate that potential impacts and risks are ALARP (Figure 5-2). Specifically, the framework considers impact severity and several guiding factors:

- Activity type
- Risk and uncertainty
- Stakeholder influence



Factor	A	B	C
Type of Activity	Nothing new or unusual Represents normal business Well-understood activity Good practice well-defined	New to the organisation or geographical area Infrequent or non-standard activity Good practice not well defined or met by more than one option	New and unproven invention, design, development or application Prototype or first use No established good practice for whole activity
Risk and Uncertainty	Risks are well understood Uncertainty is minimal	Risks amenable to assessment using well-established data and methods Some uncertainty	Significant uncertainty in risk Data or assessment methodologies unproven No consensus amongst subject matter experts
Stakeholder Influence	No conflict with company values No partner interest No significant media interest	No conflict with company values Some partner interest Some persons may object May attract local media attention	Potential conflict with company values Significant partner interest Pressure groups likely to object Likelihood of adverse attention from national or international media

Figure 5-2: OGUK (2014) Decision Support Framework

A **Type A** decision is made if the risk is relatively well understood, the potential impacts are low, activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. However, if good practice is not sufficiently well-defined, additional assessment may be required.

A **Type B** decision is made if there is greater uncertainty or complexity around the activity and/or risk, the potential impact is moderate, and there are no conflict with company values, although there may be some partner interest, some persons may object, and it may attract local media attention. In this instance, established good practice is not considered sufficient and further assessment is required to support the decision and ensure the risk is ALARP.

A **Type C** decision typically involves sufficient complexity, high potential impact, uncertainty, or stakeholder influence to require a precautionary approach. In this case, relevant good practice still must be met, additional assessment is required, and the precautionary approach applied for those controls that only have a marginal cost benefit.

In accordance with the regulatory requirement to demonstrate that environmental impacts and risks are ALARP, Beach has considered the above decision context in determining the level of assessment required.

The levels of assessment techniques considered include:

- Good practice
- Engineering risk assessment

- Precautionary approach

5.7.2.1 Good Practice

OGUK (2014) defines ‘good practice’ as the recognised risk management practices and measures that are used by competent organisations to manage well-understood impacts and risks arising from their activities.

‘Good practice’ can also be used as the generic term for those measures that are recognised as satisfying the law. For this EP, sources of good practice include:

- Requirements from Australian legislation and regulations.
- Relevant Australian policies.
- Relevant Australian Government guidance.
- Relevant industry standards and/or guidance material.
- Relevant international conventions.

If the ALARP technique is determined to be ‘good practice’, further assessment (‘engineering risk assessment’) is not required to identify additional controls. However, additional controls that provide a suitable environmental benefit for an insignificant cost are also identified at this point.

5.7.2.2 Engineering Risk Assessment

All potential impacts and risks that require further assessment are subject to an ‘engineering risk assessment’. Based on the various approaches recommended in OGUK (2014), Beach believes the methodology most suited to this activity is a comparative assessment of risks, costs, and environmental benefit. A cost–benefit analysis should show the balance between the risk benefit (or environmental benefit) and the cost of implementing the identified measure, with differentiation required such that the benefit of the control can be seen and the reason for the benefit understood.

5.7.2.3 Precautionary Approach

OGUK (2014) states that if the assessment, considering all available engineering and scientific evidence, is insufficient, inconclusive, or uncertain, then a precautionary approach to impact and risk management is needed. A precautionary approach will mean that uncertain analysis is replaced by conservative assumptions that will result in control measures being more likely to be implemented.

That is, environmental considerations are expected to take precedence over economic considerations, meaning that a control measure that may reduce environmental impact is more likely to be implemented. In this decision context, the decision could have significant economic consequences to an organisation.

5.8 Demonstration of Acceptability

Regulation 13(5)(c) of the OPGGS(E)R requires demonstration that environmental impacts and risks are of an acceptable level.

Beach considers a range of factors when evaluating the acceptability of environmental impacts and risks associated with its activities. This evaluation works at several levels, as outlined in Section 5.8.1 which is based on Beach's interpretation of the NOPSEMA EP content requirements (NOPSEMA, 2019).

5.8.1 Acceptability Criteria

Beach has defined a set of criteria to determine acceptability of an impact or risk, following risk mitigation. Where an impact or risk is not considered acceptable, further control measures are required to lower the risk, or alternative options will be considered. The Beach acceptability criteria considers:

- Principles of Ecological Sustainable Development (ESD)
- Internal Context
- External Context
- Other requirements

These criteria are described in the following sections and are consistent with NOPSEMA EP content requirements (NOPSEMA, 2019).

5.8.1.1 Principles of Ecologically Sustainable Development

Section 3A of the EPBC Act defines ESD, which is based on Australia's National Strategy for Ecological Sustainable Development (1992) that defines ESD as:

'using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased.'

Relevant ESD principles and how they are applied by Beach:

- Decision making processes should effectively integrate both long term and short term economic, environmental, social and equitable considerations. This principle is inherently met through the EP development process, as such this principal is not considered separately for each acceptability evaluation.
- 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 there is, the project shall assess whether there is significant uncertainty in the evaluation, and if so, whether the precautionary approach should be applied.
- The principle of inter-generational equity — that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations. The EP risk assessment methodology ensures that potential impacts and risks are ALARP, where the potential impacts and risks are determined to be serious or irreversible the

precautionary principle is implemented to ensure the environment is maintained for the benefit of future generations. Consequently, this principal is not considered separately for each acceptability evaluation.

- The conservation of biological diversity and ecological integrity should be a fundamental consideration in decision making. Beach considers if there is the potential to affect biological diversity and ecological integrity through the risk assessment process.

To meet this acceptance criteria, the activity must be carried out in a manner consistent with the relevant ESD principles above.

5.8.1.2 Internal Context

Beach’s OEMS includes Elements and Standards relevant to the way Beach operates.

At the core of the OEMS are 11 Elements (see Section 7.1) which detail specific performance requirements for the implementation of Beach’s Environmental Policy and management of potential HSE impacts and risks

Elements and Standards in the OEMS which are relevant to either the activity, impact, control or receptor will be described within the internal context and contribute towards the assessment of acceptability.

To meet this acceptance criteria, the impact or risk must be compliant with the objectives of Beach’s Environment Policy. Where specific internal procedures, guidelines, expectations are in place for management of the impact or risk in question, acceptability is demonstrated.

5.8.1.3 External Context

External context considers stakeholder expectations, obtained from stakeholder consultation.

Beach has undertaken stakeholder consultation, which is described in detail in Section 8. Where objections or claims have been raised, these are considered in the assessment of acceptability of related impacts and risks.

To meet this acceptance criteria, the merits of claims or objections raised by a relevant stakeholder must have been adequately assessed and additional controls adopted where appropriate.

5.8.1.4 Other Requirements

Aside from internal and external context, other requirements must be considered in the assessment of acceptability. These include:

- Environmental legislation (described in Section 2)
- Policies and guidelines (described in Section 2)
- International agreements (described in Section 2)
- EPBC Management Plans (described in Section 2.1)
- Australian Marine Park designations (described in Section 4.2.2)

This acceptance criteria is met when: compliance with specific laws or standards is demonstrated; management of the impact or risk is consistent with relevant industry practices; and the proposed impact or risk controls, environmental performance objectives and standards are consistent with the nature of the receiving environment based upon formal management plans.

5.9 Monitoring and Review

Monitoring and review activities are incorporated into the impact and risk management process to ensure that controls are effective and efficient in both design and operation. This is achieved through the environmental performance outcomes, environmental performance standards and measurement criteria that are described for each environmental impact or risk. Monitoring and review are described in detail in the Implementation Strategy (Section 7).

6 Environmental Impact and Risk Assessment

6.1 Overview

In alignment with Regulation 13 (5) of the OPGGS(E)R and Regulations 15 (3)(c), 15 (3)(d), 15 (3)(e) and 15 (4) of the OPGGS Regulations (Vic), this section of the EP details the potential environmental impacts and risks associated with the activity and provides an evaluation of all the impacts and risks appropriate to the nature and scale of each impact or risk. This evaluation includes impacts and risks arising directly or indirectly from the activity and includes potential oil pollution emergencies and the implementation of oil spill response strategies and oil spill monitoring.

In addition, this section details the control measures (systems, procedures, personnel or equipment) that will be used to reduce potential impacts and risks to ALARP and acceptable levels. Environmental performance outcomes (EPOs), environmental performance standards (EPSs) and measurement criteria associated with each of the identified control measures are provided in Section 6.16.

Aspects associated with the use of vessels for oil spill response activities are as per vessel operations in Table 6-1. Other aspects and related impacts and risks associated with oil spill response activities are described in Sections 6.15.

Table 6-1: Activity – Aspect Relationship

ACTIVITIES	ASPECT	Light emissions	Atmospheric emissions	Underwater sound emissions	Physical presence	Benthic disturbance	Planned marine discharges-Vessels	Planned marine discharges-Operations and IMR	Establishment of IMS	Disturbance to marine fauna	Unplanned Marine Discharge (Solids)	Loss of Containment
Thylacine-A Wellhead Platform operations												
Platform operations		✓	✓	✓	✓					✓	✓	✓
Otway Pipeline System Operations												
Pipeline operations					✓							✓
Subsea Facilities Operations												
Subsea infrastructure operations					✓			✓				✓
Subsea production wells				✓	✓			✓				✓
Inspection, maintenance, and repair												
Inspection, maintenance, and repair campaigns				✓	✓	✓		✓				✓
Support Operations												
Diving and RoV Operations					✓	✓						
Vessel operations		✓	✓	✓	✓		✓		✓	✓	✓	✓
Helicopter operations			✓	✓								

6.2 Light Emissions

6.2.1 Hazards

The Thylacine-A Wellhead Platform is normally unmanned, with lighting limited to that required for navigation which includes platform lighting remaining on when platform unmanned as per the Thylacine-A Platform Safety Case. The platform is not equipped with a flare.

During IMR and geophysical surveys, vessel activities may be undertaken 24 hours a day. Therefore, lighting is required at night for navigation and to ensure safe operations when working on vessels.

Light emissions from Thylacine-A Wellhead Platform and vessels will result in a change in ambient light.

6.2.2 Predicted Environmental Impacts

The predicted environmental impacts from light emissions are:

- Changes in ambient light leading to changes in fauna behaviour, through attraction or avoidance of light-sensitive species.

6.2.3 EMBA

The EMBA for light emissions is based on the National Light Pollution Guidelines for Wildlife (the Guidelines) (Commonwealth of Australia 2020a). The guidelines recommend undertaking a light impact assessment where important habitat for list species sensitive to light are located within 20 km of the light source. The 20 km threshold provides a precautionary limit based on observed effects of sky glow on marine turtle hatchlings demonstrated to occur at 15-18 km and fledgling seabirds grounded in response to artificial light 15 km away (Commonwealth of Australia 2020). Seabird grounding, as described in Rodriguez et al (2014), relates to impacts of onshore fixed light sources such as streetlights and buildings and the effect this can have on young fledgling birds making their first flight from their nests to the open ocean. Subsequently, the 20 km light EMBA adopted here is considered to be highly conservative.

The guidelines identify marine turtles, seabirds and migratory shorebirds as potentially being impacted by artificial light to a level significant enough to require assessment. Other species such as zooplankton, invertebrates and fish are discussed in the National Light Pollution Guidelines for Wildlife – Ecological Communities – Consultation draft (DCCEEW 2022).

The guidelines detail that important habitats are those areas necessary for an ecologically significant proportion of a listed species to undertake important activities such as foraging, breeding, roosting or dispersal. For this assessment a distance of 20 km from the operational area was used to identify any areas where turtles, shorebirds and seabirds may be foraging, breeding, roosting, or migrating. This area (20 km around the operational area) is called the light EMBA. The EPBC Protected Matters Report for the light EMBA is in Appendix A.3.

Table 6-2 details the shorebirds and seabirds that may be foraging, breeding, roosting or migrating within the light EMBA. These were identified from the light EMBA PMST Report (Appendix A.3) and BIAs from the National Conservation Values Atlas. No roosting or breeding behaviours have been identified within the light EMBA.

Artificial light can disrupt turtle nesting and hatching behaviours. Artificial light is listed as a key threat in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). Listed turtle species may occur within the light EMBA, however, no biologically important behaviours, BIAs, or habitat critical to survival for marine turtles were identified. In addition, there are no turtle nesting areas in the region. Therefore, impacts to turtles from light emissions is not predicted.

The HDD entry point is located approximately 500 m from the shoreline, therefore vessels operating at the HDD entry point location will be visible from the coast. The nearest homes are located at Port Campbell; approximately 2.2 km from the HDD entry point. Whilst vessels operating at the HDD entry point will be visible from the shoreline, activities will be short-term inspection, maintenance, or repair activities with light levels equivalent to other vessel traffic in the area, and therefore impacts on coastal settlements are not considered further.

Therefore, the light-sensitive receptors that may occur within the light EMBA are:

- Seabirds and migratory shorebirds.
- Zooplankton, invertebrates and fish

Table 6-2: Light Sensitive Receptors within the light EMBA with BIAs or undertaking Biologically Important Behaviour

Receptor	Biologically Important Behaviour
Albatross	
Antipodean albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Black-browed albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Buller's albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Campbell albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Indian yellow-nosed albatross	Foraging BIA
Northern Buller’s albatross	Foraging, feeding or related behaviour likely to occur within area
Northern royal albatross	Foraging, feeding or related behaviour likely to occur within area
Salvin’s albatross	Foraging, feeding or related behaviour likely to occur within area
Shy albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
Southern royal albatross	Foraging, feeding or related behaviour likely to occur within area
Wandering albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging BIA
White-capped albatross	Foraging, feeding or related behaviour likely to occur within area

Receptor	Biologically Important Behaviour
Other	
Common diving-petrel	Foraging BIA
Flesh-footed shearwater	Foraging, feeding or related behaviour likely to occur within area
Little curlew	Roosting likely to occur within area
Orange-bellied parrot	Migrating likely
Northern giant petrel	Foraging, feeding or related behaviour likely to occur within area
Pin-tailed snipe	Roosting likely to occur within area
Swinhoe's snipe	Roosting likely to occur within area
Short-tailed shearwater	Foraging BIA
Wedge-tailed shearwater	Foraging BIA Breeding BIA

6.2.4 Consequence Evaluation

For the light impact assessment, the process outlined in the guidelines is used. The aim of the guidelines is that artificial light will be managed so wildlife is:

1. Not disrupted within, nor displaced from, important habitat.

2. Able to undertake critical behaviours such as foraging, reproduction and dispersal.

Identification of light-sensitive receptors was undertaken through definition of a 20 km light EMBA. The actual predicted area of impact at any one time will be significantly less than 20 km around each vessel operating within the operational area.

Vessel activities will occur up to 500 m from the shoreline (at the HDD entry point), therefore impacts to seabird and migratory shorebird coastal habitats (such as roosting sites) could occur, with the PMST Report identifying the little curlew, pin-tailed swipe and Swinhoe's snipe likely to roost within the area of the light EMBA. These species are migratory wetland species and are covered by the Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015b) which does not identify light as a threat.

The light EMBA PMST Report (Appendix A.3) identified likely foraging behaviour for a number of albatrosses in the light EMBA. Some of these species have foraging BIAs that the light EMBA overlaps (Table 6-2). These BIAs are shown in Figure 4-28 to Figure 4-30. Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a) however, no actions are identified. Albatrosses forage most actively during daylight and are less active at night because their ability to see and capture prey from the air is reduced (Phalan et al. 2007). Thus, impacts within the small area of overlap with albatross foraging BIAs are not predicted based on these species forage most actively during daylight.

The common diving-petrel was not identified in the light EMBA PMST Report (Appendix A.3). This species is listed as marine and does not have a recovery plan or conservation advice. The light EMBA overlaps a foraging BIA within the SEMR (Figure 4-29). Brooke (2004) cited on Animal Diversity Web (2020) details that common diving petrels spend the night in burrows during the breeding season and seem to forage mainly during the day, although they also forage at night on vertically migrating plankton. They are thought to be fairly sedentary, remaining more or less in the area of their breeding colony year-round, although they may venture into the open ocean to forage outside of the breeding season and some studies suggest seasonal movements (Brooke, 2004 cited on Animal Diversity Web, 2020). Based on this information, common diving-petrels may forage at night within the light EMBA.

The northern giant petrel was identified in the light EMBA PMST Report as foraging likely within the light EMBA. It is thought to be a predominantly diurnal forager, but it feeds its chicks during both the day and at night (DCCEEW 2023a). Breeding occurs on Macquarie Island between New Zealand and Antarctica. Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a) however, no actions are identified.

The light EMBA PMST Report (Appendix A.3) identified migration route likely for the orange-bellied parrot. No BIA or habitat critical to the survival of the species where identified. The orange-bellied parrot is a ground feeding parrot which breeds in south-west Tasmania between November and March and then overwinters on the coast of south-east mainland Australia between April and October (DELWP, 2016a). The orange-bellied parrot is classed as critically endangered and there are about 50 remaining in the wild (DELWP, 2016a). The orange-bellied parrot recovery plan identifies illuminated structures and illuminated boats as a potential barrier to migration and movement (DELWP, 2016a). IMR activities may overlap the period when orange-bellied parrots migrate between Tasmania and Victoria between late February to early April (Australian Museum, 2020). The light EMBA overlaps the likely distribution and probably migration route for the orange-bellied parrot (Figure 4-31).

The flesh-footed shearwater was identified in the light EMBA PMST Report as foraging likely within the light EMBA. The flesh-footed shearwater routinely attends fishing vessels to feed on baited hooks, discarded scraps and prey attracted to the surface by such vessels (DCCEEW 2023), thus they may be attracted to light water surface area to forage.

The short-tailed shearwater was identified in the light EMBA PMST Report as foraging likely within the light EMBA. The light EMBA overlaps a foraging BIA within the SEMR (Figure 4-30). This species is listed as marine and migratory and does not have a recovery plan or conservation advice. No BIAs or habitat critical for the survival of the species occur within the light EMBA. Impacts to this species from light emissions are not predicted as the short-tailed shearwater returns to the colonies at dark after feeding at sea during the day (AAD, 2020).

The wedge-tailed shearwater was not identified in the light EMBA PMST Report (Appendix A.3). The light EMBA overlaps a foraging BIA and breeding BIA. The foraging and breeding BIAs intersected by the light EMBA are a buffer around Muttonbird Island, Victoria (Figure 4-30). This species is listed as marine and migratory and does not have a recovery plan or conservation advice. Light has not been identified as a threat to this species (DoEE, 2020d). A review of the DoEE Species Profile and Threats Database (SPRAT), Atlas of Living Australia and South-east Marine Region Profile did not provide any information on the Victorian Muttonbird Island wedge-tailed shearwater colony. The DoEE SPRAT profile does not show any locations for the wedge-tailed shearwater in Victoria and Beaver (2018) details Montague Island in NSW was the southernmost known colony, however, in 2017 breeding individuals of wedge-tail shearwaters were discovered a couple of hundred kilometres further south on Gabo Island Lighthouse Reserve, Victoria near the NSW border. However, impacts to this species from light emissions are not predicted as Warham, (1996) cited in Beaver (2018) details that the wedge-tailed shearwater forms large aggregations referred to as "rafts" just offshore from their breeding colony just on dusk and enter and leave the colony at night to avoid predators.

Normal working lights on marine research vessels—and, by implication, lights from other sources including fishing boats, cargo vessels, recreational watercraft, jetties and oil and gas platforms—have been shown to cause zooplankton and their vertebrate predators to descend away from the surface; these effects occurred at depths of up to 200 m, and up to 200 m horizontally from the light source (Berge et al., 2020 in DCCEEW 2022). Since most zooplankton need to ascend to forage on phytoplankton near the water's surface, light pollution may lead to an overall reduction in zooplankton, with cascading effects on their predators, and so on up the food chain (DCCEEW 2022).

Fish may be directly or indirectly attracted to lights. Experiments using light traps have found that some fish and zooplankton species are attracted to light sources (Meekan et al., 2001), with traps drawing catches from up to 90 m (Milicich et al., 1992). Lindquist et al (2005) concluded from a study of larval fish populations around an oil and gas platform in the Gulf of Mexico that an enhanced abundance of clupeids (herring and sardines) and engraulids (anchovies), both of which are highly photopositive, was caused by the platforms' light fields. The concentration of organisms attracted to light results in an increase in food source for predatory species and marine predators are known to aggregate at the edges of artificial light halos. Shaw et al (2002), in a similar light trap study, noted that juvenile tunas (Scombridae) and jacks (Carangidae), which are highly predatory, may have been preying upon concentrations of zooplankton attracted to the light field of the platforms. This could potentially lead to increased predation rates compared to unlit areas.

The extent of the area of potential impact is predicted to be up to 20 km from the operational area with a maximum duration of 30 days for an IMR activity.

The severity (with no controls) is assessed as moderate based on:

- For IMR activities light will be generated by a single vessel for up to 30 days and for geophysical surveys for up to 10 days. Light may also be generated by a single vessel when providing standby support to the Thylacine-A Wellhead Platform for platform campaigns that take longer than a day. For these campaigns, personnel return to and from the platform each day but the vessel stays in the area of the platform rather than return to and from shore. In these cases, vessel lighting would be the minimum required for navigational lighting as no work is being undertaken at night.
- Lighting on the Thylacine-A Wellhead Platform is limited to that required safe operating requirement in accordance with the accepted Thylacine-A Platform Safety Case. Lights on the platform have been replaced with lower impact LED lighting.
- Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a), however, no actions are identified.
- Of the seabirds that may potentially forage within the light EMBA the common diving-petrel, northern giant petrel and short-tailed shearwater were identified as potentially foraging at night.
- The orange-bellied parrot, which is classed as critically endangered, may migrate over the light EMBA during April to June. Illuminated structures and illuminated boats have been identified as a potential barrier to migration and movement for this species (DELWP, 2016a).

- No BIAs or spawning areas are identified within the light EMBA for fish or invertebrates.

6.2.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Light emissions	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from light emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
	The National Light Pollution Guidelines provide management options for mitigating the effect of light to fauna. A review of the management options relevant to the activity is provided in the additional controls section with the following to be adopted:
CM#1: Light Management Procedure	Vessels will have and implement a Light Management Procedure as per the National Light Pollution Guidelines (Commonwealth of Australia, 2020). The Light Management Procedure will detail mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox and Beach Energy's Vessel Light Management Procedure Guidance (CDN/ID 19012450). At a minimum the Vessel Light Management Procedure will cover: • screens, blinds or window tinting on windows to contain light inside the vessels. • outdoor/deck lights when not necessary for human safety or navigation will be turned off. • lights will be directed onto work areas. • program for handling grounded birds. • reporting requirements.
CM#2: Marking of Man-Made Offshore Structures	Platform navigation lighting complies with sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).

Additional controls assessed

Control	Cost/Benefit Analysis	Control Implemented?
Seasonal timing	Operations are required to occur year round, therefore activities may be undertaken at any time throughout the year. The following seasonal timings were identified for the species that may be active at night within the light EMBA: • Orange-bellied parrot: late February to early April (Australian Museum, 2020). • Common diving petrel: year round (NCVA, 2021). • Northern giant petrel; May to October (DCCEEW, 2023a) • Short-tailed shearwater: September to April (AAD, 2020) Controls have been identified to ensure lighting is reduced to that for safe operations considering that vessels may be required to resupply the platform and undertake IMR activities. In 15	No

	years of operating the Thylacine-A Wellhead Platform no orange-bellied parrots have been recorded. Avoiding the orange-bellied parrot migration is not commensurate to the level of impacts predicted. Other species are present all year round or for large portion of the year or do not forage at night thus restricting the period when activities will occur does not afford any benefit to these species.	
Implement management actions during the breeding season. Light management should be implemented during the nesting and fledgling periods.	The light EMBA is at the closest distance ~12 km from islands or a coast where nesting and fledglings may be located. As no impact to nesting or fledglings is predicted the control does not have an environmental benefit.	No
Maintain a dark zone between the rookery and the light sources	The light EMBA is at the closest distance ~12 km from islands or a coast where rookeries may occur, therefore a dark zone between the and potential rookeries and the light sources will be maintained.	Yes
Turn off lights during fledgling season.	The light EMBA is at the closest distance ~12 km from islands or a coast where rookeries may be located. As no impact to fledglings is predicted the control does not have an environmental benefit.	No
Use curfews to manage lighting such as extinguish lights around the rookery during the fledgling period by 7 pm as fledglings leave their nest early in the evening.		
Aim lights downwards and direct them away from nesting areas.	The light EMBA is at the closest distance ~12 km from islands or a coast where nesting may occur. As no impact to nesting areas is predicted the control does not have an environmental benefit.	No
CM#1: Light Management Procedure Prevent indoor lighting reaching outdoor environment.	Use of fixed window screens, blinds or window tinting on vessel windows to contain light inside has the environmental benefit of reducing light emissions from the activity.	Yes
CM#1: Light Management Procedure Reduce unnecessary outdoor, deck lighting on all vessels and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Extinguishing vessel outdoor/deck lights when not necessary for human safety and restrict lighting at night to navigation lights has the environmental benefit of reducing light emissions from activity. Thylacine-A Platform Safety Case requires platform lighting to remain on when platform unmanned as a navigation requirement.	Yes
CM#1: Light Management Procedure Vessels working in seabird foraging areas during breeding season should implement a seabird management	As the vessel activities may occur year round, a vessel Light Management Procedure will be developed and implemented as per the National Light Pollution Guidelines (Commonwealth of Australia, 2020) which will detail mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox.	Yes

plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.		
CM#1: Light Management Procedure Use flashing/intermittent lights instead of fixed beam. Use motion sensors to turn lights on only when needed. Avoid lights containing short wavelength violet/blue light. Avoid white LEDs. Avoid high intensity light of any colour.	Mitigations to manage light, including appropriate use and types of lights, will be reviewed as part of the Light Management Procedure (detailed above). Where the Light Management Procedure identifies changes to vessel lighting that has a cost/benefit these mitigations will be implemented.	Yes – where appropriate
CM#1: Light Management Procedure Design and implement a rescue program for grounded birds.	A rescue program will not prevent birds grounding, but as it has proven useful to reducing mortality of seabirds it has an environmental benefit. The program will be developed as part of the Light Management Procedure (CM#1) and will include advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover: • handling of birds. • releasing of birds • reporting to DCCEEW in the case of protected species. Note: a recovery program can only occur on the Thylacine-A Platform when it is manned.	Yes – where appropriate

Consequence rating	Moderate (2) with no controls but this would be reduced to Minor (1) with identified controls implemented.
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Light emissions were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding light emissions. As detailed in Section 4.5, this area has significant vessel activity. These vessels typically do not have controls on light emissions and are unlikely to comply with the National Light Pollution Guidelines. These vessels will contribute significantly to light pollution in the area.

Other requirements	Thylacine-A Platform Safety Case requires platform lighting to remain on when platform unmanned as a navigation requirement. Light emissions will be managed in accordance with the National Light Pollution Guidelines (Commonwealth of Australia, 2020). Light pollution is identified as a threat in the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b) and details that the National Light Pollution Guidelines (Commonwealth of Australia, 2020) provide a framework for assessing and managing these impacts around susceptible listed wildlife. Light emissions will be managed in accordance with the National Light Pollution Guidelines (Commonwealth of Australia, 2020). Light emissions are identified as a threat in National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a), however, no actions are identified. The implementation of vessel Light Management Plans will ensure that lighting is of a level that will not impact on the recovery of threatened albatrosses or petrels. There are no recovery plans, conservation advice or listing advice for the common diving-petrel, flesh-footed shearwater, little curlew, northern giant petrel, pin-tailed snipe, short-tailed, Swinhoe's snipe, shearwater or wedge-tailed shearwater that have BIAs or are undertaking biologically important behaviour within the light EMBA. Light emissions will be managed in a manner to not impact on the recovery orange-bellied parrot as per the orange-bellied parrot recovery plan (DELWP, 2016a).
Monitoring and reporting	Impacts associated with light emissions are for a short duration (i.e. during an IMR campaign), over a small area and not predicted to have long term impacts to fauna in the area. Therefore, the monitoring of light emissions is not proposed. Reporting of injury to or death of EPBC Act-listed species will be undertaken as detailed in Table 7-4.
Acceptability outcome	**Acceptable**

6.3 Atmospheric Emissions

6.3.1 Hazards

Atmospheric emissions are generally considered to be any emission or entrainment process from a point, non-point or mobile sources that results in air pollution. This includes pollutants associated with greenhouse gas (GHG) emissions). With regards to Otway Operations these emission sources include:

- Combustion engines used on the Thylacine-A Wellhead Platform.
- Vessels used to resupply the offshore platform, helicopters used to transfer personnel and equipment to the platform and vessels used for IMR campaigns.
- Thylacine-A Wellhead Platform continuous vent purge.
- Fugitive emissions.

As per the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (2004), GHG emissions are categorised as:

- Scope 1: GHG emissions that a company makes directly.
- Scope 2: GHG emissions a company makes indirectly such as through the purchase of electricity.
- Scope 3: GHG emissions associated, not with the company itself, but that the organisation is indirectly responsible for, up and down its value chain. For example, from buying products from its suppliers and the emissions associated with making the products, and from its own products when customers use them.

For the scope of this EP the following applies:

- Scope 1: GHG emissions associated with the Otway Offshore Operations i.e., Thylacine-A Wellhead Platform.
- Scope 2: are not relevant for the Otway Offshore Operations as no electricity is purchased.
- Scope 3: GHG emissions associated with supporting services such as vessels and helicopters, and the production, transport and use of Otway Offshore Operations hydrocarbon products.

The Thylacine-A Wellhead Platform generators typically use gas, although diesel can be used during non-routine activities. Vessels will be powered by diesel (marine diesel oil (MDO)).

Atmospheric emissions will also be generated by the vent system. The Thylacine-A Wellhead Platform has a continuous vent purge (approximately 0.003 MMscfd) of fuel gas to prevent air ingress to the vent and drain system. Some venting of non-combusted hydrocarbon gas also occurs during routine maintenance and intermittently during wireline activities. This is usually in the order of 100 standard cubic metres per routine.

The Thylacine-A Wellhead Platform is equipped with a relief and blowdown system which vents to the vents and drain system. This system will assist in preventing over pressurisation of the process system due to process upset conditions or jet fire impingement. A period of venting may also be required for warming up the wells prior to repressurising the production pipeline, following certain maintenance activities. The volume of gas to be vented may be between 21 tonnes (2 hours warm-up) and 52 tonnes (5 hours warm-up).

Atmospheric venting was selected over flaring because of its inherent simplicity and reliability, which is essential for an unmanned operations. There is no flare on the Thylacine-A Wellhead Platform.

6.3.1.1 Estimated Emissions Inventory

Atmospheric and Scope 1 GHG Emissions

Scope 1 GHG emissions associated with the Otway Offshore Operations are reported to the Clean Energy Regulator as part of the statutory annual *National Greenhouse and Energy Reporting Act* 2007 (NGER Act). NGER reporting includes direct emissions from fuel use, venting and fugitive emissions associated with the Thylacine and Geographe facilities. NGER reporting does not include indirect emissions associated with helicopters transfers to the Thylacine-A Wellhead Platform and vessels used for resupply or IMR activities.

NGER reporting from financial year 2022 (FY22) detailed that the direct emissions from the Thylacine and Geographe facilities as 3,325 and 54 tCO_2e respectively. An increase in reported Scope 1 emissions of approximately 1,500 tonnes from the combined facilities occurred from FY21 to FY22 due to the change in the calculation technique for fugitive emissions that came into effect on July 1, 2021. The change in calculation required Beach to estimate emissions during FY22 using the highly conservative Method 1 methodology as set down in the Commonwealth's NGER (Measurement) Determination. (Refer to later in this topic for a detailed explanation of this change, Beach's mitigative action and the overall assessment of this regulatory change.

A detailed GHG emissions study has been completed for the offshore fields to estimate full field life GHG emissions including Scope 3 emissions. This study was undertaken by Xodus Group with the findings summarised in this section. Within the Scope 3 emissions estimate, indirect emissions of fuel use from helicopter, vessel platform resupply and IMR vessel servicing the facilities have also been estimated.

Indirect emissions from fuel use from conducting these activities were calculated based on 2021 data using the published NGER emissions factors and resulted in estimates of 16.7, 485 and 347 tCO_2e respectively. Assumptions for fuel use were as follows:

- Helicopter: 12 round trips a year from Warrnambool to the Thylacine-A Wellhead Platform.
- Platform resupply: 4 round trips per year from Portland to Thylacine-A Wellhead Platform.
- IMR: one campaign per year with vessel from Portland spending 30 days in the field with a combination of moving to do inspection and stationary on DP to do maintenance work. This scenario is the estimated longest campaign so will overestimate typical IMR campaigns.

This direct and indirect data was used by the Xodus study to predict Otway Offshore GHG emissions either from the facilities themselves (Scope 1) or in servicing the facility (selected Scope 3 emission sources), over the life of the EP and the life of the activity. This study projects GHG emissions of approximately 31,260 tCO_2e over the remaining Geographe and Thylacine field life of approximately 15 years. Quantities and timeframe are indicative and may change over time due to well selection, well productivity and onshore production. Beach maintains its own internal forecast of Scope 1 emissions, Scope 2 emissions and selected Scope 3 emissions for its operating assets. The internal forecast is updated periodically at a frequency defined within the company's GHG Management Plan to reflect changes in production profiles, sales projections and planned abatement projects.

Direct and indirect GHG emissions peak in 2023 when the Thylacine subsea wells are bought onto production and then emissions decrease over the remaining years of production from these fields.

Other products of hydrocarbon combustion emitted to the atmosphere based on National Pollution Inventory data from Thylacine-A Wellhead Platform for 2020-21 were:

- Total Volatile Organic Compounds – 5,650 kg
- BTEX – 38.93 kg

Scope 3 GHG Emissions

Scope 3 or indirect GHG emissions are a result of the product from the activity being combusted or used elsewhere. Scope 3 GHG emissions can be considered indirect consequences of the activity and therefore have impacts (EPBC Act 1999 in Section 527E).

Scope 3 GHG emissions are generated by the production, transport and use of the hydrocarbon products from the Otway Offshore Operations. Scope 3 GHG emissions are not reported under the NGER Scheme but have been estimated using Australia's National Greenhouse Accounts.

The calculations utilised methods defined in the National Greenhouse and Energy Reporting (Measurement) Determination 2008. Assumptions and inclusions for Otway Offshore Scope 3 GHG emissions calculations are:

- Otway Gas Plant Scope 1 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids from the Geographe and Thylacine fields:
  - Fuel (gas and diesel engines and heaters)
  - Flare and vent emissions
  - Fugitive emissions
- Otway Gas Plant Scope 2 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids:
  - Electricity supplied by the Victorian electricity grid
- Otway Gas Plant Scope 3 emissions associated with production, treatment, and export of Otway Offshore Operations hydrocarbon fluids:
  - Otway Offshore Operations product transport and use

Assumptions:

- Proportion of Otway Gas Plant emissions allocated to Otway Offshore Operations based on Otway Offshore Operations proportion of energy content of total feed gas to the facility.

- 100% of gas transmission pipeline fugitive leaks allocated to Otway Offshore Operations delivered gas (conservative assumption with relatively immaterial emissions.
- Final Otway Offshore Operations gas customer location: 40% used in Sydney, 40% used in Melbourne and 20% used in Adelaide.
- Gas use assumes large industrial users e.g., a gas fired power station.
- Gas delivery is via transmission line to city gate (no further intracity gas distribution included).

Reported GHG emissions data for 2020/21 for these facilities were utilised to determine a GHG intensity per unit of production and were coupled with 50th percentile production forecasts to determine an estimate and trajectory of future GHG emissions. This represents the most likely outcome in terms of production and emissions. Given the nature of reservoir uncertainty over total recoverable volume of hydrocarbon, higher or lower total emissions may be realised.

The Xodus study predicts Scope 3 GHG emissions in FY 2020/21 were approximately 3 MTCO$_2$e. This is predicted to increase to 5 MTCO$_2$e in 2023, before plateauing at 2 MTCO$_2$e until 2033 and end of production in approximately 2036 (Figure 6-1).

Scope 3 GHG emissions comprise 99.9% of emissions occurring associated with the Otway Offshore Operations, the remaining 0.1% is from the facilities' Scope 1 GHG emissions. Of the Scope 3 GHG emissions, over 96% result from the final use of the hydrocarbon product for power generation by the end customer. 90% of these emissions are from gas use, 3% are from both condensate use and 3% are from LPG use (Figure 6-1).

Future decisions regarding the selection of production from offshore and near shore wells to supply the onshore gas plant may alter the projected trajectory of emissions that are presented in this EP. Therefore this data is to be taken as indicative, and the timelines over which these GHGs will be emitted may change over the duration of this EP and life of the Thylacine and Geographe facilities.

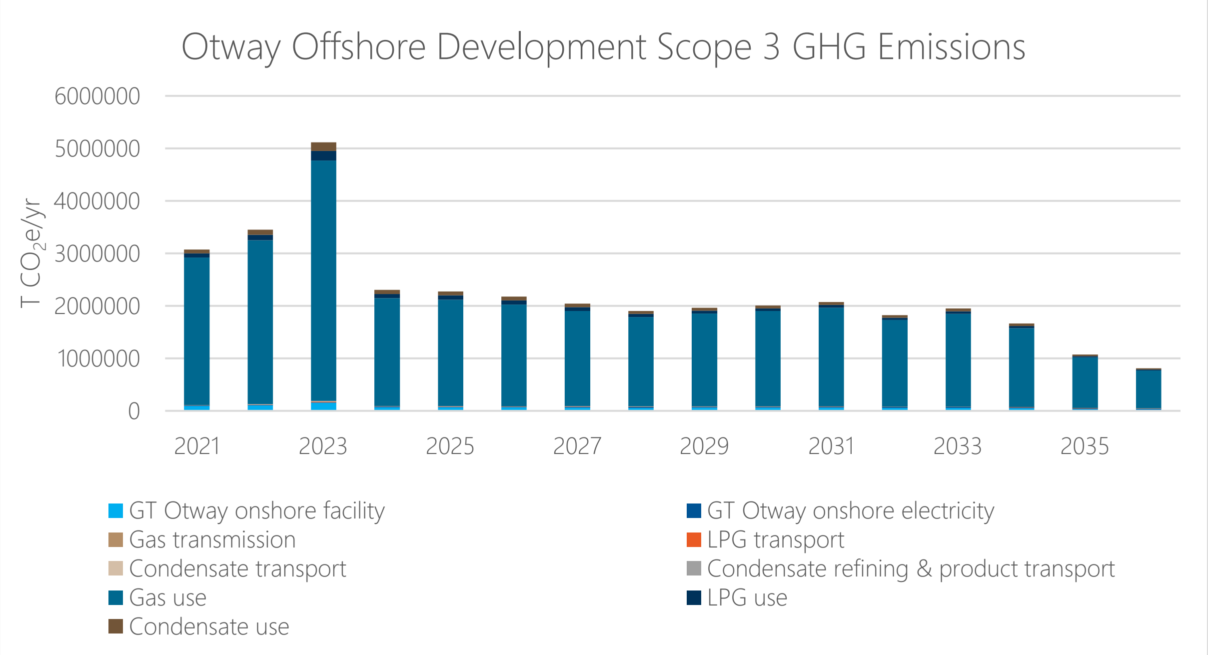


Figure 6-1: Otway Offshore Operations Scope 3 GHG Emission Estimate 2021 – 2036

As documented within Control Measure #10 (refer to Section **Error! Reference source not found.**), Beach will complete annual comparisons of actual Scope 1 and Scope 3 emissions from the Otway Offshore Facilities against the latest forecast. The mechanism for this annual comparison is as follows:

- The annual comparison of actual versus forecast will use the offshore facilities' annual NGER submission to the Clean Energy Regulator as the basis for comparison of the actual emissions against Beach’s internal forecast;
- Material variations of the sub-categories of Scope 1 emissions and overall Scope 3 emissions against forecast will be identified and if those variations require changed assumptions or methodology for accuracy of projections, those changes will be incorporated into the next revision for the asset’s greenhouse gas emissions forecast;
- Changed assumptions and/or methodology will be documented within the forecast model as a revision history page;
- As the NGER submission occurs in October of each year, the comparison exercise will therefore occur before the end of the calendar year;
- The comparison and assessment will therefore address the previous financial year’s emissions and be a key input into the upcoming emissions reforecast, at the frequency set down within the company’s GHG Management Plan.

Since the last EP submission, comparison of actual Scope 1 emissions against forecast showed that FY22 emissions deviated materially from those forecast due to the change in methodology for calculating fugitive emissions that occurred on July 1, 2022. The implementation of a leak detection and repair (LDAR) program that is compliant to NGER (Measurement) Determination Division 3.73H, the Method 3 technique, has been identified as a reasonably practicable measure to implement to reduce these fugitive emissions and has been incorporated into this EP as Control Measure #9.

The latest Beach emissions forecast incorporates both the new NGER methodology and the compliant offshore LDAR program as an abatement exercise, with the net effect being the fugitive emissions from the offshore facilities return to the levels originally forecast and that therefore, the increase in reported fugitive emissions was a transient situation and there is no on-going change to predicted environmental impacts.

6.3.2 Predicted Environmental Impacts

The predicted environmental impacts from atmospheric emissions are:

- Atmospheric emissions leading to a change in air quality and an increase in greenhouse gas emission.

Predicted impacts from atmospheric emissions associated with the Offshore Otway Operations will be limited to the operational area. Receptors which may be affected by atmospheric emissions within the operational area include:

- Air quality
- Coastal settlements
- Seabirds

GHG emissions generated during the Otway Offshore Operations and from Scope 3 GHG emissions can contribute to the overall concentration of GHG emissions in the Earth's atmosphere.

6.3.3 Consequence Evaluation

Air Quality

As the operational area is away from coastal settlements and given the limited extent of reduced air quality, adverse impact on local or regional biodiversity, ecological integrity, social amenity, or human health is not predicted.

The operational area overlaps foraging BIAs for several albatrosses, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. No habitat critical to the survival of birds occur within the operational area. As it is unlikely that seabirds would remain close to the emission source for an extended period impacts are not predicted.

Natural gas and diesel combustion, along with venting, will result in gaseous emissions of GHG such as carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). While these emissions add to the atmospheric GHG load, which adds to global warming potential, they are relatively small on a global scale, representing an insignificant contribution to overall GHG emissions. These emissions are not considered to have a determinable local-scale impact and therefore impacts are considered to be low.

The extent of the area of potential impact is predicted to be close to the emission source for the duration of the emission (continuously for venting on the Thylacine-A Wellhead Platform and during vessel activities) with a consequence level of Minor (1) based on:

- The low level of emissions.
- The open ocean environment and prevailing winds of the Otway Basin atmospheric emissions will rapidly disperse to background levels close to the emission source.

- Impacts to seabirds and coastal communities are not predicted.

Greenhouse Gas Emissions

GHG emissions generated during the Otway Offshore Operations can contribute to the overall concentration of GHG emissions in the Earth's atmosphere. This consequence evaluation considers the contribution of emissions attributed to the Otway Offshore Operations to global emissions and the potential impacts of climate change on sensitive receptors, including MNES within Australian jurisdictions.

It is important to acknowledge that climate change impacts cannot be directly attributed to any one activity, as they are the result of global GHG emissions, minus global GHG sinks, that have accumulated in the atmosphere since the industrial revolution began. Therefore, there is no direct link between GHG emissions from the Otway Offshore Operations and climate change impacts to specific ecological receptors.

Ecosystems

Ecosystems that are particularly susceptible to adverse effects of climate change include alpine habitats, coral reefs, wetlands and coastal ecosystems, polar communities, tropical forests, temperate forests and arid and semi-arid environments (DoEE, 2019). In Australia, this includes coral reefs, alpine regions, rainforests, arid and semi-arid environments, mangroves, grasslands, temperate forests and sclerophyll forests. Future climate change (increased temperature and decreased, but more variable, rainfall) has the potential to have a range of impacts on ecological factors and threaten biodiversity in the Australian Mediterranean ecosystem (CSIRO, 2017a).

Redistribution and reorganisation of natural of natural systems, driven by climate-change, is a major threat to biodiversity (Chapman et al. 2020). A report by Australia's Biodiversity and Climate Change Advisory Group summarises the potential impacts of climate change to marine and terrestrial species, habitats, and ecosystems across Australia (Steffen et al. 2009). The impacts to taxa are outlined in Table 6-3 and the impacts to ecosystems in Table 6-4.

Extensive modelling and monitoring studies over the last twenty years provide considerable evidence that global climate change is already affecting and will continue to affect species (Hoegh-Guldberg et al. 2018) however, these impacts are likely to be highly species-dependent and spatially variable. The most frequently observed and cited ecological responses to climate-change include species distributions shifting towards the poles, upwards in elevation and shifts in phenology (earlier and later autumn life history events) (Dunlop et al. 2012). Climate change may not only change species distribution patterns but also life-history traits such as migration patterns, reproductive seasonality, and sex-ratios (Table 6-3).

Impacts of climate change such as altering temperature, rainfall patterns and fire regimes, are likely to lead to changes in vegetation structure across terrestrial ecosystems within Australia (Table 6-4, Dunlop et al. 2012). Increases in fire regimes will impact Australian ecosystems altering composition structure, habitat heterogeneity and ecosystem processes. Changes in climate variability, as well as averages, could also be important drivers of altered species interactions, both native and invasive species (Dunlop et al. 2012). Climate change could result in significant ecosystem shifts, as well as alterations to species ranges and abundances within those ecosystems (Hoegh-Guldberg et al. 2018).

The IPCC Special Report describes impacts of warming above pre-industrial levels to key receptor groups including terrestrial ecosystems, mangroves, warm-water corals, unique and threatened systems, and arctic regions (Hoegh-Guldberg et. al. 2018). These receptor groups show varying sensitivity to warming conditions, with a range of responses shown at 1ºC warming; from corals suffering moderate impacts, to mangroves not showing any impacts that are detectable and attributable to climate change (Hoegh-Guldberg et al. 2018). Once warming reaches 1.5ºC, all receptor groups show impacts attributable to climate change with severity ranging from moderate impacts that are detectable and attributable to climate change (mangroves), to impacts that are severe and widespread (warm-water corals) (Hoegh-Guldberg et al. 2018). At the point where global temperature rise, due to climate change, reaches 2°C, increasing numbers of receptor groups suffer impacts which are high to very high, and likely to be irreversible (terrestrial ecosystems, warm-water corals, unique and threatened systems, and arctic regions) (Hoegh-Guldberg et al. 2018).

Terrestrial Ecosystems

All terrestrial ecosystems are likely to be impacted by a changing climate (Table 6-4, Steffen et al 2009, Hughes 2011, Dunlop et al. 2012, Hoegh-Guldberg et. al. 2018). The predicted impact of climate change on these ecosystems is highly variable, both between ecosystems and within individual ecosystems (Dunlop et al. 2012). Below is a summary of potential climate change impacts to two key terrestrial ecosystems – tropical rainforests and alpine/montane areas, other terrestrial ecosystems are summarised in Table 6-4.

Tropical Rainforests

Projections of future climate changes in the wet tropics of Australia under different scenarios are outlined by McInnes (2015). It is likely that temperatures in the wet tropics will become hotter and potentially fires and cyclones will be more intense. Consequently, there is an increased probability of fires penetrating into rainforest vegetation resulting in a shift from fire-sensitive vegetation to communities dominated by fire-tolerant species; and changing rainforest disturbance regime as cyclones become more intense) (Hughes 2011, Steffen et al. 2009). Changes in the timing of seasons (e.g., extended summer) could cause change in the seasonal response of plants, and alterations to species ranges and abundances (Hoegh-Guldberg et al. 2018).

Alpine/ Montane Areas

Alpine systems are generally considered to be among the most vulnerable to future climate change (Hughes 2003). The extent of true alpine habitat in Australia is very small (0.15% of the Australian land surface) with limited high-altitude refuge (Hughes 2003). Australian alpine regions are home to a variety of alpine vertebrates who rely on snow cover for their survival. There is evidence of a reduction in populations of dusky antechinus, broad-toothed rats, and the mountain pygmy possum. The first two species are active under the snow throughout winter and are therefore subject to increased predation by foxes when snow is reduced (Hughes 2003). The pygmy possum depends upon snow cover for stable, low temperatures during hibernation (Hughes 2003).

Marine Ecosystems

Sea surface temperatures have increased across the globe over recent decades which poses a significant threat to marine ecosystems including changes to species abundance, community structure and increased frequency and intensity of thermally induced coral bleaching events (CSIRO 2017a).

Between 1920 and 2000, sea level is estimated to have risen on average by 1.2 mm per year due to climate change (Church et al. 2006). In addition to changes in sea level, oceanic warming has also served to alter ocean currents around Australia. In response to both ocean warming and stratospheric ozone depletion the East Australian Current has increased in strength by about twenty percent since 1978 (Cai and Cowan 2006). Sea-surface temperatures are projected to continue to increase, with estimates of warming in the Southern Tasman Sea of between 0.6 to 0.9°C and between 0.3 to 0.6°C elsewhere along the Australian coast by 2030 (Church et al. 2006). Sea levels will increase by 18 to 59 cm by 2100 in response to both thermal expansion and melting of ice-sheets (Solomon et al. 2007). This will lead to some coastal inundation affecting mangroves, salt marshes and coastal freshwater wetlands. Furthermore, as CO2 is gradually absorbed by oceans and fresh water, the water becomes more acidic, which increases the solubility of calcium carbonate, the principal component of the skeletal material in aquatic organisms (Steffen et al. 2009). Below is a summary of potential climate change impacts to two key marine ecosystems - mangroves and coral reefs, other marine ecosystems are summarised in Table 6-4.

Mangroves

Mangrove ecosystems in Australia will face higher temperatures, increased evaporation rates and warmer oceans (McInnes 2015) as well as an associated sea-level rise (Hoegh-Guldberg et al. 2018). Modelling indicates an increased likelihood of future severe and extended droughts across parts of Northern Australia (Dai 2013). Consequently, mangrove ecosystems may increase their southern range as a result of warmer temperatures. However, higher temperatures and evaporation rates, and extended droughts could lead to die-offs in northern Australia and a change in mangrove distribution and abundance (Duke et al. 2017). Mangrove systems should cope with rising sea-level by accumulating more peat or mud which will give them the opportunity to adjust to a rising sea level (Field 1995).

Coral Reefs

Climate change has emerged as a threat to coral reefs, with temperatures of just 1°C above the long-term summer maximum for an area over 4–6 weeks being enough to cause mass coral bleaching and mortality (Baker et al. 2008, Hoegh-Guldberg 1999, Hughes et al. 2017, Spalding and Brown 2015). Coral mortality or die off following coral bleaching events can stretch across thousands of square kilometres of ocean (Gilmour et al. 2016, Hoegh-Guldberg 1999, Hughes et al. 2017). The impacts associated with a warming ocean, coupled with increasing acidification, are expected to undermine the ability of tropical coral reefs to provide habitat for fish and invertebrates, which together provide a range of ecosystem services (e.g., food, livelihoods, coastal protection) (Hoegh-Guldberg et al. 2018).

Socio-economic

Changes to climate can result in impact to social receptors that have values which include the ecological receptors previously discussed. This includes KEFs and AMPs. Climate change also impacts on the functions, interests or activities of other users which rely on ecological values, including commercial and recreational fisheries and tourism.

Table 6-3: Overview of Impacts of Climate Change to the Future Vulnerability of Particular Taxa (modified after Steffen et al 2009)

Taxa	Potential Vulnerability
Mammals	Narrow-ranged endemics susceptible to rapid climate change in-situ; changes in competition between grazing macropods in tropical savannas mediated by changes in fire regimes and water availability; herbivores affected by decreasing nutritional quality of foliage as a result of CO_2 fertilisation.
Birds	Changes in phenology of migration and egg-laying; increased competition of resident species; breeding of waterbirds susceptible to reduction; top predators vulnerable to changes in food supply; rising sea levels affecting birds that nest on sandy and muddy shores, saltmarshes, intertidal zones, coastal wetlands, and low-lying islands; saltwater intrusion into freshwater wetlands affecting breeding habitat.
Reptiles	Warming temperatures may alter sex ratios of species with environmental sex determination to cope with warming in-situ.
Amphibians	Frogs may be the most at-risk terrestrial taxa. Amphibians may experience altered interactions between; pathogens, predators, and fires.
Fish	Freshwater species vulnerable to reduction in water flows and water quality; limited capacity for freshwater species to migrate to new waterways; all species susceptible to flow-on effects of warming on the phytoplankton base of food webs.
Invertebrates	Expected to be more responsive than vertebrates due to short generation times, high reproduction rates and sensitivity to climatic variables.
Plants	Climate change may impact various functional dynamics of plants due to changes in; increasing CO_2, fires, plant phenology and specific environmental characteristics.

Table 6-4: Projected Impacts of CO_2 Rise and Climate Change on Australian Ecosystems (modified after Steffen et al 2009)

Key Component of Environmental Change	Projected Impacts on Ecosystems
Coral reef	
CO_2 increases leading to increased ocean acidity	Reduction in ability of calcifying organisms, such as corals, to build and maintain skeletons.
Sea surface temperature increases, leading to coral bleaching	If frequency of bleaching events exceeds recovery time, reefs will be maintained in an early successional state or be replaced by communities dominated by microalgae.
Oceanic systems (including planktonic systems, fisheries, sea mounts and offshore islands)	
Ocean warming	Many marine organisms are highly sensitive to small changes in average temperature (1-2 degrees), leading to effects on growth rates, survival, dispersal, reproduction, and susceptibility to disease.
Changed circulation patterns, including increase in temperature stratification and decrease in mixing depth and strengthening of the East Australian Current	Distribution and productivity of marine ecosystems is heavily influenced by the timing and location of ocean currents; currents transfer the reproductive phase of many organisms. Climate change may suppress upwelling in some areas and increase it in others, leading to shifts in location and extent of productivity zones.

Key Component of Environmental Change	**Projected Impacts on Ecosystems**
Changes in ocean chemistry	Increasing CO_2 in the atmosphere is leading to increased ocean acidity and a concomitant decrease in the availability of carbonate ions.
Estuaries and coastal fringe (including benthic, mangrove, saltmarsh, rocky shore, and seagrass communities)	
Sea level rise	Landward movement of some species as inundation provides suitable habitat, changes to upstream freshwater habitats will have flow-on effects to species.
Increase in water temperature	Impacts on phytoplankton production will affect secondary production in benthic communities.
Savannas and grasslands	
Elevated CO_2	Shifts in competitive relationships between woody and grass species due to differential responses.
Increased rainfall in north and northwest regions	Increased plant growth will lead to higher fuel loads, in turn leading to fires that are more intense, frequent and occur over large areas.
Tropical rainforests	
Warming and changes in rainfall patterns	Increased probability of fires penetrating into rainforest vegetation resulting in shift from fire-sensitive vegetation to communities dominated by fire-tolerant species.
Changes in length of dry seasons	Altered patterns of flowering, fruiting and leaf flush will affect resources for animals.
Rising atmospheric CO_2	Differential response of different growth forms to enhanced CO_2 may alter structure vegetation
Temperate forests	
Potential increases in frequency and intensity of fires	Changes in structure and species composition of communities with obligate seeders may be disadvantaged compared with vegetative resprouters.
Warming and changes in rainfall patterns	Potential increases in productivity in areas where rainfall is not limiting; reduced forest cover associated with soil drying projected for some Australian forests.
Inland waterways and wetlands	
Reductions in precipitation, increased frequency and intensity of drought	Reduced river flows and changes in seasonality of flows.
Changes in water quality, including changes in nutrient flows, sediment, oxygen and CO_2 concentration	May affect eutrophication levels, incidence of blue-green algal outbreaks.
Sea level rise	Saltwater intrusion into low-lying floodplains, freshwater swamps and groundwater; replacement of existing riparian vegetation by mangroves.
Arid and semi-arid regions	
Increasing CO_2 coupled with drying in some regions	Interaction between CO_2 and water supply critical, as 90% of the variance in primary production can be accounted for by annual precipitation.
Shifts in seasonality or intensity of rainfall events	Any enhanced runoff redistribution will intensify vegetation patterning and erosion cell mosaic structure in degraded areas. Changes in rainfall variability

Key Component of Environmental Change	**Projected Impacts on Ecosystems**
	and amount will also impacts on fire frequency. Dryland salinity could be affected by changes in the timing and intensity of rainfall.
Warming and drying, leading to increased frequency and intensity of fires	Reduction in patches of fire-sensitive mulga in spinifex grasslands potentially leading to landscape-wide dominance of spinifex.
Alpine/Montane areas	
Reduction in snow cover depth and duration	Potential loss of species dependent on adequate snow cover for hibernation and protection from predators; increased establishment of plant species at higher elevations as snowpack is reduced.

6.3.4 National and International Agreements and Frameworks Relevant to GHG Management

This section describes the relevant key national and international agreements and frameworks relevant to GHG management, including how these environmental requirements are relevant to the activity.

6.3.4.1 Paris Agreement

The United Nations Framework Convention on Climate Change came into force in 1994 and has been ratified by 197 countries. The convention established a goal of preventing dangerous anthropogenic interference with the climate system. Subordinate treaties and agreements have been ratified by parties to the convention, including the Paris Agreement, which was agreed under the convention at the 21st Conference of the Parties in 2015.

The primary purpose of the Paris Agreement is to strengthen the global response toward climate change. Specifically, the Agreement seeks to substantially reduce GHG emissions to limit the global temperature increase in this century to 2oC, while pursuing efforts to limit the increase even further to 1.5°C (UNFCCC 2020). The Paris Agreement is legally binding, and signatories are reviewed every five years with the submission of an updated national climate action plan, known as Nationally Determined Contribution (NDC).

The Paris Agreement is set up through articles (UNFCCC 2020), with each article focusing on a certain commitment. Some key articles that are committed in the Paris Agreement are:

- Article 2 – Long-term temperature goals
    - Limiting the global temperature increase to well below 2°C, with preference and most efforts toward keeping it below 1.5°C.
- Article 4 – Mitigation
    - The agreement establishes binding commitments by all parties to prepare, communicate and maintain a NDC and to pursue domestic measures to achieve said NDC.
- Article 9, 10, 11 – Finance, technology, and capacity-building support
    - Obligations of developed nations to support the efforts of developing nations to build clean and climate-resilient futures.

- In addition to reporting on finance already provided, developed nations commit to submit indicative information on support every two years.
- Technology framework established under the agreement, and capacity-building activities will be strengthened through inter alia, enhanced support for capacity building actions in developing nations and appropriate institutional arrangements.
- Climate change education, training, public awareness, participation, and access to information.

Australia has ratified the Paris Agreement and has adopted NDCs that can be monitored and reported on as part of the 5-year stocktake. At the Paris conference in 2016, Australia announced its first NDC to reduce GHG emissions by 26-28% below 2005 levels by 2030. This commitment was reaffirmed in 2020 after the 5-year review and further commitments were made in 2021 to reach net-zero emissions by 2050 and inscribe low emissions technology stretch goals.

In May 2022, the elected Labor government made a goal of reducing Australia's GHG emissions by 43% below 2005 levels by 2030 and reaffirmed Australia's commitment to net zero emissions by 2050. This was lodged with the UNFCCC as an updated NDC as part of Australia's obligations under the Paris Agreement. NDCs under the Paris Agreement are legally binding, and Australia mainly focuses on Article 10 with a low-emissions technology led approach. Australia's NDCs are implemented through schemes such as the Safeguard Mechanism and the Emissions Reduction Fund and the soon to be introduced Climate Change Bill 2022, in addition to continuous monitoring and focusing on alternatives to lower overall emissions.

In addition, Beach has an aspiration to achieve net zero Scope 1 and Scope 2 GHG emissions by 2050 and has a publicly released interim target to reduce Beach GHG emissions intensity (https://www.beachenergy.com.au/reducing-emissions/).

6.3.4.2 National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015

One of the key statutory instruments for regulating Australia's GHG emissions in line with Australia's NDCs under the Paris Agreement, is the National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 (Cth) (the Safeguard Mechanism) made under the NGERS Act and administered by the Clean Energy Regulator. The Safeguard Mechanism was developed to ensure that Australia's largest greenhouse gas emitters keep their net emissions below an emissions limit (a baseline). The Safeguard Mechanism currently applies to facilities that emit more than 0.1 MtCO$_2$-e per annum and requires annual emissions to be reported against a designated emissions 'baseline', including the Otway Gas Plant.

Key elements of the mechanism include:

- Safeguard facilities must meet the reporting and record-keeping requirements of the NGER Act, including the Clean Energy Regulator's requirements for audits prior to baseline setting or to check compliance management.
- If a safeguard facility is likely to exceed its baseline, the responsible emitter must act, including by purchasing and/or surrendering Australian carbon credit units, to offset excess emissions.
- Penalties for non-compliance.

The Otway Gas Plant emissions are regulated under the Safeguard Mechanism through establishment of a cap (baseline) on emissions. Under this policy, annual emissions are reported under the National Greenhouse & Energy Reporting Scheme and compared against the facility baseline, and Beach is required to generate or procure and surrender Australian Carbon Credit Units for any emissions above the baseline for the compliance period, to ensure that net emissions for the facility remain under the prescribed baseline.

6.3.4.3 National Greenhouse and Energy Reporting Scheme

The NGER Scheme is a single national framework for reporting company information about GHG emissions, energy production, and energy consumption. Key NGER Scheme legislation includes the National Greenhouse and Energy Reporting Act 2007, the National Greenhouse and Energy Reporting Regulations 2008, and the National Greenhouse and Energy Reporting (Measurement) Determination 2008.

The NGER Act provides a single, national framework for the reporting and distribution of information related to GHG emissions, energy production, and energy consumption. Beach reports direct emissions associated with the Otway Offshore Operations and Otway Gas Plant under the NGER Act.

6.3.4.4 Intergovernmental Panel on Climate Change (IPCC) 6th Report

The Intergovernmental Panel on Climate Change (IPCC) released its sixth assessment consisting of three reports, with the most recent release being in April 2022. The three releases of the report relate climate change and anthropogenic influence as well as deduce the impact that climate change has had on ecosystems, biodiversity, humans, and cities. The Physical Science Basis IPCC Report, released in August 2021, was the first to unequivocally relate climate change to human influences and the use of hydrocarbon fuels. Surface temperatures have increased at a rapid rate since 1970 compared to any other 50-year period in the last 2,000 years. The rapid changes that have occurred since the industrial revolution are unprecedented, even with the research on ice boreholes and the subsequent calculations of historical CO_2 concentrations. The IPCC states with high confidence that in 2019, atmospheric CO_2 concentrations were higher than anytime in at least 2 million years, along with very high confidence that concentrations of CH_4 and N_2O far exceeding intensities from at least 800,000 years.

The sixth assessment report presents a number of scenarios to understand climate response to a range of GHG emissions levels. The best-case scenario, scenarios with very low and low GHG emissions and CO2 emissions decreases to net zero around or after 2050 (IPCC 2021), aligns with Beach’s aspiration to achieve net zero Scope 1 and Scope 2 GHG emissions by 2050 and its interim target to reduce Beach GHG emissions intensity.

6.3.4.5 International Energy Agency World Energy Outlook

The International Energy Agency annually publishes a range of climate-related scenarios in its “World Energy Outlook” report (IEA 2021). In the most ambitious scenario, Net Zero Emissions by 2050, it projects approximately $365bn of investment in oil and gas supply is needed every year to 2030. In the Paris Agreement aligned Sustainable Development Scenario, natural gas consumption in Asia is projected to grow by over 36% between 2020 through to 2030 and remains above 2020 levels through to 2050 (IEA 2021).

Production of gas from the Beach Otway Gas Plant is critical in ensuring Victoria's energy security as demand for gas is expected to continue in Victoria and the south-eastern states particularly as a result of the decline in consumption of more emission intensive coal associated with the closure of coal-fired power stations.

As gas from the Beach Otway Gas Plant is provided to customers within Australia that has ratified the Paris Agreement and set NDCs, GHG emissions arising from third party consumption are managed and mitigated through Australia's GHG legislative frameworks and commitments to achieve Net Zero Emissions by 2050.

6.3.5 Beach Environmental Management System Relevant to GHG Emissions

Section 7 Implementation Strategy details the components of the Beach Operations Excellence Management System (OEMS) relevant to the management of the petroleum activity covered by this EP. Beach's climate change framework sits within their OEMS. Table 6-5 provides a summary of the Beach OEMS components relevant to the management of GHG emissions.

Table 6-5: Beach OEMS Components Relevant to the Management of GHG Emissions

Beach OEMS Component	Description	Contribution to Managing Climate Change
Corporate Policies		
Beach Climate Change Policy	Beach's climate change policy commitments include: • Measuring and reporting carbon emissions as required by regulatory requirements. • Integration of climate risks into project decision-making. • Evaluating investment decisions to potential changes in global climate policy and changes in climate. • Setting targets to encourage innovation and drive reductions in our carbon.	This public published policy specifies that Beach's top management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation. It identifies that the Board Risk, Corporate Governance and Sustainability Committee is responsible for overseeing the effectiveness of the policy. It formally expresses specific commitments related to climate change mitigation and adaptation. All Beach policies are approved by the Board.
Environmental Policy	The relevant commitments/aspects within Beach's Environment Policy are: • Establish environmental objectives and targets and implement programs to achieve them that will support continuous improvement. • Identify, assess, and control environmental impacts of our operations by proactive management of activities and mitigation of impacts. • Efficiently use natural resources and energy and engage with stakeholders on environmental issues. • Publicly report on our environmental performance.	Specifies that all environmental impacts will be proactively identified, assessed, and managed; and publicly reported against. All applicable legal and other requirements will be complied with and managed via Beach's OEMS. Commits to setting environmental objectives and targets, and a program of continuous improvement.

Beach OEMS Component	Description	Contribution to Managing Climate Change
Sustainability Policy	The relevant commitments/aspects within Beach's Sustainability Policy are: • Ensuring an appropriate governance system is in place to maintain a sustainable business. • Assessing and addressing material social, environmental, climate and economic risks and the impact of our operations, and integrating these considerations into business planning. • Conducting business activities in an ethical and transparent manner. • Setting clearly defined targets, measuring, monitoring and reporting sustainability performance to support continuous improvement. • Complying with relevant legislation, standards and procedures. • Providing information and training, as required, and encouraging the adoption of sustainable principles and practices.	Specifies that Beach's top management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation; and formally expresses specific commitments related to climate change mitigation and adaptation. It identifies Beach Executives and managers are responsible for leading the adoption of this policy and the integration of sustainability practices.
OEMS – Key Relevant Standards		
8.1 Risk Management Standard	Standard 8.1 defines Beach's requirements to mitigate and manage risk at all levels within the business. It defines the Risk Management Framework for identifying, understanding, managing and reporting risks. The framework defines the documents, training, tools and templates to be used, and the accountabilities to be applied in support of effective risk management. Risks to people, the environment, Beach's reputation, financial position and any legal risks are assessed through the framework. The methodology is consistent with the Australian and New Zealand Standard for Risk Management (AS/NZS ISO 31000:2018, Risk Management – Principles and Guidelines).	The potential impact of GHG emissions is assessed using Standard 8.1 and the risk assessment process described in Section 6 of this EP.
10.1 Environment Management Standard	Beach has an Environmental Management Standard (EMS) that was issued for use in December 2020 with a review frequency of 3 years. The standard requirements that are included within the EMS include: • General rules • Land Disturbance, Reinstatement and Rehabilitation • Biodiversity • Contaminated Land Management • Water Management • Air Quality and Emissions	Within Beach's EMS, there are management standards that will directly manage climate change. Most notably under the standards for Biodiversity and Air Quality and Emissions. Where Beach can manage emissions and protection to biodiversity, they will ensure that as much as they can. Notable standards for mitigating climate change include: 10.1.3.5 – Decisions to proceed with exploration, development, operation and closure activities must consider the presence of, and impact on, legally

Beach OEMS Component	Description	Contribution to Managing Climate Change
	• Noise and Vibration • Amenity (Dust, Odour, Visual, Lighting); and • Waste	designated protected areas and be recorded. 10.1.6.3 – When assessing and selecting new plant and equipment, low emissions technology must be prioritised 10.1.6.6 – An inventory of sources of air emissions including point, fugitive and mobile related emissions must be developed and maintained.
11.1 – Sustainability Standard	Standard 11.1 operationalises the requirements established by the Company's Sustainability Policy and other associated Beach policies. The Standard includes the following requirements: • Responsibility for steering the company's response on sustainability. • Completion of a Sustainability Report. • Monitoring market and societal trends and Beach's response to them. • Risk assessments to consider social, environmental, governance and economic risks. • Preparation of sustainability targets and initiatives. • Linkage to Project and Risk Management Systems.	Beach's senior management is expected to demonstrate leadership, commitment to, and accountability for climate change adaptation. The Sustainability Report allows Beach to publicly report the impacts of their activities in a transparent structured way that is transparent to stakeholders and other interested parties, incorporating recommendations from the Task Force on Climate Related Disclosures. Monitoring of trends interfaces closely with risk management and setting of targets and initiatives. In alignment with BTSD 8.1 (Risk Management Standard), operational and project level risk assessments ensures the Company continues to pursue sustainable activities and projects. The Project Management System ensures that Sustainability in Design is considered during the design phase of a project life cycle.
Leadership and Accountability		
Risk, Corporate Governance and Sustainability Committee Sustainability Steering Committee	The Beach Energy Board has the Risk, Corporate Governance and Sustainability Committee (RiskCo) which provides oversight on sustainability at Beach. The Sustainability Steering Committee sits under this. It is made up of all company executives as well as the Chief Executive Officer; and oversees the management and execution of sustainability performance and risks in the business. Both committees meet on a quarterly basis to discuss sustainability risks, opportunities, projects as well	Provides management review of the system and changing circumstances in order to inform decisions on actions needed for improvement.

Beach OEMS Component	**Description**	**Contribution to Managing Climate Change**
	as performance against the targets set out in the sustainability reports. In respect to climate change, RiskCo's purpose is to assist the Board in the following: • Regularly reviewing material risks (including through detailed reviews, or deep dives) and management actions and consider that the residual risk is appropriate. • Monitoring and reviewing the company's policies and performance in relation to health, safety, environment, community, climate change and other sustainability matters. • Developing annual sustainability reporting, including public disclosures regarding material climate change risks. • Ensuring the effectiveness of the Climate Change Policy.	
Commitment to Emissions Reduction		
Net zero Scope 1 and 2 operated emissions	Beach has an aspiration to achieve net zero Scope 1 and 2 emissions by 2050. This aspiration was announced in Beach's Financial Year report 2021, the Full Year Results ASX release, as well as being stated on the company's website under "reducing emissions".	Beach is working towards this aspiration via the processes described in this document. Estimated actual operated FY22 emissions were 12% lower than FY18. Initiatives include: • LDAR surveys completed at all assets remedial actions being taken through the maintenance management system. • Equity stake in Moomba CCS Project. • Multiple emission reduction projects completed at operated facilities.
Corporate emissions reduction target	Beach has a stated, publicly available, objective to reduce company net equity emissions intensity by 35 per cent by FY30 against FY18 levels/ targets https://www.beachenergy.com.au/reducing-emissions/.	

6.3.6 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and Acceptability Assessment: Atmospheric Emissions	
ALARP decision context and justification	This EP is an amendment to the accepted EP (2022) and contains a change in Beach's emissions reduction target. This EP also identifies an increase in fugitive emissions from the facilities These changes may be considered to pose an increased risk to the environment as the methodology used has changed. Beach has confirmed a commitment to a 35% reduction in net equity emissions intensity by 2035 against 2018 levels. Atmospheric emissions: ALARP Decision Context: Type A. Impacts from atmospheric emissions are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests.

	No objections or claims where raised by stakeholders in relation to air emissions. Changes to the fugitive emissions have an appropriate mitigative action identified and which is now in place. The new corporate emissions target will not result in an adverse environmental impact at the Otway Offshore Facilities as the commitment remains to reduce emissions at these facilities when reasonably practicable to do so. As the impact consequence is rated as Minor (1) applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP. GHG emissions: ALARP Decision Context: Type B Impacts from GHG emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, but there is significant partner and media interest in GHG emissions form oil and gas activities including Beach's activities. Additional controls may be required to ensure impacts can be managed to an acceptable level.

Adopted Control Measures	**Source of good industry practice control measures**
CM#3: MO 97: Marine Pollution Prevention – Air Pollution	Vessels will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including: • hold a valid International Air Pollution Prevention (IAPP) certificate and a current international energy efficiency certificate. • have a Ship Energy Efficiency Management Plan (SEEMP) as per MARPOL 73/78 Annex VI. • engine NOx emission levels will comply with Regulation 13 of MARPOL 73/78 Annex VI. • sulphur content of diesel/fuel oil complies with Marine Order Part 97 and Regulation 14 of MARPOL 73/78 Annex VI.
CM#4: Maintenance Management System	Combustion equipment shall be maintained in accordance with in accordance with the maintenance management system to ensure efficient operation.
CM#5: Venting Procedures	Venting is undertaken as described in the Thylacine-A Platform Safety Case, including: • Venting is conducted as per operational and maintenance isolation procedures. • Emergency blow down system designed to blow down topside only. • Fuel gas purge flow forms part of the arrival and departure checks. • Drain vents purge set points set to meet the minimum operational requirements.
CM#6 Contractor Supplier HSE Prequalification and Capability Assessment	The tender evaluation for the IMR and support vessels contract will include an evaluation of air and GHG emissions management.
CM#7: Beach Sustainability Standard	General Requirement within the Standard requires Beach to assess and maintain a register of opportunities to reduce: • emissions • energy consumption

	• venting and flaring These opportunities will be included in the yearly budget cycle for review, assessment, and approval where reasonably practicable.
CM#8: Beach GHG Management Plan	Beach has developed and will progressively implement its GHG Management Plan which formalises the framework and specific techniques used to ensure that GHG emission related EPOs will be met over the life of the facility. The GHG Management Plan also outlines how monitoring of Scope 3 GHG emissions attributed to Beach's Otway asset will be undertaken for the life of the activity.
CM#9: Fugitive Leak Detection and Repair Program	Beach undertakes periodic leak detection and repair (LDAR) fugitive emissions surveys. The methodology used for several years at the Otway Gas Plant has now been extended to the offshore platform. During these surveys minor valve and flange leaks are repaired on the spot with more significant leak repairs requiring equipment intervention are managed through the corrective maintenance program. The Otway asset oversees rectification of leaks through its maintenance backlog management process with an appropriate KPI for monitoring the close-out of correctiv work orders pertaining to leaks. For offshore infrastructure such as subsea wells, the IMR program detailed in Section 3.5.4 identifies and repairs any fugitive leaks. Thus, Beach has now implemented an offshore LDAR fugitive emissions survey to align with the onshore program with the scope, methodology, frequency, and repair guidance detailed in the GHG Management Plan (CM#8).
CM#10: Emissions Monitoring	Beach is required to annually report their direct GHG emissions (Scope 1 and 2) as per the NGERS regulatory requirements. Beach will use this annual reporting process to internally compare Scope 1 GHG emissions generated by the Otway Offshore Operations against periodic, internal GHG emissions forecasts. Scope 3 emissions derived from use of product will be reviewed against those same forecasts, with this focus reflecting the proportional contribution of final product use to overall Otway asset Scope 3 emissions (refer to Section 6.3.1.1). Assessment of actual emissions against forecasts will feed into revised assumptions in future emissions forecasts to ensure facilities' GHG impact is appropriately assessed.

Additional Controls Assessed		
Control	**Cost/Benefit Analysis**	**Control Implemented?**
Use of low GHG fuels at the Thylacine-A Wellhead Platform	The Otway Gas Project design includes best practice GHG design. The original Otway Gas Project EES/EIS and Works Approval covered best practice design elements in the facility design which considered the hierarchy of control (Eliminate, reduce, offset). Options considered and not implemented due to high cost and/or feasibility are supply of power from shore (low GHG source), renewable energy generation (offshore wind or solar) and alternative fuels (LNG, Ammonia). Gas engines were selected as the primary power source, these reduce emissions and reduce cost of operations compared to diesel. Diesel maintained as a backup.	No
Use of low GHG fuels for support and IMR vessels	Vessel that use low GHG fuels are relatively now and are not common in Australian waters. To bring vessels into Australia to support operations is an increased cost. Beach via its Contractor Supplier HSE Prequalification and Capability Assessment (CM#6) assesses suppliers emissions management and via this process would support low emission vessels if available.	Yes – as per CM#6: Contractor Supplier HSE Prequalification and Capability Assessment
Eliminate platform venting	A means to dispose of gas is required on the Thylacine-A Wellhead Platform for operability and safety requirements. Process vent was selected due to low rate of fugitive emissions per calendar year, simplicity and reliability given the unmanned platform philosophy. No reasonably practicable alternative methods for reduction or mitigation of vented or fugitive emissions have been identified (vapour recovery system and flare system have been assessed) that would further reduce the impacts. Other measures have grossly disproportionate cost to benefit.	No

Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability Assessment	
To meet the principles of ESD	Air emissions were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Giving consideration to economic development that safeguards the welfare of future generations, Otway Offshore Operations is considered to align with the following core objectives of ESD by: • Responding to the global energy transition, providing a clean and reliable energy source as gas is expected to play a key role in the future energy mix (e.g., partner with renewables). In addition, gas has the potential to contribute to an incremental reduction in global GHG emissions by displacing more carbon intensive power generation (e.g., coal), firming up renewables, or in hard-to-abate sectors. • Committing to controls for GHG emissions within operational control of Beach, given the uncertainty about future climate change trajectories.

	• Committing to controls for indirect GHG emissions that are controlled or influenced by Operator and connected to the operations of the Otway Offshore Operations. • Contributing to the UN Sustainable Development Goals of achieving universal access to energy. • Providing gas to customers within Australia that has ratified the Paris Agreement, and our responsible for accounting, reporting and reducing emissions that occur in its jurisdiction.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy, Climate Change Policy, Sustainability Policy, Risk Management Standard, Environment Management Standard and Sustainability Standard as detailed in Section 6.3.5. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding atmospheric emissions or GHG emissions associated with the Otway Offshore Operations.
Other requirements	Climate variability and change is identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). As 'Loss of habitat caused by anthropogenic emissions of greenhouse gases' has been declared a Key Threatening Process under the EPBC Act. Such changes have the potential to affect listed and migratory species covered by conservation advice and management plans. Climate change is identified as a threat in the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). To ensure that Beach's activities are not inconsistent with these conservation advices, recovery plans and management plans and to support Australia's NDC commitments air emissions and GHG emissions will be managed in accordance with applicable legislative and other requirements including: • The adopted controls and acceptability assessment has considered regulatory and other guidance as detailed in Section 2 and Section 6.3.4, in particular requirements of: o Paris Agreement o National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015 and Scheme o Victorian Climate Change Act 2017 o IPCC Sixth Assessment Report International Energy Agency World Energy Outlook • Providing gas to customers within Australia that has ratified the Paris Agreement.
Monitoring and reporting	Atmospheric and GHG emissions shall be recorded and reported in alignment with the *National Greenhouse and Energy Reporting Act* 2007 (NGER Act) and National Pollution Inventory as detailed within Section 7.12.8. Scope 1 and Scope 3 GHG emissions, generated by the Otway Offshore Operations, will be compared annually to the EP estimates detailed in EP Section 7.3.1.1 as per CM#10.
Acceptability outcome	**Acceptable**

6.4 Underwater Sound Emissions – Impulsive

6.4.1 Hazards

Impulsive underwater sound emissions will be generated by:

- Geophysical surveys

6.4.2 Predicted Environmental Impacts

Potential impacts of underwater sound emissions from geophysical activities to receptors are:

- Behavioural changes.
- Auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

Underwater impulsive sound emissions may impact the following biological receptors:

- Marine invertebrates including commercial species such as squid, rock lobster and giant crab.
- Fish (with and without swim bladders) including commercial species such as sharks and scalefish.
- Marine reptiles.
- Marine mammals.

6.4.3 Consequence Evaluation

Single-beam echo sounder

A single-beam echo sounder (SBES) typically has a frequency range between 120 and 710 kHz and a maximum sounding rate of 20 Hz. The beam width varies between 10 (120 kHz) and 2.8 (710 kHz). The single beam bathymetry received sound exposure level typically does not exceed 160 dB.

Multi-beam echo sounder

The frequency range of the multi-beam echo sounder (MBES) is typically 200–500 kHz (classified as high frequency) with a maximum angular coverage of 160°. The maximum source levels are about 236–242 dB re 1 µPa @ 1 m for the 1° and 2° beams (DoC, 2016).

Side scan sonar

Side scan sonar (SSS) typically operates in the 100–500 kHz frequency range (classified as high frequency). The maximum source levels are about 210-220 dB re 1µPa @ 1 m (DoC, 2016). The SSS towfish is typically towed 10–15 m above the seabed (depending on water depth and the exact frequency) at a distance of about 150- 200 m behind the vessel.

Sub-bottom profiler

Acoustic emissions from sub-bottom profiler (SBP) are typically in the frequency range of 0.05 to 12 kHz, with peak sound pressure level (SPL) of up to 220 dB re 1µPa @ 1 m. There are three different types of SBP, which exhibit a trade-off of in resolution versus depth of penetration based on the frequency of the acoustic signal:

3. CHIRP – uses an FM signal across a full range of frequencies, typically either 2-16 kHz or 4-24 kHz (low to high frequency). The maximum source levels of a CHIRP are about 200– 205 dB re 1 µPa @ 1 m (DoC, 2016).
4. High-frequency boomers – the typical frequency spectrum of boomer systems ranges between 0.2 and 10 kHz, with an effective bandwidth of 1 to 10 kHz (low to high frequency). The sound source level can vary from 100 to 220 dB re 1 µPa @ 1 m.
5. Medium-frequency sparkers – the generated frequencies are generally between 50 Hz (0.05 kHz) and 4 kHz (low to high frequency). The sound source level is typically between 215 and 225 dB re 1 µPa @ 1 m.

Based on a review of the geophysical equipment to be used it was identified that the boomer and SBP were most relevant to the assessment of potential impacts to receptors, due to their operating frequencies and source sound levels. Modelling results for the Otway geophysical survey (McPherson and Wood 2017) have been used as the modelled locations are within the Otway Operation Area and the equipment will be similar.

The modelling study assessed six locations as detailed in Table 6-6 and Figure 6-2. Table 6-6 details those locations relevant to the Otway Operations infrastructure areas.

To assess whether an impact may occur modelled received sound levels were compared to receptor noise effect criteria (Table 6-7). These criteria are based on published scientific research and papers as detailed in and within the relevant receptor section. In lieu of any noise criteria specific to geophysical surveys, criteria that is applied to seismic surveys have been used.

Table 6-6: Acoustic Modelling Locations Applicable to the Seabed Assessment Locations

Modelled Location	**Water Depth (m)**	**Otway Operations Area**
Site 1: THY MID PT	100.5	Thylacine
Site 2: MURCH DDIP	129.5	NA
Site 3: G3	85	Geographe
Site 4: ARTISAN	71.6	Artisan
Site 5: VICP69 NTH	72.8	N/A
Site 6: VICP69 MEEKI	79.1	N/A

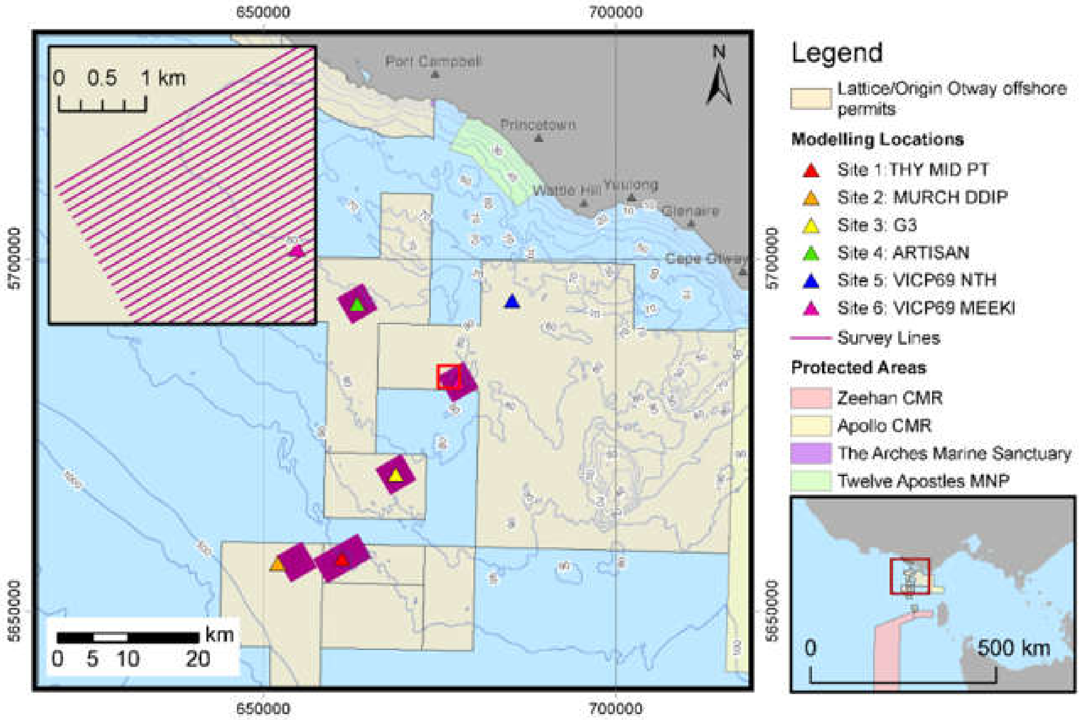


Figure 6-2: Noise Modelling Locations

Table 6-7: Effect Criteria Used and the Applicable Results for Representative Single Pulse Sites and for Accumulated SEL Scenarios

Receptor	Noise Effect Criteria	Boomer Maximum R_{max} Distance (m)	SBP Maximum R_{max} Distance (m)	Noise Effect Criteria Reference
Invertebrates: effect at the seafloor	186–190 dB SEL 192–199 dB SEL_{24h} 209–212 dB PK-PK	Not reached Not reached Not reached	Not reached Not reached Not reached	Day et al. 2016
Invertebrates: no effect at the seafloor	202 dB PK-PK	Not reached	Not reached	Payne et al. 2008
Lobster: no effect at the seafloor	183 dB SEL	Not reached	Not reached	McCauley and Duncan 2016
Squid: behavioural	166 dB SPL	36	Not reached	McCauley et al. 2000
Fish (swim bladder): mortality/potential mortal injury	>207 dB PK or 207 dB SELcum[1]	1.6 Not reached	0.3 Not reached	Popper et al. 2014
Fish (swim bladder): recoverable injury	>213 dB PK or >216 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (no swim bladder): mortality/ potential mortal injury	>213 dB PK or >219 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (no swim bladder): recoverable injury	>213 dB PK or >216 dB SELcum[1]	0.6 Not reached	0.1 Not reached	Popper et al. 2014
Fish (swim bladder or no swim bladder): TTS	>186 dB SELcum[1]	Not reached	Not reached	Popper et al. 2014

Receptor	Noise Effect Criteria	Boomer Maximum R_{max} Distance (m)	SBP Maximum R_{max} Distance (m)	Noise Effect Criteria Reference
Turtle: behavioural	166 dB SPL	36	Not reached	NSF 2011
Turtle: mortality/potential mortal injury	>207 dB PK or 210 dB SELcum[1]	1.6 Not reached	0.3 Not reached	Popper et al. 2014
Marine mammals: behavioural	160 dB SPL	145	2	NMFS 2013 NOAA 2019
Low-frequency cetaceans: PTS (humpback and pygmy blue whales)	219 dB PK 183 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Low-frequency cetaceans: TTS (humpback and pygmy blue whales)	213 dB PK 168 dB SEL_{24h}	Not reached 10	Not reached 10	NMFS 2018
Mid-frequency cetaceans: PTS (dolphins, beaked whales, sperm whales)	230 dB PK 185 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Mid-frequency cetaceans: TTS (dolphins, beaked whales, sperm whales)	224 dB PK 170 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
High-frequency cetaceans: PTS (pygmy and dwarf sperm whales)	202 dB PK 155 dB SEL_{24h}	4.5 Not reached	0.6 Not reached	NMFS 2018
High-frequency cetaceans: TTS (pygmy and dwarf sperm whales)	196 dB PK 140 dB SEL_{24h}	8.9 Not reached	1.2 Not reached	NMFS 2018
Phocid pinnipeds: PTS (seals)	218 dB PK 185 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018
Phocid pinnipeds: TTS (seal)	212 dB PK 170 dB SEL_{24h}	Not reached Not reached	Not reached Not reached	NMFS 2018

Note 1: Popper et al. 2014 do not defined an accumulation period. For this assessment 24 hrs was used based on the independent, expert peer review by Popper (Santos, 2018) that concluded that a 24-hour period to assess SELcum and any associated effects is likely to be conservative for assessing the potential effects to fish.

6.4.3.1 Marine Invertebrates

There has been a number of comprehensive reviews of seismic noise impacts to invertebrates such as Carroll et al. (2017) and Edmonds et al. (2016). Available literature suggests particle motion, rather than sound pressure, is a more important factor for crustacean and bivalve hearing. There are currently no defined noise effect criteria for invertebrates and hence the results from the Day et al. (2016) study on acoustic impacts from seismic exposure on southern rock lobsters (*Jasus edwardsii*) are typically used. The study found that sub-lethal effects, relating to impairment of reflexes, damage to the statocysts and reduction in numbers of haemocytes (possibly indicative of decreased immune response function), were observed after exposure to measured received sound levels of:

- single-pulse SEL: 186–190 dB re 1 µPa^2.s
- accumulated SEL: 192–199 dB re 1 µPa^2.s
- peak-peak pressure: 209–212 dB re 1 µPa.

Payne et al (2007) found no effects to the American lobster (*Homarus americanus*) in righting time or haemolymph biochemistry but a possible reduction in calcium after exposure to received noise levels of 202 dB re 1 µPa (PK-PK). Thus, the Payne et al (2007) level is applied as a no effect criteria. This assessment also used the no effect level proposed by McCauley and Duncan (2016) for rock lobsters of accumulated SEL 183 dB re 1 µPa^2.s.

Table 6-7 details that the sound levels from the representative boomer and SBP do not reach any of the effect or no effect criteria for invertebrates at the seafloor.

McCauley et al. (2000) assessed the effects of air gun noise on caged squid (*Sepioteuthis australis*). No sub-lethal injury or mortality as a result of exposures in this study was observed. Several squid showed alarm responses to the start-up of an airgun by firing their ink sacs and/or jetting away from the source, but this was not observed for similar or greater levels if the signal was ramped up. General habituation was observed with a decrease in alarm responses with subsequent exposures. During the trial the squid showed avoidance to the airgun by keeping close to the water surface at the end of the cage furthest from the airgun (within the sound shadow). McCauley suggests a threshold of 166 SPL would give an indication of the extent of disruption of a seismic survey by significant alteration in swimming patterns. Table 6-7 details that the noise effect criteria at which an alteration of swimming patterns may occur is predicted within 36 m of the boomer and not reached for the SBP.

Based on the modelling no mortality or injury effects to invertebrates including commercial squid, octopus, rock lobster and giant crab species are predicted.

6.4.3.2 Fish

Noise effect criteria for fish are based on the presence of a swim bladder. Typically, site-attached and demersal fish have a swim bladder, whereas pelagic fish do not. As noise effect criteria for sharks does not currently exist, they are assessed as fish without swim bladders. Noise effect criteria used in this assessment for fish are from the American National Standards Institute (ANSI) accredited report of sound exposure guidelines for fishes and sea turtles (Popper et al., 2014). These guidelines defined quantitative effect criteria for three types of immediate effects:

- Mortality, including injury leading to death.
- Recoverable injury, including injuries unlikely to result in mortality, such as hair cell damage and minor haematoma.
- TTS.

Table 6-7 details the noise effect criteria from Popper et al., 2014 and the distances at which modelling estimated they could be reaced for fish with and without a swim bladder. In summary:

- The noise effect criteria for mortality/potential mortal injury is predicted for fish with a swim bladder at a maximum distance of 1.6 m and for fish without a swim bladder at 0.6 m.
- The noise effect criteria for recoverable injury is predicted for fish with a swim bladder and without a swim bladder at a maximum distance of 0.6 m.
- The noise effect criteria for TTS for fish with and without a swim bladder was not reached.

Studies to date have not shown mortality in relation to potential impact to fish from impulsive noise, though prolonged or extreme exposure to high-intensity, low-frequency sound, may lead to physical damage such as threshold shifts in hearing or barotraumatic ruptures (Carroll et al., 2017). Based on the modelling and that the geophysical surveys will not result in prolonged or extreme exposure to fish it is unlikely that injury impacts to fish would occur.

The Operational Area does not overlap any areas where site-attached fish species are likely to be present, thus it would be expected that any impacts to fish, including sharks, would be limited to behavioural impacts such as startle response or avoidance behaviour as the vessel moves through an area. Thus, behavioural impacts to fish would be temporary and unlikely to have a significant impact on individuals or at a population level.

6.4.3.3 Marine turtles

Noise effect criteria used in this assessment for injury to turtles are from the ANSI accredited report of sound exposure guidelines for fishes and sea turtles (Popper et al., 2014). Table 6-7 details the noise effect criteria from Popper et al. 2014 and the distances at which modelling estimated they could be reached. In summary:

- The noise effect criteria for injury to turtles were not reached for the SBP.
- The noise effect criteria for injury to turtles for the boomer is predicted at a maximum distance of 1.6 m for the peak sound pressure level (PK) while the noise effect criteria based on the sound exposure level (SEL) is not reached.

Based on limited data regarding noise levels that illicit a behavioural response in turtles, the United States National Marine Fisheries Service criterion of 166 dB re 1 µPa (SPL) is typically applied (NFS, 2011). For the boomer this noise effect criteria is predicted at a maximum distance of 36 m but was not reached for the SBP.

Three marine turtle species may occur within the operational area. No BIAs or habitat critical to the survival of the species occur within the operational area. Impacts to turtles within the area where the survey is occurring are likely to be restricted to avoidance behaviour as the vessel moves through an area and unlikely to result in any injury due to the very small distance (1.6 m) within which noise levels reach the noise effect criteria for injury. Thus, behavioural impacts to turtles would be temporary and unlikely to have a significant impact on individuals or at a population level.

6.4.3.4 Marine mammals

Noise effect criteria used in this assessment for impacts to marine mammals are from:

- The United States National Marine Fisheries Service (NMFS, 2013; NOAA 2019) acoustic threshold for behavioural effects in marine mammals of 160 dB re 1 µPa (SPL).
- National Marine Fisheries Service (NMFS, 2018) thresholds for the onset of PTS and TTS. These criteria as details in Table 6-7 are based on dual acoustic injury criteria for impulsive sounds that included peak pressure level thresholds and SEL_{24h} thresholds, where the subscripted $_{24h}$ refers to the accumulation period for calculating SEL. The peak sound pressure level (PK) criterion is not frequency weighted whereas the SEL_{24h} is frequency weighted according to the marine mammal species hearing group.

Two species of pinniped may occur within the operational area: the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Twenty eight cetacean species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects the known core range and the migration and resting on migration BIA for the southern right whale and a foraging BIA for the pygmy blue whale.

Table 6-7 details the noise effect criteria and the distances at which modelling estimated they could be reached. In summary:

- The acoustic threshold for behavioural effects in marine mammals is predicted at a maximum of 2 m for the SBP and 145 m for the boomer.
- For low-frequency cetaceans the noise effect criteria for PTS is not reached. The noise effect criteria for TTS is predicted at a maximum of 10 m for the SBP and boomer for the 24-hour cumulative SEL. The noise effect criteria for TTS for the single pulse was not reached.
- For mid-frequency cetaceans the noise effect criteria for PTS and TTS is not reached.
- For high-frequency cetaceans the noise effect criteria for PTS is predicted for the single pulse at a maximum of 0.6 m for the SBP and 2.8 m for the boomer. The noise effect criteria for PTS for the 24-hour cumulative SEL was not reached. The noise effect criteria for TTS is predicted for the single pulse at a maximum of 1.2 m for the SBP and 5.5 m for the boomer. The 24-hour cumulative SEL noise effect criteria for TTS was not reached.
- For Otariid pinnipeds, such as fur-seals, the noise effect criteria for TTS and PTS where not reached.

Low frequency cetaceans

As detailed in Section 4.4.7.6 several low frequency cetacean may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects the known core range and the migration and resting on migration BIA for the southern right whale and a foraging BIA for the pygmy blue whale.

For low-frequency cetaceans the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if foraging, resting, or migrating would be within 10 m of a moving vessel for 24 hours. Predicted impacts would, therefore, be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The severity of impact to low frequency cetaceans is assessed as moderate based on:

- Geophysical surveys can be managed to ensure that they will not be inconsistent with the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) that details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area as:

  - the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if foraging, resting, or migrating would be within 10 m of a moving vessel for 24 hours.
  - the distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of displacement occurring as per the Guidance on Key Terms within the Conservation Management Plan for the Blue Whale (DAWE 2021a) that details mitigation measures must be implemented to reduce the risk of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur.

- The fin and sei whale’s conservation advice (TSSC, 2015f; TSSC, 2015g) 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, 2020a) in lieu of no conservation advice, does not identify anthropogenic noise and acoustic disturbance as a threat.
- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies acute industrial noise, of which geophysical surveys would be classed, as a threat that is classified as a minor consequence which is defined as individuals are affected but no affect at a population level. PTS and TTS impacts and not predicted to southern right whales based on the distance to TTS effect criteria is 10 m. The distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of disturbance to southern right whale migrating or resting on migration.
- Geophysical surveys can be managed to ensure that they will not be inconsistent with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) that details that actions within and adjacent to Southern Right Whale BIAs and HCTS should demonstrate that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance, as:
  - the noise effect criteria for PTS is not reached and for TTS is only reached at 10 m for the 24-hour cumulative SEL. Thus, it is not feasible that a low-frequency cetacean, even if resting, or migrating would be within 10 m of a moving vessel for 24 hours.
  - the distance to the noise effect criteria for behavioural response is 145 m and as this distance is small the control measures detailed in Section 6.4.4 can be implemented to reduce the risk of preventing southern right whales from utilising the area or cause injury (TTS and PTS) and/or disturbance.

Mid frequency cetaceans

Mid frequency cetaceans such as dolphins, sperm whales and beaked whales may occur in the operational area, but no BIAs of biologically important behaviours were identified. The noise effect criteria for TTS and PTS for these species was not reached, thus predicted impacts would be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The extent of the area of where mid frequency cetaceans may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to mid frequency cetaceans is assessed as Minor (1) based on:

- Impacts to mid frequency cetaceans are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.
- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.
- The area of impact is not within a BIA or habitat critical to the survival of a mid frequency cetacean species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

High frequency cetaceans

High frequency cetaceans such as pygmy and dwarf sperm whales may occur in the operational area, but no BIAs of biologically important behaviours were identified. The maximum distance for the PTS noise effect criteria is 2.8 m and for TTS is 5.5 m, thus predicted impacts would be limited to behavioural response such as avoidance of the area while the geophysical survey is undertaken.

The extent of the area of where seals may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to seals is assessed as Minor (1) based on:

- Impacts to high frequency cetaceans are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.
- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.
- The area of impact is not within a BIA or habitat critical to the survival of a high frequency cetaceans species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

Pinnipeds

The Australian and New Zealand fur-seals may occur in the operational area but no BIAs or haul out areas were identified. The noise effect criteria for TTS and PTS for these species was not reached, thus predicted impacts would be limited to behavioural response such as avoidance of area while the geophysical survey is undertaken.

The extent of the area of where seals may be impacted by noise is predicted to be 145 m from the vessel when undertaking the geophysical survey which has a maximum duration of up to 10 days per year. The severity of impact to seals is assessed as Minor (1) based on:

- Impacts to seals are likely to be limited to avoidance behavioural where they may move away from the vessel as it is undertaking the geophysical survey.
- The area of impact is small, as the distance to the noise effect criteria at which impacts could occur is 145 m.

The area of impact is not within a BIA or habitat critical to the survival of a seal species and thus impacts are unlikely to have a significant impact on individuals or at a population level.

6.4.4 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Underwater sound emissions	
ALARP decision context and justification	ALARP Decision Context: Type B Impacts from geophysical impulsive sound emissions are well understood though there is the potential for uncertainty in relation to the level of impact. Geophysical activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests.
Adopted Control Measures	**Source of good practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels and helicopters. Vessels will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans. These regulations stipulate a safe operating distance of 300 m, however as per Section 6.5.5 this has been increased to 500 m to take into account the distance to the noise effect criteria for vessels. This is greater than the furthest noise effect distance of 145 m for geophysical surveys. As the geophysical survey vessel is manoeuvrable, even when the geophysical equipment is in the water this requirement, the 500 m distance can be applied. Maintaining a 500 m distance to all whales will ensure that impacts will be managed such that they can continue to utilise the area without injury and will not be displaced from biologically important behaviours such as foraging, migrating, or resting.
CM#12a Geophysical survey pre-start visual observation	For geophysical surveys using SBP (boomer or sparker) a prestart visual observation period of 30 mins will be applied to 500 m prior to the start of the SBP (boomer or sparker) this is to ensure that no whales are within 500 m prior to starting the equipment. A 500 m distance is conservative as the furthest distance for noise effect criteria for the geophysical survey equipment was estimated at 145 m for behavioural effects. If during the prestart visual observation period, a whale is sighted within 500 m of the vessel the SBP equipment activation will be delayed until the whale has moved outside of the 500 m zone or 30 minutes has lapsed since the last whale sighting within 500 m. 30 minutes is sufficient time for the vessel and/or whale to have moved 500 m away and to account for blue whales that are capable of diving for periods upwards of 20 minutes. Once the survey has commenced CM#11 applies where the vessel is required to maintain a 500 m distance to all whales. SBP equipment will not be started at night if there have been three or more delays to the start-up of the equipment due to whales in the previous 24 hours.

	Applying a 500 m distance will ensure that impacts to whales will be managed such that they can continue to utilise the area without injury and are not displaced from biologically important behaviours such as foraging, migrating, or resting. These controls will be applied to all seasons as a conservative measure to cover not only the peak foraging periods in the area (January to April) but the broader period when pygmy blue whales, and other whales such as the fin, pygmy right and sei may be in the area and when southern right whales are within nearshore BIAs or moving through the area in May/June and Oct/Nov.
CM#12b Geophysical survey Marine Mammal Observer	For geophysical surveys a dedicated MMO will be present on the vessel to undertake prestart visual observations and implement the 500 m distance to any whales during: • 1 November to 30 June within the operational area • 1 May to 30 November within the Victorian coastal migration and resting on migration BIA and emerging aggregation area. These timings are based on: • Foraging whales including blue whales may be present in the region from November (though less likely prior to this time) through to May. • Southern right whales are within nearshore BIAs or moving through the area in May/June and Oct/Nov. The MMO will have proven experience in whale observation, distance estimation and reporting. At other times at least one crew member onboard the vessel will have proven experience in whale observation, distance estimation and reporting to ensure the safe operating distances are implemented.
CM#12c Geophysical survey adaptive management	If whale numbers are greater than expected such that pre-start observations are delayed three times in a 24-hour period or the vessel must move away from a whale or a pod of whales three times in a 24-hour period, a review of the controls in place will be undertaken by the Activity Offshore Representative, Activity Project Manager and Environment Advisor. The review will be documented and will be undertaken against the Implementation of the EPBC Act Policy 2.1 Part A requirements to identify if further controls need to be applied to ensure that impacts and risks are ALARP and within the defined acceptable level. The implementation of an adaptive management process will ensure that if numbers are greater than expected due to favourable conditions, impacts and risks can continue to be managed to ALARP and within the defined acceptable level.

Additional controls assessed

Control	**Cost/Benefit Analysis**	**Control Implemented?**
Seasonal timing	Blue whales are potentially in the foraging BIA within the Otway shelf waters from November through to June. Southern right whales may travel through the operational area to and from coastal aggregation and migration areas during May-June and September-November and be present in the coastal aggregation and migration areas, which the operational area overlaps, between June to October. Thus, there is no period when there is not a whale undertaking a biologically important behaviour within the Otway region. The implementation of additional controls above the legislative requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans will be implemented to manage potential impacts to whales undertaking biologically important behaviour.	No

Implementation of the EPBC Act Policy 2.1 Shutdown Zones	Geophysical equipment operates at significantly lower source levels than a commercial seismic array, and thus the resulting sound levels are proportionally lower at comparable distances. EPBC Act Policy 2.1 was developed for seismic surveys with the aim of the policy to provide: • practical standards to minimise the risk of acoustic injury to whales in the vicinity of seismic survey operations. • 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. • provide guidance to both proponents of seismic surveys and operators conducting seismic surveys about their legal responsibilities under the EPBC Act. Modelling has shown that received noise levels and distances to noise effect criteria for the geophysical survey are significantly lower than those for seismic surveys with the largest distance predicted to be 145 m for the behavioural noise effect criteria for marine mammals. The distances proposed in the policy to minimise the risk of acoustic injury to whales and risk of biological consequences from acoustic disturbance from seismic survey sources to whales in biologically important habitat areas or during critical behaviours of 1 km, for the low power zone, and 500 m, for the shut-down zone, are significantly larger than the predicted distance of 145 m for the noise effect criteria for behavioural disturbance and 10 m for the noise effect criteria for TTS. As the vessel is continuously moving, the distance from the vessel to any marine mammal will exceed the small distances within which noise levels reach the noise effect criteria within seconds. Displacement due to behavioural impacts could occur up to 145 m from the source, and with a moving vessel the distances to the threshold criteria will occur quickly (within 3 minutes for a vessel travelling at approx. 8 km/hr). By the time a whale is sighted, and equipment shut down, it is likely the distance would have been covered and the whale has passed, therefore affording no benefit. As such, based on the small distances within which the noise effect criteria for marine mammals are met, that impacts are not predicted to injure individuals or displace pygmy blue whales from the foraging BIA, the implementation of shut-down zones does not afford any further benefit.	No
Implementation of the EPBC Act Policy 2.1 Soft start	Soft starts are applied to seismic surveys to slowly ramp up the seismic source allowing fauna to move away from the source. No seismic source will be used for the activity and the geophysical equipment being used for the survey cannot be slowly ramped up.	No
Passive acoustic monitoring (PAM)	PAM is most useful in the detection of odontocetes such as sperm whales, dolphins and porpoise known to emit regular distinctive clicks and high frequency calls during long dives. PAM has limited utility in detecting lower frequency calls of baleen whales (such as blue whales, southern right whales) especially when in the presence of constant background low frequency sound such as that generated by the vessel towing the PAM system. Given the very low utility and associated unreliability of using PAM to inform mitigation decision making, any additional cost is considered disproportionate to the benefit gained.	No

Dedicated monitoring vessel	An additional dedicated vessel is not required as monitoring activities can be effectively conducted from the geophysical vessel. Cost is disproportionate to marginal environmental benefit.	No
Aerial surveillance	Aerial surveillance from aircraft or drones is not required as monitoring activities can be effectively conducted from the geophysical vessel. Cost is disproportionate to marginal environmental benefit.	No

Consequence rating	Moderate (2)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Sound emissions were assessed as having a moderate consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding impulsive sound emissions.
Other requirements	Sound emissions will be managed in accordance with legislative requirements. Sound emissions will: • Not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area (Commonwealth of Australia, 2015b; DAWE 2021a). • Not impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Not impact southern right whale established or emerging aggregation BIAs or the migration and resting on migration BIA (DSEWPaC, 2012a). • Not impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) or draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC, 2013a). Actions from the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b; DAWE 2021a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Assessing the effect of anthropogenic noise on blue whale behaviour. Section 6.4.3.4 assesses the effects of anthropogenic noise from the activity 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. Section 6.4.3.4 demonstrates that the activity can be conducted in a manner that is consistent with the conservation management

	plan and will not result in injury or displacement of pygmy blue whales from a foraging BIA. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Anthropogenic noise in biologically important areas will be managed such that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance. • Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to Southern Right Whales to the lowest possible level. Section 6.4.3.4 assesses the effects of anthropogenic noise from the activity on southern right whales and Section 6.5.5 includes consideration of national policy and guidelines relevant to geophysical surveys. • Quantify risks of anthropogenic underwater noise to Southern Right Whales, including behavioural disturbance, changes to vocalisations, and physiological effects to whales. Section 6.4.3.4 assesses the effects of anthropogenic noise from geophysical surveys on southern right whales.
Monitoring and reporting	Cetacean sightings will be recorded using the DCCEEW sighting sheets as detailed in Section 7.12.9 .
Acceptability outcome	**Acceptable**

6.5 Underwater Sound Emissions - Continuous

6.5.1 Hazards

Continuous underwater sound emissions will be generated by:

- Platform operations (venting, power, HVAC, crane usage etc.)
- Helicopter operations
- Subsea infrastructure
- Maintenance and repair activities
- Vessel operations

Vessels generate continuous sound from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment.

Sound will be generated by helicopters during take-off and landing on the Thylacine-A Wellhead Platform.

Underwater sound emissions are generated by liquid or gas flow though pipelines and valves, specifically wellheads and choke valve operations such as those found at the Geographe and Thylacine subsea facilities. The Thylacine-A Wellhead Platform is a fixed platform, with topside choke valves only, therefore does not generate underwater sound emissions.

Installation of rock bolts by divers and subsea tree top plate trimming with a disk cutter for any choke valve replacement work will also create sound while these activities are being undertaken.

6.5.2 Predicted environmental impacts

Potential impacts of underwater sound emissions from the Otway Offshore Operations are:

- Behavioural changes.
- Auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

6.5.3 EMBA

The sound EMBA is the area where sound levels are predicted to be above sound exposure criteria. Acoustic modelling undertaken to determine the sound EMBA is described below.

Underwater sound emissions may impact biological receptors within the sound EMBA such as:

- Fish (with and without swim bladders) including commercial species such as sharks and scalefish.
- Marine reptiles.
- Marine mammals.

As different sound exposure criteria apply to these receptors, sound EMBAs for each receptor is defined in the receptor consequence sections to identify potential receptors that may be affected.

6.5.4 Consequence evaluation

Helicopters

Helicopters are used to transport personnel to and from the platform. The presence of the helicopter and its associated sound field will be highly transient. On approach to the platform the helicopter will descend to the helideck where there is greatest potential to ensonify the water column. Sound pressure will be greatest at the sea surface and rapidly diminish with increasing depth. Helicopter engine sound is emitted at a range of frequencies generally, below 500 Hz (Richardson et al. 1995). Richardson et al. (1995) reported helicopter sound (for Bell 214 type) being audible in air for four minutes before it passed over receivers, but only detectable underwater for 38 seconds at 3 m depth and for 11 seconds at 18 m depth for the same flight path. Thus, the predicted extent of impact is between 3 to 18 m for a period of 11 – 38 seconds twice a day (landing and take-off). Based on such short-term, intermittent sounds the consequence to whales (including pygmy blue whales within the foraging BIA, southern right whales within the current core range and fin or sei whales which may also be foraging) and other marine fauna is assessed as Minor (1).

Subsea infrastructure

Measurements of operational wellheads (McCauley, 2002) showed sound levels of 113 dB re 1 µPa; with broadband sound level only marginally above rough sea condition ambient levels. Based on the measurements of wellhead sound discussed in McCauley (2002), which included flow in flowlines, sound produced along a flowline or pipeline may be expected to be similar to that described for wellheads, with the radiated sound field falling to ambient levels within a hundred metres of the flowline.

Woodside undertook acoustic measurements of underwater sound emissions generated by the operation of choke valves associated with the Angel facility (JASCO 2015; in Woodside, 2020). These measurements indicated choke valve sound is continuous, and the frequency and intensity of sound emitted is dependent on the rate of production from the well. Sound intensity at low production rates (16% and 30% choke positions) were approximately 154–155 dB re 1 µPa, with higher production rates (85% and 74% choke positions) resulting in lower sound levels (141–144 dB re 1 µPa). Sound emissions from choke valve operation was broadband in nature, with the majority of sound energy concentrated above 1 kHz. sound from choke valve operation was considered minor compared to sound generated by vessels using thrusters in the area.

Based on spherical spreading of underwater sound it is estimated that at the highest levels recorded of 155 dB re 1 µPa this would attenuate to below the cetacean behavioural sound criteria of 120 dB re 1 µPa within ~ 60 m. Based on this small distance the consequence to whales (including pygmy blue whales within the foraging BIA, southern right whales within the known core range and fin or sei whales which may also be foraging) and other marine fauna is assessed as Minor (1).

Rock bolt installation and subsea cutting

Subsea tree top plate trimming with a disk cutter may be required for any choke valve replacement work and would take ~1- 2 hours. Pangerc et al. (2016) described the underwater sound measurement data during an underwater diamond wire cutting of a 32” conductor (10 m above seabed in ~80 m depth) and found that at lower frequencies, the operation was generally indistinguishable above the background noise of the vessel. Acoustic modelling undertaken by JASCO (Koessler and McPherson

2021 Appendix C) modelled a stationary vessel at Thylacine North-1 on DP (operating at 20% MCR) plus a stationary vessel on DP (operating at 20% MCR) using a ROV cutting tool at Geographe-4. This showed an increase of ~30 m for the behaviour exposure criteria compared to an installation vessel on DP and ~6 m for the TTS 24 h exposure criteria. The furthest distance to either criteria is 2.98 km. As detailed in Figure 16, Figure 17, Figure 54 and Figure 55 in Koessler and McPherson (2021) (Appendix C) show that the ranges to the behaviour and TTS 24hr exposure criteria at Geographe for the vessel with the cutting tool are not influenced by the vessel at Thylacine North-1.

Information on sound levels from rock bolt installation was not available. Rock bolts are installed by hand equipment used by divers and could be presumed to be of a similar noise level to an ROV undertaking cutting as discussed above.

Vessels

Underwater sound emissions will be generated by vessel dynamic position (DP), and to a lesser extent machinery, pumps and generators on vessels (Erbe et al. 2013).

6.5.4.1 Underwater sound level modelling

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with the Beach Energy Otway Development (Koessler and McPherson 2021 Appendix C), to supplement drilling and construction results previously presented in Koessler et al. (2020), Matthews et al. (2020) and Matthews et al. (2021). The results from these previous modelling studies have been revised due to a better understanding of the propagation loss in the region gained through the validation monitoring of drilling operations at Artisan-1 (McPherson et al. 2021).

The considered locations: Artisan and Thylacine were selected to estimate sound levels that would be representative of all locations within the Otway operations (at wells and along pipeline and umbilical routes) based on water depth, proximity to the continental slope, and the seabed type. Distances to sound level thresholds for vessel activities occurring close to shore, where the water depth is significantly less and decreases rapidly, are expected to be shorter than those modelled at Artisan. This is in part because of the increased losses due to the increased number of surface and seafloor interactions the sound field experiences in shallow water, but also due to the lower frequencies where the sources are louder being less supported in significantly shallow water.

The modelling study assessed distances from activities where underwater sound levels reached exposure criteria corresponding to various levels of potential impact to marine fauna. The marine fauna considered was based on a review of receptors that may be impacted by continuous sound, these were marine mammals, turtles, and fish. The exposure criteria selected for the modelling and the impact assessment were selected as they have been accepted by regulatory agencies and because they represent current best available science (Koessler et al. 2020, Matthews et al. (2020).

Where several modelled scenarios are representative of vessel activities, such as where location or season has been varied in the modelling parameters, the furthest distance to the exposure criteria has been selected for evaluation of potential impacts.

Table 6-8 summarised the modelling scenarios applicable to Otway Offshore Operations. As the sound pressure level (SPL) metric does not depend on the duration of the operation, these estimates are valid for both, stationary (maintenance and repair) and moving (inspection) vessel activities. Note the modelling study by Koessler and McPherson (2021) (Appendix C) details results for other scenarios such as drilling and installation that are not relevant to this EP.

Table 6-8 Modelled underwater sound scenarios

#	*Activity*	*Modelled Scenario*
A4	Platform	Platform operations
A3	OSV standby transit	Offshore support vessel on standby using minimal DP
1, 2 ,3, 4	Platform and OSV resupply	Resupply of the platform can take between 2 to 8 hr depending on the activity being undertaken. Modelling based on the Siem Offshore VS491 vessel which are currently being used for supply vessel for the Otway Offshore Operations.
5, 6	Platform and OSV standby	Standoff from platform during higher risk activities such as work over, heavy lifts and well intervention. OSV standing by within 1–3 km of the platform for up to 8 hr while work on the platform is undertaken. The vessel is required to be ready to respond as required. During this time, the vessel is assumed to be operating under a mix of slow transit, minimal power DP and drifting. This modelling was based on the Siem Offshore VS491 which are currently being used for supply vessel for the Otway Offshore Operations.
7, 8	Maintenance and Repair - Thylacine	Stationary vessel on DP undertaking repair / maintenance. Pipelay Vessel (PLV) stationary on location, operating at 20% MCR (i.e. DP) This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake maintenance and repair activities.
11, 12	Maintenance and Repair stationary - Artisan	
9, 10	Inspection vessel moving- Thylacine	Slowly moving vessel undertaking inspection of subsea infrastructure. Pipelay Vessel (PLV) moving slowly, operating at 20% MCR This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake inspection activities.
13, 14	Inspection vessel moving - Artisan	
15,16	Maintenance and Repair stationary at Thylacine with Maintenance and Repair stationary at Geographe with ROV cutting tool	Stationary vessel on DP undertaking repair / maintenance. Pipelay Vessel (PLV) stationary on location, operating at 20% MCR (i.e. DP) with ROV cutting tool. This modelling was based on Skandi Singapore and would be the maximum sized vessel to undertake maintenance and repair activities.

6.5.4.2 Marine Mammals

Exposure Criteria - PTS and TTS

The US National Marine Fisheries Service (NMFS 2018) reviewed available literature to determine exposure criterion for the onset of temporary hearing TTS and PTS for marine mammals based on their frequency hearing range. NMFS (2018) details that after sound exposure ceases or between successive sound exposures, the potential for recovery from hearing loss exists, with PTS resulting in incomplete recovery and TTS resulting in complete recovery.

The NFMS (2018) exposure criteria are based on a cumulative SELs over a period of 24 h. Table 6-9 details the criteria and furthest modelled distances to them for each scenario.

The PTS and TTS 24 h criteria are only relevant to those receptors that are likely to be present in the area of ensonification for a period of 24 h. For this assessment the PTS and TTS 24 h criteria was applied to marine mammals that may be undertaking biologically important behaviours, such as calving, foraging, resting or migration (as defined by Commonwealth of Australia, 2015c), that could result in them being within the ensonification area above the PTS and TTS criteria for a period of 24 h or greater.

Exposure Criteria - Behaviour

Numerous studies on marine mammal behavioural responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioural reactions. The current interim NFMS (NOAA 2019) 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) reviewed extensive literature and studies in relation to marine mammal behavioural response to impulsive (seismic, pile driving) and non-impulsive (drilling, vessels) and found that most marine mammals exhibited varying responses between 140 and 180 dB re 1 µPa.

Table 6-9 details the furthest modelled distance to the NOAA (2019) exposure criteria for each scenario.

Phocid seals

For Phocid seals the furthest distance to the PTS criteria is reached at 80 m and the furthest distance to the TTS criteria is 430 m during resupply at the platform. From the PMST Reports Phocid seals were not identified within the operational area (500 m around the operations infrastructure) and thus PTS and TTS are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. No Phocid seals were identified within the Sound Behaviour EMBA (7.5 km) PMST report (Appendix A.5) thus behaviour impacts are not assessed further.

Otariid seals

For Otariid seal the PTS criteria is only reached at 10 m for the maintenance and repair activities while cutting and the furthest distance to the TTS criteria is 80 m during resupply at the platform. The Australian and New Zealand fur seal may occur within the operational area (500 m around the operations infrastructure) but no biologically important behaviours or biologically important areas were identified within the operational area thus PTS and TTS are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified that the Australian and New Zealand fur seal may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours, biologically important areas, aggregation areas or haul-out area identified within the predicted ensonified area.

High-frequency cetaceans

The furthest distance to the high-frequency cetacean PTS criteria is 110 m and the TTS criteria is 1.46 km. The PMST Report (Appendix A.4 Sound 24 hr EMBA 1.5 km) identified that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound 24 hr EMBA (1.5 km), however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified that that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours or biologically important areas identified within the predicted ensonified area.

Mid-frequency cetaceans

The furthest distance to the mid-frequency cetacean PTS criteria is 50 m and the TTS criteria is 100 m. The PMST Report (Appendix A.4 Sound 24 hr EMBA 1.5 km) identified several dolphin species, beaked and toothed whales, however, no biologically important areas or behaviours were identified within the area of ensonification and therefore they are not assessed further.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. The PMST Report (Appendix A.5 Sound Behaviour EMBA 7.5 km) identified several dolphin species, beaked and toothed whales that may occur within the Sound Behaviour EMBA (7.5 km). Impacts are predicted to be temporary avoidance for resupply (7.31 km), standby (450 m) and IMR activities (2.71 km) and potentially permanent avoidance of an area of 200 m around the Thylacine-A Wellhead Platform. The consequence is assessed as Minor (1) as there are no biologically important behaviours or biologically important areas identified within the predicted ensonified area.

Table 6-9: Cetacean PTS, TTS and behaviour sound criteria and predicted furthest distances and areas

Hearing group	**SEL_{24h} threshold** ($L_{E,24h}$; dB re 1 µPa^2·s)	**OSV standby transit**		**Platform**		**Platform and OSV resupply**		**Platform and OSV standby**		**Inspection vessel moving**		**Maintenance and repair vessel stationary**		**Maintenance and repair vessel stationary with ROV cutting tool**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS															
LF cetaceans	199	–	–	0.02	0.001	0.18	0.07	0.02	0.001	0.02	0.21	0.06	0.01	0.06	0.01
MF cetaceans	198	–	–	0.02	0.001	0.05	0.002	0.02	0.001	0.01	0.02	0.02	0.001	0.02	0.001
HF cetaceans	173	–	–	0.03	0.004	0.11	0.02	0.03	0.004	0.03	0.37	0.09	0.03	0.12	0.04
Phocid seals	201	–	–	0.02	0.001	0.08	0.01	0.02	0.001	0.01	0.14	0.02	0.001	0.02	0.001
Otariid seals	219	–	–	–	–	–	–	–	–	–	–	–	–	0.01	0.001
TTS															
LF cetaceans	179	–	–	0.04	0.004	1.25	4.01	0.04	0.004	1.18	13.62	0.60	1.04	0.66	1.35
MF cetaceans	178	–	–	0.03	0.003	0.10	0.02	0.03	0.003	0.02	0.22	0.07	0.02	0.09	0.03
HF cetaceans	153	–	–	0.30	0.28	0.63	1.17	0.30	0.28	1.46	16.02	0.84	2.02	0.87	2.37
Phocid seals	181	–	–	0.03	0.00	0.43	0.46	0.03	0.00	0.13	1.54	0.19	0.02	0.19	0.12
Otariid seals	199	–	–	0.02	0.001	0.08	0.01	0.02	0.001	0.01	0.15	0.02	0.001	0.02	0.001
Behaviour	**SPL threshold** (Lp; dB re 1 µPa)														
Marine mammals	120	0.38		0.20		7.31		0.45		2.71		2.71		2.98	

Note: a dash indicates the level was not reached within the limits of the modelling resolution (20 m).

Low-frequency cetaceans

The furthest distance to the low-frequency cetacean PTS criteria is 180 m and the TTS criteria is 1.25 km. Table 6-10 details the low-frequency cetaceans that have biologically important areas and/or biologically important behaviours within the Sound 24 hr EMBA (1.5 km) as identified from the Sound 24 hr EMBA PMST Report (Appendix A.4) and Table 4-9.

The distances to the behavioural threshold ranged from 200 m at the platform to 7.31 km during resupply at the platform. Table 6-10 details the low-frequency cetaceans that have biologically important areas or biologically important behaviour within the Sound Behaviour EMBA (7.5 km) as identified from the Sound Behaviour EMBA PMST Report (Appendix A.5) and Table 4-9.

The distance, area of impact and predicted duration for each activity is shown in Table 6-11.

Table 6-10: Low-frequency cetaceans with biologically important behaviours within the PTS and TTS ensonification area

Species	Biologically Important Behaviour
Blue whale	Foraging, feeding or related behaviour known to occur within area.
	High density foraging BIA
Fin whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs
Pygmy right whale	Foraging, feeding or related behaviour may to occur within area.
	No BIAs
Sei whale	Foraging, feeding or related behaviour likely to occur within area.
	No BIAs
Southern right whale	Cow and calf pairs may move through the known core range.
	Migration and resting on migration BIA

Table 6-11: Distance to sound criteria, area of impact and predicted duration for each activity

Activity	Furthest distance to sound criteria	Area of ensonification	Duration
Thylacine-A Wellhead Platform	40 m	0.004 km^2	Continuous
Thylacine-A Wellhead Platform resupply	7.31 km	167.87 km^2	Up to 6 hours for 2 days four times a year
Thylacine-A Wellhead Platform and vessel on standby	450 m	0.64 km^2	Up to 6 hours once or twice a year
Inspection vessel moving	2.71 km	23.07 km^2	Once a year for up to 30 days
Maintenance and repair vessel	2.71 km	23.07 km^2	Once every 2 years up to 30 days
Maintenance and repair vessel with ROV cutting tool or rock bolt installation	2.98 km	27.9 km^2	One off activities. Cutting ~ 1- 2 hrs Rock bolt up to 4 hrs

Blue whales

Foraging behaviour for blue whales has been identified in the area where the PTS, TTS and behavioural criteria is reached. As detailed in Section 4.4.7.6 cetacean foraging within the Otway shelf, and hence the area where the PTS, TTS and behavioural criteria is reached, is typically from January to April though whales maybe present from November to June which overlaps the period when Otway Offshore Operations activities may occur (activities occur year round).

The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) details that anthropogenic noise in BIAs will be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area.

DAWE (2021a) defines 'displaced as a foraging area' as:

> The recovery plan requirement, Action A.2.3, applies in relation to BIAs. A whale could be displaced from a Foraging Area if impact mitigation is not implemented. This means that underwater anthropogenic noise should not:
>
> - Stop or prevent any blue whale from foraging
> - Cause any blue whale to move on when foraging
> - Stop or prevent any blue whale from entering a Foraging Area
>
> It is considered that a whale is displaced from a Foraging Area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that Foraging Area. Mitigation measures must be implemented to reduce the risk of displacement occurring during operations where modelling indicates that behavioural disturbance within a Foraging Area may occur.

DAWE (2021a) defines 'injury to blue whales' as:

> For the purpose of interpreting and applying Action Area A.2 of the Blue Whale CMP, injury is both permanent and temporary hearing impairment (Permanent Threshold Shift and Temporary Threshold Shift) and any other form of physical harm arising from anthropogenic sources of underwater noise.

As detailed in Table 6-11 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- A conservative approach has been taken in applying the sound modelling and results such as the furthest distance to the PTS and TTS criteria for the scenarios modelled to assess potential impacts.

- The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) details that shipping and industrial noise are classed as a minor consequence for which the definition is: individuals are affected but no affect at a population level.

- The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) details that "It is the high intensity signals with high peak pressures received at very short range that can cause acute impacts such as injury and death." As vessel noise is continuous noise sources and do not have high intensity signals it is unlikely that they would cause injury to foraging pygmy blue whales.

- Though activities may occur during the period when pygmy blue whales are likely to be foraging within the BIA, the largest area of potential impact within the pygmy blue whale high density foraging BIA (35,627 km^2) is very small, at any one time being:
    - ~0.00001% for the Thylacine-A Wellhead Platform continuous operations.
    - ~0.47% for up to 8 hours for resupply of the Thylacine-A Wellhead Platform.
    - ~0.002% for up to 8 hours for vessel standby at the Thylacine-A Wellhead Platform.
    - ~0.065% for up to 30 days for inspection, maintenance and repair activities.
- PTS and TTS impacts are not predicted from the Thylacine-A Wellhead Platform and or the Thylacine-A Wellhead Platform and vessel on standby based on predicted distance to the 24 hr exposure criteria are 20 m and 40 m respectively. It would be highly unlikely for a pygmy blue whale to remain within those distances for 24 hours.
- Displacement of foraging blue whales at the Thylacine-A Wellhead Platform are not predicted as the platform has been operating since 2006.
- For platform resupply, vessel on standby and inspection, maintenance and repair activities adopted controls as detailed in Section 6.5.5 will prevent possible PTS, TTS and displacement impacts to pygmy blue whale that may be foraging.

Southern right whales

For southern right whales the following areas are within the predicted ensonified area as shown in Figure 6-3:

- Known core range is within the area where the PTS, TTS and behavioural criteria is reached for all activities.
- Victorian coastal migration and resting on migration BIA and emerging aggregation area off Port Campbell is within the area where the PTS, TTS and behavioural criteria is reached for inspection, maintenance and repair activities.

As detailed in Section 4.4.7.6, there is the potential for southern right whales to be within the Victorian coastal migration and resting on migration BIA and emerging aggregation area from late May/early June till October and transiting through the area during May-June and September-November as they move to and from coastal aggregation areas.

As detailed in Table 6-11 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- A conservative approach has been taken in applying the sound modelling and results such as the furthest distance to the PTS and TTS criteria for the scenarios modelled to assess potential impacts.

- The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies shipping and industrial noise as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- Though activities may occur during the period when southern right whales are within the known core range, the largest area of potential impact within the known core range (217,825 km^2) is very small, at any one time being:
    - ~0.000002% for the Thylacine-A Wellhead Platform continuous operations.
    - ~0.08% for up to 8 hours for resupply of the Thylacine-A Wellhead Platform.
    - ~0.0003% for up to 8 hours for vessel standby at the Thylacine-A Wellhead Platform.
    - ~0.011% for up to 30 days for inspection, maintenance, and repair activities.
- PTS and TTS impacts are not predicted from any of the activities to southern right whales, by themselves or with calf, that may be moving through the known core range to and from coastal aggregation and migration areas based on mean recorded swims speeds for southern right whales are between 3 – 3.3 km/hr (Mate et al. 2011; Mackay et al. 2015 cited in Charlton 2017). As the furthest distance to the PTS or TTS criteria is 1.25 km over 8 hr and 750 m over 2 hr southern right whales, by themselves or with calf, would move out of the ensonified area before PTS or TTS could occur.
- Avoidance behaviour may be exhibited if southern right whales are within the area where the behavioural criteria is reached. Disturbance on the behaviour of the mothers that could increase their energy expenditure will result in a reduction of energy available for their calf and for their return migration (Christiansen et al. 2014b). Based on an average swim speed of 3 km/hr (Charlton 2021 per com) energetic costs would be extremely low if avoidance behaviour occurred for the platform (200 m), the only continuous activity, and vessel standby (450 m), and low for platform resupply (7.31 km) and inspection, maintenance and repair activities (2.27 – 2.98 km) and thus not predicted to impact the fitness of mothers or calves moving between calving and feeding areas.
- Southern right whales may avoid the area where the behavioural criteria is reached but there is no impediment to them continuing to and from coastal aggregation and migration areas. Southern right whales are a highly mobile migratory species that travel thousands of kilometres between habitats used for essential life functions (DSEWPaC, 2012a). Along the Australian coast, individual southern right whales use widely separated coastal areas (200–1,500 km apart) within a season, indicating substantial coast-wide movement. The longest movements are undertaken by non-calving whales, though calving whales have also been recorded at locations up to 700 km apart within a single season (DSEWPaC, 2012a). As such, avoidance of the ensonified area is unlikely to prevent or hinder them from undertaking their seasonal migrations.
- PTS, TTS or behavioural criteria from activities at the platform, including vessel standby and resupply, are not reached at the Victorian coastal migration and resting on migration BIA or southern right whale emerging aggregation area.

- For inspection, maintenance and repair activities adopted controls as detailed in Section 6.5.5 will prevent possible PTS, TTS and displacement impacts to southern right whales that maybe present in the migration and resting on migration BIA and emerging aggregation area at Port Campbell. This includes CM#13b - SRW Exclusion Zone where no IMR activities will be planned within 3 km of a SRW BIA or emerging aggregation area during May to end of October when SRW are potentially present in the BIAs or emerging aggregation area. This will ensure that SRWs will not be prevented from calving in the Port Campbell emerging aggregation area or affect the survival of the SRW while leaving the aggregation area.

- Cumulative impacts from the activities proposed within this EP at the Thylacine-A Wellhead Platform, including vessel standby and resupply, and from IMR activities are not predicted at the SRW BIAs and emerging aggregation area at Port Campbell based on:

  - IMR activities will not be undertaken within 3 km (furthest distance to noise criteria for IMR activities) of a SRW BIA or emerging aggregation area when SRW are potentially present in the BIAs or emerging aggregation area and noise criteria (PTS, TTS or behavioural) from activities at the platform, including vessel standby and resupply, are not reached at the SRW BIAs or emerging aggregation area at Port Campbell.

  - The Thylacine-A Wellhead Platform is ~65 km from the emerging aggregation area at Port Campbell and ~ 70 km to the closest SRW BIA. Acoustic modelling (Koessler and McPherson 2021 Appendix C) for concurrent activities at the platform such as platform operations and resupply shows the furthest distance to the noise criteria (behaviour) is 7.31 km and for IMR activities is 2.98 km, thus if an IMR activity was to occur within 3 km of the platform the overlapping noise footprint would not be reached at a SRW BIA or the emerging aggregation area at Port Campbell due to the distance from the overlapping noise footprint being ~ 60 and 55 km, respectively from these areas.

  - Concurrent IMR campaigns are not planned.

- Cumulative impacts from activities within the surrounding area on SRWs calving in the Port Campbell emerging aggregation area and their survival while leaving the aggregation area are not predicted based on:

  - Beach Otway Development Drilling is complete.

  - Beach Geographe and Thylacine subsea installation and commissioning is complete.

  - Cooper Energy CHN Operations will also undertake IMR activities on their offshore infrastructure which is to the west of the Beach Otway Operations infrastructure. Beach will not be undertaking IMR activities within 3 km of a SRW BIA or emerging aggregation area when SRW are potentially present in the BIAs or emerging aggregation area, thus the closest distance to Cooper Energy's infrastructure and to Beach's infrastructure outside this 3 km area is 3 km. As Cooper Energy CHN Operations EP does not include acoustic modelling and the IMR activities are within the same area and likely to use similar vessels it can be presumed the furthest distance to the noise criteria (behaviour) of 2.98 km would also apply to Cooper Energy's IMR activities. Thus, if IMR activities where being undertaken by Beach and Cooper Energy at the same time impacts from these concurrent activities are not predicted to the SRW BIAs or emerging aggregation area when SRWs are present in these areas.

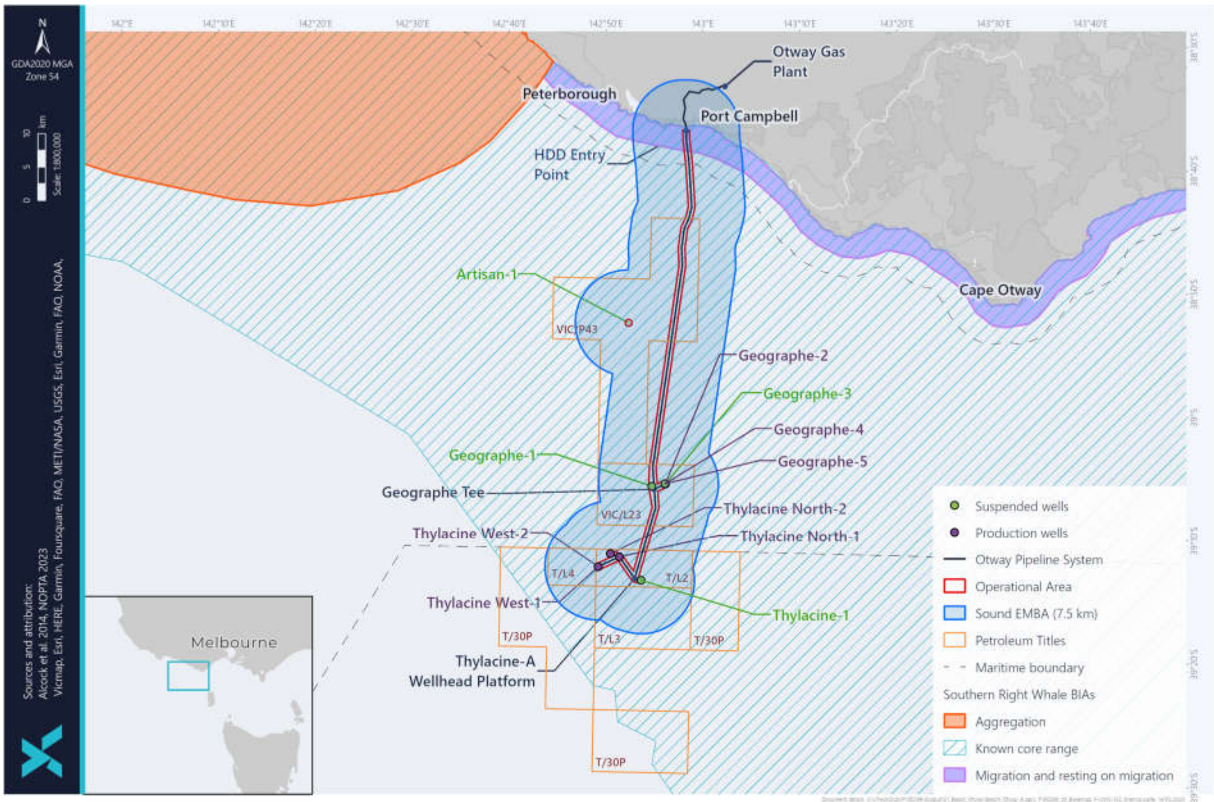


Figure 6-3: Southern Right Whale BIAs, Known Core Range, Emerging Aggregation Area and Sound EMBA

Other whales

Foraging behaviour for fin, pygmy right and sei whales has been identified in the area where the PTS, TTS and behavioural criteria is reached. As detailed in Section 4.4.7.6 cetacean foraging within the Otway shelf, and hence the area where the PTS, TTS and behavioural criteria is reached, is typically from January to April though whales maybe present from November to June which overlaps the period when Otway Offshore Operations activities may occur (activities occur year round).

The fin, pygmy right and sei whales do not have conservation management plans. The fin and sei whales have conservation advice (TSSC, 2015f; TSSC, 2016g) which both identify anthropogenic noise as a threat with the conservation and management actions of:

- 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 expansion, and coastal development) should be undertaken on this species.
- If required, additional management measures should be developed and implemented to ensure the ongoing recovery of sei whales.

As detailed in Table 6-11 the extent and duration of impact differs based on the activity being undertaken, however, the severity is assessed as moderate and is of an acceptable level based on:

- The fin and sei whale's conservation advice (TSSC, 2015f; TSSC, 2016g) has a consequence rating for anthropogenic noise and acoustic disturbance as minor with the extent over which the threat may operate as moderate-large.
- There is no conservation advice for the pygmy right whale and the Species Profile and Threats Database (DotEE, 2020a) does not identify anthropogenic noise and acoustic disturbance as a threat.
- Low numbers of fin, sei and pygmy right whales are predicted within the PTS, TTS and behaviour ensonification area based on the following:
    - the PTS and TTS ensonification area is ~75 km from the Bonney coast upwelling KEF which is known as feeding aggregation area (Gill et al. 2011; McCauley et al. 2018).
    - the PTS and TTS ensonification area is within an area with a historical frequency <10% of an upwelling occurring (Huang and Wang 2019).
    - no biologically important areas were identified for these species.
    - aerial surveys in the Otway region (2002 – 2013) recorded seven fin whale sightings consisting of 8 individuals, 12 sei whale sightings consisting of 14 individuals and one pygmy right whale sighting consisting of 100 individuals (Gill et al. 2015). Gill et al. (2015) did observer feeding behaviour for sei and fin whales but noted that it is at least an opportunistic feeding area for these species.

6.5.4.3 Marine Turtles

The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) identifies noise interference as a threat to turtles. It details that exposure to chronic (continuous) loud noise in the marine environment may lead to avoidance of important habitat.

In 2006, the Working Group on the Effects of Sound on Fish and Turtles was formed to develop sound exposure criteria for fish and turtles. The Working Group developed guidelines with specific thresholds for different levels of effects for several species groups including turtles (Popper et al. 2014).

Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to sea turtles from ship sound emissions.

Popper et al. (2014) found that there was insufficient data available to propose a quantitative exposure guideline or criteria for marine turtles for continuous sound such as those generated by vessels 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 operational area.

Finneran et al. (2017) presented revised thresholds for turtle PTS and TTS for continuous sound. Table 6-12 details the criteria and modelled distances to them (Koessler and McPherson 2021. Appendix C). The 24 hr PTS criteria was reached within 40 m when undertaking resupply at the Thylacine-A

Wellhead Platform and 20 m when the undertaking maintenance and repair activities. The 24 hr TTS criteria was reached within:

- 20 m of the Thylacine-A Wellhead Platform with and without the support vessel on standby.
- 170 m when undertaking resupply at the Thylacine-A Wellhead Platform.
- 30 m when undertaking inspection activities.
- 80 m when undertaking maintenance and repair activities.

Three marine turtle species may occur within the operational area (500 m) 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 within the operational area. The severity is assessed as Minor (1) based on:

- The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) 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 area that maybe impacted.
- Thresholds for turtle PTS and TTS over 24 hrs were predicted to occur with a maximum distance of 170 m within the operational area where no marine turtle important habits are located.
- Avoidance behaviour may occur within the operational area where no marine turtle important habits are located.
- low numbers of marine turtles are predicted in the operational area and therefore impacts would be limited to a small number of individuals.

6.5.4.4 Fish

Popper et al. (2014) details that there is no direct evidence of mortality or potential mortal injury to fish from ship sound emissions. Popper et al., (2014) details that risks of mortality and potential mortal injury, and recoverable injury impacts to fish with no swim bladder (sharks) or where the swim bladder is not involved in hearing is low and that TTS in hearing may be a moderate risk near (tens of metres) the vessel. For fish with a swim bladder involved in hearing risks of mortality and potential mortal injury impacts is low. However, some evidence suggests that fish sensitive to acoustic pressure show a recoverable loss in hearing sensitivity, or injury when exposed to high levels of sound and Popper et al. (2014) details SPL criteria for fish with a swim bladder involved in hearing. Table 6-13 details the criteria and modelled distances to them (Koessler and McPherson 2021. Appendix C).

No cumulative impacts are expected as there are no habitats likely to support site-attached fish in the operational area.

The recoverable injury threshold was not reached for any scenario. The 12 hr TTS criteria was reached within 140 m when undertaking resupply at the Thylacine-A Wellhead Platform and 30 m when the undertaking IMR activities and 40 m when undertaking maintenance and repair activities with cutting or rock bolting. As there are no habitats likely to support site-attached fish in the operational area it is also unlikely that fish species would be present for a period of 12 hours. Thus, TTS impacts are not predicted.

Behavioural impacts are more likely such as moving away from the vessel. There are no habitats or features within the operational area that would restrict fish and sharks from moving away from the vessel.

The operational area is within a distribution BIA for the white shark though no habitat critical to the survival of the species or behaviours were identified. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify sound as a threat.

Low levels of commercial fishing for fish species were identified within the operational area within shark fishing occurring nearshore and snapper and wrasse fishing within grids covering Artisan and the Otway Pipeline System. Thus, temporary avoidance may occur during inspection, maintenance and repair activities.

The extent of the area of impact is predicted to be within the operational area for the duration of vessel activities. The severity is assessed as Minor (1) based on:

- The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify sound impacts as a threat.
- Avoidance behaviour may occur within the operational area, however, no habitats likely to support site-attached fish have been identified within the operational area.
- Temporary avoidance behaviour may occur within the operational area (500 m) for commercial fish during inspection, maintenance and repair activities, however recovery would occur once the activity had finished. Based on the small area of impact, low fishing activity and that displaced fish would still being available to be caught outside of the operational area, impacts to commercial fishing are not predicted.

Table 6-12: Finneran Turtle SEL_{24h} Thresholds and Modelled Distances

Marine Turtles	**SEL_{24h} threshold**	**Platform (Scenario A4)**	**OSV standby (Scenario A3)**	**Platform and OSV standby (Scenario 5 & 6)**	**Platform resupply (Scenario 1, 2,3 ,4)**	**Vessel based inspection (DP) (Scenario 9, 10, 13, 14)**	**Vessel based maintenance / repair with and without cutting (Scenario 7, 8, 11, 12, 15, 16)**
		R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)
PTS	220 dB re 1 $\mu Pa^2 \cdot s$	Not reached	Not reached	Not reached	40 m	Not reached	20 m
TTS	200 dB re 1 $\mu Pa^2 \cdot s$	20 m	Not reached	20 m	170 m	30 m	80 m

Table 6-13: SPL Criteria for Fish with a Swim Bladder involved in Hearing and Modelled Distances

Fish: Swim bladder involved in hearing	**SPL (Lp; dB re 1 µPa)**	**Platform (Scenario A4)**	**OSV standby (Scenario A3)**	**Platform and OSV standby (Scenario 5)**	**Platform resupply (Scenario 1)**	**Vessel based Inspection/ maintenance / repair (Scenario 7, 8, 9,10)**	**Vessel based maintenance / repair with cutting (Scenario 15, 16)**
		R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)	R_{max} (km)
Recoverable injury	170 dB SPL for 48 h	Not reached	Not reached	Not reached	Not reached	Not reached	Not reached
TTS	158 dB SPL for 12 h	Not reached	Not reached	Not reached	140 m	30 m	40 m

6.5.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Underwater sound emissions	
ALARP decision context and justification	**ALARP Decision Context: Type B** Impacts from sound emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact. Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests. Additional controls may be required to ensure impacts can be managed to an acceptable level.
Adopted Control Measures	**Source of good practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans Wildlife (Marine Mammal) Regulations 2009	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans and the Vic Wildlife (Marine Mammal) Regulations 2009 describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels and helicopters. Support vessels will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 and Vic Wildlife (Marine Mammal) Regulations 2009 in relation to distances to cetaceans. These regulations stipulate a safe operating distance of 300 m. This will be increased to 500 m to take into account the furthest distance to the sound criteria (450 m) when the support vessel is on standby. Helicopters will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans. The Wildlife (Marine Mammal) Regulations 2009 only provides separation distances to seals on land and at protected or significant seal breeding colonies, none of these are within the area of predicted impact for seals.
CM#13: Otway Operations Vessel Whale Management Procedure	The Vessel Whale Management Procedure details the controls to prevent possible PTS, TTS and displacement impacts to foraging blue whale and southern right whales that maybe present in the known core range and migration and resting on migration BIA. The procedure assumes that once an activity is underway foraging whales that enter the pre-activity survey zone are not displaced as foraging behaviour has not been disrupted as the whale has commenced or continued foraging and thus aligns with the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) and DAWE (2021) definitions. In this situation only PTS and TTS need to be managed to ensure the activity is not inconsistent with the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b). Prior to an activity commencing a pre-activity survey will be undertaken of the activity survey zone for the activity: • Resupply – 7.5 km • Inspection – 3 km • Maintenance and repair – 3 km

The activity survey zones are based on the distance to the furthest modelled PTS, TTS or behaviour criteria, as detailed in Table 6-9, and have been rounded up to take into account accuracy of estimation of distance at sea.

On advice from the Blue Whale Study, a conservative approach will be adopted whereby it is assumed that all whales present on the Otway shelf are conducting biologically important behaviours (e.g., foraging blue whales). All whales will also include southern right whales with or without a calf.

Surveys will be undertaken for 30 min prior to the activity commencing. If a whale is sighted within the pre-activity survey zone the activity will not commence until:

- No whales are observed for 30 min within the pre-activity survey zone; or
- Whales are observed leaving the pre-activity survey zone.

MMOs currently contracted to the Otway drilling campaign have stated that from a vessel bridge height of ~20 m, observations are possible up to 7 km. Given that the vessels used for the drilling campaign are the same vessels that will be used to support operations and undertake resupply, the pre-activity survey zone distance of 7.5 km can be met as the vessel will be able to move around within the pre-activity survey zone providing full observation coverage prior to resupply commencing.

The period of 30 min is deemed as sufficient time to observed deep diving whales such as blue whales based on blue whale foraging behaviour and dive duration detailed in the blue whale section in Section 4.4.7.6.

Once the activity has commenced observations will be undertaken within the activity survey zone distances detailed above.

If a whale is sighted within the activity survey zone the following will occur:

- If the vessel can do so it will move away from the whale and maintain a minimum separation distance equal to the activity survey zone.
- If the vessel cannot move away from the whale, the vessel will reduce thrusters if safe to do so. The activity will cease as soon as it is safe, and the vessel will move out of the activity survey zone.

The activity can recommence once:

- No whales are observed for 30 min within the activity survey zone; or
- Whales are observed leaving the activity survey zone.

As detailed platform resupply is undertaken using the drilling support vessels from which MMOs can observe up to 7 km. Thus, once resupply commences, they may not be able to see as far as the 7.5 km activity survey zone. As resupply activities at the Thylacine-A Wellhead Platform may take up to 8 hrs and are undertaken ~5 times a year the cost, both monetary and increased sound emissions, associated with having another vessel present to be able to see the full activity survey zone is disproportionate to the benefit as the presurvey of the activity zone will be undertaken to identify if any whales are within the activity zone or likely to enter the activity zone. The probability that pygmy blue whales would enter the activity zone to forage within the period that resupply would be undertaken would be extremely low considering the short resupply time.

Activities can commence at night or in low visibility conditions (i.e., when observations cannot be undertaken) if no more than three whales have been seen in the activity survey zone in the preceding daylight hours. The no more than three whales criterion is acceptable for blue whales because it indicates the krill stock at

	the location has been diminished. More than three whales within the previous daylight hours may indicate a large krill supply and more whales could be expected. The daylight hours is justified because it is the longest possible continuous observation period (i.e., one full day of observations). Three southern right whales would be an indication that there is an increased likelihood of a southern right whale within the activity survey zone during the period that observations cannot be undertaken. During the period that drilling is occurring for the Otway Development the following will be undertaken to inform operations activities in relation to the presence of whales within the Otway Development and Operations areas: • One week prior to an activity being undertaken a review of whale data to determine if blue and/or southern right whales have been observed in the area. • When undertaking an activity presence of whales observed from drilling or operations activities will be communicated via radio.
CM#13a Marine mammal observer	A trained and experienced MMO will undertake activity survey zone observations for activities that will be undertaken over a period greater than 24 hours, this will typically be for IMR activities. For IMR activities greater than 5 consecutive days at sea an additional trained MMO will be onboard the vessel to support the trained and experienced MMO. Five consecutive days at sea was deemed appropriate to managed fatigue during periods when there are longer daylight hours in southern Australia during the summer months (up to 15 hours) which are greater than a 12-hr work shift. For a period of up to 5 consecutive days fatigue can be appropriately managed by the MMO being supported by the Officer of the Watch as per below. In addition, vessel crew who act as Officer of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO during daylight hours. Resupply activities at the Thylacine-A Wellhead Platform may take up to 8 hrs and are undertaken ~5 times a year. For resupply the vessel Officer of the Watch will undertake the activity survey zone observations. They will be trained in the Vessel Whale Management Procedure, whale observation and distance estimation. This is deemed acceptable based on: • Mitigation actions are based on sighting a whale within the activity survey zone, so identification of species and/or activity is not required and thus experience in whale identification is not required. • The vessel Officer of the Watch will be experience at distance estimation at sea as their role is to monitor for hazards at sea in all conditions. • The cost is disproportionate as there is no increase in environmental benefit as the Officer of the Watch is capable of undertaking the observations required for an activity that will take at most 8 hours.
CM#13b SRW Exclusion Zone	No IMR activities will be planned within 3 km of a SRW BIA or emerging aggregation area during May to end of October when SRW are potentially present in the BIAs or emerging aggregation area. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) includes objectives relevant for evaluation of environmental impacts of underwater noise on SRWs and requires that ‘aggregations categorised as

	emerging areas in 2011 meet criteria for an established area by 2021; OR are occupied in a greater number of years from 2011–2021 compared with 2005–2010'. The implementation of an exclusion zone for these areas, including the Port Campbell emerging aggregation area, will ensure that the activity is not inconsistent with the Conservation Management Plan for the Southern Right Whale as it will not impede the recovery objective for this emerging aggregation area.	
CM#4: Preventative Maintenance System	Power generation and propulsion systems on the vessels will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.	
Additional controls assessed		
Control	**Cost/Benefit Analysis**	**Control Implemented?**
Seasonal timing	Pygmy blue whales are potentially in the foraging BIA within the Otway shelf waters from November through to June. Southern right whales may travel through the operational area to and from coastal aggregation and migration areas during May-June and September-November and be present in the coastal aggregation and migration areas, which the operational area overlaps, between June to October. Thus, there is no period when there is not a whale undertaking a biologically important behaviour within the Otway region. The implementation of additional controls above the legislative requirements of the EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans will be implemented to manage potential impacts to whales undertaking biologically important behaviour.	No
Anchoring of the vessels	This control is not feasible for the vessels to support operations and for IMR activities based on: • Inspection activities require the vessel to be continuously moving while undertaking the inspection. • Maintenance and repair activities require minor adjustments to the vessel position while undertaking the activity and anchoring may damage existing subsea infrastructure. • Resupply operations require the vessel to use DP to maintain position adjacent to the platform to counter wind and current conditions. • Vessel standby activities require the vessel to be able to react immediately in the event of an issue on the platform.	No
Shut down zones	Implemented with safety controls. Shutting down the CSV DP system during installation activities could lead to the vessel drifting and colliding with another vessel, potentially resulting in a safety risk to personnel or an MDO spill. It may lead to damage to subsea equipment if the equipment is	No

	suspended by a crane in the air or in the water at the time of shutdown or, as a worst case, result in damage to existing subsea equipment. It could also result in a vessel strike to the whales that shutting down the propulsion system is meant to protect.	
Passive acoustic monitoring (PAM)	PAM is most useful in the detection of odontocetes such as sperm whales, dolphins and porpoise known to emit regular distinctive clicks and high frequency calls during long dives. PAM has limited utility in detecting lower frequency calls of baleen whales (such as blue whales, southern right whales) especially when in the presence of constant background low frequency sound such as that generated by the vessel towing the PAM system. Given the very low utility and associated unreliability of using PAM to inform mitigation decision making, any additional cost is considered disproportionate to the benefit gained.	No
Dedicated monitoring vessel	An additional dedicated vessel is not required as monitoring activities can be effectively conducted from the Thylacine-A Wellhead Platform and/or operations or IMR vessels. Cost is disproportionate to marginal environmental benefit.	No
Aerial surveillance	Aerial surveillance from aircraft or drones is not required as monitoring activities can be effectively conducted from the Thylacine-A Wellhead Platform and/or operations or IMR vessels. Cost is disproportionate to marginal environmental benefit.	No
Consequence rating	Moderate (2)	
Likelihood of occurrence	NA	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	Sound emissions were assessed as having a moderate consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.	
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).	
External context	There have been no stakeholder objections or claims regarding sound emissions.	
Other requirements	Sound emissions will be managed in accordance with legislative requirements. Sound emissions will: • Not impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b).	

	• Be managed such that any blue whale continues to utilise the area without injury and is not displaced from a foraging area (Commonwealth of Australia, 2015b). • Not impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Not impact southern right whale established or emerging aggregation BIAs or the migration and resting on migration BIA (Commonwealth of Australia 2015b). • Not impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) or draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). • Not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC, 2013a). Actions from the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Assessing the effect of anthropogenic noise on blue whale behaviour. Section 0 assesses the effects of anthropogenic noise from the activity 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. Section 0 demonstrates that the activity can be conducted in a manner that is consistent with the conservation management plan and will not result in injury or displacement of pygmy blue whales from a foraging BIA. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per: • Anthropogenic noise in biologically important areas will be managed such that it does not prevent any southern right whale from utilising the area or cause injury (TTS and PTS) and/or disturbance. • Ensure environmental assessments associated with underwater noise generating activities include consideration of national policy (e.g., EPBC Act Policy Statement 2.1) and guidelines related to managing anthropogenic underwater noise and implement appropriate mitigation measures to reduce risks to Southern Right Whales to the lowest possible level. Section 6.5.4.2 assesses the effects of anthropogenic noise from the activity on southern right whales and Section 6.5.5 includes consideration of national policy and guidelines relevant to vessels. • Quantify risks of anthropogenic underwater noise to Southern Right Whales, including behavioural disturbance, changes to vocalisations, and physiological effects to whales. Section 6.5.5 assesses the effects of anthropogenic noise from geophysical surveys on southern right whales.
Monitoring and reporting	Cetacean sightings records.
Acceptability outcome	**Acceptable**

6.6 Physical Presence

6.6.1 Hazards

Physical presence of the Otway Offshore Operations includes:

- Thylacine A-Platform, T-1 suspended well and associated PSZ (gazetted 2005)
- Geographe subsea wells and infrastructure and associated PSZ (gazetted 2013)
- Thylacine subsea wells and infrastructure and associated PSZ (gazetted 2022)
- Artisan-1 suspended well and associated PSZ (gazetted 2020)
- Otway Pipeline system
- 500 m safety zone around vessels when undertaking IMR activities and geophysical surveys.

6.6.2 Predicted Environmental Impacts

The physical presence of offshore infrastructure, PSZs and vessels operating within the operational area can result in the displacement of other marine users.

The physical presence of subsea infrastructure on the seabed can result in snagging of fishing equipment.

A new or increased environmental impact or risk could occur from the Thylacine subsea infrastructure that was not assessed as part of the accepted Otway Offshore Operations EP. This infrastructure was installed as part of the Thylacine Installation and Commissioning EP. This additional infrastructure includes flowlines, umbilicals and subsea manifolds.

6.6.3 EMBA

Predicted impacts from the physical presence of offshore infrastructure, PSZs and vessels will be limited to the operational area.

Other marine user identified to occur within the operational area are:

- Recreation and tourism
- Commercial shipping
- Petroleum activities
- Commercial fishing

6.6.4 Consequence Evaluation

Recreation and Tourism

Recreation and tourism could be affected by restricted access to an area (i.e. due to the presence of a PSZ), particularly if the area is of interest due to fishing opportunities or presence of marine fauna. Impacts to recreational fishing and tourism are not predicted due to the distance that the PSZs are offshore (32 km - 70 km) and the absence of emergent features within the operational area. Vessel activities and the Otway Pipeline System which may intersect areas nearshore where recreational fishing occurs ongoing for over 10 years and to date there has been no interactions or incidents with recreation and tourism activities.

Commercial shipping

The operational area includes major shipping routes (Section 4.5.5) however, the gazetted PSZs and vessel activities associated with the Otway Gas Development have been ongoing for over 10 years and to date there has been no interactions or incidents.

Commercial vessels are required to avoid the gazetted PSZs. PSZs are marked on navigation charts and communicated to marine users, allowing commercial vessels to plan their journey to ensure they are not inconvenienced by the 500 m exclusion area.

Vessels undertaking activities within the operational area will not be anchored, and any disturbance to commercial vessels will be minor disturbance only.

The extent of the area of impact is predicted to be the area of the gazetted PSZs. The severity is assessed as Minor (1) based on the area of impact is small and the exclusion is required for safe operations of the platform and commercial vessels.

Petroleum activities

Beach-managed petroleum activity may be undertaken within the operational area as part of the Otway Offshore Development, however there are no other petroleum activities managed by other titleholders planned within the operational area.

Petroleum activities managed by other titleholders will be required to avoid the permanent PSZs gazetted around the Thylacine-A Wellhead Platform, subsea infrastructure and Artisan-1 well. Displacement of other petroleum activities is therefore not predicted.

Commercial fishing

The Commonwealth SESSF and Southern Squid Jig Fishery have catch effort within the operational area as described in Section 4.5.9.

Based on Victorian Fishing Association data from 2011 to 2021 the catch effort in the fishing grids surrounding the operational area is low, with a vast majority of the fishing effort congregated around the shoreline as described in Section 4.5.10.

During stakeholder consultation for previous Beach activities up to six fishers have identified they may fish in the broader Otway Offshore Development area which includes the operational areas of the development wells (Section 7.12.9).

A report commissioned by Beach and developed by South East Trawl Fishing Industry Association (SETFIA) on Trawl and Gillnet fishing activity (October 2019) found:

- Trawl fishing in the Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector board trawl sub-sector does not occur in the Otway Offshore Project area as the grounds appear too rough for trawl fishing in its current form.
- Gillnet fishing in the Southern and Eastern Scalefish and Shark Fishery Gillnet Hook and Trap Sector does not seem to occur within the Otway Offshore Project area.
- There is no Southern and Eastern Scalefish and Shark Fishery Commonwealth Trawl Sector Danish seine sub-sector fishing in the Otway Offshore Project area.

There is a clear separation of these commercial fishers and the Offshore Project area. Therefore, no interaction is anticipated between trawl or gill net fishers and the Otway Offshore Operations.

During stakeholder consultation for previous Beach activities stakeholders have raised concerns in relation to displacement of their fishing activities in relation to new PSZs. No comments were received in relation to displacement of fishers during stakeholder consultation undertaken for the revision of this EP. The gazetted PSZs and vessel activities associated with the Otway Gas Development have been ongoing for over 10 years and to date there has been no interactions or incidents. The most recent PSZ at Thylacine was communicated to commercial fishers with no concerns raised.

The extent of displacement is the gazetted PSZs. The severity is assessed as Minor (1) based on:

- Small area of displacement (0.79 km^2) within each petroleum safety zone which have been in place since 2005 for the Thylacine-A Wellhead Platform, 2013 for the Geographe wells and subsea infrastructure, 2022 for the Thylacine wells and subsea infrastructure and 2020 for the Artisan-1 well.
- Limited fishing has been identified within the operational area other than the nearshore area of the Otway Pipeline System and HDD Entry Point.

6.6.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Physical Presence	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from physical displacement are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. Though objections and claims have been raised by stakeholders, via consultation in relation to development activities in the Otway Development Area, in relation to trawl and gillnet snagging risks on subsea wells subsequent data identified that there is no trawl or gillnet fishing in the operational areas. Objections and claims have also been raised by stakeholders, via consultation in relation to development activities in the Otway Development Area, in relation to displacement of their fishing areas, however, these have been adequately assessed and controls adopted to manage impacts to ALARP. The infrastructure that connects the Thylacine wells to the Thylacine A platform is estimated to have an additional footprint of 6,000 m^2. This was not assessed as part of the accepted Otway Offshore Operations EP.

	This infrastructure was considered to be the minimal amount to ensure safe operations of the offshore facilities with no redundant or future equipment included in the scope. The additional footprint was reduced to ALARP to ensure safe operations. No objections or claims were raised from fishers from consultation undertaken for the development of this EP. As the impact consequence is rated as Minor (1) applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#14: Ongoing consultation	Consultation will continue with relevant stakeholders as detailed in Section 8.16.
CM#15: Permanent Petroleum Safety Zone (PSZ)	PSZs, administrated by NOPSEMA under the OPGGS Act, are specified areas surrounding petroleum wells, structures or equipment which vessels or classes of vessel are prohibited from entering or being present in. Otway Pipeline System, Thylacine-A Wellhead Platform and subsea infrastructure PSZs are clearly marked on navigational charts
CM#16: Beach Fair Ocean Access Procedure	Beach's Fair Ocean Access Procedure (Appendix D) was developed with input from commercial fishing industry organisations (Bass Strait Scallop Industry Association, Scallop Fisherman's Association of Tasmania, South East Trawl Fishing Industry Association and Tasmanian Seafood Industry Council. The procedure details the process whereby a commercial fisher can claim compensation for an economic loss associated with Beach's offshore activities where impacts cannot be avoided. An information sheet on the procedure is available in Appendix D.
CM#17: Navigation and communication aids	The Thylacine-A Wellhead Platform is provided with navigational lights, RACON and foghorn in accordance with International Association of Lighthouse Authorities (IALA) requirements.
CM#18: MO 30: Prevention of collisions	AMSA MO 30: Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.
CM#19: MO 27: Safety of navigation and radio equipment	AMSA MO 27: Safety of navigation and radio equipment gives effect to SOLAS regulations regarding radiocommunication and safety of navigation and provides for navigation safety measures and equipment and radio equipment requirements.
CM#2: Marking of Man-Made Offshore Structures	Thylacine-A Wellhead Platform: Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Physical displacement was assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy.

	Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	The merits of claims or objections raised by a relevant stakeholder have been adequately assessed and additional controls adopted where appropriate. The additional footprint was discussed with Relevant Persons (see Section 7). There were some concerns raised over the loss of additional fishing grounds; however, the footprint required and the additional PSZ have been minimised to reduce impacts.
Other requirements	Physical displacement will be managed in accordance with the applicable legislative requirements.
Monitoring and reporting	Monitoring of potential impacts is undertaken via stakeholder engagement.
Acceptability outcome	**Acceptable**

6.7 Benthic Disturbance

6.7.1 Hazards

Benthic disturbance can occur as a result of activities which interact with the seabed, for example IMR activities such as use and parking of ROV on the seabed, excavation, pipeline repair, replacement of subsea infrastructure and infrastructure, including pipeline, stabilisation. The footprint of all IMR activities will be within the operational area, and where replacement occurs the footprint will not change from the original infrastructure footprint.

Vessel anchoring will not occur during the activity.

6.7.2 Predicted Environmental Impacts

Benthic disturbance can impact on benthic habitats and fauna through smothering and alteration of habitat and localised and temporary increases in suspended sediments near the seabed.

Section 6.6, notes the increased physical presence of the Thylacine infrastructure. The footprint of this infrastructure is estimated to be approximately 6,000 m^2. This footprint includes; flowlines, matresses (for flowline stabilisation) and manifolds that are resting directly on the seafloor. This smothers any benthos that may be present below the infrastructure.

6.7.3 EMBA

Predicted impacts from benthic disturbance will be limited to the operational area. Receptors which may be affected by benthic disturbance within the operational area include:

- Benthic habitats and species assemblages.

6.7.4 Consequence Evaluation

As detailed in Section 4.3.2 and 4.3.3 a seabed site assessment was undertaken over the Otway Development gas fields and proposed infrastructure corridors. This included Geographe and Thylacine fields, and the Artisan-1 wellhead location. In relation to benthic habitat within the Artisan, Geographe and Thylacine fields and broader area the following was identified:

- Seabed topography is dominated by exposed rock on the seabed.
- Small patches of very thin transgressive coarse sand are present across the survey area.
- Seabed showed a scattered sessile biota on a sandy seafloor.
- No rocky reefs or outcrops were identified.
- Sandy substrates described for Thylacine and Artisan gas fields are consistent with the reported description for the broader Otway Development area of unconsolidated seabed sediments made up of carbonate sands.
- Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of an unmodified marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2.

- There was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.
- Epibiota on the seabed in the vicinity of the Thylacine and Artisan gas fields is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates. No species or ecological communities listed as threatened under the EPBC Act were observed.

The operational areas overlap the Shelf Rocky Reefs and Hard Substrates KEF. No threatened ecological communities or habitats critical to the survival of the species were identified within the operational areas. The Shelf Rocky Reefs and Hard Substrates KEF is in all areas of the South-east Marine Region continental shelf including Bass Strait, from the sub-tidal zone shore to the continental shelf break.

The seabed site assessment identified that the substrate was hard substrate within the operational areas but did not identify rocky reefs (Ramboll, 2020. Appendix B). The seafloor supported a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges) which is characteristic of the hard grounds associated with the hard substrates' component of the Shelf Rocky Reefs and Hard Substrates KEF (Section 4.2.12). However, the hard substrate and associated biota characteristic of the hard substrate component of the Shelf Rocky Reefs and Hard Substrates KEF is not unique to the operational areas based on Commonwealth of Australia (2015c) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait. This is support by the recent seabed site assessment (Ramboll, 2020. Appendix B), that identified that the epibiota on the seabed in the vicinity of the Thylacine and Artisan gas fields is representative of what is expected at depths around 70-100 m, and also previous surveys within the Otway Basin, as detailed below, that identified hard substrate with similar biota to that in the operational areas.

A comprehensive assessment of the Otway Basin coast to continental shelf margin collecting bathymetric data and video footage for the pipeline right-of-way options was undertaken for the Otway Gas Project EIS (Woodside, 2003) (Section 4.3.2) identified:

- Local topography is predominantly irregular in nature, varying from gently undulating and locally smooth in areas of increased sediment deposition, to areas of outcropping cemented calcrete features that are from smooth to jagged relief. These areas are covered in marine growth. ROV video survey confirmed the presence of a shallow hard underlying substrate at a depth of 50 mm below the sediment in areas of marine growth (JP Kenny, 2012).
- Benthic assemblages (CEE Consultants Pty Ltd, 2003) ranged from very low density sessile; large sponge to diverse, high density sessile: sponge, coral dominated crinoids common and mobile species.
- BBG (2003) found that the substrate in water depths that predominate in the Otway Gas Project operational area (between 82 and 66 m) area was predominantly low profile limestone with an incomplete sand veneer that supported a low to medium density, sponge dominated filter feeding community. Fish and other motile organisms were uncommon.

There is limited information on the recovery of benthic habitats after the removal of equipment. As the affected areas are expected to be like the surrounding seabed it would be expected that following removal of the equipment, sand and other material would begin to fill the area of disturbance and that recolonization would occur. This could take months to a year or more but is unlikely to have lasting effects.

The extent of the area of impact is predicted to be small / within the existing infrastructure footprint for a duration of up to months to years while the disturbed area recolonises. The severity is assessed as Minor (1) based on:

- No threatened ecological communities, critical habitats, sensitive or protected benthic habitat or species, including commercial invertebrate species, have been identified in the area of impact (operational areas).
- Though the operational areas overlap hard substrate similar to that described for the Shelf Rocky Reefs and Hard Substrates KEF this feature, and associated biota are not unique to the operational area based on Commonwealth of Australia (2015c) stating that the hard grounds associated with the Shelf Rocky Reefs and Hard Substrates KEF are located in all areas of the South-east Marine Region continental shelf including Bass Strait, and on surveys within the Otway Basin that identified hard substrate with similar biota to that in the operational areas.
- Due to the small area of disturbance and that the hard substrate habitat and associated biota is not unique to the operational areas the benthic disturbance will not modify, destroy, fragment, isolate or disturb a substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results.
- There is no impediment to the disturbed areas recolonising as the benthic habitat and associated biota is not unique within the operating areas.
- Grout bags and cement from the installation of rock bolts are low toxicity.

6.7.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Benthic disturbance	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from benthic disturbance are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to benthic disturbance. The infrastructure associated with connection of the Thylacine wells has resulted in an increased impact on the environment. This infrastructure has smothered the benthos that was present in the area. The physical footprint of this infrastructure was reduced to an ALARP to ensure safe operations. The seabed and associated benthos in the area is considered to be homogenous (see section 4.3.3) and does not result in the loss of significant habitat.

	As the impact consequence is rated as Minor (1) applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#20: IMR Scope of Work	Benthic disturbance is limited to during IMR campaigns. The IMR scope of work will detail activities that may disturb the seabed and how these activities will limit the area of disturbance.
CM#21: Beach OEMS Element 6 Asset Management	The standard defines the minimum requirement for the monitoring and assurance processes that support the ongoing safe and reliable management of an asset throughout its lifecycle. All equipment associated with the Otway Gas Development is inspected, monitored, and maintained in accordance with the CMMS to ensure that it is in good condition and can be safely decommissioned when required.
CM#22: Beach Chemical Management Plan	All chemicals, including grout or cement used for stabilisation methods, will be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Benthic disturbance was assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding benthic disturbance.
Other requirements	No other requirements were identified in relation to benthic disturbance.
Monitoring and reporting	Impacts associated with benthic disturbance are over a small area and not predicted to have long term impacts to protected or commercially important receptors. Therefore, the monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.8 Planned Marine Discharges – Vessels

6.8.1 Hazards

Vessels will have planned marine discharges within the operational area such as cooling water, brine, bilge water, deck drainage, putrescible waste, sewage and grey water.

Wastewater and putrescible waste discharges from the Thylacine-A Wellhead Platform are not expected as:

- Wellhead platform is normally unmanned.
- During manned periods, all wastewater and putrescible waste will be contained and transported back to shore.
- Platform is mainly grated to allow rainwater and seawater from the bird deterrent system to easily fall through without resulting in contaminated runoff.
- Liquid collected in the closed drain system is pumped to the production pipeline by the two drain pumps operating in lead/lag mode, before the drain system is vented.
- Chemical storage areas are bunded.

6.8.2 Predicted Environmental Impacts

Planned marine discharges can result in changes in water quality such as increased temperature, salinity, nutrients, chemicals, and hydrocarbons which can lead to toxic effects to marine fauna.

Putrescible waste discharges can result in changes in fauna behaviour if result in fauna habituate to this food source.

6.8.3 EMBA

Predicted impacts from planned marine discharges from vessels will be limited to the operational area. Receptors potentially affected include water quality and marine fauna.

6.8.4 Consequence Evaluation

6.8.4.1 Planned marine discharges

The consequence evaluation considers the potential cumulative impacts from:

- Planned marine discharges of waste waters and putrescible wastes from vessels when undertaking petroleum activities within the operational area.

These discharges will result in:

- Nutrients levels may be intermittently elevated within 500 m of a vessel when sewage, greywater and putrescible waste discharged.
- Water temperature may be elevated within 100 m of the of a vessel from the constant discharge of cooling water.

- Hydrocarbon levels may be intermittently elevated within 100 m of a vessel when bilge waster is discharged.

Cumulative impacts may occur from the vessel discharges if work scopes overlap. This may only occur if re-supply operations at the Thylacine-A Wellhead Platform are undertaken during an IMR campaign. However, vessels undertaking activities under this EP will mostly be moving, increasing the dispersion of wastewater, and reducing the area of potential impacts. The small additional volumes that an additional vessel will discharge and intermittent nature of the discharges, except for cooling water which has a predicted area of impact of 100 m, would be unlikely to significantly increase the impact extent beyond 500 m or the impacts to water quality and marine receptors while concurrent activities are occurring.

For the consequence evaluation, it is assumed that vessels would be operating adjacent to existing infrastructure, therefore all wastewater discharges will dissipate within the operational area (500 m).

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that area ecologically significant.

Fish species, including commercial species maybe present within the operational area. There are no BIAs or protected habitats and commercial fishing for fish species has not been identified within the operational area. No features have been identified where site attached species would be present. As fish species would be transient in the operational area, toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the distribution BIA for white shark by although no critical habitats or behaviours are known to occur. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify vessel discharges or equivalent as a threat. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the operational area though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) though not specifically from vessels and is focus on long term exposure. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the pygmy blue whale high density foraging BIA. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) does not identify discharges from vessels as a threat to the recovery of these species. It does identify that marine pollution can have a variety of possible consequences for blue whales at an individual and population level, or indirectly through harming their prey or the ecosystem. The conservation plan identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that chemicals associated with a spill is classed as a minor consequence impacts from low toxicity discharges that would rapidly dilute would be expected to be the same or a lower consequence, The operational area overlaps the southern right whale known core range. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify discharges from vessels as a threat to the recovery of these species but does identify chemical pollution in the form of sewage and industrial discharges as a threat more likely in coastal aggregation areas. The conservation plan identifies acute chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level. Given that the conservation plan identifies acute chemical discharge as a threat more likely in coastal aggregation areas it would be expected that chemical discharges in an offshore area which would rapidly dilute would be the same or lower consequence.

The South-east Marine Region Profile (Commonwealth of Australia, 2015c) details that the oceanography of the South-east Marine Region contributes to enhanced areas of primary productivity, including:

- Spring and autumn phytoplankton blooms in the Subtropical Convergence Zone (south of Tasmania).
- Primary productivity associated with the Bass Cascade and upwelling of cool nutrient-rich waters along the mainland coast north-east of Bass Strait.
- Localised seasonal upwellings along the Bonney coast.

The closest of these high productivity areas to the Otway Offshore Operations is the Bonney coast upwelling KEF. Figure 4-20 shows that the Bonney coast upwelling KEF is ~83 km from the operational area. The Bonney coast upwelling KEF is an area of high productivity and aggregations of marine life, of importance as feeding grounds to blue, sei and fin whales and higher predatory species, typically in summer and autumn months. However, based on the large distance between the operational area and the Bonney coast upwelling KEF impacts to water quality and therefore productivity are not predicted.

The extent of impact, including any cumulative impacts, is predicted to be 500 m from a vessel. The severity is assessed as Minor (1) based on:

- Marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- Marine discharges are not predicted to have lasting effects on either the biological or physical environment in the operational area with no specific value when compared with surrounding waters.
- Operational area overlap with the white shark distribution BIA is small; and the Recovery Plan for the White Shark (DSEWPaC, 2013a) does not identify vessel discharges or equivalent as a threat.
- Operational area overlap with the pygmy blue whale foraging BIA is small; and the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) identifies acute chemical discharge (oil or condensate spill) as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.
- Operational area overlap with the southern right whale known core range is small; and the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) identifies acute

chemical discharge as a threat that is classed as a minor consequence which is defined as individuals are affected but no affect at a population level.

- Marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- Potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- As the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.
- Given the anticipated rapid dilution of low concentration of hydrocarbons and chemicals within the water column, there is no identified potential for decreases in water quality that may impact on marine fauna attracted to regional upwelling events.

6.8.4.2 Putrescible Waste

The operational area where the vessels would discharge putrescible waste overlaps foraging BIAs for several albatross species, common diving-petrel, and short-tailed and wedged-tailed shearwater (Figure 4-28, Figure 4-29 and Figure 4-30). No habitat critical to the survival of seabirds occur within the operational area. Marine pollution is identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a), however, vessel food waste discharge would be sporadic and for a short duration thus would not result in seabirds habituating to this food source. The common diving-petrel (listed as marine) and wedged-tailed shearwater (listed as marine and migratory) do not have a recovery plan or conservation advice.

Fish may also become attracted to the food waste but as for seabirds the sporadic nature of vessel food waste discharge would not lead to fish habituating to this food source.

Periodic discharge of macerated food waste to the marine environment will result in a temporary increase in nutrients in the water column that is expected to be localised to waters surrounding the discharge with no lasting effects to either the biological or physical environment.

The extent of the impact is predicted to be 500 m from the vessel while undertaking activities in the operational area. The severity is assessed as Minor (1) based on:

- Food waste discharges are sporadic and for a short duration thus would not result in fauna habituating to this food source.
- Food waste will rapidly disperse in the marine environment.
- Nutrients within putrescible waste are to be discharged within an area of regionally elevated nutrient levels created by seasonal upwelling events, therefore additional nutrients loading is not likely detrimental to marine fauna.

6.8.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Planned marine discharges – vessels	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims were raised by stakeholders in relation to planned marine discharges As the impact consequence is rated as Minor (1) applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#23: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	This Act regulates Australian regulated vessels with respect to ship-related operational activities and invokes certain requirements of the MARPOL Convention relating to discharge of noxious liquid substances, sewage, putrescible waste, garbage, air pollution etc.
CM#4: Maintenance Management System	Equipment to treat marine discharges such as bilge water, slops from deck drainage, sewage and food waste are operated in accordance with the maintenance management system to ensure efficient operations.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding planned marine discharges.
Other requirements	Planned marine discharge will be managed in accordance with legislative requirements. Planned marine discharges will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a).

	• Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact sei or fin whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or commercially important receptors. The control measures adopted ensure water quality remains within internationally recognised and acceptable parameters therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.9 Planned Marine Discharges – Operations and IMR

6.9.1 Hazards

During operations and IMR activities, planned marine discharges include:

- Hydraulic control fluid discharged during Geographe and Thylacine subsea valve actuation.
- Fugitive discharge of hydraulic fluid through the hydraulic control system.
- Hydraulic control fluid discharge during maintenance and repair of subsea infrastructure (e.g. replacement of hydraulic fluid lead (HFL).
- Dye discharged during IMR activities such as leak testing.
- Chemicals used to remove marine debris.
- MEG discharge during well choke replacement activities.

The Otway Pipeline System is a closed system, with no discharges of MEG or corrosion inhibitor chemicals expected. There are no planned discharges from the Thylacine-A Wellhead Platform, and the closed drain system discharges liquid to the wells with no discharge of treated water. No hydraulic fluid from the Thylacine production wells is released to the marine environment.

Hydraulic fluid is provided to Geographe and Thylacine via the main umbilical from the Thylacine-A Wellhead Platform. It is delivered via the infield umbilical to the Subsea Valve Skid (SVS). Each time the subsea value is actuated a small volume of hydraulic fluid is released. A maximum of 1500 kg per year of hydraulic fluid is released subsea as a result of movements of Geographe and Thylacine tree valves and SVS valves.

During IMR activities, hydraulic control fluid, MEG and other chemicals (such as dye and sulphuric acid) may be used and / or discharged to the marine environment.

All chemicals that will be or have the potential to be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.

6.9.2 Predicted Environmental Impacts

Planned discharges of hydraulic control fluid, MEG and other operational discharges can result in changes in water quality which can lead to toxic effects to marine fauna.

6.9.3 EMBA

Predicted impacts from planned marine discharges from operations and IMR will be limited to the operational area. Receptors potentially affected include water quality and marine fauna.

6.9.4 Consequence Evaluation

Hydraulic control fluids are water-based and readily biodegradable. As open marine waters are typically influenced by regional wind and large-scale current patterns resulting in the rapid mixing of surface and near surface waters any discharges of hydraulic control fluids would disperse rapidly within a small area. The extent within which the hydraulic fluids would disperse is estimated to be with 500 m of the release location.

During leak detection, dye is dosed into the system and a visual observation is made (by ROV / diver) to identify if a leak is present. Dyes are typically fluorescent to aid detection, and equipment can be used to detect dye in the water column at very low volumes. As with hydraulic fluid, the open water environment, small volumes and subsea currents means dye is expected to disperse within 500 m from the release location.

Marine debris removal may be aided by the use of chemicals such as Sulfamic Acid (or equivalent such as Citric Acid).

During choke replacement activities a small amount of MEG (up to 75 L) is likely to be release to the marine environment. MEG is a category ‘E’ OCNS (lowest toxicity rating) chemical with no substitution warning and is readily biodegradable and has a low potential for bioaccumulation.

Within the extent of potential impact, potential receptors to a change in water quality would be plankton, fish, turtles and marine mammals. As the discharges are discharged into an open oceanic environment they are predicted to mix rapidly with the surrounding waters and impacts to sediments and benthic biota including invertebrates is not predicted.

Though plankton may be sensitive to some aspects of marine discharges such as increased temperatures (Huertas et al. 2011) this is typically for prolonged exposure. In view of the high level of natural mortality and the rapid replacement rate of many plankton species (Richardson et al, 2017) impacts from short term exposure to marine discharges of low toxicity that will rapidly dilute is unlikely to have lethal effects to plankton that area ecologically significant.

Fish species, including commercial species maybe present within the operational areas. There are no BIAs or protected habitats for fish species within the operational area. No features have been identified where site attached species would be present. As fish species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area is within the distribution BIA for white shark, although no critical habitats or behaviours are known to occur. Sharks will be transient through the area thus impacts are not predicted. The Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a) does not identify chemical discharges or equivalent as a threat. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

No turtle BIAs are located within the operational area though turtle species may occur. Chemical and terrestrial discharge is identified as a threat to turtles in the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) though not specifically from hydraulic control fluid or dye used during leak testing. As these species would be transient in the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

Marine mammals can actively avoid plumes, limiting exposure. The operational area overlaps the pygmy blue whale foraging BIA. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) does not identify discharges from operations as a threat to the recovery of these species. Though pygmy blue whales could potentially forage within the operational area toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The operational area overlaps the known core range, migration and resting on migration BIA, and emerging aggregation area for the southern right whale. The Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a) does not identify chemical discharges as a threat to the recovery of these species. These species are likely to be transient within the operational area thus toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

The draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identifies chronic chemical pollution as a threat with a minor consequence, but no actions are detailed. Chronic toxicity impacts are not predicted to southern right whales due to the low volume and low toxicity of the marine discharges and rapid dilution.

The extent of the impact is predicted to be 500 m from the discharge point (i.e. within the operational area). The severity is assessed as Minor (1) based on:

- Marine discharges will be of low toxicity with controls such as treatment and chemical assessment in place.
- No sensitive resident receptors or particular values were identified within the area that may be affected when compared with surrounding waters.
- Marine discharges do not interfere with wind-generated upwelling events, nor are they likely to impact marine fauna attracted to the area by regional upwelling events.
- Potential impacts to plankton are not expected to result in impacts to foraging marine species given the overall abundance of food resources within the region.
- Discharges will rapidly disperse in the marine environment.
- Chronic toxicity impacts are not predicted due to the low toxicity of the marine discharges and rapid dilution.

6.9.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Planned marine discharges – operations and IMR	
ALARP decision context and justification	ALARP Decision Context: Type A Impacts from planned marine discharges are well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests, and no significant media interests. No objections or claims where raised by stakeholders in relation to marine discharges of hydraulic control fluids or other operational discharges. As the impact consequence is rated as Minor (1) applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP. As the risk is rated as low applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.

Adopted Control Measures	Source of good industry practice control measures
CM#22: Beach Chemical Management Plan	All chemicals that could be discharged to the marine environment must be assessed prior to use to ensure the lowest toxicity, most biodegradable and least accumulative chemicals are selected which meet the technical requirements of the application.
CM#4: Maintenance Management System	Systems that generate or treat planned discharges will be operated in accordance with the computerised maintenance management system (CMMS) to ensure efficient operation
CM#24: Hydraulic Control System	The hydraulic power unit (HPU) on Thylacine-A wellhead platform provides control of Thylacine and Geographe subsea wells. The HPU monitors system pressure and hydraulic fluid inventory and is inspected and maintained in accordance with the CMMS.
Consequence rating	Minor (1)
Likelihood of occurrence	NA
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	Planned marine discharges were assessed as having a minor consequence which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding planned marine discharges.
Other requirements	Planned marine discharge will be managed in accordance with legislative requirements. Planned marine discharges will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact se or fin whales, covered by conservation advice.
Monitoring and reporting	Impacts associated with planned marine discharges are over a small area and not predicted to have long term impacts to protected or

	commercially important receptors. The control measures adopted ensure water quality remains within acceptable parameters given the chemicals are assessed to internationally recognised standards, therefore, monitoring is not proposed.
Acceptability outcome	**Acceptable**

6.10 Establishment of Invasive Marine Species

6.10.1 Hazards

The introduction of marine pests could occur during vessel operations as a result of:

- Discharge of ballast water containing foreign species.
- Translocation of species through biofouling of the vessel hull, anchors and/or niches (e.g. sea chests, bilges, and strainers).
- Disposal of contaminated waste and materials.

Successful IMS invasion requires the following three steps:

- Colonisation and establishment of the marine pest on a vector (e.g., vessel hull) in a donor region (e.g., home port).
- Survival of the settled marine species on the vector during the voyage from the donor to the recipient region (e.g., project area).
- Colonisation (e.g., dislodgement or reproduction) of the marine species in the recipient region, followed by successful establishment of a viable new local population.

6.10.2 Predicted Environmental Risks

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. However, establishment of introduced marine species is mostly likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

If the risk of establishment of IMS is realised, the following known and potential environmental impacts may occur:

- Change in ecosystem dynamics.
- Changes to the functions, interests or activities of other users.

Change in ecosystem dynamics may include reduction in native marine species diversity and abundance, displacement of native marine species, socio-economic impacts on commercial fisheries, and changes to conservation values of protected area.

6.10.3 EMBA

Predicted impacts from the risk of establishment of IMS will be limited to the operational area. Receptors potentially affected include marine invertebrates and benthic habitats, and commercial fisheries.

6.10.4 Consequence Evaluation

IMS or pathogens may become established where conditions are suitable, and these species may have impacts on local ecological and economic values. Establishment of introduced marine species is most likely to occur in shallow waters in areas where large numbers of vessels are present and are stationary for an extended period.

In the event of an IMS being introduced to the marine environment, successful colonisation is dependent upon suitable substrate availability. The operational area does not present a location conducive to marine pest survival because it is mostly located in deep waters (offshore infrastructure location in water greater than 70 m (83m – 101m)), however the Otway Pipeline System and HDD entry point are located in shallower waters (6 m at the HDD entry point; 66 m – 72 m at the Hot Tap Tee locations).

IMS introduced during the activity has the potential to impact ecosystem dynamics. As a result of a change in ecosystem dynamics, further impacts may occur, which include change in the functions, interests, or activities of other users.

Receptors potentially impacted by a change in ecosystem dynamics include:

- Marine invertebrates
- Benthic habitat (soft sediment, macroalgae, soft corals)
- Commercial fisheries.

Given the distance from planned operations (50 km to closest AMP), no impacts to Australian Marine Parks are predicted.

6.10.4.1 Marine Invertebrates and Benthic Habitats

IMS are likely to have little or no natural competition or predators, thus potentially outcompeting native species for food or space, preying on native species, or changing the nature of the environment. It is estimated that Australia has more than 250 established marine pests, and that approximately one in six introduced marine species becomes a pest (Department of the Environment, 2015). Once established, some pests can be difficult to eradicate (Hewitt et al., 2002) and therefore there is the potential for a long-term or persistent change in habitat structure. It has been found that highly disturbed environments (such as marinas) are more susceptible to colonisation than open-water environments, where the number of dilutions and the degree of dispersal are high (Paulay et al., 2002).

The chances of successful colonisation in the Otway region are considered small given:

- The Fugro seabed survey (2019) identified that the seabed is dominated by exposed rock with very thin transgressive coarse sand and no rocky reefs or outcrops. This type of habitat is not conducive to the establishment of IMS and is outside of coastal waters where the risk of IMS establishment is considered greatest (BRS, 2007).
- The offshore operations are geographically isolated from other subsea or surface infrastructure which might be suitable for colonisation.
- The offshore location of the Thylacine-A wellhead platform and subsea facilities does not present a location conducive to marine pest survival because it is located in deep waters with the operational area in water greater than 70 m (83 m – 101 m).

- Vessel activities at shallower locations (HDD entry point, Hot Tap Tee locations) will be limited to IMR, with no routine activities undertaken in shallower waters.

Areas of higher value or sensitivity are located away from the well sites with Twelve Apostles Marine National Park on the Victorian coast approximately 54 km away from the operational area. While unlikely, if an IMS was introduced, and if it did colonise an area, it is expected that any colony would remain fragmented and isolated, and only within the vicinity of the Thylacine-A Wellhead Platform / subsea infrastructure (i.e. it would not be able to propagate to nearshore environments, and protected marine areas present in the wider region).

Given the impact of a successful IMS colonisation has the ability to significantly impact local species and thus change local epifauna and infauna populations permanently, the consequences have been evaluated as Serious. However, it is considered such an event is Remote due to the unfavourable conditions within the operational area required for colonisation. As outlined in Section 6.10.5 Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered low.

6.10.4.2 Commercial Fisheries

The introduction of IMS has the potential to result in changes to the functions, interest, or activities of other users, including commercial fisheries. Marine pest species can deplete fishing grounds and aquaculture stock, with between 10% and 40% of Australia’s fishing industry being potentially vulnerable to marine pest incursion. For example, the introduction of the Northern Pacific Seastar (*Asterias amurensis*) in Victorian and Tasmanian waters was linked to a decline in scallop fisheries (DSE, 2004). However, areas suitable for commercial scallop fishing are not expected near the well locations; commercially suitable scallop aggregations occur in the waters of eastern Victoria (Koopman et al. 2018).

Whilst it has been assessed that the introduction of an IMS would have a Serious impact on state and Commonwealth fisheries the likelihood has been assessed as Remote. Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered low.

6.10.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Establishment of invasive marine pests	
ALARP decision context and justification	ALARP Decision Context: Type B On the basis of the impact assessment completed, Beach considers the control measures described are appropriate to manage the impacts associated with the risk of introduction and establishment of IMS. The Victorian DJPR (now DEECA) have expressed interest in the management of IMS in Victorian State waters.
Adopted Control Measures	**Source of good practice control measures**
CM#25: Beach Domestic IMS Biofouling Risk Assessment Process	All vessels mobilised from domestic waters to undertake offshore petroleum activities within the operational area must complete the Beach Domestic IMS Biofouling Risk Assessment Process as detailed in the Beach Introduced Marine Species Management Plan (S400AH719916) prior to the initial mobilisation into the operational area. The Beach Domestic IMS Biofouling Risk Assessment Process:

	• Validates compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational area. • Identifies the potential IMS risk profile of vessels and submersible equipment prior to deployment within the operational area. • Identifies potentially deficiency of IMS controls prior to entering the operational area. • Identifies additional controls to manage IMS risk. • Prevents the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).

Additional controls assessed

Control	Control Type	Cost/Benefit Analysis	Control Implemented?
Only use vessels that are based in Victoria to reduce the potential for introducing IMS.	Equipment	Specialised IMR vessels are likely required to undertake IMR activities. Using vessels that are based in Victoria (if available) may reduce the likelihood of introducing an IMS, but this would depend on the IMS risk level of the port where the vessel is based. The control measures that are to be implemented are required to be undertaken for vessels from any port in Victoria or Australia. Thus, there is limited environmental benefit associated with implementing this response.	Not selected

Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of the establishment of IMS was assessed as low and the consequence was assessed as serious which has the potential to result in serious or irreversible environmental damage. However, this is assessed as acceptable based on: • There is little uncertainty associated with this aspect as the activities are well known, the cause pathways are well known, and activities are well regulated and managed. • No impacts to MNES are predicted. • The implementation of controls make it a remote likelihood that IMS will be introduced from the activity resulting in a low residual risk. • It is not considered that there is significant scientific uncertainty associated with this aspect. Therefore, the precautionary principle has not been applied.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).

External context	There have been no stakeholder objections or claims regarding the introduction or establishment of invasive marine pests in relation to the activity.
Other requirements	The impact will be managed in accordance with legislation requirements and guidance, including: • Offshore Installations - Biosecurity Guide (DAWR 2019) • National Biofouling Management Guidance for the Petroleum Production and Exploration Industry (Commonwealth of Australia 2009) • Australian Ballast Water Management Requirements (Commonwealth of Australia, 2020) and Australia Biofouling Management Requirements (DAWE 2022) gives effect to the Biosecurity Act 2015 and associated regulations; International Convention for the Control and Management of Ships' Ballast Water and Sediments (Ballast Water Convention) and relevant guidelines or procedures adopted by the Marine Environment Protection Committee of the International Maritime Organization (IMO) • IMO Biofouling Guidelines There are no EPBC management plans (management plans, recovery plans or conservation advice) which relate specifically to IMS introduction and establishment as a threat. The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) identifies IMS, and diseases translocated by shipping, fishing vessels and other vessels as a threat to the AMP network. The implementation of the controls make it unlikely that IMS will be introduced from the activity and spread to nearby AMPs.
Monitoring and reporting	Impacts as a result of the introduction of marine invasive species will be monitored and reported in accordance with the Section 7.10.
Acceptability outcome	**Acceptable**

6.11 Disturbance to Marine Fauna

6.11.1 Hazards

Disturbance to marine fauna could occur as a result of activities within the operational area, through:

- Vessel operations resulting in collision with marine fauna.
- Bird deterrent system on the Thylacine-A Wellhead Platform disturbing birds.

6.11.2 Potential Environmental Impacts

Disturbance to marine fauna can result in injury or death.

Disturbance to fauna from underwater noise emissions is addressed in Section 6.4 and 6.5.

6.11.3 EMBA

Predicted impacts resulting from the risk of disturbance to marine fauna will be limited to the operational area. Receptors include marine fauna, specifically slow moving marine fauna and seabirds.

6.11.4 Consequence Evaluation

Marine fauna species most susceptible to vessel strike are typically characterised by one or more of the following characteristics:

- Commonly dwells at or near surface waters.
- Often slow moving or large in size.
- Frequents areas with a high levels of vessel traffic.
- Fauna population is small, threatened, or geographically concentrated in areas that also correspond with high levels of vessel traffic.

The National Strategy for Mitigating Vessel Strike of Marine Mega-fauna (Commonwealth of Australia, 2017a) identifies cetaceans and marine turtles as being vulnerable to vessel collisions.

Three marine turtle species may occur within the operational area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (DotEE, 2017d) identified vessel strike as a threat.

Two species of pinniped may occur within the operational area: the New Zealand fur-seal and the Australian fur-seal. No BIAs or habitat critical to the survival of the species were identified for pinnipeds.

Twenty two whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (sei, blue, fin and pygmy right whales); no other important behaviours were identified. The operational area intersects the known core range, migration and resting on migration BIA, and emerging aggregation area for the southern right whale and a foraging BIA for the pygmy blue whale. The Conservation Management Plan for the blue whale and the southern right whale, Conservation Advice for the sei whale and fin whale and Conservation Listing for the humpback whale identify vessel strike as a threat.

Protected species vulnerable to vessel strikes are identified as being transient in the area except for pygmy blue whales within the foraging BIA and southern right whales in the migration and resting on migration BIA and emerging aggregation area.

Pygmy blue whales are likely to be foraging within the BIA (November to June) which overlaps the period of the activity. The Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) detail that collisions will impede the recovery of blue whale populations if a sufficient number of individuals in the population lose reproductive fitness or are killed.

Southern right whales are likely to be present in the migration and resting on migration BIA and emerging aggregation area during May to end of October, however, as per CM#13b no IMR activities will be planned within 3 km of a SRW BIA or emerging aggregation area during May to end of October when SRW are potentially present in the BIAs or emerging aggregation area.

The occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.

Birds are often found associated with offshore platforms as they provide a safe and relatively undisturbed site for birds to roost. For the Thylacine platform crested terns and gannets roosted on the helideck, support structures, crane boom and lesser extent, flat surface of structures mainly on the upper deck (Avisure 2016). The birds are often found on the helideck and pose a hazard to safe helicopter operations by increasing the risk of bird collision and potential harm to both marine fauna and human life. In addition, defecating on the platform can cover important safety marking on the helideck as well as being a slip hazard (Figure 6-4).

Figure 6-4: Birds on the Thylacine Platform Helideck

The crested tern and gannet species (listed species not threatened species) roost on the helideck are not covered by a species specific management plans, however, the crested tern and Australasian gannet are covered by the Wildlife Conservation Plan for Seabirds (CoA 2020b) which identifies resource extraction stating that seabirds are known to aggregate around oil and gas platforms in above average numbers due to night lighting, flaring, food concentrations and other visual cues (Wiese et al. 2001). The Wildlife Conservation Plan for Seabirds (CoA 2020b) details that implementing a comprehensive monitoring program of impacts of these offshore platforms should include nature, timing and extent of bird mortality caused by these structures. This information can then be used to better inform regulators responsible for exploration and extraction proposals. Beach have a bird injury/mortality reporting program that is reviewed to identify improvements to the bird deterrent system. Since Beach has operated the bird deterrent system on Thylacine-A wellhead platform there has been four bird strikes associated with the helicopter rotors. The aim of the bird deterrent system on Thylacine-A wellhead platform is to deter the birds from landing on the platform and disperse any birds on the platform prior to the helicopter arriving and departing to avoid any collisions.

The bird deterrent system on Thylacine-A wellhead platform has been developed by a bird management specialist (Avisure) to ensure that appropriate management actions are implemented to deter birds from the platform. As a result of site visits and a detailed assessment of the platform, a bird deterrent system was developed which aims to minimise the bird attraction to the helideck, reduce perching opportunities, monitor bird activity and optimise flight operations to reduce bird strike risk. The key components of the bird deterrent system are:

- Bird spikes / bird wires: bird spikes / anti-perch wire are installed on various structural members to deter birds and reduce perching opportunities.
- Bird spray: There are several sea water spray nozzles installed around the helideck. These sprinklers aim to irritate birds; pump and nozzle combination do not generate sufficient pressure or flow rate to harm birds.
- Marine horn: An electric marine horn (Kahlenberg KB-20) has been adapted as a form of noise deterrent. KB-20 horns are standard marine horn used on marine vessels, with no known impacts to birds.
- Laser: Currently (March 2023) isolated and maybe required for future use due to the increased number of birds on the helideck and the potential for a serious aviation incident as the result of bird strikes. If the bird laser is required, a management of change (MoC), including environment review, will be undertaken as per Section 7.8.1 to ensure any potential impacts to birds are assessed and can be managed to the acceptable and area ALARP. Any resulting changes will also be assessed to determine if this EP needs to be revised and submitted to NOPSEMA as per Section 7.12.6. The MoC, including whether the revised EP is required to be submitted to NOPSEMA, will be undertaken prior to the laser being tested or used.

Table 6-2 details the shorebirds and seabirds that may be foraging, breeding, roosting, or migrating within the light EMBA and may be attracted to the platform. These were identified from the light EMBA PMST Report (Appendix A.3) and BIAs from the National Conservation Values Atlas.

Although the bird deterrent system has been designed to avoid injury to birds, it is possible that operation of the bird deterrent system may injure or kill birds either through direct contact or stunning them such that they become entangled in plant, equipment and netting below the helideck. The bird deterrents (primary and secondary methods) are designed to scare birds, rather than injure them to ensure safety risks associated with helicopter operations are adequately managed. The water sprinkler is used daily (when birds are present), even when helicopter flights are not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers, and hence lowering the risk of being harmed.

The extent of the area where disturbance to marine fauna may occur is within the operational area and the risk could occur while the activity is undertaken. The severity is assessed as moderate and likelihood as highly unlikely based on:

- Within the operational area vessels will be slow moving to stationary.
- The occurrence of vessel strikes is very low with no incidents occurring to date associated with Beach's activities in the Otway or Bass Strait region.
- The bird deterrent system is designed to scare birds, rather than injury them.
- If an incident occurred, it would be restricted to individual fauna.

6.11.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Disturbance to marine fauna	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of disturbance to marine fauna is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to air emissions. As the risk is rated as low applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans describes strategies to ensure whales and dolphins are not harmed during offshore interactions with vessels.
CM#26: Bird Deterrent system	Operators of the bird deterrent systems are trained and follow standard operating systems. The water sprinkler is used daily (when birds are present), even when helicopter flights are not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers and hence lowering the risk of being harmed. If current bird deterrent systems prove to be ineffective, the laser, which is currently (March 2023) isolated maybe required. If the laser is to be used a MoC will be undertaken as per Section 7.8.1 to ensure any potential impacts to birds are assessed and can be managed to the acceptable and area ALARP. Any resulting changes will also be assessed to determine if this EP needs to be revised and submitted to NOPSEMA as per Section 7.12.6. The MoC, including whether the revised EP is required to be submitted to NOPSEMA, will be undertaken prior to the laser being tested or used.
CM#13b SRW Exclusion Zone	No IMR activities will be planned within 3 km of a SRW BIA or emerging aggregation area during May to end of October when SRW are potentially present in the BIAs or emerging aggregation area. The Conservation Management Plan for the Southern Right Whale (DSEWPaC 2012a) details that reducing ship strike mortality can be most easily done either by reducing vessel speed or by separating vessels and

	whales. This also aligns with the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a). The implementation of an exclusion zone for these areas, including the Port Campbell emerging aggregation area, will ensure that the activity is not inconsistent with the Conservation Management Plan for the Southern Right Whale as it will not impede the recovery objective for this emerging aggregation area.
Consequence rating	Moderate (2)
Likelihood of occurrence	Highly Unlikely (2)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of disturbance to marine fauna was assessed as low and the consequence was assessed as moderate which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding disturbance to marine fauna.
Other requirements	Disturbance to marine fauna will be managed in accordance with legislative requirements. Disturbance to marine fauna if it occurred will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). Actions from the recovery plan applicable to vessel collision will be implemented. • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact the recovery of sei or fin whales, covered by conservation advice. The activity is not inconsistent with the Wildlife Conservation Plan for Seabirds (CoA 2020b) as the bird deterrent system is designed to scare birds, rather than injury them. Applicable actions associated with the plan have been addressed as per: • Implementing a comprehensive monitoring program of impacts of these offshore platforms should include nature, timing and extent of bird mortality caused by these structures. Beach records any injury/deaths of bird species associated with the platform, and these are reported to NOPSEMA as recordable incidents.

	Actions from the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b) applicable to the activity to minimise vessel collisions have been addressed as per: • Ensure all vessel strike incidents are reported in the National Ship Strike Database. Vessel collision with protected marine fauna are required to be reported as detailed in Section 7.10. • Ensure the risk of vessel strikes on blue whales is considered when assessing actions that increase vessel traffic in areas where blue whales occur and, if required, appropriate mitigation measures are implemented. Section 6.11 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP. Actions from the draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) applicable to the activity to minimise vessel collisions have been addressed as per: • Assess risk of vessel strike to Southern Right Whales in BIAs. Section 6.11 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP. • Ensure environmental impact assessments and associated plans consider and quantify the risk of vessel strike and associated potential cumulative risks in BIAs. Section 6.11 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP. No cumulative impacts are predicted as IMR vessels will not be within the southern right whale BIAs when they are present (CM#13b SRW Exclusion Zone). • Ensure all vessel strike incidents are reported in the National Ship Strike Database managed through the Australian Marine Mammal Centre, Australian Antarctic Division. Vessel strikes to marine fauna will be reported in the National Ship Strike Database as per Section 7.10.1
Monitoring and reporting	Vessel strikes to protected marine fauna area required to be reported as detailed in Section 7.10.1.
Acceptability outcome	**Acceptable**

6.12 Unplanned Marine Discharges - Solids

6.12.1 Hazards

Solids which may be accidentally discharged include:

- Waste maybe accidently blown overboard off the vessels or Thylacine-A Wellhead Platform.
- Grit may be used to remove paint or debris from the platform topside during maintenance. Containment will be used to recover grit and debris; however unplanned discharges may occur.

6.12.2 Predicated Environmental Impacts

Solids accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement.

6.12.3 EMBA

Impacts resulting from the risk of unplanned marine discharge (solids) will be limited to the operational area.

6.12.4 Consequence Evaluation

The Threat Abatement Plan for the impacts of Marine Debris on Vertebrate Wildlife of Australia's Coasts and Ocean (Commonwealth of Australia, 2018) details harmful marine debris impacts on a range of marine life, including protected species of birds, sharks, turtles and marine mammals. Harmful marine debris refers to 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 non-biodegradable floating materials lost or disposed of at sea.

Solids accidently released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement. Impacts will be restricted in exposure and quantity and will be limited to individual fauna.

The operational area overlaps foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater. No habitat critical to the survival of birds occur within the operational area. Marine debris is identified as a threat in the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a).

Three marine turtle species (or species habitat) may occur within the operational area though no BIAs or critical habitat to the survival of the species were identified. The Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b) identified marine debris as a threat.

Two species of pinniped (or species habitat) may occur within the operational area; the New Zealand fur-seal and the Australian fur-seal. The operational area does not overlap any BIAs for pinnipeds.

Twenty two whale species (or species habitat) may occur within the operational area. Foraging behaviours were identified for some species (blue, fin, pygmy right and sei whales); no other important behaviours were identified. The operational area intersects a foraging BIA for the pygmy blue whale and the known core range and migration and resting on migration BIA for the southern right whale.

The Conservation Management Plan for the blue whale and for the southern right whale and Conservation Advice for the sei whale and fin whale do not identify marine debris as threat. The Conservation Listing for humpback whales identifies marine debris as threat.

The draft National Recovery Plan for the Southern Right Whale (DCCEEW 2022a) identifies marine debris as a threat, specifically vessel-sourced, solid, non-biodegradable floating materials disposed of or lost at sea. It details that ingestion of marine debris, however, is thought to be unlikely for southern right whales in Australian coastal waters given whales are less likely to be feeding. No actions from the recovery plan were identified specific to vessel debris.

The extent of the area of where the risk of unplanned waste being discharged to the marine environment is within the operational area and the risk could occur at any time. The severity is assessed as Minor (1) and remote as unplanned release of waste is uncommon; if waste was lost overboard impacts would be restricted in exposure and quantity and would be limited to individual fauna.

6.12.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Unplanned marine discharges - Solids	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of an unplanned marine discharge of solids impacts to marine fauna is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation unplanned marine discharge of solids. As the risk is rated as low applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#27: MO 95: Marine Pollution Prevention – Garbage	Marine Order Part 95 (Marine pollution prevention — garbage gives effect to MARPOL Annex V. MARPOL is the International Convention for the Prevention of Pollution from Ships and is aimed at preventing both accidental pollution, and pollution from routine operations. Specifically, MARPOL Annex V requires that a garbage / waste management plan and garbage record book is in place and implemented.
CM#28: Fabric Maintenance	Grit blasting on the platform jacket and topsides uses containment and recovery to minimise losses to the ocean. Grit blasting material will meet the requirements of the Chemical Management Plan as per Section 7.11.2.
Consequence rating	Minor (1)
Likelihood of occurrence	Remote (1)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a marine fauna injury or death from unplanned discharge of solids was assessed as low and the consequence was assessed as minor which is not considered as having the potential to result in serious or

	irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding marine fauna injury or death from unplanned discharge of solids
Other requirements	Waste on board the vessels and Thylacine-A Wellhead Platform will be managed in accordance with legislative requirements. Marine fauna injury or death from unplanned discharge of solids if occurred will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). • Impact the recovery of sei or fin whales, covered by conservation advice.
Monitoring and reporting	Unplanned discharge of solids is required to be reported as per Section 7.12.8.
Acceptability outcome	**Acceptable**

6.13 Loss of Containment – Hazardous Substances

6.13.1 Hazards

Several loss of containment scenarios of hazardous substances have been identified as credible during Otway Offshore Operations. These are described in Table 6-14.

Table 6-14 Credible Loss of Containment (hazardous substances) scenarios

Scenario	Description
Loss of Containment – hazardous substances stored on Thylacine-A Wellhead Platform and vessels	Routine operation of the Thylacine-A Wellhead Platform and vessels includes handling, use and transfer of hydrocarbons and chemicals with the following were identified as potentially leading to a loss of containment event: • use, handling and transfer of hydrocarbons and chemicals on board • hydraulic line failure from equipment
Loss of Containment – hose failure	Hose failure during transfer of hazardous substances could occur as a result of equipment damage, resulting in a loss of containment of the hose volume.
Loss of containment – MEG pipeline	The MEG pipeline is a closed system; however, loss of containment could occur as a result of: • equipment damage • loss of pipeline integrity • dropped objects

6.13.2 Predicted Environmental Impacts

The predicted environmental impacts of a loss of containment (hazardous substances) are:

- Change in water quality.

As a result of a change in water quality, further impacts may occur, which include:

- Injury / mortality to fauna.
- Change in fauna behaviour.
- Change in ecosystem dynamics.
- Changes to the functions, interests or activities of other users.

6.13.3 EMBA

Impacts resulting from the risk of a loss of containment of hazardous substances will be limited to the operational area.

6.13.4 Consequence Evaluation

An evaluation of the types of minor spill events was completed to determined indicative volumes associated with each type of event. Both hydraulic line failure and use of hazardous materials onboard were associated with small volume spill events – with the maximum volume based upon the loss of an intermediate bulk container ~1 m^3.

The estimated fluid inventory of the MEG pipeline is approximately 550 m^3, based on 82 km of DN 100 pipe. Typically, the MEG pipeline is 80-90 wt% MEG: 10-20 wt% water mixture plus a corrosion inhibitor and alkyl hydroxide.

MEG is a category 'E' OCNS chemical with no substitution warning and is readily biodegradable and has a low potential for bioaccumulation.

The potential consequence of a loss of containment of hazardous substances within the operational area would be limited to a localised and temporary change in water quality in the vicinity of the release, and the potential change to fauna behaviour within surface waters affected by the spill, such as avoidance. As such, the consequence of this scenario has been evaluated as Minor (1) given there is unlikely to be a lasting effect to biological and physical environment in an area that is not formally managed.

6.13.5 Control Measures, ALARP and Acceptability Assessment

Control, ALARP and acceptability assessment: Loss of Containment – hazardous substances	
ALARP decision context and justification	ALARP Decision Context: Type A The risk of a minor spill is well understood and there is nothing new or unusual. Good practice is defined, and uncertainty is minimal. There are no conflicts with company values, no partner interests and no significant media interests. No objections or claims where raised by stakeholders in relation to minor spills during the activity. As the risk is rated as low applying good industry practice (as defined in Section 5.7.2.1) is sufficient to manage the impact to ALARP.
Adopted Control Measures	**Source of good industry practice control measures**
CM#29: Spill containment	Vessel management system includes provision to maintain spill containment aboard the vessel and clean spills aboard the vessel to prevent release to the marine environment. Computerised Maintenance Management Plan (CMMS) on the platform requires that bunded areas are maintained to prevent unplanned spills of chemicals to the marine environment. Spill kits are present on the Thylacine-A Wellhead Platform.
CM#30: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a Shipboard Marine Pollution Emergency Plan (SMPEP) or SOPEP (according to class) is required. These will follow the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
CM#31 NOPSEMA accepted Safety Case	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 set out the requirements for safety cases. The Thylacine-A Wellhead Platform and Otway Pipeline System Safety Cases demonstrate how the risks to the integrity of the MEG system will be reduced to as low as reasonably practicable (ALARP). The safety cases: • identify the hazards and risks. • describe how the hazards and risks are controlled. • describe the management system in place to ensure the controls are effectively and consistently applied.

	• describe the operation, monitoring, inspection and maintenance of the MEG system. • describe the leak detection, and emergency shutdown and isolations systems to reduce the extent of loss of containment of MEG.
CM#32: Thylacine-A Wellhead Platform Hose Integrity Management Plan	Hoses are managed and maintained as per Thylacine-A Wellhead Platform Hose Integrity Management Plan
Consequence rating	Minor (1)
Likelihood of occurrence	Unlikely (3)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a loss of containment (hazardous substances) was assessed as low and the consequence was assessed as minor which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	There have been no stakeholder objections or claims regarding loss of containment (hazardous substances).
Other requirements	Loss of containment (hazardous substances) will be managed in accordance with legislative requirements. Loss of containment (hazardous substances) will not: • Impact on the recovery of marine turtles as per the Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b). • Impact the recovery of the white shark as per the Recovery Plan for the White Shark (*Carcharodon carcharias*) (DSEWPaC, 2013a). • Impact the long-term survival and recovery of albatross and giant petrel populations breeding and foraging as per the National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). • Impact the conservation of listed seabirds in Australia and beyond as per the Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b). • Impact the recovery of the blue whale as per the Conservation Management Plan for the Blue Whale (Commonwealth of Australia 2015b). • Impact the recovery of the southern right whale as per the Conservation Management Plan for the Southern Right Whale (DSEWPaC, 2012a). • Impact the recovery of sei or fin whale, covered by conservation advice.
Monitoring and reporting	Loss of containment (hazardous substances) are required to be reported as per Section 7.10.
Acceptability outcome	**Acceptable**

6.14 Loss of Containment - Hydrocarbons

6.14.1 Hazards

Activities associated with the Otway Offshore Operations have the potential to result in an accidental release of hydrocarbons to the marine environment.

Guidance on the identification of worst-case credible spill scenarios is given in AMSA's Technical Guidelines for Preparing Contingency Plans for Marine and Coastal Facilities (AMSA 2015) and Technical Report on Calculation of Worst-Case Discharge (SPE 2016). These documents were used to identify potential hydrocarbon spill scenarios for the Otway Offshore Operations as detailed in Table 6-15.

There is no refuelling of vessels within the operational area.

Table 6-15 Loss of Containment Resulting in a Hydrocarbon Spill Scenarios

Scenario	**Description**	**Worst-case release volume and rate**
Vessel Collision - Marine Diesel Oil (MDO) spill	Collision between a resupply or IMR vessel and third-party vessel.	Based on the types of vessel used for IMR and resupply activities a largest tank volume of 300 m^3 is considered appropriate.
Pipeline loss of containment – gas and condensate	Loss of containment from the Otway Gas Pipeline or flexible flowline from the Geographe or Thylacine subsea facilities as a result of erosion, corrosion, or external forces (e.g. dropped object; fishing vessel interactions). A release could occur anywhere along the flowline or pipeline.	A Flow Assurance assessment calculated that the maximum credible spill volume from a pipeline loss of containment is between 320 to 560 m^{3,} depending on production rates and the production wells online.
Loss of well containment – gas and condensate	Loss of containment as a result of well integrity failure.	The highest maximum production rates for each producing field are: • Geographe subsea wells: 40 MMscf/day with an associated condensate rate of 640 bbls/day (101.7 m^3/day). • Thylacine-A Wellhead Platform wells - 28 MMscf/day with an associated condensate rate of 280 bbls/day (44.5 m^3/day). • Thylacine wells - 139 MMscf/day with an associated condensate rate of 1,337 bbls/day (212.6 m^3/day). It is likely that these rates would decline by 2-3% per month of flowing time.

6.14.2 Quantitative Hydrocarbon Spill Modelling

Beach commissioned RPS Group (RPS) to conduct quantitative spill modelling for a MDO and a condensate spill scenario.

The quantitative spill modelling assessment was undertaken for two distinct periods, defined by the unique prevailing wind and general current conditions: summer (November–April) and winter (May–October).

For details of the spill modelling see the RPS Reports in Appendix E.

Scenario 1: a 212.6 m^3 subsea release of condensate over 86 days (RPS 2023) (Appendix E.1).

The modelled scenario was based on a loss of control of a subsea well at the Thylacine West-1 well location using the condensate composition of the Thylacine field.

The Thylacine West-1 well was selected as this has the highest flow rate for the Thylacine and Geographe production wells as detailed in Table 6-15.

Beach has a high degree of confidence in the estimated release rates as they are based on known reservoir properties and flow rates. Release rates and volumes are based on a total LOC which assumes the failure of multiple control systems.

The modelled duration of 86 days represents the time determined to implement a full dynamic well kill via the drilling of a relief well at any of the well locations.

The loss of containment from the Thylacine West -1 well represents the greatest potential extent of hydrocarbon exposure and is therefore used to evaluate the potential consequences of a loss of containment of condensate. To develop the condensate planning area the low threshold area of exposure from the modelling was used.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2023, Appendix E.1) are detailed in Table 6-17 and assessed in Table 6-18 (surface), Table 6-19 (shoreline) and Table 6-20 (in-water)

Scenario 2: a 300 m^3 surface release of marine diesel oil (MDO) over 6 hours (RPS 2022) (Appendix E.2).

This scenario represents a loss of inventory from the largest fuel tank on a supply or IMR vessel due to a hypothetical vessel collision incident. The calculation of discharge volume and timing aligns with the methodology recommended in the AMSA Technical guidelines for preparing contingency plans for marine and coastal facilities (Commonwealth of Australia, January 2015).

The most feasible vessel collision scenario is at the Thylacine platform and represents the greatest potential extent of hydrocarbon exposure and is therefore used to evaluate the potential consequences of a loss of containment of diesel. To develop the diesel planning area the low threshold area of exposure from the modelling was used.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2022, Appendix E.2) are detailed in Table 6-17 and assessed in Table 6-18 (surface), Table 6-19 (shoreline) and Table 6-20 (in-water).

6.14.2.1 Hydrocarbon Exposure Thresholds

In the event of an oil spill incident, the environment may be affected in several ways, depending on the concentration and duration of exposure of the environment to hydrocarbons. The hydrocarbon exposure thresholds used for the spill modelling are based on the NOPSEMA Bulletin: Oil Spill Modelling (NOPSEMA 2019) and are detailed in Table 6-16.

These thresholds have been used to:

- Predict potential hydrocarbon exposure at conservative (low exposure) concentrations to inform the description of the environment (Section 4).
- Inform the oil spill impact and risk evaluation (Section 6.14.4 Diesel and Section 6.14.6 Condensate).
- Inform oil spill response planning (Section 6.15 and OPEP) based on the actionable thresholds of:
  - Surface moderate exposure (10 g/m^2). As detailed in the OPEP Beach use the more conservative moderate exposure for oil response planning.
  - Shoreline moderate exposure (100 g/m^2).
- Inform oil spill monitoring planning (Section 7.9.4 and OSMP) based on the low exposure thresholds.

Table 6-16: Hydrocarbon Exposure Thresholds

	Threshold	**Description**
Surface		
Low exposure	1 g/m^2	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring.
Moderate exposure	10 g/m^2	Approximates lower limit for harmful exposures to birds and marine mammals.
High exposure	50 g/m^2	Approximates surface oil slick and informs response plan.
Shoreline		
Low exposure	10 g/m^2	Predicts potential for some socio-economic impact.
Moderate exposure	100 g/m^2	Loading predicts area likely to require clean-up effort.
High exposure	1000 g/m^2	Loading predicts area likely to require intensive clean-up effort.
Dissolved*		
Low exposure	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
Moderate exposure	50 ppb	Approximates potential toxic effects, particularly sublethal effects to sensitive species.

	Threshold	Description
Surface		
High exposure	400 ppb	Approximates toxic effects including lethal effects to sensitive species
Entrained*		
Low exposure	10 ppb	Establishes planning area for scientific monitoring based on potential for exceedance of water quality triggers.
High	100 ppb	As appropriate given oil characteristics for informing risk evaluation.

* In-water (entrained & dissolved) hydrocarbon thresholds are based upon an instantaneous (1 hr) hydrocarbon exposure

Table 6-17: Identification of Receptors Predicted to be Exposed to Oil from the Oil Spill Modelling

* Identified in the PMST Report for the planning area but either not on the coastal area or not identified in the spill modelling reported as being exposed to oil.

Receptor Group	**Receptor**	**Predicted Oil Exposure MDO Release**				**Predicted Oil Exposure Condensate Release**			
		Shoreline	**Surface**	**Dissolved**	**Entrained**	**Shoreline**	**Surface**	**Dissolved**	**Entrained**
State Waters	Victorian	✓	×	×	✓	✓	×	✓	✓
	Tasmanian	✓	×	×	✓	✓	×	✓	✓
World Heritage Properties	None present	–	–	–	–	–	–	–	–
Australian Marine Parks	Apollo Marine Park	×	×	✓	✓	×	×	✓	✓
	Beagle Marine Park	×	×	×	×	×	×	✓	×
	Franklin Marine Park	×	×	×	×	×	×	✓	✓
	Zeehan Marine Park	×	×	×	✓	×	×	✓	✓
National Heritage Places	Great Ocean Road and Scenic Environs (historic)	✓	×	×	×	✓	×	×	×
	Western Tasmania Aboriginal Cultural Landscape	×	×	×	×	✓	×	×	×
Commonwealth Heritage Places	Cape Wickham Lighthouse*	×	×	×	×	×	×	×	×
	Wilsons Promontory Lighthouse*	×	×	×	×	×	×	×	×
Protected Underwater Cultural Heritage	None present	–	–	–	–	–	–	–	–
Wetlands of International Importance	Lavinia*	×	×	×	×	×	×	×	×

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	**Surface**	**Dissolved**	**Entrained**	**Shoreline**	**Surface**	**Dissolved**	**Entrained**
Nationally Important Wetlands	Aire River/Lower Aire River Wetlands	✓	×	×	×	✓	×	×	×
	Lavinia*	×	×	×	×	×	×	×	×
	Princetown	×	×	×	×	✓	×	×	×
	Shallow Inlet Marine and Coastal Park*	×	×	×	×	×	×	×	×
	Western Port	×	×	×	×	✓	×	×	×
Victoria Marine Protected Areas	Bunurong Marine National Park*	×	×	×	×	×	×	×	×
	Marengo Reefs Marine Sanctuary*	×	×	×	×	×	×	×	×
	Point Addis Marine National Park*	×	×	×	×	×	×	×	×
	Shallow Inlet Marine and Coastal Park	×	×	×	×	×	×	✓	×
	The Arches Marine Sanctuary*	×	×	×	×	×	×	×	×
	Twelve Apostles Marine National Park	×	×	×	✓	×	×	✓	✓
	Wilsons Promontory National Park	×	×	×	×	×	×	✓	✓
Victorian Terrestrial Protected Areas	Aire River Heritage River*	×	×	×	×	×	×	×	×
	Bay of Islands Coastal Park*	×	×	×	×	×	×	×	×
	Cape Liptrap Coastal Park*	×	×	×	×	×	×	×	×
	Great Otway National Park	✓	×	×	×	✓	×	×	×
	Phillip Island Nature Park	×	×	×	×	✓	×	×	×
	Port Campbell National Park	×	×	×	×	✓	×	×	×
	Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks	×	×	×	×	✓	×	×	×
Tasmanian Marine Protected Areas	Kent Group National Park*	×	×	×	×	×	×	×	×
	Cape Wickham Conservation Area	✓	×	×	×	✓	×	×	×
	Cataraqui Point Conservation Area	✓	×	×	×	✓	×	×	×

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
Tasmanian Terrestrial Protected Areas	Porky Beach Conservation Area	×	×	×	×	✓	×	×	×
	Seal Rocks State Reserve	✓	×	×	×	✓	×	×	×
	Stokes Point Conservation Area	✓	×	×	×	✓	×	×	×
	West Point State Reserve	×	×	×	×	✓	×	×	×
Key Ecological Features	Bonney Coast Upwelling*	×	×	×	×	×	×	×	×
	West Tasmanian Marine Canyons	×	×	✓	✓	×	×	✓	✓
	Shelf Rocky Reefs and Hard Substrates*	×	×	×	×	×	×	×	×
	Bass Cascade*	×	×	×	×	×	×	×	×
Threatened Ecological Communities	Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	✓	×	×	×	✓	×	✓	✓
	Giant Kelp Marine Forests of South East Australia	×	×	×	✓	×	×	✓	✓
	Subtropical and Temperate Coastal Saltmarsh	✓	×	×	✓	✓	×	✓	✓
Benthic Habitats and Species Assemblages	Seagrass Algae Coral	×	×	×	✓	×	×	✓	✓
Mangroves	None present	–	–	–	–	–	–	–	–
Saltmarsh	Saltmarshes ecosystems	✓	×	×	×	✓	×	✓	✓
Fauna	Plankton	×	×	✓	✓	×	×	✓	✓
Fauna	Invertebrates	×	×	✓	✓	×	×	✓	✓
Threatened Species	Fish	×	×	✓	✓	×	×	✓	✓
	Birds	✓	✓	✓	✓	✓	✓	✓	✓
	Marine Reptiles	×	✓	✓	✓	×	✓	✓	✓
	Cetaceans	×	✓	✓	✓	×	✓	✓	✓

Receptor Group	Receptor	Predicted Oil Exposure MDO Release				Predicted Oil Exposure Condensate Release			
		Shoreline	Surface	Dissolved	Entrained	Shoreline	Surface	Dissolved	Entrained
	Pinnipeds	✓	✓	✓	✓	✓	✓	✓	✓
Socio-economic	Coastal settlements	✓	✗	✗	✗	✓	✗	✗	✗
	Petroleum exploration and development	✗	✓	✗	✗	✗	✓	✗	✗
	Other infrastructure – none present	–	–	–	–	–	–	–	–
	Defence – none present	–	–	–	–	–	–	–	–
	Shipping	✗	✓	✗	✗	✗	✓	✗	✗
	Tourism	✓	✓	✗	✗	✓	✓	✗	✗
	Recreational diving	✗	✓	✗	✓	✗	✓	✓	✓
	Recreational fishing	✓	✓	✗	✓	✓	✓	✓	✓
	Commercial fisheries	✗	✓	✓	✓	✗	✓	✓	✓
	Seaweed industry	✓	✗	✗	✓	✓	✗	✓	✓
First Nations	Sea Country	✓	✓	✓	✓	✓	✓	✓	✓
	Native title	✓	✗	✗	✓	✓	✗	✓	✓
	Indigenous Protected Areas	✗	✗	✗	✓	✗	✗	✓	✓
	Indigenous Land Use Agreements – none present	–	–	–	–	–	–	–	–

6.14.3 Predicted Environmental Impacts

The known and potential environmental impacts of a hydrocarbon spill are:

- Change in water quality

As a result of a change in water quality, further impacts may occur, which include:

- Injury / mortality to fauna
- Change in fauna behaviour
- Change in ecosystem dynamics
- Changes to the functions, interests, or activities of other users

6.14.4 Consequence Evaluation - Diesel

Circumstances resulting in a loss of containment of MDO such as a vessel collision and subsequent fuel tank rupture are low probability events in open ocean areas without restricted navigation. Though shipping activity is relatively high within the operational area (Section 4.5.5), modern navigational aids assist in reducing the likelihood of a collision event. Higher commercial and recreational vessel traffic occurs in and around ports and harbours, which is therefore where the greatest risk of collision occurs. While undertaking the resupply or IMR activities vessels will often be stationary or moving slowly, further reducing the risk of collision with third-party vessels.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2022, Appendix E.2) are detailed in Table 6-17. The potential environmental impacts to receptors from a diesel spill are discussed in to Table 6-18 (surface), Table 6-19 (shoreline) and Table 6-20 (in-water) and are based on the spill modelling areas of exposure detailed below.

6.14.4.1 Potential extent of hydrocarbon exposure to surface waters

The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 39.3 km (east-southeast) during summer conditions, 15.3 km (east-southeast) during winter conditions and 2.7 km (west-southwest) during winter conditions, respectively (Figure 6-5).

Victorian and Tasmanian waters were not predicted to be exposure to surface oil.

No conservation values or sensitivities (Section 4.2) were identified to be exposed to surface oil at the low threshold or above.

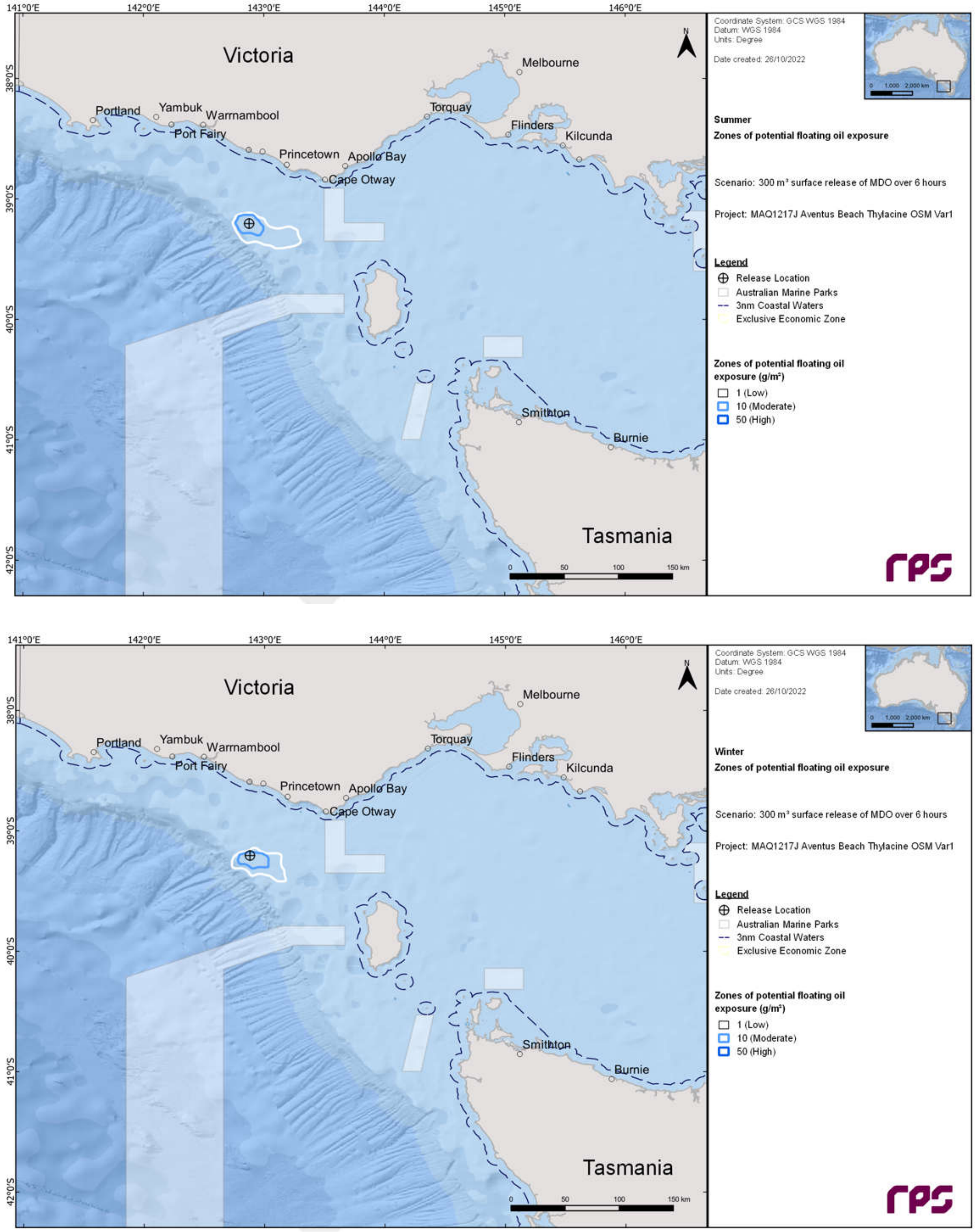


Figure 6-5: Zones of Potential Surface Oil for 300m^3 Diesel Spill -Summer and Winter

6.14.4.2 Potential extent of hydrocarbon exposure to shorelines

The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 0% during summer conditions and 5% during winter conditions (Figure 6-6). The minimum time before oil accumulation at, or above, the low threshold was 7.58 days winter conditions. The maximum total volume ashore for a single spill trajectory during winter conditions was 4.3 m^3, and the maximum length of shoreline accumulation at the low threshold was 11 km. No shoreline accumulation was observed for the summer season nor the moderate or high thresholds for winter.

Shoreline oil at the low threshold had a 4% probability of exposure on the west side of King Island and a 1% probability of exposure at Cape Otway. The minimum time for low threshold shoreline accumulation was 7.58 days for King Island, where the maximum shoreline accumulation (4.3 m^3) also occurred.

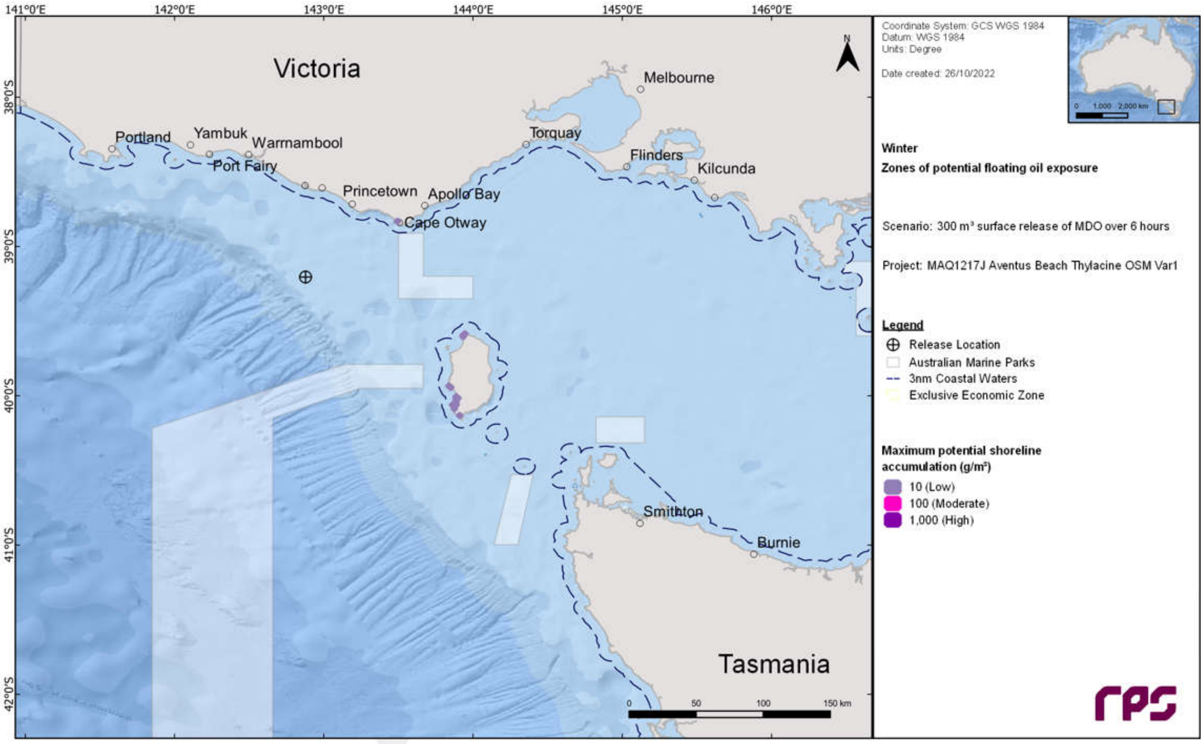


Figure 6-6: Zones of Potential Shoreline Oil for 300m^3 Diesel Spill -Winter

6.14.4.3 Potential extent of in-water dissolved hydrocarbon exposure

At the depths of 0-10 m, during the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor was predicted to be 57 ppb and 58 ppb, respectively, which occurred within receptors containing the release location (Figure 6-7).

There was no predicted exposure to identified receptors at high threshold and a low probability of exposure (maximum 2%) at the moderate threshold.

Victorian and Tasmanian waters were not predicted to be exposed to dissolved hydrocarbons.

The Apollo AMP and the West Tasmania Canyons KEF were predicted to be exposed above the low threshold during both summer and winter conditions.

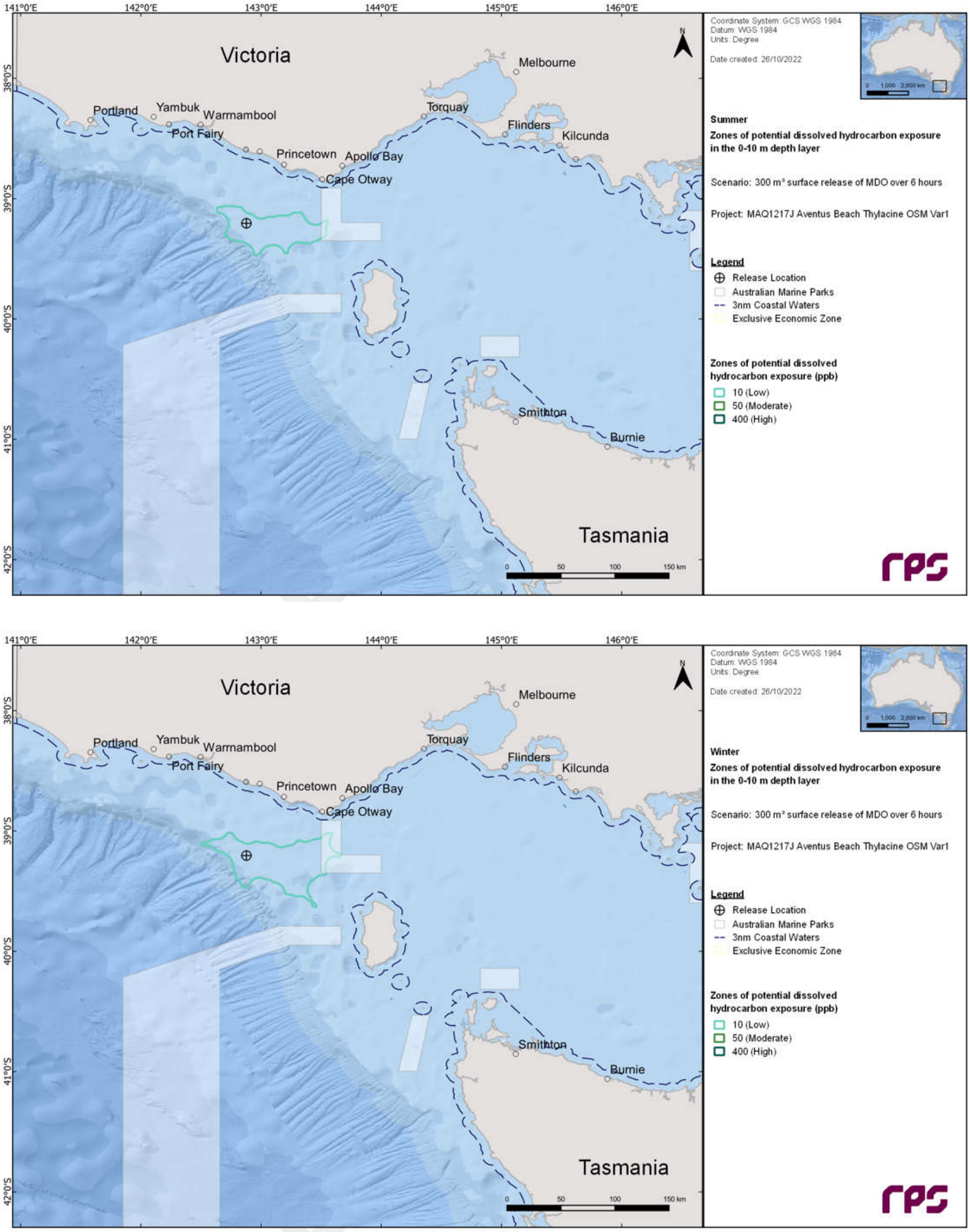


Figure 6-7: Zones of Potential Dissolved Oil for 300m^3 Diesel Spill -Summer and Winter

6.14.4.4Potential extent of in-water entrained hydrocarbon exposure

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure during summer and winter conditions was 6,323 ppb and 7,007 ppb, respectively. Victorian and Tasmanian waters were not predicted to be exposed to entrained hydrocarbons at the high threshold but had a 14% probability of exposure for Tasmanian waters and a 5% probability for Victorian waters (Figure 6-8).

The Apollo AMP and West Tasmania Canyons KEF were predicted to be exposed at the high threshold during both summer and winter conditions. While the Zeehan AMP and Twelve Apostles Marine National Park were predicted to be exposed at the low threshold during both summer and winter conditions.

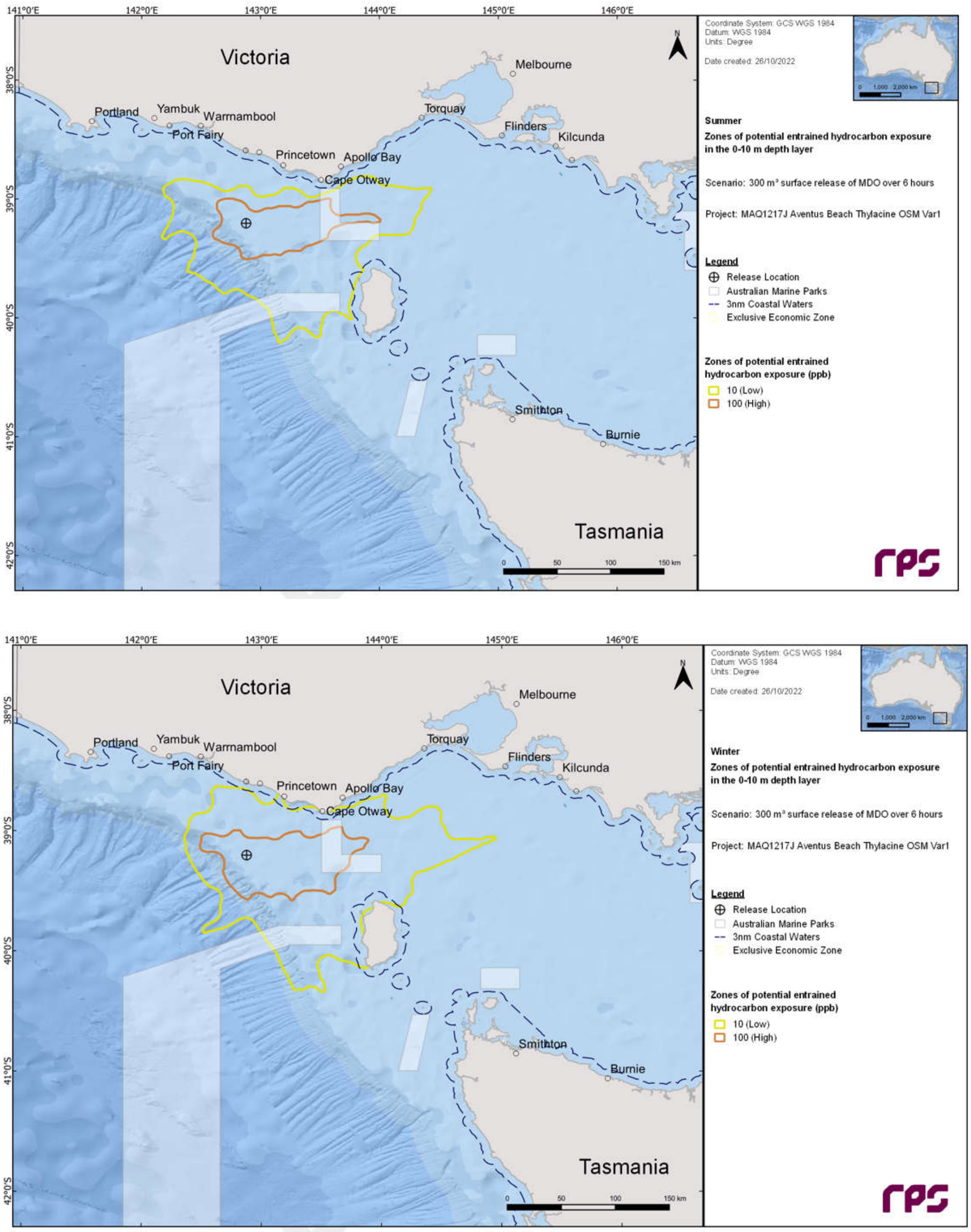


Figure 6-8: Zones of Potential Entrained Oil for 300m^3 Diesel Spill -Summer and Winter

Table 6-18: Consequence Evaluation to Receptors – Sea Surface

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Change in fauna behaviour Injury / mortality to fauna	Several listed Threatened, Migratory and/or listed marine species have the potential to be rafting, resting, diving and feeding within 15.3 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel, short-tailed shearwater and wedge-tailed shearwater are present in the area (Figure 4-29 and Figure 4-30) predicted to be above moderate levels of surface hydrocarbons. Foraging and breeding BIAs for little penguins are within the planning area, but not within the predicted area of surface exposure at moderate levels. Colonies of little penguins, without defined BIAs, are known to along parts of Port Campbell Bay area; therefore, it is possible that little penguins may be present in the area exposed to surface hydrocarbon at moderate levels.	When first released, diesel has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of moderate concentrations >10 g/m^2 out to 15.3 km from the release location) may be impacted; however, it is unlikely that many birds will be affected as volatile surface hydrocarbons are expected to evaporate over 3-4 days. Seabirds rafting, resting, diving or feeding at sea have the potential to encounter areas where hydrocarbons concentrations are greater than 10 g/m^2 and due to physical oiling may experience lethal surface concentrations. As such, acute or chronic toxicity impacts (death or long-term poor health) to birds are possible but unlikely for a diesel spill because of the limited period of exposure above 10 g/m^2. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, however, impacts to aggregations may occur. Consequently, the potential consequence to seabirds is considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Marine reptiles	Change in fauna behaviour Injury / mortality to fauna	There may be marine turtles in the area predicted to be exposed to surface oil. However, there are no BIAs or habitat critical to the survival of the species within this area (Section 4.4.7.5).	Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing. The number of marine turtles that may be exposed to surface diesel is expected to be low as there are no BIAs or habitat critical to the survival of the species present; however, turtles may be transient within the area of exposure. Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would likely be limited to individuals, with population impacts not anticipated. Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Pinnipeds (seals and sea lions)	Change in fauna behaviour Injury / mortality to fauna	The Australian and New Zealand fur-seals may occur within the area predicted to be exposed to moderate surface hydrocarbons >10 g/m^2. No BIAs, breading colonies or haul outs areas are within the area of exposure (Section 4.4.7.7). There is a foraging BIA for the Australian sea-lion but it is outside of the predicted area of surface exposure at >10 g/m^2.	Seals 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. Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Fur seals are particularly vulnerable to hypothermia from oiling of their fur. The number of seals that may be exposed to surface diesel at >10 g/m^2 is expected to be low as there are no BIAs or habitat critical to the survival of the species present; however, seals may be transient in low numbers within areas of potential surface exposure at >10 g/m^2 (Section 4.4.7.7). Sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				Consequently, the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Cetaceans (whales)	Change in fauna behaviour Injury / mortality to fauna	Several threatened, migratory and/or listed marine species have the potential to be within the area predicted to be exposed to moderate surface hydrocarbons of >10 g/m^2. BIAs for foraging for pygmy blue whales and the known core range for southern right whales are within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (Section 4.4.7.6).	Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may displace individuals from important habitat, such as foraging. If whales are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however sea surface oil >10 g/m^2 (10 µm) is only predicted for the first 36 hrs limiting the period when oiling may occur. Also, the area exposed by moderate levels of surface hydrocarbons (15.3 km from the release location) is relatively small compared to the overall distribution area of cetaceans. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and known core range for southern right whales, the risk of displacement to whales is considered low. Otway Offshore Operations could occur at any time of year. Therefore, there is potential for interaction with southern right whales given the activity window overlaps with the northern migration period of May-June, the peak breeding (July-August) and southern migration period (September-November) (Section 4.4.7.6). The activity timing overlaps with the blue whale season for migration and foraging in the operational area and planning area. Visual and acoustic surveys suggest that blue whales are present in the Otway region between November to June, peaking in February and March (Section 4.4.7.6). It is expected that foraging whales would be present in the area. As such in the event of a spill potential hydrocarbon exposure could

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				possibly affect aggregations of blue or other foraging whale species. Consequently, the potential consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of recognised conservation value.
	Cetaceans (dolphins)	Change in fauna behaviour Injury / mortality to fauna	Several dolphin species have the potential to be within the area predicted to be exposed to moderate surface hydrocarbons of >10 g/m^2. However, there are no BIAs or habitat critical to the survival of the species (Section 4.4.7.6).	Dolphins surface to breathe air and may inhale hydrocarbon vapours or be directly exposed to dermal contact with surface hydrocarbons. Direct contact with oil can result in direct impacts to the animal, due to toxic effects if ingested, damage to lungs when inhaled at the surface, and damage to the skin and associated functions such as thermoregulation (AMSA 2010). Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low. If dolphins are foraging at the time of the spill, a greater number of individuals may be present in the area where sea surface oil is present, however due to the short duration of the surface exposure above the impact threshold (approximately 36 hours), this is not likely. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
Socio-economic	Petroleum Exploration and Production	Displacement of other marine users	There are no oil and gas operations or activities within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	No impact predicted as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Shipping	Displacement of other marine users	Shipping occurs within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	Vessels may be present in the area where sea surface oil is present, however, due to the short duration of the surface exposure (approximately 36 hours) deviation of shipping traffic would be unlikely.
	Tourism and recreation (including recreational diving and recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 40 km. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.
	Commercial fisheries	Change in aesthetic value Changes to the functions, interests or activities of other users	Commercial fishing occurs within the area predicted to be exposed to surface hydrocarbons >10 g/m^2 (13.5 km from the release location).	Commercial fishing vessels may be present in the area where sea surface oil is present, however, due to the short duration of the surface exposure (approximately 36 hours) deviation of vessels would be unlikely. Impacts to commercial fish and invertebrate species are not predicted from surface oil. A short-term fishing exclusion zone may be implemented. However, given the temporary nature of any surface oil and the low intensity in the area of exposure, there are unlikely to be any significant impact on fisheries in terms of lost catches (and associated income). The relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 40 km. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the areas of Sea Country. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.

Table 6-19: Consequence Evaluation to Receptors– Shoreline

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	National Heritage Places	Change in aesthetic value **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Ocean Road and Scenic Environs. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Nationally Important Wetlands	Change in aesthetic value Change in ecosystem dynamics **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Aire River/Lower Aire River Wetlands. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The Aire River/Lower Aire River Wetlands consist of three shallow freshwater lakes, brackish to saline marshes and an estuary on the Aire River floodplain. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	State Terrestrial Protected Area	Change in aesthetic value Change in ecosystem dynamics **Changes to the functions, interests or activities of other users**	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Otway National Park and the following on the west side of King Island; Cape Wickham Conservation Area, Cataraqui Point Conservation Area, Seal Rocks State Reserve and Stokes Point Conservations Area. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. However, impacts to fur - seals at the low threshold is not predicted to result impact to this species. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Threatened Ecological Communities Saltmarshes	**Change in ecosystem dynamics**	Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community and Subtropical and Temperate Coastal Saltmarsh may be exposure to shoreline oil at the low threshold. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into these coastal communities at low concentrations which are not predicted to impact their ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Threatened Species	Pinnipeds (seals and sea lions)	Injury/Mortality to fauna Change in fauna behaviour	The modelling predicts potential shoreline exposure at the low threshold at Seal Rocks on King Island which is a New Zealand fur-seal breeding colony. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Breeding colonies (used to birth and nurse until pups are weaned) are particularly sensitive to hydrocarbon spills (Higgins & Gass, 1993). Pinnipeds are further at risk because of their tendency to stay near established colonies and haul-out areas and consequently are unlikely to practice oil avoidance behaviours. ITOPF (2011a) report that species that rely on fur to regulate their body temperature (such as fur-seals) are the most vulnerable to oil as the animals may die from hypothermia or overheating, depending on the season, if the fur becomes matted with oil. However, impacts to fur-seals are unlikely at the low thresholds that are predicted for shoreline oil at Seal Rocks. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Socio-economic	Coastal settlements Recreation and tourism (including recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at Cape Otway (Corangamite Shire) and on the west side of King Island. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Shoreline oil at the low threshold had a 4% probability of exposure on the west side of King Island and a 1% probability of exposure at Cape Otway. The minimum time for low threshold shoreline accumulation was 7.58 days for King Island. Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Seaweed industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	The modelling predicts potential shoreline exposure at the low threshold in areas along the west side of King Island where bull kelp is collected.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – North America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. As bull kelp is collected from the shoreline there is a potential for some plants to be affected and not be suitable for collection and processing. However, given the low levels of shoreline oil predicted it is

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at Cape Otway (Eastern Maar native Title claim) and on the west side of King Island. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of Sea Country. The predicted minimum time for oil to reach a shoreline is 7.58 days and it is likely to have dissipated during that time. Both Cape Otway and the west side of King Island are exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Table 6-20: Consequence Evaluation to Receptors – In Water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	Australian Marine Parks	Change in values Changes to the functions, interests or activities of other users	Apollo AMP may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column. Zeehan AMP may be exposed to hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The Apollo AMP is located in waters 80 m to 120 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features and the wreck of the MV City of Rayville are not predicted to be impacted. The conservation value of important migration area for blue, fin, sei and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Apollo AMP is an important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these 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. The Zeehan AMP is located in waters 50 m to 3,000 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features are not predicted to be impacted. The conservation value of important migration area for blue and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Zeehan AMP is also an important foraging habitat for black-browed, wandering and shy albatrosses, and great-winged and cape petrels. There is a low probability that seabirds would be feeding exclusively or

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				predominantly on fish found in these 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. Consequently, the potential consequence to these AMPS are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	State Marine Protected Areas	Change in values Changes to the functions, interests or activities of other users	The Twelve Apostles Marine National Park may be exposed (1% probability) to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	As impacts are only predicted within 0 – 10 m of the water column values such as the wreck of the Loch Ard, underwater limestone formations of arches and canyons, diverse range of encrusting invertebrates and dive sites are not predicted to be impacted. The unique limestone rock formations, including the Twelve Apostles, marine habitats representative of the Otway marine bioregion and indigenous culture based on spiritual connection to sea country and a history of marine resource use are unlikely to be impacted by entrained hydrocarbons at the low threshold. Consequently, the potential consequence to the Twelve Apostles Marine National Park is considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	Key Ecological Features	Change in ecosystem dynamics	The West Tasmania Canyons KEF may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column.	The West Tasmania Canyons KEF is in water depths > 70 m and thus impacts from in-water hydrocarbons are not predicted.
Ecological	Threatened Ecological Communities	Change in ecosystem dynamics	The Giant Kelp Marine Forests of South East Australia and Subtropical and Temperate Coastal Saltmarsh may be exposed to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	Entrained hydrocarbons at the low threshold are not predicted to impact on the ecological function of the Giant Kelp Marine Forests of South East Australia and Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Communities.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Benthic Habitat	Algae	Change in habitat	Video surveys confirmed the presence of high density macroalgae dominated epibenthos in waters shallower than 20 m, however, it is not a dominant habitat feature in eastern Victoria (Section 4.4.1.3). In-water exposure (dissolved and entrained hydrocarbons) is only predicted to occur within the 0 -10 m of the water column. Macroalgae communities in 20 m water depth are not predicted to be exposed to dissolved hydrocarbons at any threshold or high levels of entrained hydrocarbons at which potential impacts could occur.	NA
	Soft Coral	Change in habitat	Corals do not occur as a dominant habitat type within the planning area, however, their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway (Section 4.4.1.4). In-water exposure (dissolved and entrained hydrocarbons) is only predicted to occur within the 0 -10 m of the water column. Coral communities are not predicted to be exposed to dissolved hydrocarbons at any threshold or high levels of entrained hydrocarbons at which potential impacts could occur.	NA
	Seagrass	Change in habitat	Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons as seagrass is known to occur within Twelve Apostles Marine Park (Section 4.4.1.2) which has the potential to be	There is the potential that entrained in-water hydrocarbon exposure could result in sub-lethal impacts from smothering, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984).

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			exposure to entrained hydrocarbons at the low threshold.	Given that there is no predicted dissolved hydrocarbon exposure and entrained hydrocarbons exposure is only predicted at the low concentrations within the 0 -10 m of the water column, impacts to seagrass is not predicted.
Marine fauna	Plankton	Injury/ Mortality to fauna	Plankton are likely to be exposed to in-water hydrocarbons. Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest.	Relatively low concentrations of hydrocarbon are toxic to both plankton including zooplankton and ichthyoplankton (fish eggs and larvae). Plankton risk exposure through ingestion, inhalation and dermal contact. Impacts would predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level Section 4.4.4). Once background water quality conditions have re-established, the plankton community may take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, given the limited area exposed by moderate levels of dissolved hydrocarbons, the potential consequence to plankton are considered to be Minor, as they could be expected to result in localised low-level short-term and recoverable impacts.
	Marine invertebrates	Injury/ Mortality to fauna	In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Impact by direct contact of in-water hydrocarbons to benthic species in the	Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g. crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Invertebrates with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			deeper areas of potential exposure are not predicted. Species located in shallow nearshore or intertidal waters may be exposed to in-water hydrocarbons low thresholds. Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to moderate levels of entrained in-water hydrocarbons.	Tainting of recreation or commercial species is considered unlikely to occur given exposure is limited to entrained hydrocarbons, however if it did it is expected to be localised and low level with recovery expected. Consequently, the potential consequence to invertebrates, including commercially fished invertebrates are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of value.
	Fish	Injury/ Mortality to fauna	Entrained hydrocarbon droplets can physically affect fish exposed for an extended duration (weeks to months). Effects will be greatest in the upper 10 m of the water column and areas close to the spill source where hydrocarbon concentrations are likely to be highest. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, which is not likely to be exposed). Therefore, any impacts are expected to be highly localised. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the area of exposure, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2011a). Subsurface hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. Consequently, the potential consequence to fish, including those commercially fished, are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts to species of value. Impacts on fish eggs and larvae entrained in the upper water column are not expected to be significant given the temporary nature of the resulting change in water quality. As egg/larvae dispersal is widely distributed in the upper layers of the water column it is expected that current induced drift will rapidly replace any oil affected populations. Consequently, the potential consequence to eggs/larva are considered to be Minor, as they could be expected to result in localised low-level short-term impacts.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Pinnipeds (seals and sea lions)	Injury/ Mortality to fauna Change in fauna behaviour	Australian and New Zealand fur-seals may occur within the area of exposure (Section 4.4.7.7). There are no identified BIAs for seals or sea lions within the area of exposure. No known breeding colonies of Australian or New Zealand fur-seals are exposed to moderate dissolved or high entrained exposure thresholds. Given the mobility of pinnipeds, there may be small numbers of seals in the areas predicted to be temporarily exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 - 10 m of the water column.	Exposure to moderate dissolved or high entrained exposure thresholds in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Due to the temporary and localised nature of the spill, pinnipeds widespread nature, the low-level exposure zones and rapid loss of the volatile components of diesel in choppy and windy seas (such as that of the area exposed), the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Cetaceans (whales and dolphins)	Injury/ Mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the area predicted to be exposed to in-water hydrocarbons. BIAs for foraging for pygmy blue whales and the known core range for southern right whales are within the area predicted to be exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 -10 m of the water column.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with ‘fresh’ hydrocarbon; the risk of impact declines rapidly as the MDO weathers. The potential for impacts to cetaceans and dolphins would be limited to a relatively short period following the release and would need to coincide with seasonal foraging or aggregation event to result in exposure to a large number of individuals, as may be the case during seasonal upwelling events within the Otway region. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and known core range for southern right whales.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				Consequently, the potential consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
Socio-economic	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the planning area and overlap the spatial extent of the water column hydrocarbon predictions (Section 4.5.9, Section 4.5.10 and Section 4.5.11).	Any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure are unlikely to manifest at a fish population viability level. Any exclusion zone established would be limited to the immediate vicinity of the release point, and due to the rapid weathering of diesel would only be in place 1-3 days after release, therefore physical displacement to vessels is unlikely to be a significant impact. Consequently, the potential consequence to commercial and recreational fisheries are considered to be Minor, as they could be expected to result in localised low-level short-term impacts.
	Recreation and tourism	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Tourism and recreation are also linked to the presence of marine fauna (e.g. whales), particular habitats and locations for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds	Any impact to receptors that provide nature-based tourism features (e.g. whales) may cause a subsequent negative impact to recreation and tourism activities. Refer also to: Fish Birds Pinnipeds Cetaceans (whales and dolphins) Marine invertebrates Recreational fisheries Any impact to receptors that provide nature-based tourism features (e.g. fish and cetaceans) may cause a subsequent negative impact to

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			can result in indirect impacts to recreational values. It is important to note that the impact from a public perception perspective may be even more conservative. This may deter tourists and locals from undertaking recreational activities. If this occurs, the attraction is temporarily closed, economic losses to the business are likely to eventuate. The extent of these losses would be dependent on how long the attraction remains closed.	recreation and tourism activities. However, impacts would be localised and for a relatively short duration. Consequently, the potential consequence to recreation and tourism are considered to be Moderate, as they could be expected to result in localised short-term impacts.
	Seaweed Industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to entrained diesel may result in a reduction in commercially targeted seaweed species. Areas along the west side of King Island where bull kelp is collected may be exposed to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – north America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. The study did not look at how this would affect the productivity of bull kelp. However, given the low levels of entrained hydrocarbons predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title Indigenous Protected Area	Change in aesthetic value Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons is predicted along the Victorian and Tasmanian coastal waters within the planning area which is Sea Country for a number of First Nations groups and is adjacent to the Eastern Maar Native Title claim and Preminghana Indigenous Protected Area.	Section 4.6 details the connection First Nations people have to Sea Country which could be potentially impacted by in-water exposure to hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

6.14.5 Control Measures, ALARP and Acceptability Assessment – Diesel Spill

Control, ALARP and acceptability assessment: Loss of Containment - diesel	
ALARP decision context and justification	ALARP Decision Context: Type B Vessels have been used for activities within the Otway Offshore Development including operations for over a decade with no major incident. Vessel activities are well regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these events. However, if a diesel spill occurred from a vessel collision this could attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
CM#14: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Office (AHO) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue radio-navigation warnings. Relevant details in relation to the vessel activity will be provided to the AHO and AMSA and to relevant stakeholders to ensure the presence of the vessel is known in the area. See Section 8.16 (Ongoing Stakeholder Consultation).
	Under the *OPGGS Act 2006* there is provision for ensuring that petroleum activities are carried out in a manner that doesn't interfere with other marine users to a greater extent than is necessary or the reasonable exercise of the rights and performance of the duties of the titleholder. Beach ensures this is achieved by conducting suitable consultation with relevant stakeholders. Consultation with potentially affected fisheries ensures the risk of interaction with these users is limited.
CM#30: SMPEP or SOPEP (appropriate to class)	In accordance with MARPOL Annex I and AMSA MO 91 [Marine Pollution Prevention – oil], a Shipboard Marine Pollution Emergency Plan (SMPEP) or Shipboard Oil Pollution Emergency Plan (SOPEP) (according to class) is required to be developed based upon the Guidelines for the Development of Shipboard Oil Pollution Emergency Plans, adopted by IMO as Resolution MEPC.54(32) and approved by AMSA. To prepare for a spill event, the SMPEP/SOPEP details: • Response equipment available to control a spill event. • Review cycle to ensure that the SMPEP/SOPEP is kept up to date. • Testing requirements, including the frequency and nature of these tests. In the event of a spill, the SMPEP/SOPEP details: • Reporting requirements and a list of authorities to be contacted. • Activities to be undertaken to control the discharge of hydrocarbon. • Procedures for coordinating with local officials. Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.
CM#33: MO 21: Safety and emergency arrangements	AMSA MO 21: Safety and emergency arrangements gives effect to SOLAS regulations dealing with life-saving appliances and arrangements, safety of navigation and special measures to enhance maritime safety.
CM#18: MO 30: Prevention of collisions	AMSA MO 30: Prevention of collisions requires that onboard navigation, radar equipment, and lighting meets the International Rules for Preventing Collisions at Sea (COLREGs) and industry standards.

CM#34: MO 31: SOLAS and non-SOLAS certification	All vessels contracted to Beach will have in date certification in accordance with AMSA MO 31: SOLAS and non-SOLAS certification		
CM#19: MO 27: Safety of navigation and radio equipment	AMSA MO 27: Safety of navigation and radio equipment gives effect to SOLAS regulations regarding radiocommunication and safety of navigation and provides for navigation safety measures and equipment and radio equipment requirements.		
CM#35: Vessel fuel type	Vessels contracted to conduct activities under this EP will only carry marine diesel.		
Additional controls assessed			
Control	**Control Type**	**Cost/Benefit Analysis**	**Control Implemented?**
Eliminate or substitute the use of diesel.	Equipment	The use of diesel for fuel for vessels and machinery cannot be eliminated. Substituting for another fuel, i.e. Heavy Fuel Oil or bunker fuel oil, would have a higher environmental impact than diesel.	No
Consequence rating	Moderate (2)		
Likelihood of occurrence	Highly Unlikely (2) based upon AMSA Annual Report 2017-18 (serious incident reports)		
Residual risk	Medium		
Acceptability Assessment			
To meet the principles of ESD	The risk of a loss of containment resulting in a diesel spill was assessed as medium and the highest consequence assessed as moderate which is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required.		
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).		
External context	No objections or claims have been raised during stakeholder consultation regarding the potential for diesel spills.		
Other Requirements	• Vessel activities undertaken during Otway Offshore Operations will adhere to relevant legislative requirements as detailed in the controls section. • The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure or source of pressure on the conservation values of the South-east Marine Reserves Network. The Apollo AMP may be exposed to dissolved hydrocarbons at the low threshold and entrained hydrocarbons at the high threshold within the upper 0 -10 m of the water column and the Zeehan AMP may be exposed to hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Impacts to these AMP major conservation values are assessed as short-term and recoverable based on the majority of the exposure being to dissolved hydrocarbons for a short period of time. Impacts to AMP major conservation values for ecosystems, habitats, communities and cultural and heritage sites are not predicted as in-water hydrocarbons are only		

	predicted within 0 – 10 m of the water column which does not intersect with these values. • The following Conservation Advices / Recovery Plans identify pollution as a key threat: ◦ Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution) ◦ Conservation Advice for *Sterna nereis nereis* (Australian fairy tern) (DSEWPC, 2011c) ◦ National Recovery Plan for the Australian Painted Snipe (Commonwealth of Australia, 2022) identified as a deterioration of water quality ◦ Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015e) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) ◦ National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a) ◦ Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015b) ◦ Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b) • These Conservation Advices and Recovery Plan identify the following conservation actions: ◦ Minimise chemical and terrestrial discharge. Controls have been identified and will be implemented to minimise the risk of minimise chemical discharges. ◦ Ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. No habitats for turtles are identified within the diesel planning area. OPEP and OSMP cover management of response to oiled turtles. ◦ Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. OPEP and OSMP cover response strategies for management breeding sites vulnerable to oil spills. ◦ Implement measures to reduce adverse impacts of habitat degradation and/or modification. Controls have been identified and will be implemented to reduce adverse impacts of habitat degradation and/or modification.
Monitoring and reporting	Loss of containment resulting in a diesel spill is required to be reported as per Section 7.10. Impacts as a result of a loss of containment resulting in a diesel spill will be monitored and reported in accordance with the OSMP.

Acceptability outcome	**Acceptable**

6.14.6 Consequence Evaluation - Condensate

Circumstances resulting in a loss of containment of condensate from the Otway Gas Pipeline, subsea wells and infrastructure or Thylacine-A Wellhead Platform are low probability events.

Identification of receptors predicted to be exposed to oil surface, shoreline, dissolved or entrained oil, based on the oil spill modelling (RPS 2023, Appendix E.1) are detailed in Table 6-17. The potential environmental impacts to receptors from a diesel spill are discussed in to Table 6-22 (surface), Table 6-23 (shoreline) and Table 6-24 (in-water) and are based on the spill modelling areas of exposure detailed below.

6.14.6.1 Potential extent of hydrocarbon exposure to surface waters

The maximum distance from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 44.5 km (southeast) during summer conditions and 0.4 km (south) during winter conditions, respectively (Figure 6-9). No floating oil exposure above the high (> 50 g/m2) threshold was predicted by the modelling.

Floating oil exposure above the low threshold was predicted at the West Tasmania Canyons KEF (2%) during summer only. No other conservation values or sensitivities identifies in Section 4.2 were exposed to surface oil above threshold levels.

No Victorian or Tasmania waters were exposed to surface oil above threshold levels.

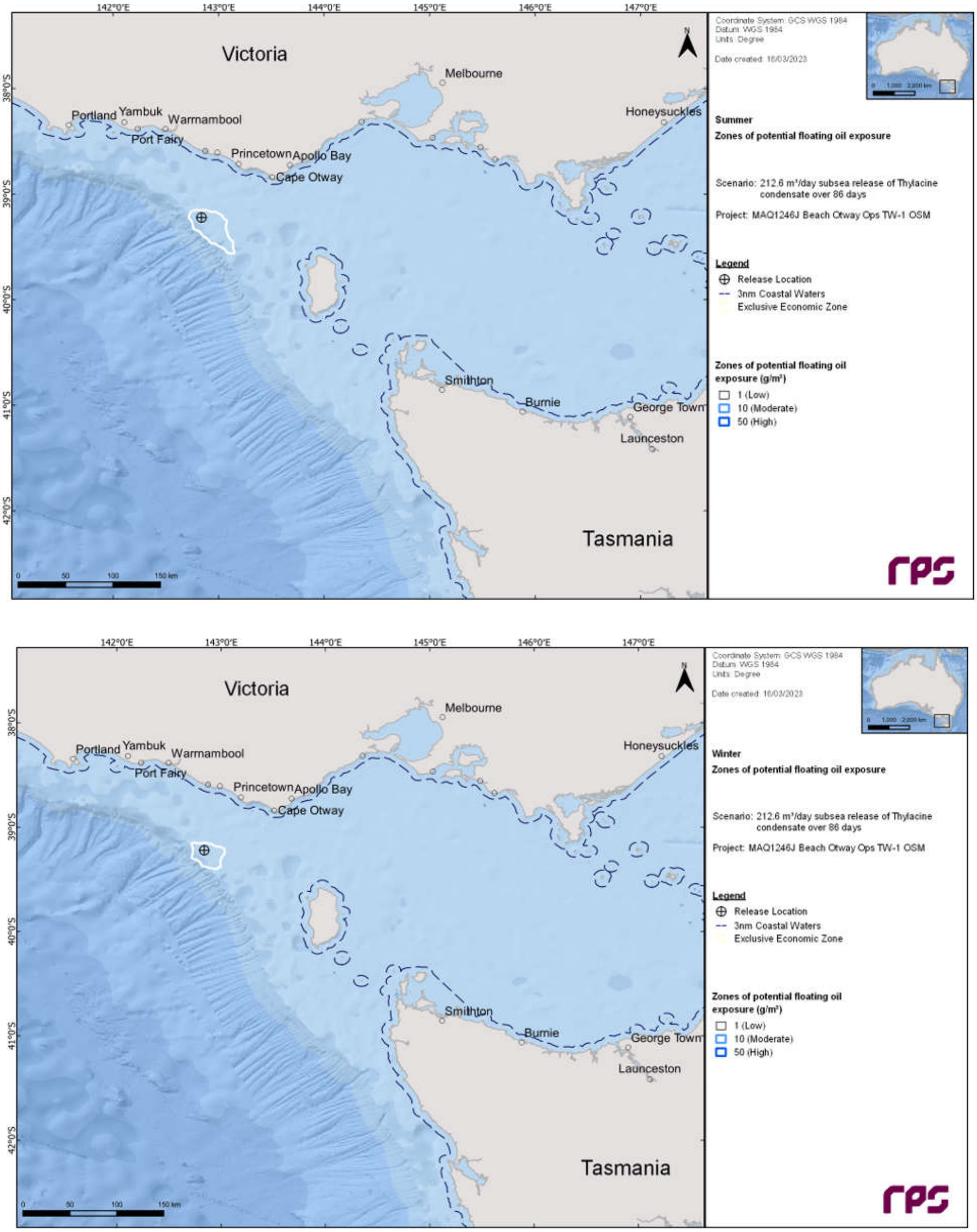


Figure 6-9: Zones of Potential Surface Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

6.14.6.2 Potential extent of hydrocarbon exposure to shorelines

The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 41% during summer conditions and 75% during winter conditions (Figure 6-10). The minimum time before oil accumulation at, or above, the low threshold was 13 days during summer conditions, and 6.54 days during winter conditions.

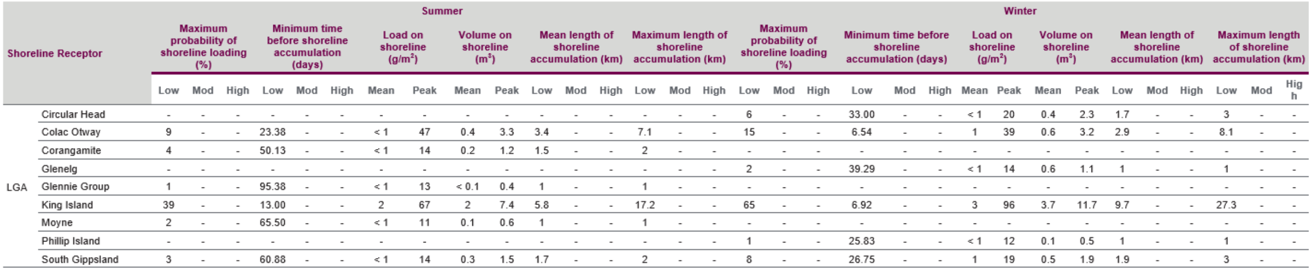
The maximum volume ashore for a single spill trajectory during the summer and winter conditions was 11.6 m^3 and 16.6 m^3, respectively, whilst the maximum length of shoreline accumulation at the low threshold was 18.9 km and 28.9 km, respectively.

No shoreline accumulation was predicted for the moderate (100 g/m^2) or high (1,000 g/m^2) threshold.

King Island recorded the highest probability of shoreline accumulation at the low threshold with 39% (summer) and 65% (winter) and the largest shoreline accumulation with 17.2 m^3 and 11.7 m^3, respectively.

The minimum time before shoreline accumulation above the low threshold was 13 days predicted for King Island during summer conditions and 6.54 days during the winter conditions predicted for Colac Otway West sub-Local Government Area (LGA) (which is part of Colac Otway West LGA) (Table 6-21). See Figure 4-53: Local Government Areas within the Planning AreaFigure 4-53 for LGA locations.

Table 6-21: Summary of Shoreline Oil Accumulation on Local Government Areas



Shoreline Receptor		Summer																Winter															
		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)			Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA	Circular Head	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	33.00	-	-	< 1	20	0.4	2.3	1.7	-	-	3	-	-
	Colac Otway	9	-	-	23.38	-	-	< 1	47	0.4	3.3	3.4	-	-	7.1	-	-	15	-	-	6.54	-	-	1	39	0.6	3.2	2.9	-	-	8.1	-	-
	Corangamite	4	-	-	50.13	-	-	< 1	14	0.2	1.2	1.5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	39.29	-	-	< 1	14	0.6	1.1	1	-	-	1	-	-
	Glennie Group	1	-	-	95.38	-	-	< 1	13	< 0.1	0.4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	King Island	39	-	-	13.00	-	-	2	67	2	7.4	5.8	-	-	17.2	-	-	65	-	-	6.92	-	-	3	96	3.7	11.7	9.7	-	-	27.3	-	-
	Moyne	2	-	-	65.50	-	-	< 1	11	0.1	0.6	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Phillip Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	25.83	-	-	< 1	12	0.1	0.5	1	-	-	1	-	-
	South Gippsland	3	-	-	60.88	-	-	< 1	14	0.3	1.5	1.7	-	-	2	-	-	8	-	-	26.75	-	-	1	19	0.5	1.9	1.9	-	-	3	-	-

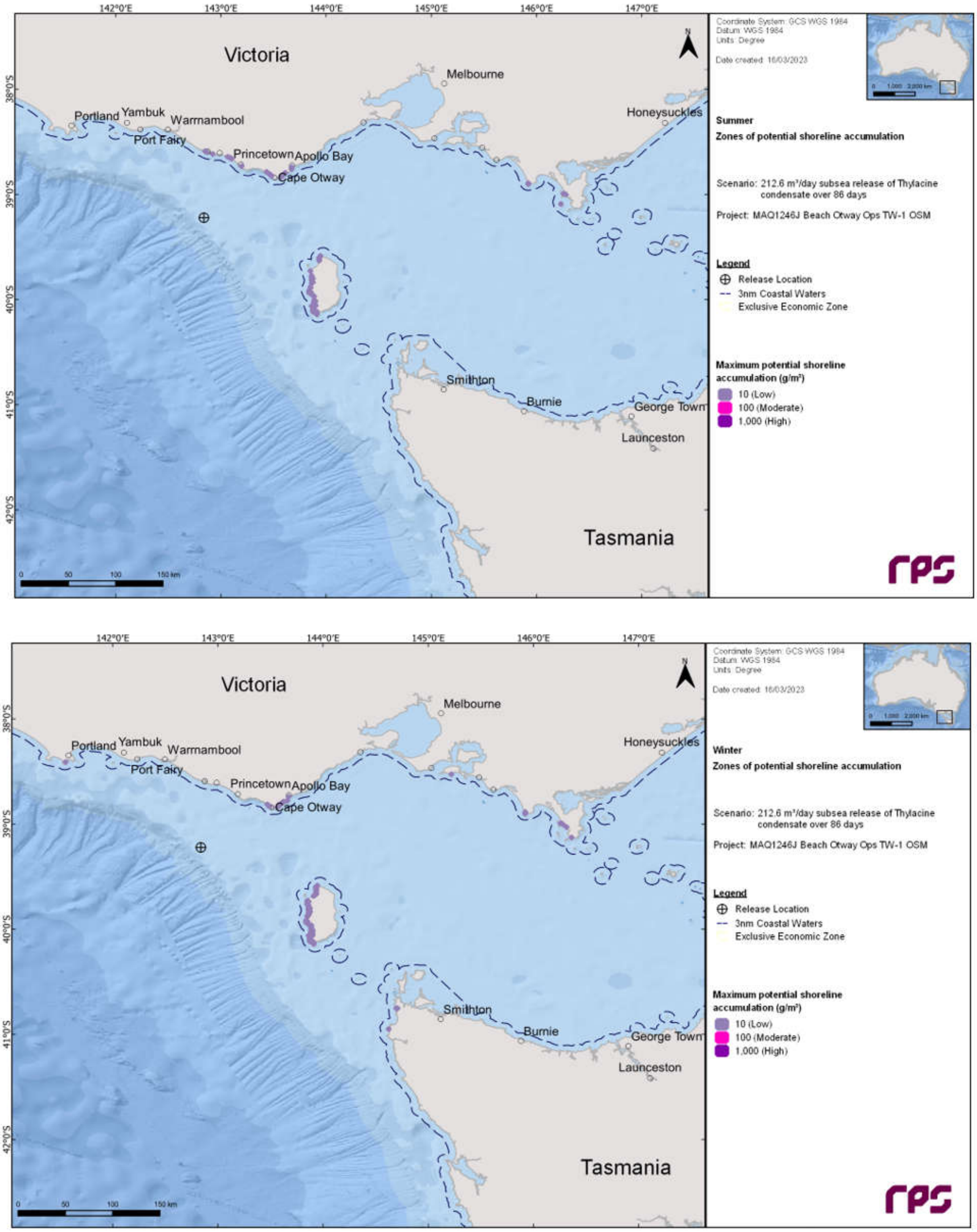


Figure 6-10: Zones of Potential Shoreline Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

6.14.6.3 Potential extent of in-water dissolved hydrocarbon exposure

At the depths of 0-10 m, during the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor was predicted to be 686.4 ppb and 664.658 ppb, respectively, which occurred within the release location (Figure 6-11).

Victorian waters were predicted to be exposed to dissolved hydrocarbons at the low threshold (5% summer and 10% winter) and at the moderate threshold for winter only (1%).

Tasmanian waters were predicted to be exposed to dissolved hydrocarbons at the low threshold (36% summer and 48% winter) and at the moderate threshold (2% summer and 3% winter).

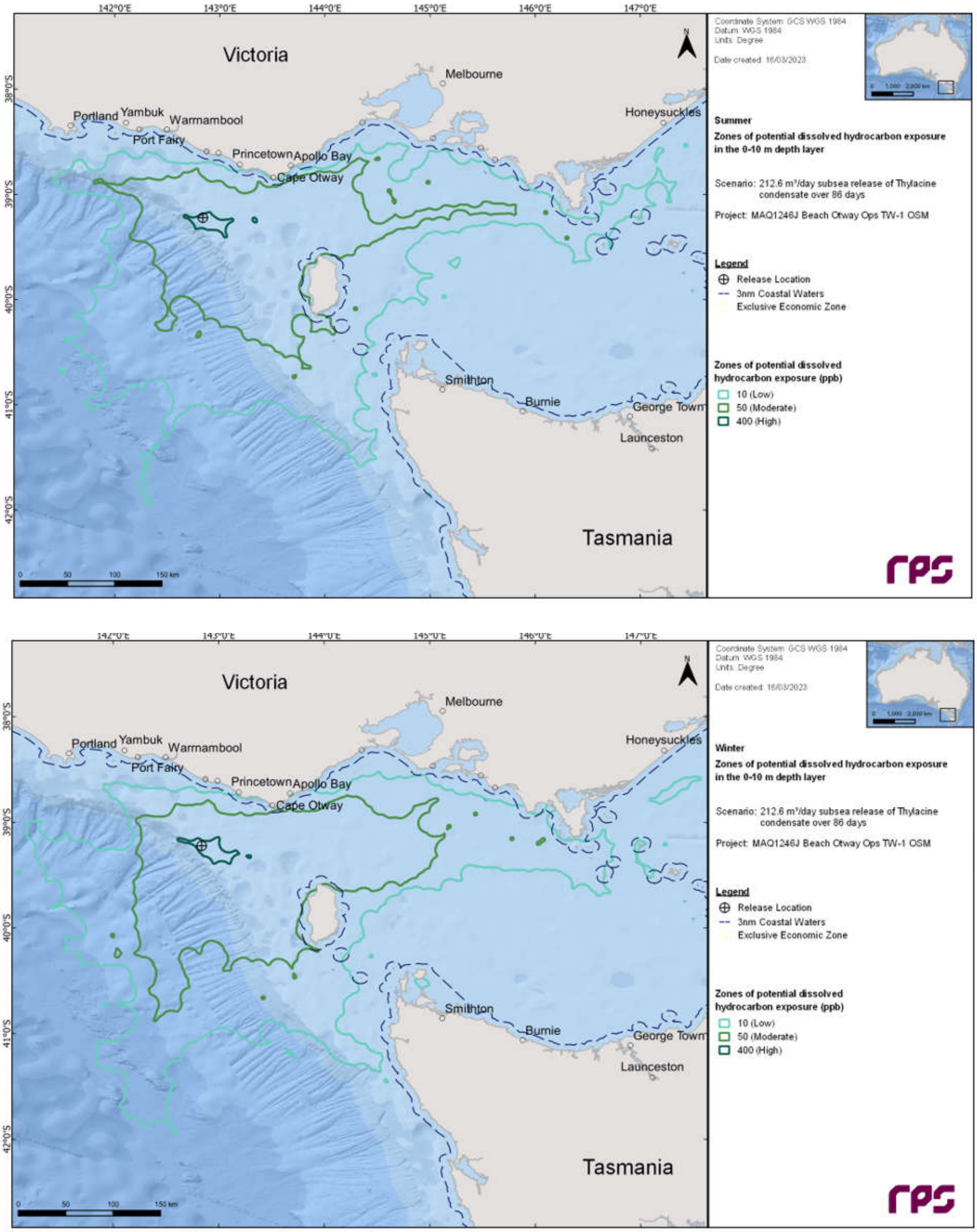


Figure 6-11: Zones of Potential Dissolved Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

6.14.6.4 Potential extent of in-water entrained hydrocarbon exposure

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure during summer and winter conditions was 927.6 ppb and 1,000.9 ppb, respectively, which occurred within the release location (Figure 6-12).

Victorian waters were predicted to be exposed to entrained hydrocarbons only at the low threshold (8% summer and 27% winter).

Tasmanian waters were predicted to be exposed to entrained hydrocarbons only at the low threshold (54% summer and 62% winter).

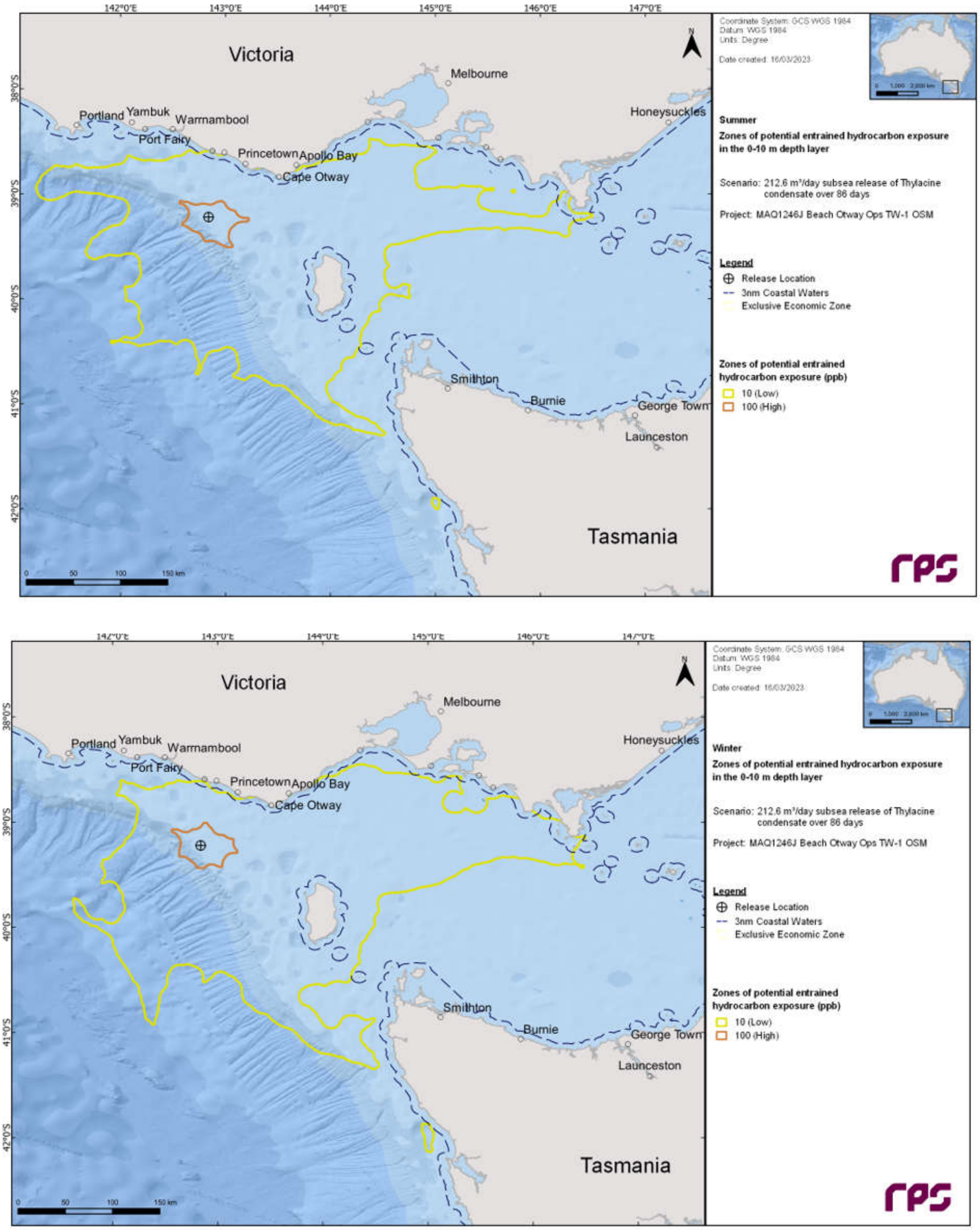


Figure 6-12: Zones of Potential Entrained Oil for 212.3 m^3/day Condensate Spill -Summer and Winter

Table 6-22: Consequence Evaluation to Receptors – Sea Surface

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Marine fauna	Seabirds	Injury / mortality to fauna Change in fauna behaviour	Several listed Threatened, Migratory and/or Listed Marine species have the potential to be rafting, resting, diving or feeding within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. Foraging BIAs for several albatross species, the wedge-tailed shearwater, common diving-petrel and short-tailed shearwater and wedge-tailed shearwater (Section 4.4.7.4) within the area predicted to be exposed to moderate thresholds of surface oil.	When first released, gas condensate has higher toxicity due to the presence of volatile components. Individual birds making contact close to the spill source at the time of the spill (i.e. areas of concentrations >10g /m^2 out to 0.4 km from the release location) may suffer impacts however it is unlikely that a large number of birds will be affected. Exposure at the high threshold (>25 g/m^2) were not predicted. Seabirds exposed to surface hydrocarbons at moderate exposure levels may experience acute or chronic toxicity impacts, however the area of contact is localised (0.4 km) and the presence of birds is expected to be limited to foraging individuals of a transitory nature, given the absence of offshore aggregation areas and the large foraging BIAs. Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Marine reptiles	Injury / mortality to fauna Change in fauna behaviour	There may be transiting marine turtles within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. However, there are no BIAs or habitat critical to the survival of the species (Section 4.4.7.5) within the area predicted to be exposed to moderate thresholds of surface oil.	Marine turtles are vulnerable to the effects of oil at all life stages. Marine turtles can be exposed to surface oil externally (i.e. swimming through oil slicks) or internally (i.e. swallowing the oil). Ingested oil can harm internal organs and digestive function. Oil on their bodies can cause skin irritation and affect breathing. The number of marine turtles that may be exposed to surface condensate is expected to be low as there are no BIAs or habitat critical to the survival of the species present and the localised (0.4 km from the release location) extent of exposure above the 10 g/m^2 threshold; however, turtles may be transient within the area. Therefore, potential impact would be limited to individuals, with population impacts not anticipated.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				Consequently, the potential consequence to marine turtles are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	The Australian and New Zealand fur-seals may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. No BIAs, breading colonies or haul outs areas (Section 4.4.7.7) within the area predicted to be exposed to moderate thresholds of surface oil.	Exposure to surface oil can result in skin and eye irritations and disruptions to thermal regulation. Fur seals are particularly vulnerable to hypothermia from oiling of their fur – however the characteristics of Thylacine condensate mean this is not likely. The number of pinnipeds exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value
	Cetaceans (whales)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine species have the potential to be foraging within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. The area of exposure overlaps a foraging BIA for pygmy blue whales and the known core range for southern right whale (Section 4.4.7.6).	Geraci (1988) found little evidence of cetacean mortality from hydrocarbon spills; however, some behaviour disturbance (including avoidance of the area) may occur. While this reduces the potential for physiological impacts from contact with hydrocarbons, active avoidance of an area may displace individuals or aggregations from important habitat, such as foraging. If whales are foraging at the time of the spill, a greater number of individuals may be present in the plume, however due to the small area of the surface exposure above the impact threshold (0.4 km from release location), this is not likely. Given this is a relatively small area of the total foraging BIA for pygmy blue whales and known core range for southern right whales, the risk of displacement to whales is considered low. Otway Offshore Operations could occur at any time of year. Therefore, there is potential for interaction with southern right whales given the activity window overlaps with the northern

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				migration period of May-June, the peak breeding (July-August) and southern migration period (September-November) (Section 4.4.7.6). The activity timing overlaps with the blue whale season for migration and foraging. Visual and acoustic surveys suggest that blue whales are present in the Otway region between November to June, peaking in February and March (Section 4.4.7.6). As such in the event of a spill potential hydrocarbon exposure could possibly affect blue or other foraging whale species. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Cetaceans (dolphins)	Injury / mortality to fauna Change in fauna behaviour	There may be dolphins within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter. However, it is not identified as critical habitat, and there are no spatially defined aggregations (Section 4.4.7.6) within the area predicted to be exposed to moderate thresholds of surface oil.	Dolphins surface to breathe air and may inhale hydrocarbon vapours or be directly exposed to dermal contact with surface hydrocarbons. Direct contact with oil can result in direct impacts to the animal, due to toxic effects if ingested, damage to lungs when inhaled at the surface, and damage to the skin and associated functions such as thermoregulation (AMSA 2010). Dolphins are highly mobile and are considered to have some ability to detect and avoid oil slicks. Direct surface hydrocarbon contact may pose little problem to dolphins due to their extraordinarily thick epidermal layer which is highly effective as a barrier to the toxic, penetrating substances found in hydrocarbons. The number of dolphins exposed is expected to be low, with population impacts not anticipated. Due to the rapid weathering of condensate, the potential exposure time is short. Consequently, the potential consequence to dolphins are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Socio-economic	Petroleum Exploration and Production	Displacement of other marine users	There are no oil and gas platforms, or activities within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	No impact predicted as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.
	Shipping	Displacement of other marine users	Shipping may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	Vessels may be present in the area where moderate levels of sea surface oil are predicted, however, due to small area of exposure (0.4 km) the area of deviation is small and within the existing PSZs, and no impact is predicted.
	Tourism and recreation (including recreational diving and recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 44.5 km in summer and 20.6 km in winter. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. However, the relatively short duration and distance from shore means there may be short-term and localised consequences, which are ranked as Moderate.
	Commercial fisheries	Displacement of other marine users	Commercial fishing may occur within 0.4 km of the release location predicted to be exposed to moderate levels of surface hydrocarbons during winter.	Commercial fishing vessels may be present in the area where moderate levels of sea surface oil are predicted, however, due to small area of exposure (0.4 km) the area of deviation is small and within the existing PSZs, and no impact is predicted.
First Nations	Sea Country	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts visible surface sheen at the low threshold up to 44.5 km in summer and 20.6 km in winter. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.	Visible surface hydrocarbons (i.e. a rainbow sheen) have the potential to reduce the visual amenity of the areas of Sea Country. However, the relatively short duration means there may be short-term and localised consequences, which are ranked as Moderate. Refer also to: ecological receptors above.

Table 6-23: Consequence Evaluation to Receptors – Shorelines

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	National Heritage Places	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Ocean Road and Scenic Environs and Western Tasmania Aboriginal Cultural Landscape (Section 4.2.3). The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach the Otway coast where the Great Ocean Road and Scenic Environs is 6.58 days and 33 days for the coast where the where the Western Tasmania Aboriginal Cultural Landscape is located. The relatively short are of shoreline affected and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	Nationally Important Wetlands	Change in aesthetic value Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Aire River/Lower Aire River, Princetown and Western Post Wetlands (Section 4.2.7). The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach the shoreline adjacent to the River/Lower Aire River and Princetown Wetlands is 6.54 days and it is likely to have dissipated during that time. Cape Otway is exposed to substantial wave action that would further breakdown any shoreline hydrocarbons. The Aire River/Lower Aire River Wetlands consist of three shallow freshwater lakes, brackish to saline marshes and an estuary on the Aire River floodplain. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The Princetown Wetlands and upstream of the Gellibrand River mouth at Princetown Beach. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the estuary and wetlands at low concentrations

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				which are not predicted to impact the aesthetic and ecological value of the wetlands. Shoreline exposure of 1% during winter is predicted for Phillip Island which is within the Western Port Wetland. Minimum time for shoreline accumulation is 25.83 days. Depending on where the shoreline contact occurs there is a potential for shoreline oil to move into the wetlands at low concentrations which are not predicted to impact the aesthetic and ecological value of the wetlands. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
	State Terrestrial Protected Area	Change in aesthetic value Change in ecosystem dynamics Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts potential shoreline exposure at the low threshold at Great Otway National Park, Phillip Island Nature Park, Port Campbell Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks, and the following on the west side of King Island; Cape Wickham Conservation Area, Cataraqui Point Conservation Area, Porky Beach Conservation Area, Seal Rocks State Reserve, Stokes Point Conservations Area and West Point State Reserve. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities within protected areas. The predicted minimum time for oil to reach a shoreline is 6.54 for the Victorian coast and it is likely to have dissipated during that time due to substantial wave action that would further breakdown any shoreline hydrocarbons. The predicted minimum time for oil to reach a King Island is 6.92 days it is likely to have dissipated during that time due to substantial wave action that would further breakdown any shoreline hydrocarbons. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony. However, impacts to fur -seals at the low threshold is not predicted to result impact to this species. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Threatened Ecological Communities Saltmarsh	Change in habitat Change in ecosystem dynamics	The modelling predicts potential shoreline exposure at the low threshold where saltmarsh communities and the Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community and Subtropical and Temperate Coastal Saltmarsh Threatened Ecological Communities may be present. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Saltmarshes are considered to have a high sensitivity to hydrocarbon exposure. Saltmarsh vegetation offers a large surface area for oil absorption and tends to trap oil. Evidence from case histories and experiments shows that the damage resulting from oiling, and recovery times of oiled marsh vegetation, are very variable. In areas of light to moderate oiling where oil is mainly on perennial vegetation with little penetration of sediment, the shoots of the plants may be killed but recovery can take place from the underground systems. Good recovery commonly occurs within one to two years (IPIECA, 1994). Consequently, the potential consequences to saltmarsh exposed to low threshold shoreline hydrocarbons is considered to be Moderate, as they could be expected to short-term and localised.
Threatened Species	Seabirds and shorebirds Pinnipeds	Injury / mortality to fauna Change in fauna behaviour	Impacts to birds and pinnipeds are not predicted as shoreline oil exposure is not predicted at the moderate threshold where impacts to fauna may occur.	NA

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Socio-economic	Coastal settlements Recreation and tourism (including recreational fisheries)	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold at the following local government areas (LGA) (see Figure 4-53 for LGA locations): • Circular Head • Colac Otway • Corangamite • Glennie Group • King Island • Moyne • Phillip Island • South Gippsland The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of the area for tourism and discourage recreational activities. The predicted minimum time for oil to reach a shoreline is 6.54 days (Colac Otway) up to 95 days (Glennie Group) and it is likely to have dissipated during that time due to substantial wave action that would breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Seaweed industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	The modelling predicts potential shoreline exposure at the low threshold in areas along the west side of King Island where bull kelp is collected.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – North America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. As bull kelp is collected from the shoreline there is a potential for some plants to be affected and not be suitable for collection and processing. However, given the low levels of shoreline oil predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title	Change in aesthetic value Changes to the functions, interests or activities of other users	Marine pollution can result in reduced visual aesthetic. The modelling predicts shoreline exposure at the low threshold within Victorian Traditional Owner areas of Eastern Maar Aboriginal Corporation (and Native Title claim) and Bunurong Land Council Aboriginal Corporation. The modelling predicts shoreline exposure at the low threshold on the western side of King Island and two locations within the north-west coast of Tasmania. The low threshold of 10 g/m^2 equates to ~2 teaspoons of hydrocarbon per square metre and would appear as a stain/film.	Visible shoreline hydrocarbons has the potential to reduce the visual amenity of Sea Country. The predicted minimum time for oil to reach a shoreline is 6.54 days for the Victorian coast, 6.92 days for King Island and 33 days for north-west Tasmania and it is likely to have dissipated during that time due to substantial wave action that would breakdown any shoreline hydrocarbons. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

Table 6-24: Consequence Evaluation to Receptors – In Water

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
Conservation Values and Sensitivities	Australian Marine Parks	Change in values Changes to the functions, interests or activities of other users	Apollo and Zeehan AMPs may be exposed to dissolved hydrocarbons at the moderate threshold and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Beagle AMP may be exposed to dissolved hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Franklin AMP may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The Apollo AMP is located in waters 80 m to 120 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Western Bass Strait Shelf Transition and the Bass Strait Shelf Province and associated with the seafloor features and the wreck of the MV City of Rayville are not predicted to be impacted. The conservation value of important migration area for blue, fin, sei and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -10 m of the water column for a substantial period to elicit a toxic effect. The Apollo AMP is an important foraging area for black-browed and shy albatross, Australasian gannet, short-tailed shearwater and crested tern. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in the hydrocarbon exposed area, thus there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The Zeehan AMP is located in waters 50 m to 3,000 m deep and thus conservation values such as ecosystems, habitats and communities associated with the Tasmania Province, the West Tasmania Transition and the Western Bass Strait Shelf Transition and associated with the seafloor features are not predicted to be impacted. The conservation value of important migration area for blue and humpback whales is unlikely to be impacted as these whales would be moving through the area and thus unlikely to be exposed to in water hydrocarbons within 0 -

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				10 m of the water column for a substantial period to elicit a toxic effect. The Zeehan AMP is also an important foraging habitat for black-browed, wandering and shy albatrosses, and great-winged and cape petrels. There is a low probability that seabirds would be feeding exclusively or predominantly on fish found in these areas of hydrocarbon exposure, thus there is low probability of seabirds themselves experiencing sub-lethal or toxic impacts as a result of consuming hydrocarbon-tainted fish. The Beagle AMP is located in waters 50 m to 70 m water depth and thus conservation values such as ecosystems, habitats and communities associated with the Southeast Shelf Transition and associated with the seafloor features, and shipwrecks are not predicted to be impacted. The Beagle AMP is also an important migration and resting areas for southern right whales and provides important foraging habitat for the Australian fur-seal, killer whale, great white shark, shy albatross, Australasian gannet, short-tailed shearwater, Pacific and silver gulls, crested tern, common diving petrel, fairy prion, black-faced cormorant and little penguin. These species are not precited to be impacted at the low thresholds for dissolved hydrocarbons. The Franklin AMP is located in waters 40 m to 150 m water depth and thus conservation values such as ecosystems, habitats and communities associated with the Tasmanian Shelf Province, Western Bass Strait Shelf Transition and associated with sea-floor features are not predicted to be impacted. The Franklin AMP is also an important foraging area for shy albatross, short-tailed shearwater, Australasian gannet,

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				fairy prion, little penguin, common diving petrel, black-faced cormorant, and silver gull. These species are not predicted to be impacted at the low thresholds for dissolved and entrained hydrocarbons. Consequently, the potential consequence to these AMPS are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	State Marine Protected Areas	Change in values Changes to the functions, interests or activities of other users	Shallow Inlet Marine and Coastal Park, Twelve Apostles Marine National Park and Wilsons Promontory Marine National Park may be exposed (1% probability) to dissolved hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Twelve Apostles Marine National Park (3% probability), Wilsons Promontory Marine National Park (7% probability) and Wilsons Promontory Marine Park (1% probability) may be exposed to entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	The establishment of the Shallow Inlet Marine and Coastal Park was primarily in recognition of its high value as habitat for migratory waders and other shorebirds. These species are not predicted to be impacted at the low thresholds for dissolved hydrocarbons. Impacts to Wilsons Promontory Marine National Park and Wilsons Promontory Marine Park values such as abundant and diverse marine flora and fauna, important breeding sites for a significant colony of Australian fur seals, important habitat for several threatened shorebird species, including species listed under international migratory bird agreements, outstanding landscapes, seascapes and spectacular underwater scenery, seascape, cultural places and objects of high traditional and cultural significance to Indigenous people, Indigenous cultural lore and interest maintained by the Gunai / Kurnai and Boonwurrung people and important maritime and other history, are not predicted to be impacted by low threshold level of entrained and dissolved hydrocarbons. As impacts are only predicted within 0 – 10 m of the water column Twelve Apostles Marine National Park values such as the wreck of the Loch Ard, underwater limestone formations of arches and canyons, diverse range of

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				encrusting invertebrates and dive sites are not predicted to be impacted. The unique limestone rock formations, including the Twelve Apostles, marine habitats representative of the Otway marine bioregion and indigenous culture based on spiritual connection to sea country and a history of marine resource use are unlikely to be impacted by dissolved or entrained hydrocarbons at the low threshold. Consequently, the potential consequence to these State Marine Protected Areas is considered to be Moderate, as they could be expected to result in localised minor short-term impacts to an area of recognised conservation value.
	Key Ecological Features	Change in ecosystem dynamics	The West Tasmania Canyons KEF may be exposed to dissolved hydrocarbons at the low and moderate threshold and entrained hydrocarbons at the low and high threshold within the upper 0 -10 m of the water column.	The West Tasmania Canyons KEF is in water depths > 70 m and thus impacts from in-water hydrocarbons are not predicted.
	Threatened Ecological Communities	Change in ecosystem dynamics	The following Threatened Ecological Communities may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column. Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community. Giant Kelp Marine Forests of South East Australia. Subtropical and Temperate Coastal Saltmarsh.	Entrained hydrocarbons at the low threshold are not predicted to impact on the ecological function of the Threatened Ecological Communities.
Benthic Habitat	Algae	Change in habitat	Video surveys confirmed the presence of high density macroalgae dominated epibenthos in waters shallower than 20 m, however, it is not a dominant habitat feature in eastern Victoria (Section 4.4.1.3).	Reported toxic responses to oils have included a variety of physiological changes to enzyme systems, photosynthesis, respiration, and nucleic acid synthesis (Lewis & Pryor 2013). A review of field studies conducted after spill events by Connell et al (1981) indicated a high degree of

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			Dissolved hydrocarbons in the upper 0 – 10 m of the water column at the moderate threshold that could impact algae, have a 3% probability for exposure to Tasmanian waters and 1% for Victorian waters where waters may be shallower than 10 m. Entrained hydrocarbons in the upper 0 – 10 m of the water column at the high threshold that could impact algae are not predicted in Tasmanian waters or Victorian waters where waters may be shallower than 10 m.	variability in the level of impact, but in all instances, the algae appeared to be able to recover rapidly from even very heavy oiling. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and only the predicted moderate threshold concentrations of dissolved hydrocarbons predicted in shallow waters, any impact to algae is not expected to result in long-term or irreversible damage. Consequently, the potential consequence to algae are considered to be Minor, as they could be expected to result in localised low-level impacts.
	Soft Coral	Change in habitat	Corals do not occur as a dominant habitat type within the planning area, however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway (Section 4.4.1.4) where low threshold concentrations of dissolved or entrained hydrocarbons are predicted.	Exposure of entrained hydrocarbons to shallow subtidal corals has the potential to result in lethal or sublethal toxic effects, resulting in acute impacts or death at moderate to high exposure thresholds (Shigenaka, 2001). Contact with corals may lead to reduced growth rates, tissue decomposition, and poor resistance and mortality of sections of reef (NOAA, 2010). However, given the lack of coral reef formations, and the sporadic cover of hard or soft corals in mixed nearshore reef communities along the Otway coast, such impacts are considered to be limited to isolated corals. Also only low exposure thresholds are predicted at known coral habitat sites. Consequently, the potential consequence to algae are considered to be Minor, as they could be expected to result in localised low-level impacts.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Seagrass	Change in habitat	In-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 – 10 m of the water column; therefore, benthic habitat within intertidal or shallow nearshore waters has the potential to be exposed. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the condensate. Seagrass may be present within the area predicted to be exposed to in-water hydrocarbons (e.g. seagrass is known to occur within Twelve Apostles Marine Park, and areas around Warrnambool) (Section 4.4.1.2). Exposure in nearshore and intertidal areas is predicted to only be at a low thresholds for dissolved and entrained hydrocarbons.	There is the potential that exposure could result in sub-lethal impacts, more so than lethal impacts, possibly because much of seagrasses' biomass is underground in their rhizomes (Zieman et al., 1984). Exposure also can take place via uptake of hydrocarbons through plant membranes and seeds may be affected by contact with oil contained within sediments (NRDA 2012). When seagrass leaves are exposed to petroleum oil, sub-lethal quantities of the soluble fraction can be incorporated into the tissue, causing a reduction in tolerance to other stress factors (Zieman et al. 1984). The toxic components of petroleum oils are thought to be the PAH, which are lipophilic and therefore able to pass through lipid membranes and tend to accumulate in the thylakoid membranes of chloroplasts (Ren et al. 1994). Susceptibility of seagrasses to hydrocarbon spills will depend largely on distribution, with deeper communities protected from oiling under all but the most extreme weather conditions. Shallow seagrasses are more likely to be affected by dispersed oil droplets. Given the restricted range of exposure (shallow nearshore and intertidal waters only) and the predicted low concentrations of hydrocarbons predicted in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage. Consequently, the potential consequence to seagrass are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to habitat of recognised conservation value.
Marine fauna	Plankton	Injury / mortality to fauna	Plankton are likely to be exposed to in-water hydrocarbons within the upper 0 – 10 m of the water column. Effects will be greatest in the area	Relatively low concentrations of hydrocarbon are toxic to both plankton including zooplankton and ichthyoplankton (fish eggs and larvae). Plankton risk exposure through ingestion, inhalation, and dermal contact. Impacts would

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			close to the spill source where hydrocarbon concentrations are likely to be highest.	predominantly result from exposure to dissolved fractions, as larval fish and plankton are pelagic, and are moved by seawater currents. Potential impacts would largely be restricted to planktonic communities, which would be expected to recover rapidly following a hydrocarbon spill. Plankton are numerous and widespread but do act as the basis for the marine food web, meaning that an oil spill in any one location is unlikely to have long-lasting impacts on plankton populations at a regional level Section 4.4.4). Once background water quality conditions have re-established, the plankton community may take weeks to months to recover (ITOPF, 2011a), allowing for seasonal influences on the assemblage characteristics. Additionally, with the elevated nutrient loading expected during seasonal upwelling events within the Otway region (November to April), plankton are likely to recover more rapidly than when upwelling of nutrient-rich waters is less prevalent. Consequently, given the limited area exposed by moderate levels of dissolved hydrocarbons, the potential consequence to plankton are considered to be Minor, as they could be expected to result in localised low-level short-term and recoverable impacts.
	Marine invertebrates	Injury / mortality to fauna	In-water invertebrates of value have been identified to include squid, crustaceans (rock lobster, crabs) and molluscs (scallops, abalone). Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not predicted as in-water exposure (dissolved or entrained) is only predicted to occur in the upper 0 – 10 m of the water column. Species located in shallow	Acute or chronic exposure through contact and/or ingestion can result in toxicological risks. However, the presence of an exoskeleton (e.g. crustaceans) reduces the impact of hydrocarbon absorption through the surface membrane. Invertebrates with no exoskeleton and larval forms may be more prone to impacts. Localised impacts to larval stages may occur which could impact on population recruitment that year.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			nearshore or intertidal waters may be exposed to in-water hydrocarbons low thresholds. Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to moderate levels of entrained in-water hydrocarbons.	Tainting of recreation or commercial species is considered unlikely to occur given exposure is limited to entrained hydrocarbons, however if it did it is expected to be localised and low level with recovery expected. Consequently, the potential consequence to invertebrates, including commercially fished invertebrates are considered to be Moderate, as they could be expected to result in localised short-term impacts to species of value.
	Fish	Injury / mortality to fauna	In-water exposure (dissolved or entrained) is only predicted to occur in the upper 0 – 10 m of the water column the surface layers of the water column. Several fish communities in these areas are demersal and therefore more prevalent towards the seabed, as such, exposure to these species is not expected to occur. Any fish or shark species within the surface layers of the water column, may come into contact with the area of predicted exposure for in-water hydrocarbons. The Australian grayling spends most of its life in fresh water, with parts of the larval or juvenile stages spent in coastal marine waters, therefore it is not expected to be present in offshore waters in large numbers. There is a known distribution and foraging BIA for the white shark in the planning area, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.	Pelagic free-swimming fish and sharks are unlikely to suffer long-term damage from oil spill exposure because dissolved/entrained hydrocarbons in water are not expected to be sufficient to cause harm (ITOPF, 2010). Subsurface hydrocarbons could potentially result in acute exposure to marine biota such as juvenile fish, larvae, and planktonic organisms, although impacts are not expected cause population-level impacts. Consequently, the potential consequence to fish, including those commercially fished, are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts to species of value. Impacts on eggs and larvae entrained in the upper water column are not expected to be significant given the temporary period of water quality impairment, and the limited geographical extent of the spill. As egg/larvae dispersal is extensive in the upper layers of the water column and it is expected that current induced drift will rapidly replace any oil affected populations. Impacts are assessed as temporary and localised, and therefore considered to be Moderate. Refer to management advice and evaluation of acceptability in Section 6.14.6.4.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
	Pinnipeds (seals and sea-lions)	Injury / mortality to fauna Change in fauna behaviour	Australian and New Zealand fur-seals may occur within the area of exposure (Section 4.4.7.7). There are no identified BIAs for seals or sea lions within the area of exposure. No known breeding colonies of Australian or New Zealand fur-seals are exposed to moderate dissolved or high entrained exposure thresholds. Given the mobility of pinnipeds, there may be small numbers of seals in the areas predicted to be temporarily exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 -10 m of the water column.	Exposure to moderate dissolved or high entrained exposure thresholds in the water column or consumption of prey affected by the oil may cause sub-lethal impacts to pinnipeds. Due to the temporary and localised nature of the spill, pinnipeds widespread nature, the low-level exposure zones and rapid loss of the volatile components of diesel in choppy and windy seas (such as that of the area exposed), the potential consequence to pinnipeds are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
	Cetaceans (whales and dolphins)	Injury / mortality to fauna Change in fauna behaviour	Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within the area predicted to be exposed to in-water hydrocarbons. BIAs for foraging for pygmy blue whales and the known core range for southern right whales are within the area predicted to be exposed to moderate dissolved or high entrained exposure thresholds in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper 0 -10 m of the water column.	Cetacean exposure to entrained hydrocarbons can result in physical coating as well as ingestion (Geraci and St Aubin, 1988). Such impacts are associated with 'fresh' hydrocarbon; the risk of impact declines rapidly as the MDO weathers. The potential for impacts to cetaceans and dolphins would be limited to a relatively short period following the release and would need to coincide with seasonal foraging or aggregation event to result in exposure to a large number of individuals, as may be the case during seasonal upwelling events within the Otway region. However, such exposure is not anticipated to result in long-term population viability effects. A proportion of the foraging or distributed population of whales could be affected in the relatively localised area and water depth of the total foraging BIA for pygmy blue whales and known core range for southern right whales.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
				Consequently, the potential consequence to cetaceans are considered to be Moderate, as they could be expected to result in localised minor short-term impacts to species of recognised conservation value.
Socio-economic	Commercial and recreational fisheries	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture. Actual or potential contamination of seafood can affect commercial and recreational fishing and can impact seafood markets long after any actual risk to seafood from a spill has subsided (NOAA, 2002) which can have economic impacts to the industry. Several commercial fisheries operate in the planning area and overlap the spatial extent of the water column hydrocarbon predictions (Section 4.5.9, Section 4.5.10 and Section 4.5.11).	Any acute impacts are expected to be limited to small numbers of juvenile fish, larvae, and planktonic organisms, which are not expected to affect population viability or recruitment. Impacts from entrained exposure are unlikely to manifest at a fish population viability level. Any exclusion zone established would be limited to the safety exclusion zone around the vicinity of the release point, and due to the rapid weathering of hydrocarbons would only be in place whilst well-control activities are enacted, therefore physical displacement to vessels is unlikely to be a significant impact. Consequently, the potential consequence to commercial and recreational fisheries are considered to be Moderate, as they could be expected to result in localised low-level short-term impacts.
	Recreation and tourism	Changes to the functions, interests or activities of other users Change in aesthetic value	Tourism and recreation are linked to the presence of marine fauna (e.g. whales), particular habitats and locations for recreational fishing. The area between Cape Otway and Port Campbell is frequented by tourists. It is a remote stretch of coastline dominated by cliffs with remote beaches subject to the high energy wave action. Access to the entire coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles. Recreation is also linked to the presence of marine fauna and direct impacts to marine fauna such as whales, birds, and pinnipeds can result in	Any impact to receptors that provide nature-based tourism features (e.g. whales) may cause a subsequent negative impact to recreation and tourism activities. Refer also to: • Fish • Birds • Pinnipeds • Cetaceans (whales and dolphins) • Marine invertebrates • Recreational fisheries

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
			indirect impacts to recreational values. It is important to note that the impact from a public perception perspective may be even more conservative. This may deter tourists and locals from undertaking recreational activities. If this occurs, the attraction is temporarily closed, economic losses to the business are likely to eventuate. The extent of these losses would be dependent on how long the attraction remains closed.	Any impact to receptors that provide nature-based tourism features (e.g. fish and cetaceans) may cause a subsequent negative impact to recreation and tourism activities. However, the relatively short duration, and distance from shore means there may be short-term and localised consequences, which are ranked as Moderate.
	Seaweed Industry	Change in ecosystem dynamics Changes to the functions, interests or activities of other users	In-water exposure to hydrocarbons may result in a reduction in commercially targeted seaweed species. Areas along the west side of King Island where bull kelp is collected may be exposed to dissolved and entrained hydrocarbons at the low threshold within the upper 0 -10 m of the water column.	Experiments verified the susceptibility of *Nereocystis luetkeana* (bull kelp – north America) tissue to the direct exposure to several petroleum types. Antrim et al (1995) showed that petroleum treatments resulted in visible tissue damage, with a distinct bleached line being the most visible indication of plant contact with the petroleum. Moderate to heavy colour loss, which was generally followed by rapid decay of tissue, was most pronounced in 24 h exposures to unweathered and weathered diesel. The study did not look at how this would affect the productivity of bull kelp. However, given the low levels of dissolved and entrained hydrocarbons predicted it is unlikely to be a significant impact on seaweed collection and associated income. The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.
First Nations	Sea Country Native Title Indigenous Protected Area	Change in aesthetic value Changes to the functions, interests	In-water exposure to hydrocarbons is predicted along the Victorian and Tasmanian coastal waters within the planning area which is Sea Country for a number of First Nations groups and is adjacent	Section 4.6 details the connection First Nations people have to Sea Country which could be potentially impacted by in-water exposure to hydrocarbons.

Receptor Group	Receptor Type	Impacts	Exposure Evaluation	Consequence Evaluation
		or activities of other users	to the Eastern Maar Native Title claim and Preminghana Indigenous Protected Area.	The relatively short duration and low volume means there may be short-term and localised consequences, which are ranked as Moderate.

6.14.7 Control Measures ALARP and Acceptability Assessment – Condensate Spill

Control, ALARP and acceptability assessment: Loss of Containment (condensate)	
ALARP decision context and justification	ALARP Decision Context: Type B Operations of wells, pipeline and subsea infrastructure have been ongoing within the Otway Offshore Development for over a decade with no major incident. Operations are highly regulated with associated control measures, well understood, and are implemented across the offshore industry. During stakeholder engagement, no concerns were raised regarding the acceptability of impacts from these LOC events. However, a LOC incident would likely attract public and media interest. Consequently, Beach believes that ALARP Decision Context B should be applied.
Adopted Control Measures	**Source of good practice control measures**
Preventative	
CM#14: Ongoing consultation	Under the *Navigation Act 2012*, the Australian Hydrographic Office (AHO) are responsible for maintaining and disseminating hydrographic and other nautical information and nautical publications such as Notices to Mariners. AMSA also issue radio-navigation warnings. Relevant details in relation to the operations will be provided to the AHO and AMSA and to relevant stakeholders as required. See Section 8.16 (Ongoing Stakeholder Consultation).
CM#15: Permanent Petroleum Safety Zone (PSZ)	PSZs, administrated by NOPSEMA under the OPGGS Act, are specified areas surrounding petroleum wells, structures or equipment which vessels or classes of vessel are prohibited from entering or being present in. Otway Pipeline System and Thylacine-A Wellhead Platform and subsea infrastructure PSZs are clearly marked on navigational charts
CM#2: Marking of Man-Made Offshore Structures	Lighting on the Thylacine-A Wellhead Platform meets Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures (IALA, Ed 2, 2013).
CM#36: NOPSEMA accepted WOMP	Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 set out the requirements for WOMPs. All production and suspended wells covered by this EP have a WOMP detailing • Identify the risks to well integrity. • Describe how the risks are controlled. • Describe the management system in place to ensure the controls are effectively and consistently applied. • Describe the design, construction, operations, management and monitoring of the wells showing how risks to well integrity is reduced to ALARP.
CM#31: NOPSEMA accepted Safety Case	Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations 2009 set out the requirements for safety cases. The Thylacine-A Platform and Otway Pipeline System Safety Cases demonstrate how the risks to the integrity of the platform, pipeline and subsea facilities will be reduced to as low as reasonably practicable (ALARP). The safety cases: • Identify the hazards and risks. • Describe how the hazards and risks are controlled.

	• Describe the management system in place to ensure the controls are effectively and consistently applied. • Describe the operation, monitoring, inspection and maintenance of the platform, pipeline and subsea facilities. • Describe the leak detection, and emergency shutdown and isolations systems to reduce the extent of loss of containment of hydrocarbons in the event of a loss of containment of the platform, pipeline or subsea facilities.
Response	
CM#36: NOPSEMA accepted WOMP	Part 5 of the Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011 set out the requirements for WOMPs. All production and suspended wells covered by this EP have a WOMP detailing • Identify the risks to well integrity. • Describe how the risks are controlled. • Describe the management system in place to ensure the controls are effectively and consistently applied. • Describe the design, construction, operations, management and monitoring of the wells showing how risks to well integrity is reduced to ALARP.
CM#37: Source Control Contingency Plan (SCCP) and Relief Well Plan (RWP)	Emergency response capability to implement timely source control in the case of a loss of well integrity is maintained in accordance with well-specific SCCP. Beach SCCPs are consistent with International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (January 2019). Specifically detailing: • The structure and function of the Beach Source Controls Incident Management Team (IMT). • A timeline for the effective implementation of source control key events / actions. • A well-specific worst-case discharge analysis. • Casing design. • Structural integrity analysis. • Gas plume study. Beach relief well plans are developed in accordance with Beach Energy WECS Standard 21 – Source Control Contingency Plan (INT-1000-DRL-STD-17891671) and the Oil & Gas UK Guidelines on Relief Well Planning for Offshore Wells (the OGUK guidelines). Relief well plan ensures that Beach has considered the response requirements in order to: • Reduce the time required to initiate relief well drilling operations in the event of a LOC. • Allow the relief well to be completed in the shortest time practicable. Relief well plans include a detailed schedule with estimated times to: • Source, mobilise and position a MODU. • Drill and intercept the well. • Complete the well kill successfully.

CM#38: NOPSEMA accepted OPEP	Under the OPGGS(E)R, NOPSEMA require that the petroleum activity have an accepted Oil Pollution Emergency Plan (OPEP) in place before the activity commences. In the event of a LOC, the OPEP will be implemented. The Offshore Victoria – Otway Basin OPEP was developed to support all Beach activities within the Otway Basin and includes response arrangements for a worst-case LOC scenario from a development well. The OPEP also includes Tactical Response Plans (TRPs) for identified protection priority areas within the region.
CM#39: NOPSEMA accepted OSMP	Under the OPGGS(E)R NOPSEMA require that the Implementation Strategy of the Environment Plan provides for monitoring of an oil pollution emergency. The Beach OSMP details: • Operational monitoring to inform response planning. • Scientific monitoring to inform the extent of impacts from hydrocarbon exposure and potential remediation requirements.

Additional controls assessed

Control	Control type	Cost/benefit analysis	Control implemented?
Preventative			
Do not undertake production activities	Elimination	Production of fields in the Otway Basin is required to maintain gas supply to the Otway Gas Plant.	No
Source control			
MODU on standby	Equipment	Any MODU on standby would require an in-force Safety Case to operate in Australian Commonwealth waters. The key benefit would be a reduction in the overall shoreline loading from weathered, residual fractions of the condensate. The predicted maximum length of shoreline potentially impacted by low thresholds of hydrocarbon is between 18.9-28.9 km, with the average predicted being between 6.5-9.4 km. There is no predicted shoreline exposure at moderate or high thresholds. Having a MODU on standby would potentially halve the time to implement source control, therefore, the overall potential reduction in exposure to shorelines by halve. Halving the potential loading at a low threshold would produce a marginal overall environment benefit given the nature of weathered condensate. Having a MODU on standby would result in significant additional costs (approx. $800k / day) to Beach that that are considered grossly disproportionate to the level of environmental benefit gained given the relatively small level of potential low threshold shoreline oiling.	No
Capping Stack System (CCS)	Equipment	Well CCS is designed to stem the hydrocarbon flow prior to permanent plugging of the well. As detailed in Table 6-25: Response option feasibility, effectiveness, ALARP identified risks and capability needs analysis, Beach undertook a feasibility review of CCS for the Otway wells. The feasibility analysis combined with a review of the Otway Basin metocean conditions has confirmed that due to the technical complexity of deploying a capping stack in shallow waters with a gas	No

		plume environment and harsh metocean conditions, a relief well is the preferred means of primary source control for the development wells.	
Dispersant application	Equipment	Chemical dispersants are generally ineffective for gas-condensate hydrocarbon releases. However, dispersants may be effective to reduce VOCs at surface to below lower explosive limits. Given the installation of a capping stack is not a feasible response option for the production or suspended wells, and a relief well would be offset to the release location, there is no potential benefit with applying subsea dispersants.	No

Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1) (7.2 x 10-^{5} per producing well based upon producing gas wells operated to North Sea Standard) ref IOGP Risk Assessment Data Directory Blowout Frequencies September 2019: https://www.iogp.org/bookstore/product/risk-assessment-data-directory-blowout-frequencies/
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of a loss of containment from a well or pipeline was assessed as low and the highest consequence assessed as serious as there is the potential to result in serious or irreversible environmental damage. However, this is assessed as acceptable based on: • There is little uncertainty associated with this aspect as the activities are well known, the cause pathways are well known, and activities are well regulated and managed. • The implementation of controls make it a remote likelihood that a LOC would occur resulting in a low residual risk. • The actual area of exposure for an individual spill event will be relatively small, with exposure shown to be transient and temporary due to the influence of waves, currents and weathering processes, thus no irreversible environmental damage is predicted. • It is not considered that there is significant scientific uncertainty associated with this risk. Therefore, the precautionary principle has not been applied.
Internal context	The proposed management of the risk is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the Implementation Strategy (Section 7).
External context	No objections or claims have been raised during stakeholder consultation regarding the potential for a LOC incident.
Other requirements	• Operations and integrity of wells, pipeline and subsea equipment is managed as per the requirements of the EP, safety cases and WOMPs required under the OPGGS(E)R and Offshore Petroleum and Greenhouse Gas Storage (Safety) Regulations and Offshore Petroleum and Greenhouse Gas Storage (Resource Management and Administration) Regulations 2011, respectively. • The South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013) identifies oil pollution associated with shipping, other vessels and offshore mining operations as a pressure or source of pressure on the conservation values of the South-east Marine Reserves Network. As detailed in Section 6.14.6 Apolla, Beagle, Franklin and Zeehan AMPs may be potentially exposed to hydrocarbons but impacts to AMP vlues are not predicted at the threshold levels of exposure. • The following Conservation Advices / Recovery Plans identify pollution as a key threat: ◦ Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution)

	◦ Conservation Advice for *Sterna nereis nereis* (Australian fairy tern) (DSEWPC, 2011c) ◦ National Recovery Plan for the Australian Painted Snipe (Commonwealth of Australia, 2022) identified as a deterioration of water quality ◦ Conservation Advice *Calidris ferruginea* (curlew sandpiper) (DoE, 2015f) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Numenius madagascariensis* (eastern curlew) (DoE, 2015e) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice for *Charadrius leschenaultia* (greater sand plover) (TSSC, 2016b) identified as Habitat degradation/ modification (oil pollution) ◦ Conservation Advice *Calidris canutus* (red knot) (TSSC 2016d) ◦ National Recovery Plan for Albatrosses and Petrels 2022 (CoA, 2022a). ◦ Wildlife Conservation Plan for Migratory Shorebirds – 2015 (DoE, 2015b) ◦ Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2020b) • These conservation advices and recovery plan identify the following conservation actions: ◦ Minimise chemical and terrestrial discharge. Controls have been identified and will be implemented to minimise the risk of minimise chemical discharges. ◦ Ensure spill risk strategies and response programs include management for turtles and their habitats, particularly in reference to 'slow to recover habitats', e.g. nesting habitat, seagrass meadows or coral reefs. No habitats for turtles are identified within the LOC planning area. OPEP and OSMP cover management of response to oiled turtles. ◦ Ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. OPEP and OSMP cover response strategies for management breeding sites vulnerable to oil spills. ◦ Implement measures to reduce adverse impacts of habitat degradation and/or modification. Controls have been identified and will be implemented to reduce adverse impacts of habitat degradation and/or modification.
Monitoring and reporting	Loss of containment resulting in a condensate spill is required to be reported as per Section 7.10. Impacts as a result of a loss of containment resulting in a condensate spill will be monitored and reported in accordance with the OSMP.
Acceptability outcome	**Acceptable**

6.15 Oil Spill Response

This section presents the risk assessment for oil spill response options as required by the OPGGS(E)R and OPGGS Regulations (Vic).

6.15.1 Response option selection

Not all response options and tactics are appropriate for every oil spill. Different oil types, spill locations, and volumes require different response options and tactics, or a combination of response options and tactics, to form an effective response strategy.

Table 6-25 provides an assessment of the available oil spill response options, their suitability to the potential spill scenarios and their recommended adoption for the potential spill scenarios.

6.15.2 Hazards

The following activities have been identified for responding to a spill event:

- Mobilisation, use and demobilisation of spill response personnel, plant and equipment.
- Handling, treatment and/or relocation of affected fauna (oiled wildlife response).

Response option feasibility, effectiveness, capability needs analysis and capability assessment is detailed in Table 6-25.

Table 6-25: Response option feasibility, effectiveness, ALARP identified risks and capability needs analysis

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
Monitor and Evaluate	Visual – aerial & vessel Satellite Predictive modelling	Gas condensate	Feasible. Effective – Gas condensate expected to spread to a thin layers on the sea surface within 1 km of the release location. Monitoring used to inform both response planning and monitoring requirements. Hydrocarbons likely visible on sea surface for duration of LOC event. Visual and satellite operational monitoring implemented during LOC event. Scientific monitoring implemented to inform extent of impact and remediation requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. All feasible monitoring techniques have been applied and monitoring personnel and equipment are readily available for deployment. No further benefit gained by having additional monitoring capability. OSMP details the vessels and personnel to implement the appropriate scientific studies.	Yes	Actionable on-water hydrocarbon thresholds limited to immediate vicinity of well site. Up to 8 km of coastline subject to moderate oiling. 1 x plane & observer required and/or 1 x vessel & observer and / or 5 x vessels and OSMP study teams Remote oil spill trajectory modelling (OSTM)	As detailed in OPEP: • fixed wing contract in place • aerial observers available via AMOSC • vessel contract in place • OSTM contract in place and available via AMOSC • environmental monitoring consultants accessible Implement response as per OPEP and under direction of the State Control Agency (if in State waters) Capability in place and sufficient to implement timely response.
	Visual – aerial and vessel	MDO	Effective - MDO rapidly spreads to thin layers on surface waters. Monitoring used to inform both response planning and monitoring requirements. Aerial surveillance is considered more effective than vessel to inform spill response and identify if oil has contacted shoreline or wildlife. Vessel surveillance limited in effectiveness in determining spread of oil. Scientific monitoring implemented to inform extent of impact and remediation requirements. Both vessel and aerial monitoring capability in place. Trained aerial observers available via AMOSC Core Group and available for deployment. Vessel and aircraft contracts in place. No further benefit gained by having additional monitoring capability.	Yes		
Source Control	Relief well	Gas condensate	Due to the remote location of the Otway Basin, available MODU are monitored on a monthly basis throughout operations thus ensuring the mobilisation of a MODU remains feasible within the assumed timeframe of approximately 35 days (the largest time component of the relief well kill). The ongoing assessment of MODU availability shall be conducted with reference to: • MODU with a valid Australian Safety Case. • MODU with the ability to conduct relief well kill operations. • MODU ability to operate in shallow water. • proximity to the Otway Basin. • ability to engage in a mutual aid agreement with the Operator. MODU broker reports shall be used to monitor the MODU market on a monthly basis and, if required, assist in sourcing and contracting a suitable MODU: • The MODU broker can be contracted to identify and contract a suitably specified MODU (including Australian Safety Case status) within 14 days. This allows sufficient time to engage with other operators as well as drilling contractors to confirm availability of MODUs with suitable technical specifications to meet the required engineering well design. • To facilitate timely response, Beach is a signatory to the APPEA Memorandum of Understanding: Mutual Assistance for transfer of MODUs between operators in the case of an Emergency. A MODU that is not currently operating, or in transit to the next operating well, will be preferential and result in a reduced period from the 14 days	Yes	MODU – with Australian Safety Case Casing, drill pipe and consumables identified 3 x Support vessels Well control personnel as detailed in SCCP	As detailed in OPEP, SCCP and relief well plan: • access to MODU via APPEA MoU • contracts with Well Control Specialists • relief well mobilisation strategy and schedule • Source Control IMT Implement response as per OPEP, SCCP and relief well plan Capability in place and sufficient to implement timely response

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			allowed for engaging and selecting suitable MODUs. The full 14 days will be required where there are no suitable MODUs not currently in operation and the selected MODU will be required to safely suspend well operations on its existing well prior to commencing of mobilisation to Beach's location. • A MODU mobilised from the NW Shelf or Singapore is likely to take 35 days. These periods have been factored into the relief well schedule within the well-specific relief well plans. • Rating of well control equipment: MODUs considered shall have equipment rated to at least 10,000 psi to perform the required well kill. • Pump capacity of MODU: Suitable to execute the dynamic well kill as per modelling. • Water depth: MODU being considered for relief well drilling must be rated for the minimum water depth of 70 m-100 m. Source control planning has identified all reasonable controls to implement relief well in a timely manner. Beach considers the potential environmental benefit gained by having a pre-positioned alternate MODU on location to be grossly disproportionate given the high financial and logistical support cost associated with having a MODU on standby. All reasonable pre-planning has been undertaken to facilitate the timely initiation of a relief well if required.			
	Capping stack system (CSS)	Gas condensate	To assess the feasibility of CSS deployment Beach engaged Trendsetter Engineering, as the OEM manufacturer of capping stacks, to review various capping stack options for the Otway Basin. The challenge with the Otway Basin is the shallow water (71 m – 101 m) were the production and suspended wells are located and the prevailing metocean conditions of the Otway Basin. The feasibility analyses are detailed in the following two studies: • Beach Energy Capping Stack Shallow Water Feasibility Assessment • GER-9002748_BE CS Non-Vertical Study The assessment focused on gaining a thorough understanding of the issues faced with shallow water deployment of a CSS in a shallow water, gas blowout well environment (such as a development well within the Otway Basin). Trendsetter reviewed available concepts promoted within industry and selected the two most viable deployment concepts for further evaluation with the various CSS. Two alternative offset installation (non-vertical access) methods were applied to four different CSS identified by Beach for potential use on a typical shallow water subsea blowout gas well. The two offset installation methods were: 1. Delmar offset installation method 2. Trendsetter offset installation method The methods are further summarised below. The feasibility analysis combined with a review of the Otway Basin metocean conditions has confirmed that due to the technical complexity of deploying a capping stack in shallow waters with a gas plume environment and harsh metocean conditions, a relief well is the preferred means of primary source control for the development and suspended wells. **Delmar Offset Installation Method** After the review of Delmar offset installation report of the capping stack, one major observation or assumption identified from Delmar's primary installation method was the requirement that the subsea blowout wellhead was left clear, with BOP stack removed previously or not installed at all, so that Delmar's subsea wellhead winches could be established for drawdown operations. For the Delmar method the subsea winch is the primary installation method, with the mudmat winch the secondary drawdown method. The positioning of the capping stack is solely dependent on the use of the drawdown winches.	N/A	N/A	N/A

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			The subsea hook up would need to be made with vessel support from outside the plume diameter, with adequate safety margin, estimated to be at least 335 m. Furthermore, with the Delmar method the vertical control is fully dependent on the positive buoyancy of the system, and successful deployment relies heavily on the precisely calculated buoyancy force of the chained buoys, with only minimum control or adjustable measures to compensate the required vertical lifting of the payloads. If the gas plume impact forecast to the buoys is not within the assumed design, then the buoyancy performance will be outside the calculated parameter range. The main disadvantages that impact the successful installation of the CSS using the Delmar method are thus summarised as: • dependent on success of BOP stack removal and installation of subsea winches. With a less heavy 7” 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8” 15,000 psi capping stack (OSRL and WWCI). • increased time for subsea installation of winches, mudmat installations. • gas plume impact on buoyancy modules needs to be well estimated given vertical control for deployment is dependent purely on the positive buoyancy of the system. • complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable. **Trendsetter Offset Installation Method** The Trendsetter method relies on a series of chained oceangoing barges to assist in lifting and deployment of the CSS and BOP adaptor spool. The barges are used to assist positioning and ensure the anchor handling vessel is maintained in a safe zone away from the gas plume. In addition, two subsea winches, may be deployed on clump weights on the seabed approximately 30 m from the wellhead and used for lowering and guidance of the capping stack over the damaged well. In general, the subsea drawdown system would be recommended with a less heavy 7” 15,000 psi capping stack (Boots and Coots) and also to assist with successful guidance of the CSS assembly. Unlike the Delmar method that uses buoyancy modules, these are not required for the Trendsetter method. Furthermore, the use of the drawdown capability is dependent on the wet weight of the stack and the up-thrust forces from the blowout well. The Trendsetter method does require additional vessels available, and also the successful deployment would be limited in the Otway Basin due to the weather and metocean conditions. The main disadvantages that impact the successful installation of the CSS using the Trendsetter method are thus summarised as: • Gas plume impact on oceangoing barges in exclusion zone above blowout well can impact success of the deployment. • Increased tie for subsea installation of winches, likely recommended to ensure successful guidance of the CSS assembly. With a less heavy 7” 15,000 psi capping stack (Boots and Coots) the subsea drawdown becomes even more critical to success compared to a 18-5/8” 15,000 psi capping stack (OSRL and WWCI). • Complexity of deployment with gas plume and the local metocean conditions makes deployment not operationally suitable. **Summary** Rough sea states (as per prevailing in the Otway Basin), including high waves and longer wave periods, can affect the safe operating limits of CSS deployment. The sea state can negatively impact the ability to safety deploy capping stack using a deck crane or A-frame located on the stern of the deployment vessel. Furthermore, if the vessel is experiencing too			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			much heave due to wave action, the CSS could unintentionally hit the subsea wellhead during deployment causing damage to the equipment itself and to the wellhead. High winds can affect both relief well drilling operations and support vessel operations. Support vessels have wind ratings for routine and critical operations, above which, operations may be suspended, and high wind speeds will tend to increase wave heights in open water conditions which can further limit operations. Thus, defined operating limits of acceptable sea states are required for successful deployment of the equipment in adverse sea state environments such as the Otway Basin. The feasibility analysis confirmed a sea state limit of 2 m significant wave height (Hs) and 15 knots (27.8 km/h) winds for defining these limits. The Otway Basin is a predominant moderate to high wave energy environment with wave heights in the summer months average between 2.5 and 3.0 m (8.20 and 9.84 ft), and maximum heights range between 5.6 and 7.7 m (18.4 and 23.0 ft). Wave conditions are more severe in winter, when mean heights range from 3.1 to 3.7 m (10.2 to 12.1 ft) and maximum heights are between 7.6 and 10.3 m (25.0 to 33.8 ft), but all seasons show a relatively high level of wave activity. Winds in the eastern Otway and western Bass Strait area also are generally strong, exceeding 13 knots (more than 23.4 km/h) for 50% of the time. The conditions are thus not operationally suitable for deployment of the CSS. Furthermore, the gas plume environment in shallow water conditions is manifestly different to a deeper water environment due to the exclusion zone above the wellhead preventing vertical installation of the equipment. The feasibility analysis has confirmed that due to the technical complexity of deploying a CSS in shallow waters with a gas plume environment and harsh metocean conditions the use of a capping stack is not operationally suitable for Beach wells within the Otway Basin. Additionally, given the use of a CSS is not operationally suitable for the development wells, the debris clearance tooling as part of the SFRT is not required.			
	Right stricken vessel Transfer MDO to secure tank	MDO	Effective – primary response strategy for all spills in accordance with vessel SMPEP/SOPEP. For MDO source control in Commonwealth waters, AMSA is the Control Agency and has access to NatPlan resources, therefore no further controls are considered. For MDO source control in Victorian state waters, Department of Transport and Planning (DTP) is the Control Agency. Upon establishment of incident control by DTP, Beach shall continue to provide planning and resources as required by the EMT Leader. Beach will make available to DTP an Emergency Management Liaison Officer (EMLO) who can mobilise to the incident control centre. In the event of a cross-jurisdictional response (i.e. where a response is required in State and Commonwealth waters), Beach and DTP will establish a Joint Strategic Coordination Committee (as per the DTP guidance) to facilitate effective co-ordination between DTP and AMSA.	Yes	Contract vessels	Vessel contract in place Capability available at request of AMSA as Control Agency
	Shut-down of production pipeline	Gas condensate	Effective – primary response strategy for all spills resulting from loss of containment from the Otway Pipeline System System pressures are monitored via the distributed control system (DCS) onshore, and the platform and pipeline can be shut down via the DCS or emergency shut down (ESD) can be implemented from the Central Control Room at the Otway Gas Plant.	Yes	None required – remote ESD	None required
Offshore Containment and Recovery	Booms and skimmers	Gas condensate	Not feasible. Actionable surface thickness of 10 g/m^2 is expected in the vicinity of the release location (<1 km) for both seasons and within a response exclusion zone in the event of a LOC scenario.	N/A	N/A	N/A
		MDO	Not feasible. MDO spreads rapidly to less than 10 g/m^2 and suitable thicknesses for recovery are only present for the first 36 hours for a large offshore spill, and there is insufficient mobilisation time to capture residues.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
			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.			
Protection and Deflection	Booms and skimmer	Gas condensate	Potentially feasible. Not effective. No actionable shoreline oil (>100 g/m^2) is predicted to occur on shorelines. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational NEBA	Response personnel Booms & skimmers Waste facilities	As detailed in OPEP: • Core responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. • Environmental monitoring providers accessible • Waste contracts in place Tactical Response Plans developed for: • Aire River • Princetown • Port Campbell Bay • Curdies Inlet Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response
		MDO	Potentially feasible. No actionable shoreline oil (>100 g/m^2) is predicted to occur on shorelines. MDO spreads rapidly to less than 10 μm and suitable thicknesses for recovery are only present for the first ~ 36 hours for a worst-case spill. If operational monitoring indicates river mouths and inlets are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing oil within these inland water ways.	Subject to operational NEBA	Response personnel Booms & skimmers Waste facilities	
Shoreline Clean-up	The active removal and/or treatment of oiled sand and debris	Gas condensate	Feasible. Unlikely to be effective in coastal environments of Cape Otway West. The maximum length of actionable shoreline oil is approximately 8 km with initial shoreline contact predicted to occur within 3 days of the release with a maximum loading of 33 m^3 predicted. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings. The nature of condensate means that it is difficult to collect from shorelines and can easily be mobilised into lower layers of sand or saltmarsh as may be case in Cape Otway West. Given Beach have access to both AMOSC equipment and Core Group personnel available for timely deployment as per Tactical Response Plans, no further controls have been identified.	Subject to operational Net Environmental Benefit Analysis (NEBA) – unlikely to present net benefit	Based up a clean-up rate of 1 m^3 per day per person, a single clean-up team (10 persons) could clean 10 m^3 / day. Based on a waste generation (bulking) factor of 10:1, waste clean-up and recovery could take up to 1 month for a team of 10 people. This assumes that all 33 m^3 of stranded hydrocarbon is both accessible and retrievable. In reality, the total retrievable volume (if any) would be smaller.	As detailed in OPEP: • Core Group responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. • Waste contracts in place Tactical Response Plans developed for: • Aire River • Princetown • Port Campbell Bay • Curdies Inlet Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response
		MDO	Feasible. May be effective at reducing shoreline loading where access to the shoreline is possible. If operational monitoring indicates shorelines are potentially exposed to actionable levels of hydrocarbons and accessible to response personnel and equipment, protection and deflection may be an effective technique for reducing shoreline loadings.			
Oiled Wildlife Response (OWR)	Capture, cleaning and rehabilitation of oiled wildlife.	Gas condensate	Feasible. Effective. At the conservative environmental impact threshold (10 g/m^2) the predicted exposure is limited to the vicinity of the release location (up to 15.3 km for diesel and 0.4 km for condensate). No exposure is predicted at the high threshold (>50 g/m^2) for condensate and up to 2.7 km for diesel. Unlikely to require shoreline oiled wildlife response given no predicted shoreline loading.	Yes	Personnel Equipment Triage and waste facilities	As detailed in OPEP: • Core Group responders and equipment available via AMOSC • NRT and NRST available via Control Agency request under NatPlan. DEECA are the State agency responsible for responding to wildlife affected by a marine pollution emergency in Victorian waters. DEECA's response to oiled wildlife is undertaken in accordance with the Victorian Wildlife Response Plan for Marine Pollution Emergencies.
		MDO	Feasible. Effective. Unlikely to require shoreline oiled wildlife response given no predicted shoreline loading. Potential that individual birds could become oiled in the offshore environment.			

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
						The Tasmanian Oiled Wildlife Response Plan (WildPlan) is administered by the Resource Management and Conservation Division of the DNRET. If an incident occurs in Commonwealth waters which affects wildlife, AMSA may request support from DEECA or DNRET to assess and lead a response if required. Both DEECA & DNRET have a number of first strike kits as well as access to AMOSC oiled wildlife equipment. Capability in place and sufficient to implement timely response
Chemical Dispersant Application	Application of chemical dispersants either surface or subsea	Gas condensate	Feasible. Not recommended for Group I oils such as condensate due to the very low viscosity and high volatility – generally no environmental benefit gained by the application of dispersant on Group I oils. Subsea dispersant injection (SSDI) may reduce volatile organic compounds (VOCs) at sea surface within the response area, therefore creating a safer work environment for responders. Given the use of a CSS is not operationally suitable for the production wells, the application of chemical dispersants to reduce surface VOCs is not required.	No	N/A	N/A
		MDO	Feasible. Although "conditional" for Group II oil, the size of potential spill volume and the natural tendency of spreading into very thin films is evidence that dispersant application will be an ineffective response. The dispersant droplets will penetrate through the thin oil layer and cause 'herding' of the oil which creates areas of clear water and should not be mistaken for successful dispersion (see ITOPF – Technical Information Paper No. 4: The Use of Chemical Dispersants to Treat Oil Spills). Dispersant use will have a net negative effect on the environment. Dispersants push the MDO into the water column, creating longer lasting impacts in the water column than allowing the MDO to weather naturally from the sea surface.	No	N/A	N/A

6.15.3 Relief Well Drilling

In the event of a loss of well containment, the Otway and Bass Relief Well Plan (RWP) (T-5100-35-MP-005) will be implemented. This involves mobilising a MODU to site and drilling a deviated well to kill the well in question. This process is described in the RWP.

A relief well is typically drilled as a straight hole down to a planned kick-off point, where it is turned toward the target well using directional drilling technology and tools to get within 30-60 m of the original well. The aim is to align the two wellbores at an incident angle of 3-5° for the eventual intersect rather than aiming directly at the blowout wellbore. The drilling assembly is then pulled and a magnetic proximity ranging tool is run on wireline to determine relative distance and bearing from the target well. Directional drilling continues to about half the distance to the planned intersection, and another magnetic ranging run is made to update relative distance and bearing. Once the target well is penetrated, dynamic kill commences by pumping mud and/or cement downhole to seal the original well bore.

6.15.3.1 Capability Assessment

Beach has put in place the following capabilities to implement a relief well drilling activity:

- The use of qualified and experienced offshore drilling engineers and drilling superintendents to implement source control including a relief well. The Beach Wells Team has competent well engineers that would project manage the relief well in conjunction with Wild Well Control and be guided by the Beach Well Engineering & Construction Management System Standard (WECS) workflow and technical standards.
- Access to a MODU through either:
    - The APPEA MoU.
    - A MODU broker (with monthly reports provided).
- Contracts with world-renowned well control contractors (Wild Well Control and Cudd Well Control) for the provision of specialist personnel and equipment.
- An EMT and Source Controls IMT (and associated plans) that is trained and undertakes regular drills and exercises to maintain a state of preparedness.
- A RWP that outlines a kill well design, MODU mobilisation times and technical considerations that has been prepared in line with international standards.

6.15.3.2 Known and potential environmental impacts

Known and potential environmental risks from mobilising and drilling of a relief well include:

- Localised and temporary impacts to marine users and fishing due to physical presence of the MODU (similar to those described and assessed in Section 6.6).
- Localised and temporary disturbance to marine fauna due to increased light, atmospheric and noise emissions (similar to those described and assessed in Sections 6.2, 6.3, 6.5).

- Localised and temporary impacts to water quality due to increased nutrient and turbidity levels from discharge of putrescible wastes, sewage and grey water, cooling and brine water and bilge water/deck drainage (similar to those described and assessed in Sections 6.8);
- Localised and temporary impacts to water quality and the benthic environment due to the discharge of drill muds, cuttings and cement.
- Localised and temporary disturbance to the benthic environment due to MODU anchoring.
- Impacts associated with the introduction of IMS (Section 6.10).

6.15.3.3 Consequence Evaluation

Physical presence

The physical placement of a MODU will result in physical disturbance of the sea floor. This impact would result in localised physical disturbance to benthic habitats. Surveys of previous seabed disturbances from drilling activities of the Victorian coast Basin indicate that recovery of benthic fauna in soft sediment substrates occurs within 6 to 12 months of cessation of drilling (Currie, 2004).

A safety exclusion zone would be required around the MODU, which has potential to impact fisheries and shipping activities. Such impacts are not likely to be any greater than those discussed for the Thylacine-A Wellhead Platform which are assessed as Minor (1). No significant additional impacts on fishing or maritime activities are expected to result from relief well drilling activities.

Routine emissions - light, air and noise

Lights are required for safe operation and navigational safety of a MODU, with visibility considered one of the key controls in place to prevent collisions with third-party vessels. The impacts of lighting will be similar to those from the platform and vessels, which are addressed in Section 6.2 and determined to have a Minor (1) impact.

Air emissions associated with drilling relate to the combustion of MDO on the MODU and in support vessels. As with the impacts assessed in Section 6.3, these are considered to have a Minor (1) environmental impact.

The noise emitted from a MODU consists of a combination of down-hole drill pipe operations including conductor driving and onboard machinery. This typically produces a low intensity but continuous sound for the duration of the drilling activity. The primary concern arising from noise generation from drilling is the potential effect on marine fauna. Impacts on marine fauna from noise from vessels and operations is addressed in Section 6.5 of this EP. The noise generated from a MODU is unlikely to result in significant physiological or behavioural impacts when considered individually or cumulatively with existing noise sources. It is expected that any impacts on marine fauna will be limited to behavioural changes of individuals close to the location and will not result in effects at a species population or ecosystem level. The impacts of sound from the MODU are similar to those of vessels and as outlined in Section 0, these impacts are considered Minor (1).

Routine discharges – putrescible waste, sewage and grey water, cooling and brine water, bilge water/deck drainage

Routine discharges from a MODU are very similar to those as described for vessels and assessed in Sections 6.8.of this EP.

The key difference is that a MODU contains more POB (typically about 100 people), so there is an increased volume of putrescible and sewage and grey water discharges (though for a short time only). As with the routine discharges of waste from vessels, the impacts of such discharges from a MODU are considered Minor (1).

Introduction of IMS

The introduction of IMS from vessels is addressed in Section 6.10 of this EP. The same issues apply to the operation of a MODU and support vessels due to ballast water discharges and hull fouling. The MODU and support vessels will be required to have relevant biosecurity certifications and be in possession of a ballast water discharge log. This risk is likely to be low to medium.

Discharge of drilling muds and cuttings

Drilling fluids are used to transport drilling cuttings to the surface, prevent well control issues, preserve wellbore stability, and cool and lubricate the drill bit and drill string during drilling. Drill cuttings are rock, gravel and sand removed from the well during the drilling process. The characteristics of the cuttings to be discharged can be predicted from the lithology of other wells drilled in the region and are anticipated to be dominated by calcarenite, shale and sandstone. The cuttings are expected to range in size from fine to course, with a mean size no larger than one centimetre.

The most appropriate drilling fluid for the conditions will be used for relief well drilling. It is likely that water-based muds (WBM) would be used, and the assessment of impacts provided below assumes this. Use of synthetic based muds (SBM), although unlikely, cannot be entirely discounted as it is not possible to define specific drilling requirements for all scenarios where relief well drilling may be required. All drilling products selected will have the lowest environmental risk ranking practicable based on CHARM and OCNS. It is likely that bulk discharge of muds would occur at the conclusion of a relief well drilling campaign, as per normal offshore drilling practice.

The known impacts arising from the discharge of WBM drilling fluids and cuttings are:

- Increased turbidity in the water column.
- Burial of benthic organisms.
- Alteration of the benthic substrate.

There is a substantial amount of literature demonstrating that impacts from the discharged cuttings and muds are generally very localised (100 to 250m from the well), short-lived (less than 24 months), and concentrations of metals or hydrocarbons are generally not detectable beyond 1,000 m (Hinwood et al., 1994).

Potential impacts to water quality and benthic organisms are discussed in the following sections. Note that the volume of muds used will be minimised by use of solids control equipment to ensure maximum retention of fluids within the active mud system.

Water quality and turbidity

Disposal of cuttings with adhered fluid and bulk mud discharges during drilling operations will create plumes of increased turbidity below the point of discharge. Within this plume the larger particles (90-95%) quickly settle on the seabed, usually within a radius of 100-200 m from the MODU. Such particle behaviour has been demonstrated by Terrens et al (1998) at the Fortescue platform in eastern Bass Strait drilling locations.

The dilution of cuttings and drilling fluid plumes is rapid. Data compiled by the US Environmental Protection Agency (US EPA) from numerous studies on the growth and dilution of drilling mud discharge plumes found that the mud had been diluted by approximately one million times by the time it reached a distance of 1 km from the discharge point (USEPA 1985). Nonetheless, drilling cuttings and muds in suspension have the potential to impact components of the marine ecosystem entrained in a discharge plume. Such exposure will in most cases be short term, episodic or pulse-wise depending on plume behaviour.

Some studies have demonstrated minor adverse impacts from turbidity induced by WBM discharges on hard bottom fauna abundance (Hyland et al., 1994), scallops (Cranford et al., 1999) and the blue mussel (Bechmann et al., 2006). These studies indicate that the effect mechanism of cuttings and drilling fluid plumes is mainly physical stress, although chemical toxicity cannot unequivocally be ruled out. The levels of suspended WBM and cuttings causing effects have been above 0.5 mg/L. Such levels are typically restricted to a radius of less than 1-2 km in the water masses (Neff, 1987).

During drilling of a relief there will be an increase in turbidity the immediate area of drilling activity as a result of discharges of cuttings and muds. However, this will be a temporary effect. Tidal currents are substantial, and the interaction of surface and oceanic currents facilitates the dispersion and dilution of cuttings and muds discharged from the MODU, aiding in minimising water column turbidity.

Any reductions in primary productivity (i.e., plankton growth) in the water column as a result of discharges of cuttings and muds will be very localised in the context of the surrounding marine environment. The water depth at the Thylacine and Geographe fields is beyond the photic zone (depth of ocean that receives sufficient sunlight for photosynthesis to occur). Any shading effect of the discharge plume, therefore, will be very low.

In summary, environmental impacts of a turbid plume of cuttings and muds in the highly localised area around the MODU are expected to be Minor (1).

Burial of benthic organisms

Most offshore field studies have shown a minor impact of WBM discharges on benthic fauna except immediately adjacent to platforms where cuttings piles form and persist. Some changes in the local infaunal community structure will occur due to burial and the altered sediment character. The increased bottom micro relief afforded by the accumulation of cuttings may also attract fish and other motile animals and alter the character of epibenthic infaunal communities. Bakke et al (1986) found that fauna recolonisation on sediments capped with 10 mm of WBM cuttings differed little in overall diversity from that on natural sediment after 1 year, but the species composition was clearly different, which was thought to be due to the WBM cuttings being classified as ‘very fine sand’ as opposed to the natural sediment being ‘medium sand’.

Monitoring in the North Sea has not revealed any in situ effects of WBM cuttings on sediment macrofauna community structure, implying that any such effects, if present, will be confined to the innermost stations in these studies (i.e., nearer than 25-250 m from the discharge point) (various studies cited in Bakke et al., 2013).

Environmental studies undertaken at the Fortescue platform in 70 m depth in western Bass Strait showed that effects to benthic communities from discharge of cuttings and water-based fluids were generally localised and short-lived, with most benthic organisms recovering within four months (Currie et al., 2004). This study showed no detectable trace element indicators when water-based fluids alone were used.

For Apache's East Spar Development in Commonwealth Waters, the area of impact from WBM discharges was not more than 100 m from the drill site and short lived with recovery in less than 18 months (SKM, 1996; Kinhill, 1998). Other studies of the effects of WBM cuttings on sediment fauna also suggest that the impact is normally restricted to within 100-250 m and recovery is rapid (various studies cited in Bakke et al., 2013). There is therefore strong evidence to conclude that sedimentation of WBM cuttings onto the seafloor has only local and short-term effects on the sediment fauna.

In summary, impacts to benthic organisms from the discharge of muds and cuttings from drilling of a relief well are expected to be highly localised and short-term. As the seabed sediments in the Otway Basin are generally uniform and widespread, any consequences at the ecosystem level due to impacts in the highly localised area of the drilling location are expected to be Minor (1).

Discharge of cement

Cementing of a relief well is required to provide effective isolation of the well, and to abandon the well afterwards. Most cement is pumped downhole, however, a small amount of overfill and cement-contaminated mud is likely to occur during the grouting of the uppermost surface casings. No technology currently exists to prevent cement from the uppermost casing wellbores being fully cemented to surface without cement releasing onto the sea floor.

Cement discharges may result in localised, temporary increases in pH at the discharge site. Discharges on the seabed may result in smothering of benthic organisms and areas where cement is overlying sediments will not be suitable for recolonisation by benthic species. Chemicals in the cement mix may result in localised reductions in water quality at the time of the discharge.

The cement chemicals selected for any relief well drilling will be selected in accordance with the chemical selection process (described in Section 7.11.2 of this EP) in order to minimise the impact on the environment of the cement prior to setting as an inert aggregate.

6.15.4 Other Oil Spill Response activities

6.15.4.1 Known and potential environmental impacts

Impacts and risks associated with monitoring and evaluation, source control and protection and deflection response strategies (in responding to a hydrocarbon spill) are similar to those discussed for vessel and ROV operations in Section 6. This section covers detailed impact and risk evaluations for source control, oiled wildlife response, shoreline protection and clean-up and the application of chemical dispersants.

Oiled wildlife response

Untrained resources capturing and handling native fauna may cause distress, injury and death of the fauna. AMSA as the Control Agency for a vessel spill in Commonwealth waters will managed any OWR and Beach will only undertake OWR if directed by AMSA. Potential impacts are:

- injury/Mortality of fauna
- change in fauna behaviour

Shoreline protection and clean up

Sensitive/protected shoreline habitats may be degraded, or marine fauna and flora and other users of the land may be disturbed due to movement of human responders and removal of oiled material on shorelines. Potential impacts are:

- change in fauna behaviour
- injury/Mortality of fauna
- change in habitat
- changes to the functions, interests or activities of other users

6.15.4.2Consequence evaluation

This section assesses the impacts and risks specific to OWR and shoreline clean spill response strategies.

Oiled wildlife response

OWR includes pre-emptive techniques such as hazing, capturing and relocating of un-oiled fauna as well as post-oiling techniques such cleaning and rehabilitation. Deliberate disturbance of wildlife from known areas of ecological significance (e.g. resting, feeding, breeding or nesting areas) to limit contact of individuals with hydrocarbons may result in inhibiting these species from accessing preferred habitats or food sources. This approach may also result in additional disturbance/handling stress to the affected species with little benefit as many species tend to display site fidelity and return to the location from which they have been moved.

The incorrect handling of oiled fauna has also the potential to result in increased stress levels which has may result in increased fauna mortality. Although fauna interactions from oiled wildlife response and shoreline clean-up techniques are expected to be limited to the duration of the response, there is the potential that these effects may result in longer term impacts to local populations where a large proportion of the local population may be exposed to oil and subsequently oiled wildlife response.

Oiled wildlife preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Oiled wildlife surveillance and wildlife impact studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).

Shoreline protection and clean up

Damage or removal of habitat (such as sand from beaches) from shoreline protection and clean-up techniques may expose shorelines to erosion processes or decrease in fauna and flora. Damage to intertidal shoreline habitats and communities may have indirect effects on ecosystem dynamics through impacts on food chains of the macrofauna communities which they support.

Shorelines are not predicted to be exposure to hydrocarbons at thresholds that are conducive to clean-up thus if shoreline clean-up was undertaken it is unlikely to affect significant stretches of coastline, with prolonged effects on local communities or tourism sites.

If shoreline clean-up is undertaken the movement of spill response personnel, vehicles and equipment through coastal areas has the potential to disturb or damage artefacts or sites of cultural heritage significance. Adverse effects are expected to be localised to the area of disturbance. For known recognised sites, relocation of artefacts or implementation of exclusion zones may be considered as part of the operational NEBA.

Shoreline protection and clean-up preparedness and response shall be undertaken in accordance with the relevant EPOs and EPSs detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).

Hydrocarbon on shorelines and shoreline sediment impacts studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).

6.15.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: oil spill response			
ALARP decision context and justification	ALARP Decision Context: B The purpose of implementing spill response activities is to reduce the severity of impacts from an oil spill to the environment. However, if the strategies do more harm than good (i.e. they are not having a net environmental benefit) then the spill response is not ALARP.		
Control measures	**Source of good practice control measures**		
All spill response control measures and associated Environmental Performance Outcomes (EPOs) and Environmental Performance Standards (EPSs) are detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (CDN/ID S4100AH717907).			
All relevant operational and scientific monitoring studies are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (CDN/ID S4100AH717908).			
Additional controls assessed			
Control	**Control type**	**Cost/benefit analysis**	**Control implemented?**
Monitor and evaluate: AUVs	Engineering Risk Assessment	This control measure is not expected to provide significant environmental benefit as the development wells are in close proximity to shore (54 km – 70 km), and mobilisation of in-field	No

		monitoring, or aerial surveillance may be implemented rapidly via existing contracts.	
Monitor and evaluate: Night-time monitoring – infrared	Engineering Risk Assessment	Side looking airborne radar, systems are required to be installed on specific aircraft or vessels. The costs of sourcing such vessels/aircraft is approximately $20,000 per day. Infrared may be used to provide aerial monitoring at night-time, however the benefit is minimal given trajectory monitoring (and infield monitoring during daylight hours) will give good operational awareness. In addition to this, satellite imagery may be used at night to provide additional operational awareness.	No
OWR: Pre-positioning of oiled wildlife response resources.	Precautionary approach	Oiled wildlife response equipment containers for first strike activities are positioned in Geelong. Positioning the equipment any closer to the potential spill area is not considered to provide a considerable environmental benefit considering that any visible shoreline contact is not predicted until day 6 of the spill, therefore there is adequate time to deploy equipment positioned in Geelong. Additionally, spill modelling indicates potential (hypothetical) areas of exposure to hydrocarbons, post-spill operational monitoring would be required to predict actual or likely exposure locations, therefore determining an area to pre-position equipment may be inaccurate pre-spill.	No
Shoreline protection and clean up: Tactical Response Plans	Precautionary approach	Identified areas for priority protection have pre-populated tactical response plans to reduce response planning timeframes in the event of potential shoreline exposure. Refer to OPEP for TRPs. CM#38: NOPSEMA accepted Oil Pollution Emergency Plan (OPEP)	Yes
Chemical Dispersant: Pre-positioning of dispersant and application equipment.	Precautionary approach	No clear benefit identified as stockpiles of dispersant already available in Melbourne and elsewhere in Australia. Application equipment and dispersant can be readily mobilised to site, with no identified restriction on logistics pathways or response timing.	No
Consequence rating	Moderate (2)		

Residual impact category	Low
Acceptability assessment	
To meet the principles of ESD	The activities were evaluated as having the potential to result in a Moderate (2) consequence thus is not considered as having the potential to result in serious or irreversible environmental damage. Consequently, no further evaluation against the principles of ESD is required. While some response strategies may pose additional risk to sensitive receptors, to not implement response activities may potentially result in greater negative impact to the receiving environment and a longer recovery period. Response activities will be undertaken in accordance with controls which reduce and/or prevent additional risks. The mutual interests of responding and protecting sensitive receptors from further impact due to response activities will be managed using a NEBA during response strategy planning in preparedness arrangements, as well as during a response. Proposed response activities are consistent with industry practice. No impact to KEFS, RAMSAR Wetlands, BIAs or state marine protected areas are expected during spill response.
Internal context	The proposed management of the impact is aligned with the Beach Environment Policy. Activities will be undertaken in accordance with the SCCP including relief well plan, OPEP, Tactical Response Plans and OSMP.
External context	No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons. During any spill response, a close working relationship with key regulatory bodies (Control Agencies) will occur and thus there will be ongoing consultation with relevant persons during response operations.
Other requirements	Response has been developed in accordance with: • OPGGS Act. • AMSA Technical Guideline for the Preparation of Marine Pollution Contingency Plans for Marine and Coastal Facilities (AMSA, 2015); and NOPSEMA (2017). • South-east Commonwealth Marine Reserves Network Management Plan 2013-23 (Director of National Parks, 2013). In regard to oil spill response, activities associated with Otway Offshore Operations will not be conducted in a manner inconsistent with the objectives of the respective zones of the AMPs, and the principles of the IUCN Area Categories applicable to the values of the AMPs.
Monitoring and reporting	Impacts will be monitored in accordance with Section 7.9.3.
Acceptability outcome	**Acceptable**

6.16 Environmental Performance Outcomes, Standards and Measurement Criteria

Beach uses EPOs, EPSs and measurement criteria to demonstrate it is managing its environmental impacts and risks. Outcomes have been developed for each of the identified environmental impacts and risks and have been based around the key identified controls from the control assessment and are aligned with Beach's HSE Policy (refer Figure 7-2). For each EPO and EPS has been developed in conjunction with measurement criteria. The EPOs, EPSs and measurement criteria related to operations are provided in Table 6-26; and those related to IMR and vessel operations in Table 6-27.

Table 6-26: Environmental performance outcomes, standards and measurement criteria - Operations

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity. **EPO3:** Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken. **EPO4:** No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity. **EPO5:** Reduce Beach equity GHG emissions	CM#2: Marking of Man-Made Offshore Structures	• When platform unmanned lighting is restricted to navigational lighting.	Platform inspection	Operations Manager
	CM#4: Maintenance Management System	• Power generation systems on platform will be operated in accordance with maintenance management system to ensure efficient operation. • Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.	Maintenance Management System (MMS) records	Operations Manager
	CM#5: Venting Procedures	• Venting is conducted as per operational and maintenance isolation procedures. • Emergency blow down system designed to blow down topside only. • Drain vents purge set points set to meet the minimum operational requirements. • Drain vents purge set points checked as part of platform pre-departure checklist.	Operations and maintenance isolation procedures Blow down system design Platform pre-departure checklist	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
from the Otway Offshore Facilities to as low as reasonably practicable **EPO6**: No impact to water quality or sediment quality at a distance > 500 m from planned activities from planned marine discharges. **EPO7:** Seabed and associated biota disturbance will be within the operational area.	CM#7: Emission Abatement Opportunities	Per the requirements of the OEMS Sustainability Standard, Beach will maintain a register of opportunities for emissions reduction across its asset portfolio to reduce: • emissions from combustion • electricity consumption • venting and flaring These opportunities will be evaluated according to the criteria in the GHG Management Plan (CM#8), the criteria including relative cost per tonne of CO_2 equivalent abated and Net Present Value compared to other facilities both in Australia and New Zealand. These opportunities that are determined to be practicable for the Otway Offshore Facilities will be included in the yearly budget cycle for review, assessment, and approval where appropriate. Completion of GHG reduction opportunities related to the Otway Offshore Facilities will be independently tracked through to completion via Beach's Sustainability Steering Committee as a standing agenda item.	Opportunities register Yearly budget cycle documents Sustainability Steering Committee meeting minutes	Operations Manager
	CM#8: Beach GHG Management Plan	Beach Energy will progressively implement its GHG Management Plan from 1 January 2023. The GHG Management Plan formalises the framework and specific techniques used to ensure that GHG emission related EPOs will be met over the life of the facilities. In particular, the GHG Management Plan will set out the requirements for: • Monitoring of Scope 1, Scope 2 and Scope 3 GHG emissions at each asset. • Methodology used to monitor yearly indirect emissions generated by selected offshore upstream suppliers and downstream contractors and estimates of indirect emissions from the use of the total hydrocarbon products from Beach's Otway asset.	Beach Energy GHG Management Plan developed and implemented Annual Scope 1, Scope 2 and Scope 3 GHG emissions monitoring reports Customer GHG emission reduction policy and implementation reviews	Head of Sustainability and Energy Solutions responsibilities

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• A stewardship program to monitor indirect (Scope 3) GHG emissions by: ◦ Monitoring GHG emission reduction commitments of customers. ◦ Working with Beach customers to explore GHG emission reduction opportunities. • Review of the GHG Management Plan requirements by comparison of Scope 1 and 2 emissions against internal forecasts and monitoring Scope 3 emissions for Beach's Otway asset against internal forecasts. • Maintaining of a record of opportunities related to reductions of fuel, flare and venting Scope 1 emissions. • Establishing a LDAR program at the Otway Offshore Facilities documenting the scope, methodology, frequency, and repair guidance. • Assessment criteria to be used to assess merits of emissions reduction opportunities and decision making criteria for adoption.	Records demonstrate review of decarbonisation opportunities with customers	
	CM#9: Fugitive Leak Detection and Repair Program	Implement an offshore leak detection and repair (LDAR) fugitive emissions surveys aligned with the LDAR program for onshore facilities as per the GHG Management Plan (CM#8) in which the scope, extent, frequency, method, and repair decision-making criteria are detailed to meet the Protocol for Environmental Management (Minimum control requirements for stationary sources) – US EPA Publication 21.	LDAR surveys implemented as per GHG Management Plan requirements LDAR fugitive emissions report	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#10: Emissions Monitoring	GHG emissions will be reported as required by NGERS regulatory requirements. Scope 1 GHG emissions, generated by the Otway Offshore Operation and reported via NGERS, will be compared annually to internal forecasts. Stewardship of Scope 3 emissions derived from Beach's Otway asset's activities includes: • Emissions from combustion of final product will be estimated for the Otway asset and compared against annual forecast. • Customer commitments to emissions reduction and published targets will be monitored • Engagement with customers to discuss emission reduction opportunities • Scope 3 emissions from upstream and downstream service providers will be recorded and monitored.	Annual review of Scope 1 and Scope 2 GHG emissions. Estimates of Scope 3 emissions from product use Monitoring of indirect Scope 3 emissions from aviation and offshore vessels. GHG emissions regulatory requirement reports.	Head of Sustainability and Energy Solutions responsibilities

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#26: Bird Deterrent system	• Bird deterrent system has been developed as per the recommendations of the bird management specialists. • Water sprinkler used when birds are present. • Operators of the bird deterrent systems are trained and following standard operating systems. Operators of the bird deterrent systems are trained and follow standard operating systems. The water sprinkler is used daily (when birds are present), even when helicopter flights are not scheduled. This prevents birds from habituating to an inactive helideck, reducing the numbers and hence lowering the risk of being harmed. If the laser is to be used a MoC will be undertaken as per Section 7.8.1 to ensure any potential impacts to birds are assessed and can be managed to the acceptable and area ALARP. Any resulting changes will be assessed to determine if this EP needs to be revised and submitted to NOPSEMA as per Section 7.12.6. The MoC, including whether the revised EP is required to be submitted to NOPSEMA, will be undertaken prior to the laser being tested or used.	Bird deterrent system report Operator training records MoC Report Submission of EP, if required	Operations Manager
	CM#22: Beach Chemical Management Plan	• Chemicals that could be discharged to the marine environment will meet the requirements of the Beach Chemical Management Plan (Section 7.11.2).	Completed and approved chemical assessment Register of approved chemicals	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#24: Hydraulic Control System	• Hydraulic system is fitted with low pressure and low level alarms that are monitoring at the Otway Gas Plant. • Hydraulic control system inventory levels are monitored monthly, and any excess use is investigated. • Hydraulic control system inspected and maintained in accordance with the Maintenance Management System.	Hydraulic system alarm records Monthly monitoring report Excess use investigation Maintenance Management System records	Operations Manager
EPO8: Undertake the activity in a manner that will not interfere with other marine users to a greater extent than is necessary for the exercise of right conferred by the titles granted.	CM#14: Ongoing consultation	• Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 7.12.9 (Stakeholder Consultation).	Notification records Communication records	Offshore Project Manager
	CM#15: Permanent Petroleum Safety Zone (PSZ)	• A permanent PSZ shall be maintained for the Thylacine-A wellhead platform and Geographe and Thylacine subsea infrastructure. • Otway Pipeline Systems and Thylacine-A wellhead platform and Geographe and Thylacine subsea infrastructure PSZ marked on navigational chart.	PSZ Gazetted Notice Navigational chart	Operations Manager
	CM#16: Beach Fair Ocean Access Procedure	• The Beach Fair Ocean Access Procedure (Appendix D for overview) shall be implemented with Fishers who have identified they fish in the area and have a commercial loss due to Beach's activities.	Communication records	Community Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#17: Navigation and communication aids	• Platform is provided with navigational lights, RACON and foghorn in accordance with International Association of Lighthouse Authorities (IALA) requirements: • Foghorn is provided with its own battery back-up which will supply power for 96 hours. • Navigational lights on the Thylacine-A wellhead platform are in accordance with Navigation Act 2012 (Cth) (Chapter 6, Part 3, Division 2 – Collisions, Lights and Signals).	Platform inspection CMMS	Operations Manager
EPO10: No unplanned discharge of waste to the marine environment.	CM#27: MO 95: Marine Pollution Prevention – Garbage	• Waste with potential to be windblown shall be stored in covered containers.	HSE inspection records Garbage record book Incident report	Operations Manager
	CM#28: Fabric Maintenance	• Grit blasting on the platform jacket and topsides uses containment and recovery to minimise losses to the ocean. • Grit blasting material will meet the chemical acceptance criteria as per Section 8.21.	Maintenance activity reports	Operations Manager
EPO11: No spills of chemicals or hydrocarbons to the marine environment.	CM#31: NOPSEMA accepted Safety Case	• Pipelines and subsea infrastructure and integrity managed in accordance with the accepted Safety Case.	Accepted Safety Case in place Inspection records	Operations Manager
	CM#29: Spill containment	• Suitable bunding will be installed to prevent unplanned spills of chemicals entering the environment. • Spill kits are present on the platform.	Platform / vessel inspection	Operations Manager
	CM#32: Thylacine-A Wellhead Platform Hose Integrity Management Plan	• Hoses are managed and maintained as per Thylacine-A Wellhead Platform Hose Integrity Management Plan.	Thylacine-A Wellhead Platform Hose Integrity Management Plan	Operations Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#14: Ongoing consultation	• Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 7.12.9 (Stakeholder Consultation).	Notification records Communication records	Offshore Project Manager
	CM#2: Marking of Man-Made Offshore Structures	• Lighting on the Thylacine-A Wellhead Platform meets Sections 2.1 and 2.2 of the Recommendation O-139 on The Marking of Man-Made Offshore Structures.	Platform inspection	Operations Manager
	CM#36 NOPSEMA accepted WOMP	• Wells and well integrity managed in accordance with the accepted WOMP.	Accepted WOMP in place Inspection records	Operations Manager
	CM#37: Source Control Contingency Plan (SCCP) and Relief Well Plan (RWP)	• Emergency response capability to implement timely source control in the case of a loss of well integrity is maintained in accordance with well-specific SCCP and RWP.	Capability as per SCCP and RWP in place	Wells Manager Otway Offshore
		The SCCP shall be consistent with the International Oil and Gas Producers (IOGP) Report 594 - Subsea Well Source Control Emergency Response Planning Guide for Subsea Wells (2019), Specifically detailing: • the structure and function of the Beach Source Controls Incident Management Team. • a timeline for the effective implementation of source control key events / actions. • a well-specific worst-case discharge analysis. • casing design. • structural integrity analysis. • gas plume study. The relief well plan ensures that Beach has considered the response requirements in order to: • reduce the time required to initiate relief well drilling operations in the event of a LOC.	Capability as per SCCP and RWP in place	Wells Manager Otway Offshore

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		- allow the relief well to be completed in the shortest time practicable. The relief well plan includes a detailed schedule with estimated times to: - source, mobilise and position a MODU. - drill and intercept the well. - complete the well kill successfully.		
	CM#38: NOPSEMA accepted OPEP CM#39: NOPSEMA accepted OSMP	Emergency spill response capability is maintained in accordance with the OPEP	Outcomes of internal audits and tests demonstrate preparedness	Senior Crisis, Emergency & Security Advisor
		Implement spill response in accordance with relevant EPOs and EPSs in the accepted OPEP.	EMT log	Beach EMT
		Operational and scientific monitoring capability is maintained in accordance with the OSMP.	Outcomes of internal audits and tests demonstrate preparedness	Senior Crisis, Emergency & Security Advisor
EPO12: All structures, equipment and property associated within the Beach title areas in Table 2 2 will be maintained in good condition and repair to ensure it can be removed, unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP.	CM#21: Beach OEMS Element 6 Asset Management	IMR programs are undertaken to maintain structures, equipment and property in good condition and repair until it is removed, unless there is agreement at that time from NOPSEMA to do otherwise through an accepted EP, by - Wells and well integrity managed in accordance with the accepted WOMP. - Thylacine-A Wellhead Platform, pipelines and subsea infrastructure and integrity managed in accordance with the accepted Safety Case.	Accepted Safety Case in place Accepted WOMP in place Inspection records	Operations Manager

Table 6-27: Environmental performance outcomes, standards and measurement criteria – IMR, Geophysical Surveys and Support Operations

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity. **EPO2:** Sound emissions in BIAs will be managed such that any whale, including blue whales, continue to utilise the area without injury, and is not displaced from a foraging area. **EPO3:** Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.	CM#1: Light Management Procedure	• Vessels will have a Lighting Management Procedure (or equivalent) to minimise light spill by: ◦ keeping lights off when not needed. ◦ directing lighting onto work areas. ◦ screening interior lights with curtains and blinds. ◦ developing a program for handling grounded birds. ◦ reporting requirements. • The Vessel Lighting Management Procedure (or equivalent) will meet the requirements detailed in Beach Energy's Vessel Light Management Procedure Guidance (CDN/ID 19012450).	Lighting Management Procedure (or equivalent) Beach Energy's Vessel Light Management Procedure Guidance Vessel inspection	Vessel Master
	CM#11: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	• Vessel operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with dolphins specifically: i. Do not approach a dolphin. ii. Maintain a distance of 150 m from a dolphin. iii. If a dolphin approaches the vessel try to maintain the separation distances without changing direction or moving into the path of the animal. • Vessel operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with whales, specifically: i. Do not approach a whale. ii. Maintain a distance of 500 m from a whale. • If a whale approaches the vessel it will try to maintain the separation distances without changing direction or moving into the path of the animal. • Helicopters will not fly lower than 1650 ft when within 500 m horizontal distance of a cetacean except when landing or taking off and will not approach a cetacean from head on.	Project induction DCCEEW cetacean sighting sheets	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO4: No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity.		• Marine mammal sightings will be recorded and submitted to DCCEEW via the National Marine Mammal Data Portal. Sighting will be reported within 1 month of sighting occurring or two months of the end of a geophysical survey.		
	CM#13: Otway Operations Vessel Whale Management Procedure	• Prior to an activity commencing a pre-activity survey will be undertaken of the activity survey zone for the activity: ▪ Resupply – 7.5 km ▪ Inspection – 3 km ▪ Maintenance and repair – 3 km • Surveys will be undertaken for 30 min prior to the activity commencing. If a whale is sighted within the pre-activity survey zone the activity will not commence until: ▪ No whales are observed for 30 min within the pre-activity survey zone; or ▪ Whales are observed leaving the pre-activity survey zone. • Once the activity has commenced observations will be undertaken within the activity survey zone: ▪ Resupply – 7.5 km ▪ Inspection – 3 km ▪ Maintenance and repair – 3 km • If a whale is sighted within the activity survey zone the following will occur: ▪ If the vessel can do so it will move away from the whale and maintain a minimum separation distance equal to the activity survey zone. ▪ If the vessel cannot move away from the whale, the vessel will reduce thrusters if safe to do so. The activity will cease as soon as it is safe, and the vessel will move out of the activity survey zone. • Activities can commence at night or in low visibility conditions (i.e., when observations cannot be undertaken) if no more than three whales have been seen in the activity survey zone in the preceding daylight hours.	Daily report MMO report Review of whale data	Operations Manager Activity Offshore Representative Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	CM#13a: Otway Operations Vessel Marine Mammal Observer	• A dedicated MMO with experience in whale observation, distance estimation and reporting, will undertake activity survey zone observations for vessel activities undertaken over a period greater than 24 hours. • In addition, vessel crew who act as Officer of the Watch will receive training from the MMO in whale observation and distance estimation to assist the MMO during daylight hours. • For vessel activities greater than 5 consecutive days at sea an additional dedicated MMO trained in whale observation, distance estimation and reporting will be onboard the vessel to support the experienced MMO. • For vessel activities that will be undertaken over a period less than 24 hours the vessel Officer of the Watch will undertake the activity survey zone observations. They will be trained in the Vessel Whale Management Procedure, whale observation and distance estimation.	MMO qualifications Daily report MMO report Officer of the Watch training	Operations Manager Activity Offshore Representative Vessel Master
	CM#13b: SRW Exclusion Zone	No IMR activities will be planned within 3 km of a southern right whale BIA or emerging aggregation area during May to end of October when SRW are potentially present in the BIAs or emerging aggregation area.	IMR schedule	Operations Manager
	CM#12a: Geophysical survey pre-start visual observation	For the geophysical survey: • A prestart visual observation period of 30 mins will be applied to 500 m prior to the start of SBP equipment activation. • If during the prestart visual observation period, a whale is sighted within 500 m of the vessel the SBP equipment activation will be delayed until the whale has moved outside of the 500 m zone or 30 minutes has lapsed since the last whale sighting within 500 m. • SBP equipment will not be started at night if there have been three or more delays to the start-up of the equipment due to whales in the last 24 hours. • Once the survey has comments CM#11 applies where the vessel is required to maintain a 500 m distance to all whales.	Daily report details pre-start Observation period, any sightings and any actions required.	Activity Offshore Representative
	CM#12b: Geophysical survey Marine Mammal Observer	For geophysical surveys utilising SBP a dedicated MMO will be present on the vessel to undertake prestart visual observations and implement the 500 m distance to any whales during: • 1 November to 30 June within the operational area	MMO resume. Daily report detailing MMO observations.	Activity Offshore Representative

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		- 1 May to 30 November within the Victorian coastal migration and resting on migration BIA and emerging aggregation area. The MMO will have proven experience in whale observation, distance estimation and reporting. At other times at least one crew member onboard the vessel will have proven experience in whale observation, distance estimation and reporting to ensure the safe operating distances are implemented.		
	CM#12c Geophysical survey adaptive management	For geophysical surveys utilising SBP if whale numbers are greater than expected such that pre-start observations are delayed three times in a 24-hour period or the vessel must move away from a whale or a pod of whales three times in a 24-hour period, a review of the controls in place will be undertaken by the Activity Offshore Representative, Activity Project Manager and Environment Advisor. - the review will be initiated within 2 hours of the adaptive management trigger being reached. the review will be documented and will be undertaken against the Implementation of the EPBC Act Policy 2.1 Part A requirements to identify if further controls need to be applied to ensure that impacts and risks are ALARP and within the defined acceptable level.	Adaptive management review report	Activity Offshore Representative
	CM#3: MO 97: Marine Pollution Prevention – Air Pollution	- Use of very low sulphur fuel oil (VLSFO) (e.g. maximum 0.50% S VLSFO-DM, maximum 0.50% S VLSFO-RM). - Vessels with diesel engines>130 kW must be certified to emission standards (e.g. International Air Pollution Prevention [IAPP]). - Vessels shall implement their Ship Energy Efficiency Management Plan to monitor and reduce air emissions (as appropriate to vessel class).	Bunker receipts Ship Energy Efficiency Management Plan (SEEMP) records Certification documentation Vessel inspection	Vessel Master
	CM#4: Maintenance Management System	- Power generation and propulsion systems on vessels will be operated in accordance with maintenance management system to ensure efficient operation.	Maintenance Management System (MMS) records	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
			Vessel inspection	
	CM#6: Contractor Supplier HSE Prequalification and Capability Assessment	• The tender evaluation for the IMR and support vessels contract will include an evaluation of air and GHG emissions management.	Contractor Supplier HSE Prequalification and Capability Assessment	IMR Project Manager Operations Manager
EPO6: No impact to water quality or sediment quality at a distance > 500 m from planned activities from planned marine discharges. **EPO7:** Seabed and associated biota disturbance will be within the operational area.	CM#20: IMR Scope of Work	• IMR scope of work will detail activities that may disturb the seabed and how these activities will limit the area of disturbance.	IMR Scope of Work	IMR Project Manager
	CM#23: *Protection of the Sea (Prevention of Pollution from Ships) Act 1983* and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	• Oil contaminated water shall be treated via a MARPOL (or equivalent) approved oily water separator and only discharge if oil content less than 15 ppm. • Sewage discharged at sea shall be treated via a MARPOL (or equivalent) approved sewage treatment system. • Food waste only discharged when macerated to ≤25 mm and at distance greater than 3 nm from land.	Oil record book MARPOL certification Garbage record book Vessel inspection	Vessel Master
	CM#4: Maintenance Management System	• Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system.	Maintenance Management System (MMS) records	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
			Vessel inspection	
	CM#22: Beach Chemical Management Plan	- Chemicals that will be or have the potential to be discharged to the marine environment will meet the chemical acceptance criteria as per Section 7.11.2.	Completed and approved chemical assessment Register of approved chemicals	Vessel Master
EPO8: Undertake the activity in a manner that will not interfere with other marine users to a greater extent than is necessary for the exercise of right conferred by the titles granted.	CM#14: Ongoing consultation	- Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 7.12.9 (Stakeholder Consultation).	Notification records Communication records	IMR Project Manager
	CM#16: Beach Fair Ocean Access Procedure	- The Beach Fair Ocean Access Procedure (Appendix D for overview) shall be implemented with Fishers who have identified they fish in the area and have a commercial loss due to Beach's activities.	Communication records	Community Manager
EPO9: No introduction of a known or potential invasive marine species	CM#25: Beach Domestic IMS Biofouling Risk Assessment Process	Prior to the initial mobilisation into the operational area of any vessel or submersible equipment, Beach shall undertake a domestic IMS biofouling risk assessment as per Section 7.11.3 of this EP to: - Validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational area. - Identify the potential IMS risk profile of vessels and submersible equipment prior to deployment within the operational area. - Identify potentially deficiency of IMS controls prior to entering the operational area. - Identify additional controls to manage IMS risk.	Domestic IMS Biofouling Risk Assessment records	IMR Project Manager

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		• Prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).		
EPO10: No unplanned discharge of waste to the marine environment.	CM#27: MO 95: Marine Pollution Prevention – Garbage	Waste with potential to be windblown shall be stored in covered containers.	Vessel inspection Garbage record book Incident report	Vessel Master
EPO11: No spills of chemicals or hydrocarbons to the marine environment.	CM#29: Spill containment	Materials and equipment that have the potential to spill onto the deck or marine environment shall be stored within a contained area.	Vessel inspection.	Vessel Master
	CM#30: SMPEP or SOPEP (appropriate to class)	Vessels shall have a SMPEP (or equivalent appropriate to class) which is: • implemented in the event of a spill to deck or marine environment. • tested as per the vessel test schedule. • spill response kits shall be available and routinely checked to ensure adequate stock is maintained.	Vessel SMPEP Vessel inspection Vessel exercise schedule	Vessel Master
	CM#14: Ongoing consultation	Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 8.16 (Stakeholder Consultation).	Notification records Communication records	IMR Project Manager
	CM#33: MO 21: Safety and emergency arrangements	Vessels shall meet the safety measures and emergency procedures of the AMSA MO 21.	Vessel inspection	Vessel Master
	CM#18: MO 30: Prevention of collisions	Vessels shall meet the navigation equipment, watchkeeping, radar and lighting requirements of AMSA MO 30.	Vessel inspection	Vessel Master
	CM#34: MO 31: SOLAS and	Support vessels will meet survey, maintenance and certification of regulated Australian vessels as per AMSA MO 31.	Vessel certification	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
	non-SOLAS certification			
	CM#19: MO 27: Safety of navigation and radio equipment	Vessels shall meet the safety of navigation and radio equipment requirements of AMSA MO 27. Vessels shall ensure their navigation status is set correctly in the ship's AIS unit.	Vessel inspection	Vessel Master
	CM#35: Vessel fuel type	Vessels contracted to conduct activities under this EP will only carry marine diesel.	Vessel inspection	Operations Manager Project Manager

7 Implementation Strategy

Regulation 14 of the OPGGS(E)R requires that the EP must contain an implementation strategy for the activity.

The Beach Operations Excellence Management System (OEMS) will be used to govern the activity. The OEMS provides guidance on how Beach will meet the requirements of its Environmental Policy (Figure 7-2). The Beach OEMS has been developed considering Australian/New Zealand Standard ISO 14001:2016 Environmental Management Systems. The OEMS is an integrated management system and includes all HSE management elements and procedures.

The Implementation Strategy described in this section provides a summary of the OEMS elements and how they will be applied to effectively implement the control measures detailed in this EP. Specifically, it describes:

- The OEMS.
- Environment-specific roles and responsibilities.
- Arrangements for monitoring, review and reporting of environmental performance.
- Preparedness for emergencies.
- Arrangements for ongoing consultation.

7.1 Operations Excellence Management System

The OEMS documents the Environmental Policy, the 11 OEMS Elements and 30 OEMS Standards. It provides a management framework for achieving the requirements in a systematic way but allows flexibility to achieve this in a manner that best suits the business. The OEMS is aligned with the requirements of recognised international and national standards including:

- ISO 14001 (Environmental Management)
- OHSAS 18001 (Occupational Health and Safety)
- ISO 31000 (Risk Management)
- AS 4801 (Occupational Health and Safety Management Systems)

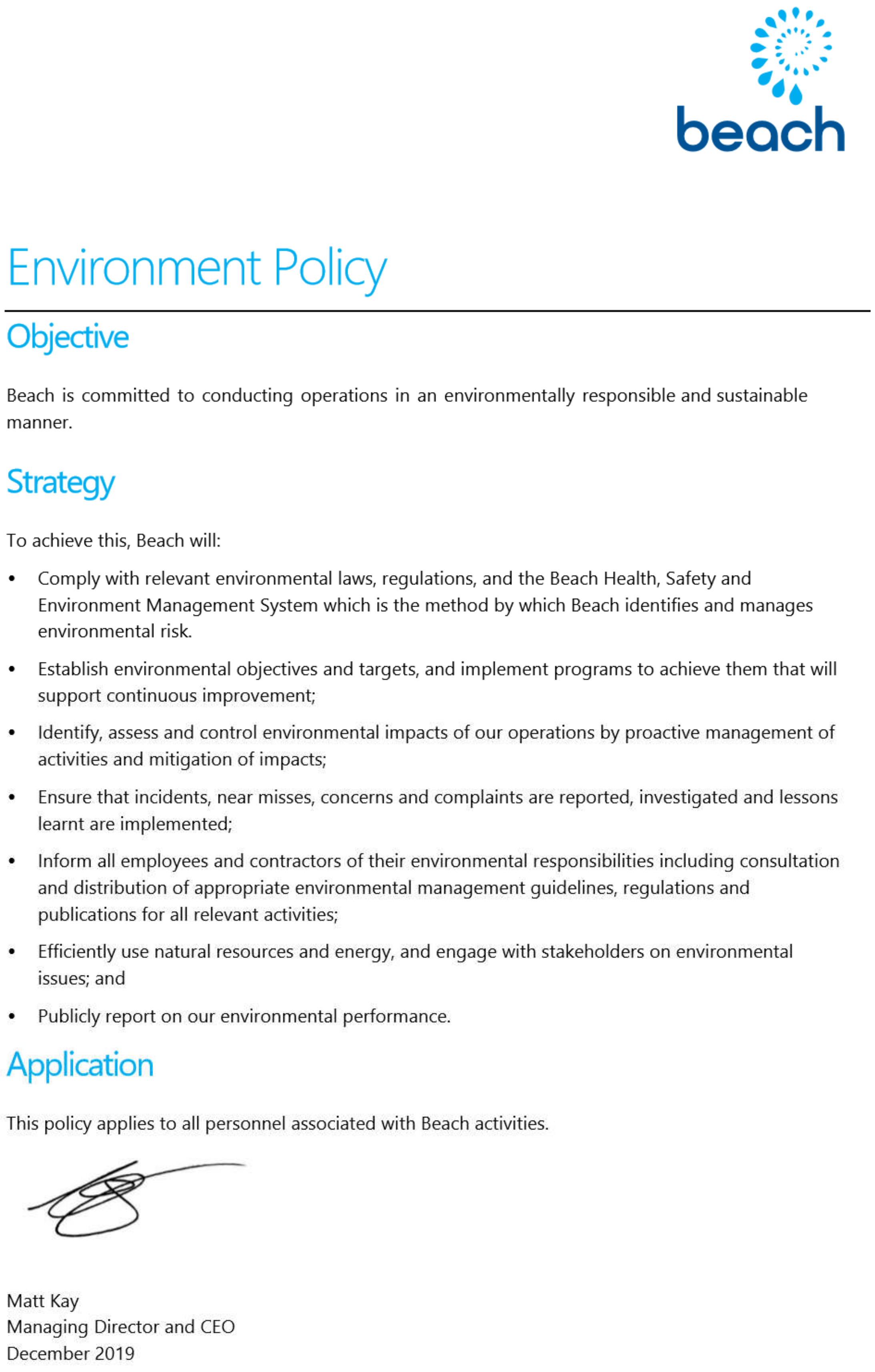
At the core of the OEMS are 11 elements and associated standards that detail specific performance requirements that incorporate all the requirements for the implementation of the Environmental Policy (Figure 7-2) and management of potential HSE impacts and risks (Figure 7-1, Table 7-1). The Elements, via the nominated expectations, sponsor 30 Beach OEMS Standards, which provide more granular minimum compliance rule sets under which the company operates. At the business level, the system is complemented by asset and site procedures and plans such as this EP.

Whilst Beach is the titleholder for the activity, the vessel contractor maintains operational control as per the requirements of their management system. The application of OEMS Elements and Standards relevant to the activity are described in the following sections.

Figure 7-1: Beach OEMS

Table 7-1: Beach OEM Elements and Standards

Element		Standard
1	Partners, Leadership and Authority	Leadership Standard
		Technical Authority Standard
		Joint Venture Management Standard
2	Financial Management and Business Planning	Integrated Planning Standard
		Phase Gate Standard
		Hydrocarbon Resource Estimation and Reporting Standard
		Financial Management Standard
3	Information Management and Legal Requirements	Regulatory Compliance Standard
		Document Management Standard
		Information Management Standard
4	People, Capability and Health	Training and Competency Standard
		Health Management Standard
5	Contracts and Procurement	Contracts and Procurement Standard
		Transport and Logistics Standard
6	Asset Management	Asset Management Standard
		Maintenance Management Standard
		Well Integrity Management Standard
		Well Construction Management Standard
		Project Management Standard
7	Operational Control	Operational Integrity Standard
		Process Safety Standard
		Management of Change Standard
8	Risk Management and Hazard Control	Risk Management Standard
		Safe Systems of Work
		Emergency and Security Management Standard
9	Incident Management	Incident Management Standard
10	Environment and Community	Environment Management Standard
		Community Engagement Standard
11	Assurance and Reporting	Sustainability Standard
		Assurance Standard



beach

Environment Policy

Objective

Beach is committed to conducting operations in an environmentally responsible and sustainable manner.

Strategy

To achieve this, Beach will:

- Comply with relevant environmental laws, regulations, and the Beach Health, Safety and Environment Management System which is the method by which Beach identifies and manages environmental risk.
- Establish environmental objectives and targets, and implement programs to achieve them that will support continuous improvement;
- Identify, assess and control environmental impacts of our operations by proactive management of activities and mitigation of impacts;
- Ensure that incidents, near misses, concerns and complaints are reported, investigated and lessons learnt are implemented;
- Inform all employees and contractors of their environmental responsibilities including consultation and distribution of appropriate environmental management guidelines, regulations and publications for all relevant activities;
- Efficiently use natural resources and energy, and engage with stakeholders on environmental issues; and
- Publicly report on our environmental performance.

Application

This policy applies to all personnel associated with Beach activities.

Matt Kay
Managing Director and CEO
December 2019

Figure 7-2: Beach's Environmental Policy

7.2 Element 1 – Partners, Leadership and Authority

Element 1 focuses on ensuring the organisation is equipped, structured and supported to ensure a healthy, efficient and successful company. Communications with internal and external bodies, including joint venture partners, is essential to delivering successful projects and operations. The leadership styles and actions demonstrated within Beach will influence the performance of all staff and contractors. Clear levels of authority are necessary to remove organisational ambiguity and to support effective decision making.

The Beach Energy CEO has the ultimate responsibility for ensuring that Beach Energy has the appropriate organisation in place to meet the commitments established within this EP. However, the Otway Operations Manager has the responsibility and delegated authority to ensure that adequate and appropriate resources are allocated to comply with OEMS and this EP.

Figure 7-3 shows the organisation chart for the key roles for the EP implementation and the roles responsible for the implementation, management and review of this EP are detailed in Table 7-2.

Roles and responsibilities for an oil pollution emergency response are described in the OPEP.

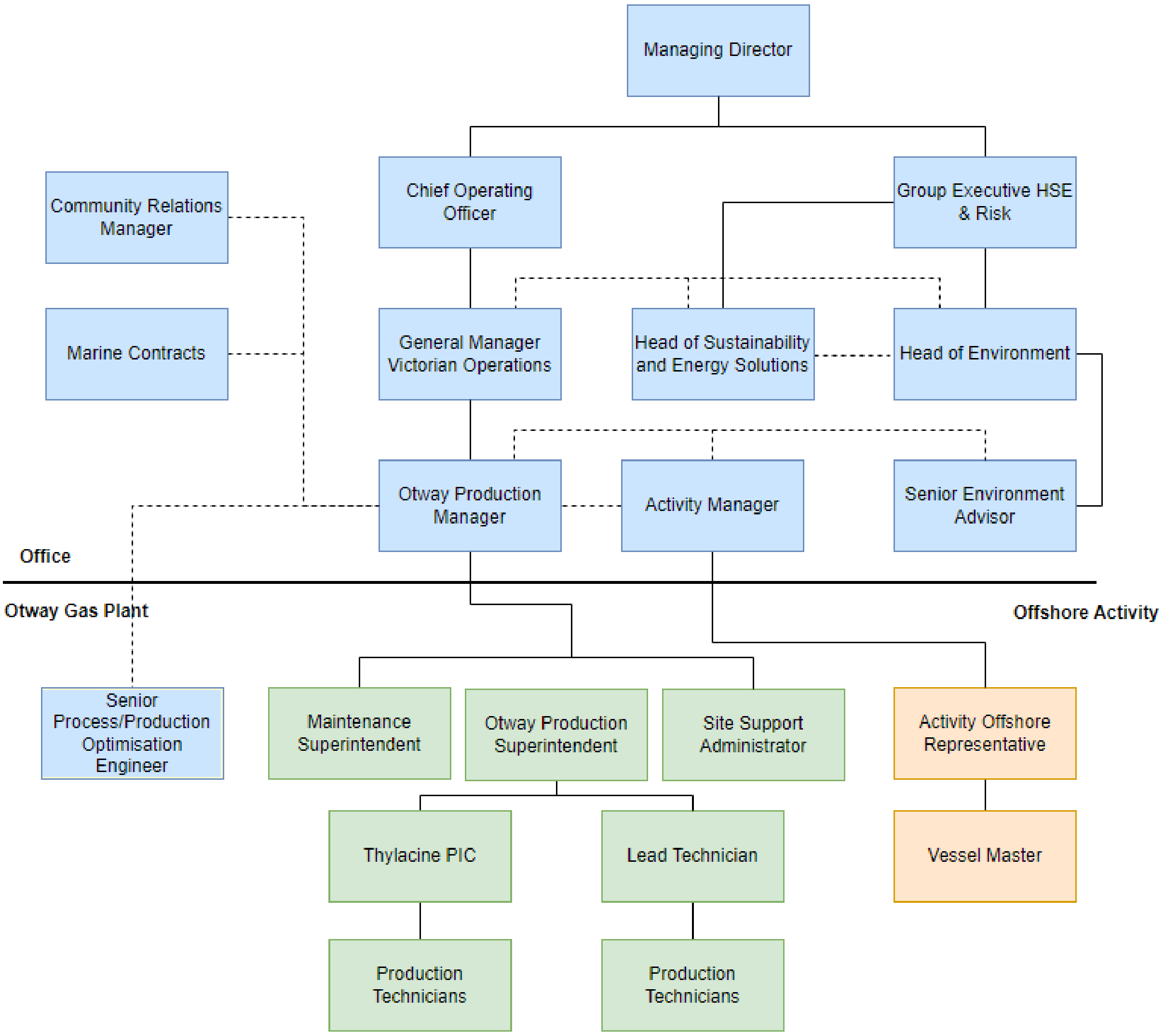


Figure 7-3: Otway Operations key roles for the EP implementation

Table 7-2: Roles and responsibilities for key roles for the EP implementation

Role	Responsibilities
Office	
Managing Director	• Responsible for HSE performance of all Beach activities. • Ensures policies and systems are in place to guide the company's environmental performance.
Chief Operating Officer	• Responsible for HSE performance of all Beach operational assets and their activities. • Ensures policies and systems are in place to guide the company's environmental performance. • Ensures adequate resources are available for the safe operation of all facilities and operations. • Ensures that the OEMS continues to meet the evolving needs of the company.
General Manager Victorian Operations	• Responsible for HSE performance of all activities across their asset

Role	Responsibilities
	• Responsible Person/Person Conducting Business Undertaking for the development, implementation and compliance with the asset's Safety Cases, Safety Management System, Safety Management Plans and Operations and Environmental Management Plans. • Ensuring the Production Manager and Production Superintendent have the required skills and can fulfil their duties as the 'Accountable Person' for managing HSE performance at each site. • Implementing and ensuring compliance with the OEMS. • Ensuring that appropriate reporting, verification, authorisation and escalation processes are in place for the review and actioning of all incidents, defects, hazards, inadequacies of procedures. • Maintaining relationship and reporting relevant requirements under the Safety Cases, Safety Management Systems, Safety Management Plans, Operations and Environmental Management Plans and HSE legislation.
Otway Operations Manager	• Responsible for the safe day-to-day operations of the facility. Ensure: • Compliance with the Environment Policy, regulatory and other requirements, and this EP. • Records associated with the activity are maintained as per Section 7.4.2. • Personnel who have specific responsibilities pertaining to the implementation of this EP or Oil Pollution Emergency Plan (OPEP) know their responsibilities and are competent to fulfil their designated role. • Assurance Processes as detailed in Section 8.12.2 are undertaken to confirm that control measures detailed in the EP are effective in reducing the environmental risks of the activity to ALARP and acceptable levels, and the EPOs and EPSs are continually met. • 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 process detailed in Section 7.8.1. • Incidents are managed and reported as per Section 7.10. • EP report is submitted to NOPSEMA not more than three months after the anniversary date of the EP acceptance. • 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 Management of Change process detailed in Section 7.8.1. • Oil spill response arrangements are tested as per Section 12.2 of the OPEP. • Audits and inspections are undertaken in accordance with Section 7.12.4.
Group Executive Health, Safety, Environment and Risk	• Ensures adequate environmental resources are available for the implementation of this EP.
Head of Environment	• Ensures this EP is revised as required. • Reviews EP audits. • Leads the investigation and reporting of any environmental incidents. • Reviews and approves reportable incident reports to the regulators. • Reviews changes to operations for their environmental and regulatory implications.
Senior Environment Advisor	• Maintains ongoing communications with the PIC regarding regulatory requirements and environmental management in general. • Prepares environmental inductions and training packages.

Role	Responsibilities
	• Monitors environmental performance against this EP. • Undertakes Assurance Processes as detailed in Section 8.12.2 to confirm that control measures detailed in the EP are effective in reducing the environmental risks of the activity to ALARP and acceptable levels, and the EPOs and EPSs are continually met. • Prepares and submits monthly recordable incident reports to the regulators. • Prepares reportable incident reports for submission to the regulators. • Supports the Management of Change (MoC) process with regard to environmental issues impacting on operations. • Supports the investigation and reporting of any environmental incidents. • Prepares and submits reportable incident reports to the regulators. • Reviews changes to operations with the Head of Environment.
Head of Sustainability and Energy Solutions	• Ensures the GHG Management Plan is developed and progressively implemented from 1 January 2023. • Ensures NGERS and NPI reporting requirements are met. • Ensures the Scope 1 and Scope 3 GHG emissions (from sold product only) generated by the Otway Offshore Operations are compared to periodic, internal forecasts • Ensures a program to monitor indirect (Scope 3) GHG emissions by monitoring GHG emission reduction commitments of customers and working with Beach customers to explore GHG emission reduction opportunities is undertaken as per the GHG Management Plan requirements.
Community Relations Manager	• Ensures that relevant persons (as defined in Chapter 9) are consulted about operations issues that may impact their functions or interests. • Maintains a record of stakeholder communications. • Reports stakeholder concerns to the PIC and Senior Environment Advisor for resolution. • Keeps relevant persons informed of emergency events that may impact their functions or interests.
Marine Contracts	• Ensures vessels used for Otway Operations comply with the requirements of this EP. • Undertakes Assurance Processes for vessels as detailed in Section 8.12.2 to confirm that control measures detailed in the EP are effective in reducing the environmental risks of the activity to ALARP and acceptable levels, and the EPOs and EPSs are continually met.
Senior Production Optimisation Engineer	• Ensure that all asset monitoring and inspection programs are completed in line with the CMMS, associated plans and procedures. • Participate in environmental inductions and training. • Participate in environmental risk reviews and assessments. • Report asset performance to Otway Production Manager. • Maintain Otway operations emissions and discharge records. • Assist in environmental incident investigations and implementation of environmental related corrective actions.
Otway Gas Plant	
Otway Production Superintendent	• Responsible for the safe day-to-day operations of the facility. • Ensures compliance with the Environment Policy. • Communicates environmental hazards to the facility crew.

Role	Responsibilities
	• Delivers environmental inductions (as required). • Reports environmental incidents to the Otway Production Manager. • Acts as the onsite Emergency Response Team (ERT) Leader in the event of major incidents, in line with the ERT structure.
Maintenance Superintendent	• Inspects and maintains plant and equipment in line with the CMMS to ensure all plant and equipment is operating safely and within OEM specifications. • Ensures all maintenance contractors and staff abide by HSE standards, management plans and procedures and works have been adequately risk assessed with controls implemented prior to starting works.
Site Support Administrator	• Ensure records associated with inductions and training are maintained.
Thylacine PIC / Lead Technician	• Reports environmental incidents to the Otway Production Superintendent. • Ensures the facility-based environmental inspections and audits are resourced and completed as per the CMMS.
Production Technicians	• Ensures asset monitoring and inspection programs are completed in line with the CMMS, associated plans and procedures. • Participates in environmental inductions and training. • Follows good housekeeping practices. • Reports environmental hazards and incidents promptly to their supervisor. Considers environmental issues in JSAs and PTWs.
Gas Plant personnel	• Complete inductions. • Report hazards and/or incidents via company reporting processed. • Stop any task that they believe to be unsafe or will impact on the environment.
Offshore Activity	
Activity (Geophysical survey or IMR campaign) Manager	Ensures: • Activity is carried out in accordance with regulatory requirements and this EP. • Vessel personnel are competent to fulfil their designated role. • HSE issues are communicated via systems such as the daily report and daily pre-start meetings. • Emissions and discharges identified in Section 7.12.8 are recorded and provided to the Senior Environment Advisor. • Personnel who have specific responsibilities pertaining to the implementation of this EP or Oil Pollution Emergency Plan (OPEP) know their responsibilities and are competent to fulfil their designated role. • Assurance Processes as detailed in Section 8.12.2 are undertaken to confirm that control measures detailed in the EP are effective in reducing the environmental risks of the activity to ALARP and acceptable levels, and the EPOs and EPSs are continually met. • 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 process detailed in Section 7.8.1. • Incidents are managed and reported as per Section 7.10. • EP report is submitted to NOPSEMA not more than three months after the anniversary date of the EP acceptance. • 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 Management of Change process detailed in Section 7.8.1.

Role	Responsibilities
	• Oil spill response arrangements are tested as per Section 12.2 of the OPEP. • Audits and inspections are undertaken in accordance with Section 7.12.4.
Activity (Geophysical survey or IMR campaign) Offshore Representative	Ensures: • Activity is carried out in accordance with regulatory requirements and this EP. • Vessel personnel complete the environmental component of the activity induction. • Vessel distances and vessel management practices for marine mammals as per the control measures and environmental performance standards detailed in Table 6-26 and Table 6-27 are communicated to Vessel Master and crew. • Vessel personnel are competent to fulfil their designated role. • HSE issues are communicated via systems such as the daily report and daily pre-start meetings. • Environmental incidents are managed and reported as per Section 7.10. • Emissions and discharges identified in Section 7.12.8 are recorded and provided to the Activity Manager. • Activity 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 7.8.1. • Chemicals that will or may be discharged offshore are assessed as per Section 7.11.2 prior to use. • Weekly vessel inspections are undertaken to ensure ongoing compliance with the EP as per Section 7.12.4.
Vessel Master	Ensure: • Vessel operations are carried out in accordance with regulatory requirements and this EP. • Vessel adheres to the distances and vessel management practices for marine mammals as per the control measures and environmental performance standards detailed in Table 6-26 and Table 6-27. • Environmental incidents are reported to the Activity Offshore Representative within required timeframes as per Section 7.10. • Oil spill response arrangements are in place and tested as per the vessel's SMPEP or equivalent.
Vessel personnel	• Complete project induction. • Report hazards and/or incidents via company reporting processed. • Stop any task that they believe to be unsafe or will impact on the environment.

7.3 Element 2 – Financial Management and Business Planning

Element 2 seeks to ensure robust and achievable business plans are developed and supported by a consistent and realistic understanding of facility constraints. It drives robust analysis and accountable decision-making to deliver assets that maximise lifecycle value, providing clear cost control throughout the life of an asset.

There are four standards (Table 7-1) and ten outcomes to be delivered under this element.

This EP does not cover the risks involved in financial management and impact on the activity. The relevant impacts of financial and business planning risks are managed under the other OEMS elements described in this chapter.

7.4 Element 3 – Information Management and Legal

Element 3 describes the measures Beach must take to ensure ongoing compliance with regulatory and legal obligations in order to protect the Company's value and reputation, and to maintain Beach's licences to operate. Beach's ability to safely perform its duties in line with its legal obligations relies on robust management of documents and information.

There are three standards (Table 7-1) and seven outcomes to be delivered under this element. The standards relevant to the implementation of this EP are described below.

7.4.1 Standard 3.1 – Regulatory Compliance Standard

Standard 3.1 describes the responsibilities of each stakeholder and the processes for identifying, maintaining, managing and reporting Beach's regulatory compliance obligations. The Standard details the minimum requirements of a system to ensure effective Regulator engagement can be maintained across all its activities including permissions, project execution, operating and reporting.

Chapter 2 of this EP details the key environmental requirements applicable to the activity. The acceptability discussion for each aspect is assessed in Chapter 6 and specifically details the environmental requirements pertaining to each aspect.

7.4.2 Standard 3.2 – Document Management Standard

Standard 3.2 specifies the minimum requirements to ensure that all Beach documents and records are managed in alignment with legal, regulatory and stakeholder requirements. It requires documents to be classified, developed, authorised, published, stored, accessed, reviewed and disposed consistently and in a manner that complies with company and statutory obligations. The document management system will clearly support the safe and efficient operations of the Company.

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 Beach document control system ('BoardWalk') for a minimum of five years. These records will be made available to regulators in electronic or printed form upon request.

7.4.3 Standard 3.3 – Information Management Standard

Standard 3.3 ensures that Beach implements appropriate Information Management practices to ensure information is managed as a corporate asset, enabling it to be exploited to support corporate objectives as well as satisfying Beach's legal and stakeholder requirements.

7.5 Element 4 – People, Capability and Health

Element 4 focuses on ensuring the people within the business are fully equipped with the competencies required to perform their assigned duties and are physically and mentally prepared. This element is important in protecting workers' health and is closely aligned with Standard 8.1 (Risk Management) and Standard 8.2 (Safe Systems of Work).

There are two standards (Table 7-1) and four outcomes to be delivered under this element. Standard 4.1 is discussed below, noting that the health management standard is not relevant to the EP.

7.5.1 Standard 4.1 – Training and Competency Standard

Standard 4.1 describes the minimum company requirements to ensure peoples training requirements are identified and meet the tasks they are required to perform, and that verification of competency is carried out where necessary. The Standard defines the responsibilities for ensuring suitable training programmes are available and for ensuring peoples levels of capability are maintained at the required level.

Each employee or contractor with responsibilities pertaining to the implementation of this EP shall have the appropriate competencies to fulfil their designated role.

To ensure that personnel are aware of the EP requirements for the activity all offshore personnel will complete an induction, as a minimum. Records of completion of the induction will be recorded and maintained as per Section 7.4.2. The induction will at a minimum cover:

- Description of the environmental sensitivities and conservation values of the operational area and surrounding waters.
- Controls to be implemented to ensure impacts and risks are ALARP and of an acceptable level.
- 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.
- Requirement for responding to and reporting environmental hazards or incidents.
- Overview of emergency response and spill management plans.
- Fauna sighting and vessel interaction procedures.
- Beach Vessel Whale management Procedure.

In addition to the activity-specific induction, each employee or contractor with specific responsibilities pertaining to the implementation of this EP shall be made aware of their responsibilities, and the specific control measures required to maintain environmental performance and legislative compliance.

7.5.2 Communications

The Otway Operations Manager has responsibility for ensuring that systems are in place to facilitate the communication of HSE issues. Communication is typically via the daily report and daily pre-start meetings; and through the monthly Operations HSE meeting.

The meetings are used to identify and communicate:

- Issues associated with implementation of the EP.
- Any proposed changes to equipment, systems or methods of operation of equipment, where these may be HSE implications.

- Any proposals for the continuous improvement of environmental protection, including the setting of environmental objectives and training schemes.

7.6 Element 5 – Contracts and Procurement

Element 5 addresses the acquiring of external services and materials, and the transportation of those materials. It ensures Beach's business interests are met while maintaining compliance with all legal obligations and retaining HSE performance as the top priority. Element 5 also documents requirements for management of land transport risks.

There are two standards (Table 7-1) and four outcomes to be delivered under this element.

Beach undertakes a pre-qualification of all contractors in which their HSE systems are reviewed to ensure that the contractor's HSE management system (HSEMS) is adequate for meeting their legal obligations and has identified the significant risks and control measures related to the scope of work being undertaken for Beach. This process includes verifying evidence of HSEMS implementation.

Training and competency of contractor personal engaged to work on the activity shall be managed in accordance with the contractor's HSEMS (or equivalent).

Section 7.12.4 details how the contractors will be assessed to ensure they have the capabilities and competencies to implement the control measures identified in Section 6.

7.7 Element 6 – Asset Management

The focus of Element 6 is the design, build and operation of assets. The underpinning standards reflect the importance of inherent safety in design, recognising that hazards and risk are to be reduced to ALARP in the design phase of an asset. The standards define the minimum requirement for the monitoring and assurance processes that support the ongoing safe and reliable management of an asset throughout its lifecycle. Element 6 draws heavily on the principles of process safety and is closely aligned with Elements 7 (Operational Control) and Element 8 (Risk Management).

There are five standards (Table 7-1) and eight outcomes to be delivered under this element.

Equipment that have 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 as detailed in Section 6.

7.8 Element 7 – Operational Control

Element 7 focuses on the definition of parameters, practices and procedures required to ensure adequate controls and safe execution of work at operating assets. It deals with the ongoing management of barrier integrity throughout asset lifecycle, ensuring good process safety practices are consistently deployed, and that facility changes manage holistic risk.

There are three standards (Table 7-1) and ten outcomes to be delivered under this element. The standard of relevance to this EP Management of Change is discussed below.

7.8.1 Standard 7.3 – Management of Change Standard

Standard 7.3 defines the minimum planning and implementation requirements for technical and organisational change at Beach. It details the requirement for holistic assessment of the change, the requirement for consultation with stakeholder’s dependent upon the nature of the change, and the need for clear accountability for the change. Risk associated with change is mitigated by ensuring change is appropriately approved, effectively implemented, formally assured and closed out upon completion. Any changes must be classified as either temporary or permanent.

The intent of the Management of Change (MoC) Standard is that all temporary and permanent changes to the organisation, personnel, systems, procedures, equipment, products and materials are identified and managed to ensure HSE risks arising from these changes remain at an acceptable level.

Changes to equipment, systems and documentation are managed in accordance with the MoC Standard 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 (called ‘Stature’), which provides assurance that all engineering and regulatory requirements have both been considered and met before any change is operational. The MoC process includes not just plant and equipment changes, but also documented procedures where there is an HSE impact, regulatory documents and organisational changes that impact personnel in safety critical roles.

Not all changes require a MoC review. Each change is assessed on a case-by-case basis. The potential environmental impacts and/or risks are reviewed by a member of the Beach Environment Team to determine whether the MoC review process is triggered.

Where risk and hazard review processes nominated in Section 7.9 identify a change in impacts, risks or controls (compared to those described and assessed in Chapter 6), and triggers a regulatory requirement to revise this EP, the revision shall be defined, endorsed, completed and communicated in accordance with the MoC Standard.

7.9 Element 8 – Risk Management and Hazard Control

The identification, assessment and treatment of risk is central to maintaining control of assets. Element 8 defines the means by which Beach manages all types of risk to the business. This element includes general risk management, the Safe Systems of Work by which site activities are controlled and executed, and the emergency and security arrangements in place to protect the Company from unplanned events or the attempts of others to do harm to the business.

There are three standards (Table 7-1) and seven outcomes to be delivered under this element. The standards of relevance to this EP are discussed below.

7.9.1 Standard 8.1 – Risk Management Standard

Standard 8.1 defines Beach’s requirements to mitigate and manage risk at all levels within the business. It defines the Risk Management Framework for identifying, understanding, managing and reporting risks. The framework defines the documents, training, tools and templates to be used, and the accountabilities to be applied in support of effective risk management. Risks to people, the environment, Beach’s reputation, financial position and any legal risks are assessed through the framework. The Standard defines the purpose and use of risk assessments and risk registers. The environmental risk management framework applied to the activity is described in Chapter 5 and applied to all the aspects assessed in Chapter 6 of this EP.

As described in Section 7.12.5, Beach will undertake a review of this EP if required in order to ensure that any changes to the activity, controls, regulatory requirements and information from research, stakeholders, industry bodies or any other sources to inform the EP are assessed using the risk management tools nominated. The review will ensure that the environmental impacts and risks of the activity continue to be reduced to ALARP and an acceptable level.

If revision of this EP is trigged though a change in risk or controls, the revision process shall be managed in accordance with the MoC process outlined in Section 7.8.1.

Additional, or increased, impacts or risks, are identified, outside of the management of change process by the assurance process detailed in Table 7-5.

7.9.2 Standard 8.3 – Emergency and Security Management Standard

Standard 8.3 defines the minimum performance requirements to effectively manage credible emergency and security events, and to enable an efficient recovery to normal operations following such an event. The Standard defines the prevention, preparedness, response and recovery principles to be applied, the organisational structures to support emergency and security measures, and the training and testing protocols that must be in place to assure Beach maintains a state of readiness.

The emergency response framework to be applied to the activity is outlined below.

Emergency Response Framework

The Beach Crisis and Emergency Management Framework consists of a tiered structure whereby the severity of the emergency triggers the activation of emergency management levels. The emergency response framework contains three tiers based on the severity of the potential impact, as outlined in Figure 7-4. This framework is described in the Beach Emergency Management Plan (EMP) (CDN/ID 128025990).

The responsibilities of the Emergency Response Team (ERT), Emergency Management Team (EMT) and Crisis Management Team (CMT) are outlined in Table 7-3

The key emergency response arrangements for the activity are outlined herein.

Beach Emergency Management Plan

The Beach EMP provides the standard mechanism for the EMT to operate from and includes guidance on effective decision-making for emergency events, identification, assessment and escalation of events and provides training and exercise requirements. The EMP provides information on reporting relationships for command, control and communications, together with interfaces to emergency services specialist response groups, statutory authorities and other external bodies. The roles and responsibilities are detailed for onshore and offshore personnel involved in an emergency, including the response teams, onshore support teams, visitors, contractors and employees. The EMP details the emergency escalation protocol depending on the nature of the emergency.

Associated with the EMP are the Emergency Response Duty Roster and Contact Lists. These documents constitute a suite of emergency response documents that form the basis for Beach's response to an emergency situation.

IMR Activity Emergency Response Plan

For IMR activities Beach will prepare a bridging emergency response plan (ERP) that bridges to the emergency response measures in the vessel contractor's vessel-specific ERP to ensure that all emergency management functions are accounted for. The Bridging ERP will be supported by the Beach EMP.

The Bridging ERP will describe the emergency roles and responsibilities for those on the vessel and outline the actions to be taken for potential activity-specific scenarios (e.g., loss of containment, vessel collision, fire, man overboard, fatality, etc). The Bridging ERP will define the communication requirements to notify both the company and external bodies of the incident so as to obtain assistance where needed and to fulfil reporting obligations.

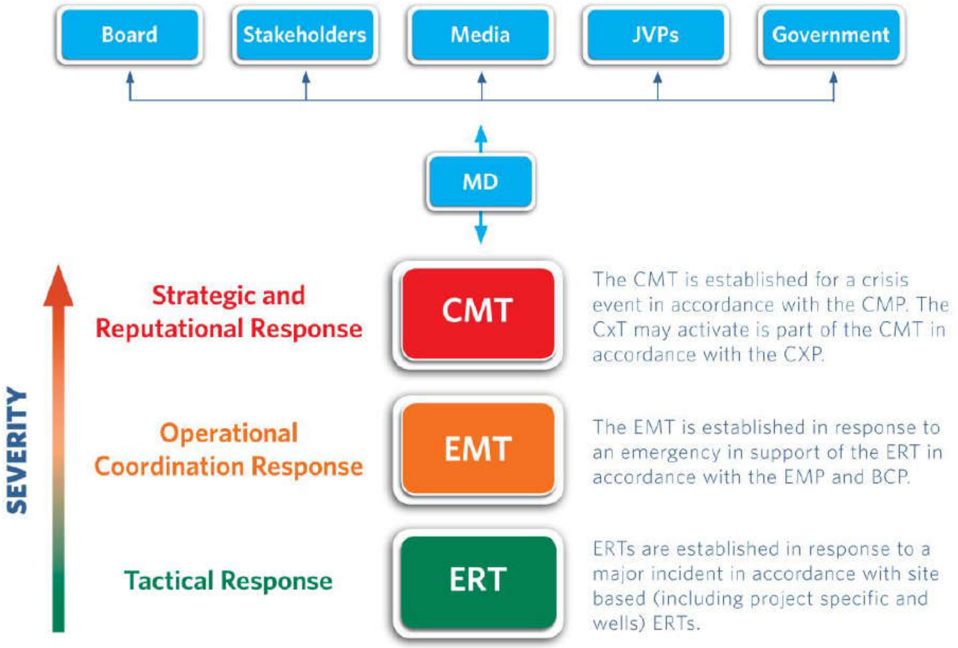


Figure 7-4: Beach Crisis and Emergency Management Framework

Table 7-3: Responsibilities of the Beach Crisis and Emergency Management Teams

Team	Base	Responsibilities
CMT	Adelaide head office	• Strategic management of Beach's response and recovery efforts in accordance with the Crisis Management Plan. • Provide overall direction, strategic decision-making as well as providing corporate protection and support to activated response teams.

Team	Base	Responsibilities
		• Activate the Crisis Management Team (CMT) if required.
EMT	Adelaide, Melbourne	• Provide operational management support to the Emergency Response team to contain and control the incident. • implement the Business Continuity Plan. • Liaise with external stakeholders in accordance with the site-specific Emergency Response Plan. • Regulatory reporting.
ERT	Site Vessel	• Respond to the emergency in accordance with the site-specific ERP.

7.9.3 Oil Pollution Emergency Plan

Oil spill response arrangements associated with Otway Offshore Operations are detailed in the Beach Victorian Offshore Oil Pollution Emergency Plan (OPEP) (CDN/ID 18986979/VIC 1000 SAF PLN).

The COVID-19 pandemic resulted in restrictions or measures being implemented to address the pandemic. These restrictions or measures can potentially impact oil spill response arrangements. For all Beach activities within the Otway Development area, which includes the Otway Offshore Operations, the environmental risk profile has been reviewed with respect to the commitments in EPs and OPEP.

Section 7.12.4 Audits and Assessments and the OPEP Section 10 On-Going Response Preparedness and Exercises detail the processes that Beach will undertake to ensure that oil spill response requirements can be met during operations and for IMR activities.

7.9.4 Operational and Scientific Monitoring Plan

Operational and scientific monitoring arrangement associated with Otway Offshore Operations are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and Otway Offshore Operations OSMP Addendum (CDN/ID 18987652).

The planning area is based on low exposure shoreline, surface and in-water threshold for a diesel or condensate spill. The particular values and sensitivities that may require monitoring in the event of a diesel or condensate spill are detailed in the following Sections:

- Conservation Values and Sensitivities – Section 4.2
- Ecological Environment – Section 4.4
- Biologically Important Areas - Section 4.4.7.2
- Socio-economic Environment – Section 4.5
- First Nations – Section 4.6

7.9.5 Testing of Spill Response Arrangements

The OPEP details the oil spill response testing arrangements.

7.10 Element 9 – Incident Management

Element 9 defines how Beach classifies, investigates, reports and learns from incidents. An incident is any unplanned event or change that results in potential or actual adverse effects or consequences to people, the environment, assets, reputation, or the community.

There is one standard (Table 7-1) and five outcomes to be delivered under this element, with the standard discussed below.

7.10.1 Standard 9.1 – Incident Management Standard

Standard 9.1 defines the requirement for incident notification, reporting and subsequent investigation requirements. It ensures that incident classification is applied consistently across the company, and that the appropriate level of investigation and approval authority is implemented. The standard describes the requirement for identifying and assigning remedial actions, and for communicating key learnings throughout the business. As such, the standard also defines the requirement for adequate training for those persons involved in performing investigations.

The incident management standard requires that all HSE incidents, including near misses, are reported, investigated and analysed to ensure that preventive actions are taken, and learnings are shared throughout the organisation.

Incident reports and corrective actions are managed using the Beach Incident Management System.

Reportable and recordable incidents are identified by the incident notification processes. In addition, recordable incidents are also identified as per the assurance processes detailed in Table 7-5.

As part of the review and investigation of incidents additional, or increased, environmental impacts or risks may be identified. These are managed as per the Management of Change process detailed in Section 7.8.1.

Notification and reporting requirements for environmental incidents to external agencies are provided in Table 7-4.

Table 7-4: Regulatory incident reporting

Requirement	**Timing**	**Contact**	**Responsible Person**
Recordable incident As defined within the OPGGS(E)R a recordable environmental incident is a breach of an EPO or EPS in the EP that applies to the activity that is not a recordable incident.			
As a minimum, the written monthly recordable report must include a description of: • all recordable incidents which occurred during the calendar month; • all material facts and circumstances concerning the incidents that the operator knows or is able to reasonably find out; • corrective actions taken to avoid or mitigate any adverse environmental impacts of the incident; and • corrective actions that have been taken, or may be taken, to prevent	Before the 15th day of the following calendar month	• NOPSEMA – submissions@nopsema.gov.au	Otway Operations Manager

Requirement	Timing	Contact	Responsible Person
a repeat of similar incidents occurring. Regulation 26B of the OPGGS(E)R requires a recordable incident report to be submitted if there is a recordable incident, thus nil reports are not required.			
Reportable incident As defined within the OPGGS(E)R, a reportable incident is an incident relating to the activity that has caused, or has the potential to cause, moderate to significant environmental damage. In the context of the Beach Environmental Risk Matrix moderate to significant environmental damage is defined as any incident of actual or potential consequence category Serious (3) or greater. These risks include: • pipeline or well loss of containment. • vessel collision resulting in a loss of containment or otherwise. • introduction of marine pests to the operational area			
Verbal notification The notification must contain: • all material facts and circumstances concerning the incident; • any action taken to avoid or mitigate the adverse environmental impact of the incident; and • the corrective action that has been taken or is proposed to be taken to stop control or remedy the reportable incident.	Within two hours of becoming aware of incident	• NOPSEMA – 1300 674 472 • NOPSEMA – submissions@nopsema.gov.au • DEECA – marine.pollution@ecodev.vic.gov.au (0409 858 715) • NOPTA – reporting@nopta.gov.au	Otway Operations Manager
Written notification Verbal notification of a reportable incident to the regulator must be followed by a written report. As a minimum, the written incident report will include: • the incident and all material facts and circumstances concerning the incident; • actions taken to avoid or mitigate any adverse environmental impacts; • the corrective actions that have been taken, or may be taken, to prevent a recurrence of the incident; and • the action that has been taken or is proposed to be taken to prevent a similar incident occurring in the future.	Not later than 3 days after the first occurrence of the incident	• NOPSEMA – submissions@nopsema.gov.au	Otway Operations Manager

Requirement	Timing	Contact	Responsible Person
Written incident reports to be submitted to NOPTA and DEECA (for incidents in Commonwealth waters).	Within 7 days of written report submission to NOPSEMA	• DEECA – marine.pollution@ecodev.vic.gov.au • NOPTA – reporting@nopta.gov.au	Otway Operations Manager
Vessel spill to marine environment All discharges /spills or probable discharges/spills to the marine environment of oil or oily mixtures, or noxious liquid substances in the marine environment from vessels. Reporting info: http://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf.	Verbal notification ASAP	Immediate notification by the Vessel Master to AMSA. Follow-up with Marine Pollution Report (POLREP). • Ph: 1800 641 792 • Email: rccaus@amsa.gov.au • AMSA POLREP: https://amsa-forms.nogginoca.com/public/	Vessel Master
Australian Marine Park (AMP) In the event an AMP may be exposed to hydrocarbons	Verbal notification ASAP	• Marine Park Compliance Duty Officer – 0419 293 465 Notification must be provided to the Director of National Parks and include: • titleholder details • time and location of the incident (including name of marine park likely to be affected) • proposed response arrangements as per the OPEP (e.g. dispersant, containment, etc.) • confirmation of providing access to relevant monitoring and evaluation reports when available • contact details for the response coordinator. Note: DNP may request daily or weekly Situation Reports, depending on the scale and severity of the pollution incident.	EMT Lead (or delegate)
Vessel strike with cetacean	Within 72 hours	• DCCEEW – online National Ship Strike Database https://data.marinemammals.gov.au/report/shipstrike	Vessel Master
	ASAP for cetacean injury assistance	• DEECA Whale and Dolphin Emergency Hotline – 1300 136 017	Vessel Master / Operations Environment Advisor

Requirement	Timing	Contact	Responsible Person
		• Seals, Penguins or Marine Turtles 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678.	
Injury to or death of EPBC Act-listed species	Within seven days	• DCCEEW – 1800 803 772 • EPBC.Permits@environment.gov.au	Operations Environment Advisor
Suspected or confirmed Invasive Marine Species introduction	Verbal notification ASAP	• Agriculture Victoria 136 186 marine.pests@agriculture.vic.gov.au	Operations Environment Advisor
Identification of any historic shipwrecks, aircraft or relics	Written notification within 1 week	• Written notification via the notification of discovery of an historic shipwreck or relic online submission form.	Otway Operations Manager

7.11 Element 10 – Environment and Community

Element 10 focuses on the measures the organisation must take to ensure that it upholds its reputation as a responsible and ethical company and continues its open and transparent engagements with its communities and stakeholders. Beach operates in environmentally sensitive areas, in close proximity to communities, with potential impacts on stakeholders. Beach has an obligation to ensure that potential impacts from its activities are clearly identified, minimised to ALARP and mitigated where there is an economic loss to a stakeholder directly impacted by Beach activities.

There are two standards (Table 7-1) and three outcomes to be delivered under this element, with the standards discussed below.

7.11.1 Standard 10.1 – Environment Management Standard

Standard 10.1 ensures that Beach implements appropriate plans and procedures to conduct its operations in an environmentally responsible and sustainable manner. The standard defines the requirement to assess environmental impacts and risks that may result from the company's operations and for site-specific management plans to protect the environment from harm. The standard covers land disturbance, reinstatement and rehabilitation activities, and defines obligations for management of biodiversity, water systems, air quality, noise and vibration, amenities and waste.

This EP provides the key means of satisfying this OEMS standard. Two process identified as controls in Section 6 are described below.

7.11.2 Chemical Management Plan

The Hazardous Materials and Secondary Containment Directive addresses the management of hazardous substances and dangerous goods (termed "hazardous materials") on Beach controlled sites/facilities.

The Beach Chemical Management Plan (S400AD719917) is used to assess chemicals that could be discharged to the marine environment to ensure that the impacts and risks associated with offshore discharge are reduced to ALARP. It considers aquatic toxicity, bioaccumulation and persistence data, along with the discharge concentration, duration, frequency, rate, and volume to assess chemicals that may or will be discharged to the marine environment. The assessment and outcome is recorded on the Offshore Chemical Register.

Figure 7-5 provides a summary of the offshore chemical environmental risk assessment process.

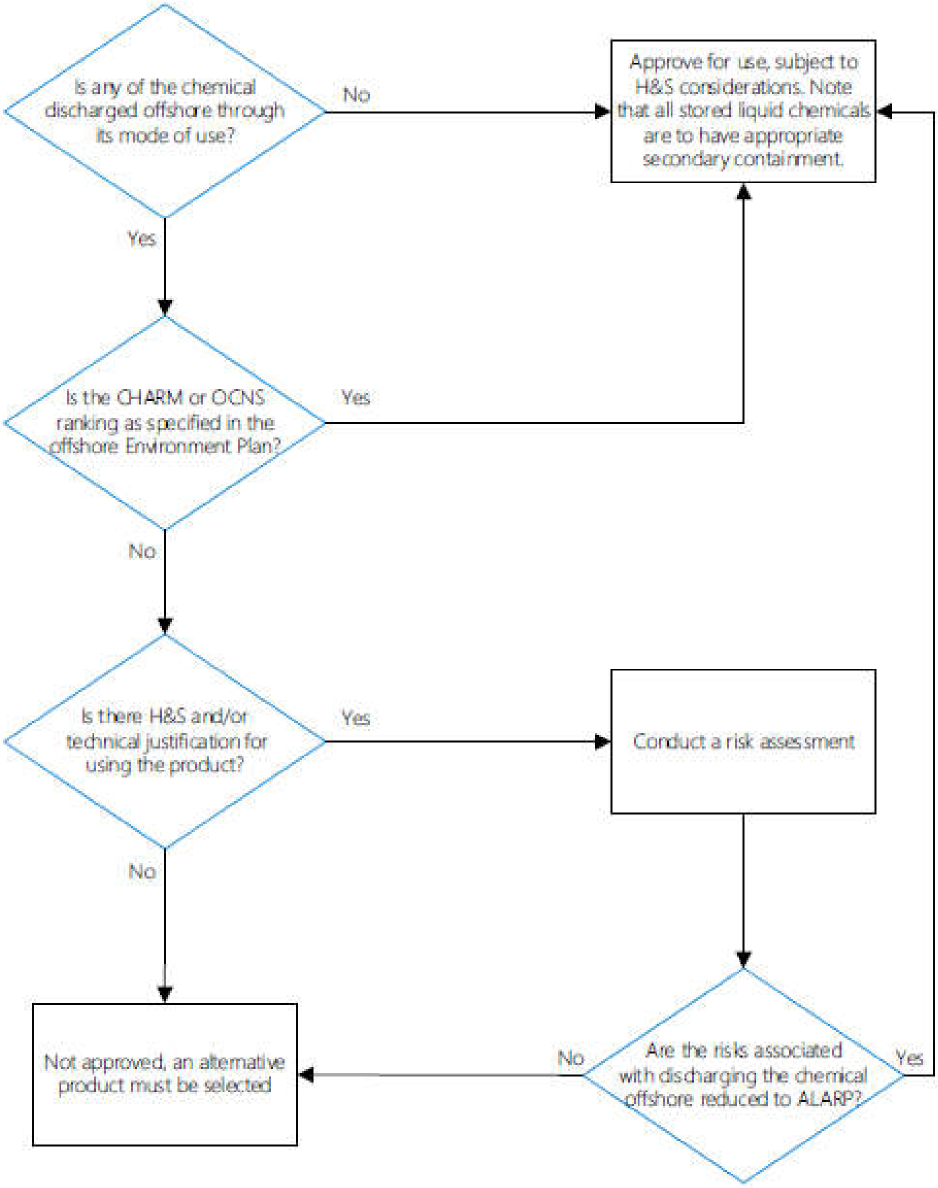


Figure 7-5: Beach Offshore Chemical Environmental Risk Assessment Process Summary

7.11.3 Beach Energy Domestic IMS Biofouling Risk Assessment Process

Scope

All MODUs, vessels and submersible equipment mobilised from domestic waters to undertake offshore petroleum activities within the operational area must complete the Beach Domestic IMS Biofouling Risk Assessment Process as detailed in the Beach Introduced Marine Species Management Plan (S400AH719916) prior to the initial mobilisation into the operational area.

This domestic IMS biofouling risk assessment process does not include an evaluation of potential risks associated with ballast water exchange given all MODU and vessel operators contracted to Beach must comply with the most recent version of the Australian Ballast Water Management Requirements.

Purpose

- Validate compliance with regulatory requirements (Commonwealth and State) in relation to biosecurity prior to engaging in petroleum activities within the operational / project area.
- Identify the potential IMS risk profile of MODUs, vessels and submersible equipment prior to deployment within the operational / project area.
- Identify potential deficiencies of IMS controls prior to entering the operational area.
- Identify additional controls to manage IMS risk.
- Prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational / project area).

Screening Assessment

Prior to the initial mobilisation of the MODU, vessels or submersible equipment to the operational / project area, a screening assessment must be undertaken considering:

- All relevant IMO and regulatory requirements under the Australian Biosecurity Act 2015 and/or relevant Australian State or Territory legislation must be met.
- If mobilising from a high or uncertain risk area, the MODU / vessel / submersible equipment must have been within that area for fewer than 7 consecutive days or inspected and deemed low-risk by an independent IMS expert, within 7 days of departure from the area.
- Vessels must have valid antifouling coatings based upon manufacturers specifications.
- Vessels must have a biofouling control treatment system in use for key internal seawater systems.
- MODUs and vessels must have a Biofouling Management Plan and record book consistent with the International Maritime Organization (IMO) 2011 Guidelines for the control and management of ships' biofouling to minimize the transfer of invasive aquatic species (IMO Biofouling Guidelines).

Where relevant criteria have been met, no further management measures are required, and the MODU / vessel / submersible equipment may be deployed into the operational / project area.

Where relevant criteria have not been met, or there is uncertainty if these criteria have been met, Beach must engage an independent IMS expert to undertake a detailed biosecurity risk assessment, and the MODU / vessel / submersible equipment must be deemed low-risk prior to mobilisation into the operational / project area.

Basis of Detailed IMS Biofouling Risk Assessment

The basis by which an independent IMS expert evaluates the risk profile of a MODU / vessel / submersible equipment includes:

- The age, type and condition of the MODU / vessel / submersible equipment.
- Previous cleaning and inspection undertaken and the outcomes of previous inspections.
- Assessment of internal niches with potential to harbour IMS.
- The MODU / vessel / equipment history since previous inspection.
- The origin of the MODU / vessel / submersible 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 / project area.
- The mobilisation method – whether dry or in-water (including duration of low-speed transit through high or uncertain risk areas).
- For vessels, the application, age and condition of antifouling coatings.
- presence and condition of internal seawater treatment systems.
- Assessment of Biofouling Management Plan and record book against IMO Biofouling Guidelines.
- Where appropriate, undertake in-water inspections.

7.11.4 Standard 10.2 – Community Engagement Standard

Standard 10.2 defines the minimum requirements for the conduct of Beach and its staff within the community, and the commitments to plan and execute effective community engagement in the course of its business. Beach staff will conduct themselves as ambassadors for the company and engage positively and respectfully with the community.

The standard describes the obligation of the company to proactively engage with the community at the outset of any activity that may have an impact on that community, and to develop a stakeholder engagement plan to manage that engagement.

Stakeholder consultation specific to the activity is discussed in Section 8 of this EP.

7.12 Element 11 – Assurance and Reporting

Element 11 establishes that the company must apply the requirements of relevant policies, and the commitments detailed in the OEMS standards throughout its activities. An assurance process therefore exists to systematically quantify compliance with those commitments, and with the underlying procedures and systems. This Element also documents Beach's approach to sustainability and reporting company performance using established sustainability performance metrics.

There are two standards (Table 7-1) and four outcomes to be delivered under this element, with the standards relevant to the activity discussed below.

7.12.1 Standard 11.1 – Sustainability Standard

The purpose of this standard is to operationalise the requirements established by the Company's Sustainability Policy and other associated Beach policies. The standard details how Beach incorporate environmental, social and government requirements into the Board, sustainability reporting, performance monitoring and evaluation, company and project risk assessments and emissions reduction assessments and activities.

7.12.2 Standard 11.2 – Assurance Management Standard

Standard 11.2 describes the "Three Lines of Defence" assurance model employed by Beach to govern its activities and ensure compliance with its commitments and standards. The standard defines Beach's requirements for the establishment and management of risk-based assurance activities at all levels within the company. The assurance process establishes the adequacy and effectiveness of Beach's risk controls and quantifies the status of compliance against our obligations. It ensures the organisation proactively closes any gaps in performance so it can address those issues before harm is manifested. As such, the assurance programme identifies improvement opportunities in business processes and risk controls.

The Standard describes the need to have assurance plans across the business, and for the assurance activities to take place on multiple levels of the organisation. This approach collectively ensures the operational activities Beach perform are compliant with its procedures, standards and ultimately with governing policies and legislative obligations. The holistic results of the assurance programme are reportable to the Board and Committees.

7.12.3 EP Assurance

Table 7-5 provides a summary of the processes (*specific measures*) undertaken by Beach to ensure that for the duration of the activity:

- The environmental impacts and risks of the activity continue to be identified and reduced to a level that is ALARP.
- Control measures detailed in this EP are effective in reducing the environmental impacts and risks of the activity to ALARP and an acceptable level.
- Environmental performance outcomes and standards set out in this EP are being met.

Non-compliances and opportunities for improvements identified via the assurance processes in Table 7-5 and the following sections are communicated to the appropriate supervisor and/or manager to report and action in a timely manner. Tracking of non-compliances and actions is undertaken using Beach's incident management system which includes assigning a responsible person for ensuring the action is addressed and closed out. Any additional, or increased, impacts or risks identified are managed as per the Management of Change process detailed in Section 7.8.1.

Where an assurance processes identifies a breach of an EPO or EPS in the EP this will be reported as a recordable incident as per Table 7-4.

Table 7-5: Otway Operations EP Assurance Processes

Process	Frequency	Responsible
EP Assurance Checks covering: • EPOs, EPS and implementation strategy requirements. See Section 7.12.4.	As detailed in Table 7-6.	Senior Environment Advisor
Incident reviews and investigations covering:		
• Review of all incidents to identify any recordable incidents and reportable incidents and any additional, or increased, environmental impacts or risks.	Weekly	Senior Environment Advisor
• Reporting and investigation of incidents to identify recordable and reportable incidents and any additional, or increased, environmental impacts or risks. See Section 7.10.	As required	Otway Production Manager with support from Senior Environment Advisor
Otway Operations Environmental Impact and Risk Register to ensure impacts and risks continue to be ALARP and an acceptable level and any additional, or increased, environmental impacts or risks identified.	Annually	Senior Environment Advisor
Activity (geophysical survey or IMR campaign impact) and risk review to ensure impacts and risks can be manage to ALARP and an acceptable level and any additional, or increased, environmental impacts or risks identified.	As required	Project Manager
EP Performance Report covering: • Review of EPOs and EPs. See Section 0.	Annually	Senior Environment Advisor
Otway Operations emissions and discharge records See Section 7.12.8.	As detailed in Table 7-8	Senior Optimisation Engineer

7.12.4 Audits and Inspections

The Otway Offshore Operations Environment Plan Assurance Checklists (TAS 9100 ENV REG) details the assurance checks required to ensure that for the duration of the EP:

- EPOs, EPSs and implementation strategy requirements are met.
- Controls measures are effective in reducing the environmental impacts and risks of the activity to ALARP and acceptable levels
- Any additional, or increased, impacts or risks are identified.

Table 7-6 details the Assurance Checks undertaken and the timing of these checks.

The assurance checks are scheduled in CMMS to ensure they are undertaken as per the timing in Table 7-6.

Non-compliances and opportunities for improvements identified via assurance checks or any other means are communicated to the appropriate supervisor and/or manager to report and action in a timely manner. Any additional, or increased, impacts or risks identified are managed as per the Management of Change process detailed in Section 7.8.1. Tracking of non-compliances and actions is undertaken using Beach's incident management system which includes assigning a responsible person for ensuring the action is addressed and closed out.

Where an assurance check identifies a breach of an EPO or EPS in the EP this will be reported as a recordable incident as per Table 7-4.

The assurance checks inform the annual performance report submitted to the relevant regulator as per Section 0.

Table 7-6: Otway EP Assurance Checks

Timing	**Assurance Check**
Once	EPOs, EPSs and implementation strategy requirements to be reviewed once during the life of the EP. These have been identified as those requirements that are not likely to change over the 5-year period of the EP or are only implemented or undertaken once during the lifetime of the EP.
Vessel including platform support, geophysical surveys and IMR	EPOs and EPSs and implementation strategy requirements applicable to vessels used to support the platform or undertake geophysical surveys or IMR campaigns. This checklist is undertaken prior to a vessel being engaged be Beach for an activity under this EP.
Annual Office	EPOs and EPSs and implementation strategy requirements that can be reviewed in the office. These have been identified as those requirements that are not likely to change over a one-year period or are only undertaken annually.
Annual Platform including workovers	EPOs and EPSs and implementation strategy requirements that are required to be reviewed on the platform or require information from the platform. These have been identified as those requirements that are not likely to change over a one-year period or are only undertaken annually.
6 Monthly Office	EPOs and EPSs and implementation strategy requirements that can be reviewed in the office. These have been identified as those requirements that are likely to change or are required to be undertaken within a 6 -month period. They are also more likely to be critical controls.

Timing	Assurance Check
6 Monthly Platform	EPOs and EPSs and implementation strategy requirements that are required to be reviewed on the platform or require information from the platform. These have been identified as those requirements that are likely to change or are required to be undertaken within a 6 -month period. They include critical controls.
Quarterly Platform	EPOs and EPSs and implementation strategy requirements that are required to be reviewed on the platform or require information from the platform. These have been identified as those requirements that are likely to change or are required to be undertaken within a quarterly period. They include critical controls.

Operations

As detailed in Table 7-6 assurance checks are undertaken for Otway operations based on a defined interval which has been determined based on the frequency that the control is implemented or undertaken and how critical the control is in managing the impact or risk to an acceptable level and ALARP.

The assurance check consists of reviewing this EPs EPOs, EPSs and implementation strategy requirements applicable to the Otway operations.

Where a vessel assurance check identifies a breach of an EPO or EPS in the EP that applies to the activity this will be reported as a recordable incident as per Table 7-4.

IMR or geophysical surveys – Vessel Activities

As detailed in Table 7-6 a pre-mobilisation assurance check is undertaken at least two weeks prior to commencement of vessel operations. The assurance check consists of reviewing this EPs EPOs, EPSs implementation strategy requirements applicable to the vessel activity (platform support, geophysical survey or IMR campaign).

In addition, for geophysical surveys and IMR campaigns the following will be undertaken:

- Vessel weekly offshore inspection throughout the activity to ensure ongoing compliance with relevant EP requirements. Inspection will include, but not be limited to:
    - Spill preparedness such as spill kit checks.
    - Waste management.
    - Review of any new or changed chemicals that maybe discharged offshore.
    - Validation compliance with EPOs and EPSs relevant to vessel activity are maintained.

Where a vessel assurance check identifies a breach of an EPO or EPS in the EP that applies to the activity this will be reported as a recordable incident as per Table 7-4.

7.12.5 Environment Plan Review

Beach may determine that a review of the EP is required when one or more of the following occurs:

- Changes to impacts and risks and/or controls identified during the activity.

- Annual environmental performance reporting identifies issues in the EP that require review and/or updating.
- Implementation of corrective actions to address internal audits findings or external inspection recommendations.
- 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 to risk and controls identified through the Risk Management Processes as per Section 7.9.
- New information or changes in information from stakeholders, research and studies, protected species, legal and other requirements. This shall be achieved by:
    - Subscription to regulator and relevant industry distribution lists (such as APPEA and IOGP).
    - Subscription to the NOPSEMA website to identify any new petroleum activities within the Otway Basin that may overlap with the Otway Operations locations and timings.
    - Annual review of the EP inclusive of relevant regulatory requirements (when in force for longer than 12 months).
    - Ongoing Stakeholder communications.

Where the EP is revised it will be logged in Section 10 (Document Information and History).

Any revisions to the EP are to be assessed against the criteria for submission of a revised EP to NOPSEMA as detailed in Table 7-7 and Management of Change as per Section 7.8.1 shall be evaluated.

7.12.6 Environment Plan Revision

In accordance with Regulation 17 of the OPGGS(E)R, a revision of this EP shall be submitted to NOPSEMA as per the regulatory requirements in Table 7-7.

Table 7-7: Regulatory requirements for submission of a revised EP

OPGGS(E)R	EP Revision Submission Requirements
17(1)	With the regulator’s approval before the commencement of a new activity.
17(5)	Before the commencement of any significant modification or new stage of the activity that is not provided for in the EP as currently in force.
17(6)	Before, or as soon as practicable after, the occurrence of any significant new or significant increase in environmental impact or risk; or The occurrence of a series of new or a series of increases in existing environmental impacts or risks which, taken together, amount to the occurrence of a significant new or significant increase in environmental impact or risk.
17(7)	A change in titleholder that results in a change in the manner in which the environmental impacts and risks of an activity are managed.

Revisions and re-submission of the EP generally centre around 'new' activities, impacts or risks and 'increased' or 'significant' impacts and risks. Beach defines these terms in the following manner:

New impact or risk – one that has not been assessed in Section 6.

Increased impact or risk – one with greater extent, severity, duration, or uncertainty than is detailed in Section 6.

Significant change –

- The change to the activity 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 3.
- The change affects the ability to achieve ALARP or acceptability for the existing impacts and risks described in Section 6.
- The change affects the ability to achieve the EPO and EPS contained in Section 6.

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 6; 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 Guideline When to submit a proposed revision of an EP (N04750-GL1705, Rev 1, January 2017).

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 risks and impacts of the activity do not trigger a requirement for a revision, as outlined in Table 8.9.
- Minor revisions to the EP will not be submitted to the regulators for formal assessment. Minor revisions will be tracked in the document control system.

7.12.7 Annual Performance Report

In accordance with OPGGS(E) Regulation 14(2), Beach will submit a report on the environmental performance of the activity to NOPSEMA. Performance will be measured against the EPOs and EPSs described in this EP. The report will be submitted not more than three months after the anniversary date of the EP acceptance by NOPSEMA. The interval between reports will not be more than one year.

7.12.8 Emissions and Discharge Records

In accordance with OPGGS(E) Regulation 14(7), emissions and discharges shall be recorded for the duration of the activity. Table 7-8 details the types of emissions and discharges that shall be recorded including the monitoring method and frequency of reporting. Air emissions (from fuel combustion and venting) are reported annually as part of statutory National Greenhouse and Energy Act (NGER) 2007 reporting and National Pollution Inventory (NPI) reporting.

Table 7-8: Emissions and discharges monitoring requirements

Emission / Discharge	Monitoring parameter	Recording method	Reporting frequency	Responsibility
Fuel	Volume of gas used	Monthly monitoring	Monthly	Otway Operations Manager
Venting	Volumes	Monthly monitoring	Monthly	Otway Operations Manager
Hydraulic control fluids	Chemical name Volume discharged	Monthly monitoring, calculated annually based on tank replenishment and cargo manifests	Monthly	Otway Operations Manager
IMR Vessel				
Fuel	Volume used	Daily report	Monthly	Vessel Operator
Bilge	Volume discharged	Oil record Book	As required	Vessel Operator
Sewage	Volume discharged	Garbage record book	As required	Vessel Operator
Putrescible food	Volume discharged	Garbage record book	As required	Vessel Operator

7.12.9 Marine Mammal Sighting Reports

Marine mammal sightings will be recorded and submitted to DCCEEW via the National Marine Mammal Data Portal. Sightings will be reported within 1 month of sighting occurring or two months of the end of a geophysical survey.

8 Stakeholder Consultation

8.1 Consultation Background

The Otway Development commenced production in late February 2008. Woodside Energy, the titleholder at the time, undertook significant consultation with the community, non-government organisations and Government departments. Consultation has been ongoing through the change of titleholders to Origin Energy and then Lattice Energy and now Beach.

In 2017 Lattice commenced consultation in relation to the Otway Development Project which included the Geographe and Thylacine subsea wells and associated seabed assessment and drilling activities. Beach then commenced consultation with stakeholders in early 2019 when they decided to progress with the Otway Development Project.

Activities for the Otway Offshore Project have run over several phases and many years, beginning with seabed assessments, drilling of exploration wells and production wells in the Geographe and Thylacine gas fields, and installation of seabed infrastructure to support tie-in of the wells to the existing Thylacine-A Platform and pipeline. Notwithstanding the requirements for separate activity EPs, Beach has undertaken a holistic approach throughout its consultations with Relevant Persons, by explaining how each activity supports the Otway Offshore Project.

This activity cover the operation of the Otway Development with the inclusion of production from the Thylacine subsea wells.

In early 2019, consultation with Relevant Persons (including Commonwealth and State government departments) specifically included information that explained the Otway Offshore Project with the aim to bring online production from the Geographe and Thylacine subsea wells.

Consultation with Relevant Persons has continued throughout the Otway Offshore Project, and specifically for the purpose of developing numerous EPs for those activities. Information regarding consultation for the Otway Offshore Development including production from the Thylacine subsea wells can be found in the following accepted EPs:

- Otway Offshore Operations EP (CDN/ID 17275058)
- Artisan Exploration Drilling EP (CDN/ID S4810AH717904)
- Otway Development Drilling and Well Abandonment EP (CDN/ID S4100AH717905)
- Otway Phase 5 Early Dive Installation Campaign EP (CDN/ID S4130AF725242)
- Thylacine Subsea Installation & Commissioning (T/L2 and T/L4) (CDN/ID: S4121AF728393)

These EPs, along with all Beach's accepted EPs, can be viewed on the NOPSEMA website.

8.2 Consultation Purpose

In addition to the consultation described in Section 8.1, Beach has undertaken further consultation with existing and additional Relevant Persons, to ensure compliance with the appeal decision of Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193 (appeal decision) on 2 December 2022, which from this date, represents the law regarding requirements for consultation in accordance with the

Environment Regulations, and NOPSEMA Guideline Consultation in the Course of Preparing an Environment Plan.

Beach also undertakes consultation in accordance with internal policies and procedures including:

- Community Engagement Policy
- Community Engagement Standard BST 10.2

8.3 Applicable Regulations

Table 8-1 details the relevant consultation regulatory requirements from the OPGGS(E) Regulations.

Table 8-1: Applicable Consultation Regulatory Requirements

Legislation	**Summary**	**Requirement**
OPGGS Act S 280	No interference	A person carrying out activities in an offshore permit area should not interfere with other users of the offshore area to a greater extent than is necessary for the reasonable exercise of the rights and performance of the duties of the first person.
OPGGS(E)R 13	Environment description	Description of the environment (2) The environment plan must: (a) describe the existing environment that may be affected by the activity; and (b) include details of the particular relevant values and sensitivities (if any) of that environment. Note: The definition of environment in regulation 4 includes its social, economic and cultural features. (3) Without limiting paragraph (2)(b), particular relevant values and sensitivities may include any of the following: (a) the world heritage values of a declared World Heritage property within the meaning of the EPBC Act; (b) the national heritage values of a National Heritage place within the meaning of that Act; (c) the ecological character of a declared Ramsar wetland within the meaning of that Act; (d) the presence of a listed threatened species or listed threatened ecological community within the meaning of that Act; (e) the presence of a listed migratory species within the meaning of that Act; (f) any values and sensitivities that exist in, or in relation to, part or all of: (i) a Commonwealth marine area within the meaning of that Act; or (ii) Commonwealth land within the meaning of that Act.
OPGGS(E)R 11A	Relevant persons	(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;

Legislation	Summary	Requirement
		b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant; c) the Department of the responsible State Minister, or the responsible Northern Territory Minister; d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan; e) any other person or organisation that the titleholder considers relevant.
OPGGS(E)R 11A	Sufficient Information	(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.
OPGGS(E)R 11A	Reasonable period	(3) The titleholder must allow a relevant person a reasonable period for the consultation.
OPGGS(E)R 11A	Sensitive information	(4) The titleholder must tell each relevant person the titleholder consults that: (a) the relevant person may request that particular information the relevant person provides in the consultation not be published; and (b) information subject to such a request is not to be published under this Part.
OPGGS(E)R 9(8)	Sensitive information	All sensitive information (if any) in an environment plan, and the full text of any response by a relevant person to consultation under regulation 11A in the course of preparation of the plan, must be contained in the sensitive information part of the plan and not anywhere else in the plan.
OPGGS(E)R 14(9)	Ongoing consultation	The implementation strategy must provide for appropriate consultation with: (a) relevant authorities of the Commonwealth, a State or Territory; and (b) other relevant interested persons or organisations.
OPGGS(E)R 16(b)	Consultation report	The environment plan must contain: (b) a report on all consultations under regulation 11A of any relevant person by the titleholder, that contains: i. a summary of each response made by a relevant person; and ii. an assessment of the merits of any objection or claim about the adverse impact of each activity to which the environment plan relates; and iii. a statement of the titleholder's response, or proposed response, if any, to each objection or claim; and iv. a copy of the full text of any response by a relevant person.
OPGGS(E)R 10A	Measures adopted from consultations are appropriate	For regulation 10, the criteria for acceptance of an environment plan are that the plan: (g) demonstrates that: (i) the titleholder has carried out the consultations required by Division 2.2A; and (ii) the measures (if any) that the titleholder has adopted, or proposes to adopt, because of the consultations are appropriate;

8.4 Applicable Case Law & Guidance

The OPGGS(E) Regulations are the legal basis for undertaking offshore operations in the oil and gas industry. These regulations are administered by NOPSEMA who are responsible for ensuring compliance.

A judicial review of a NOPSEMA decision to accept the Barossa Development Drilling and Completions Environment Plan was undertaken by Justice Bromberg. Justice Bromberg found in favour of the Applicant (Dennis Murphy Tipakalippa) that NOPSEMA could not be reasonably satisfied that all relevant persons were consulted as is required under regulations 10A and Division 2.2A and set aside the accepted EP (Tipakalippa v National Offshore Petroleum Safety and Environmental Management Authority (No. 2) [2022] FCA 1121 (the Decision)).

Santos NA Barossa Pty Ltd appealed the Decision made by Justice Bromberg, with a hearing held 15 – 16 November 2022. Justices Kenny, Mortimer and Lee reviewed the decision, found in favour of the Applicant, and confirmed that Santo's EP should be set aside (Santos NA Barossa Pty Ltd v Tipakalippa [2022] FCAFC 193 (the Appeal)).

Based on these findings NOPSEMA developed a Guideline "Consultation in the course of preparing an environment plan Doc No N-04750-GL2086 A900179" to assist Titleholders in comply with their obligations to consult relevant persons.

Some of the key findings from the Appeal are listed below:

The Appeal

[46] Third, we observe that reg 11A(1) provides for a statutory concept of "relevant person", and that this concept is broader than the meaning ordinarily given to "person" by s 2C of the Acts Interpretation Act 1901 (Cth). Rather, reg 11A creates an artificial definition. For example, certain Departments of the Commonwealth, the States and the Northern Territory are expressed to be a "relevant person" (singular), notwithstanding that a Department is not ordinarily classified as a 'person' either under that Act or ordinary English usage (not being a body politic or corporate, or an individual).

[57] The consultation under reg11A is also designed to ensure that the titleholder adopts appropriate measures in response to concerns conveyed to the titleholder by the affected authorities, organisations and individuals: see reg 10A(g)(ii). Equally importantly, the titleholder is obliged to inform NOPSEMA of the identity of the affected authorities, organisations and individuals, the nature of the titleholder's consultation with them, and the measures that the titleholder has adopted or proposes to adopt to meet the concerns notified to the titleholder in the consultations: reg 10A(g). Construed in this way, the Regulations are directed to fulfilling their objects, consistently with the EPBC Act.

[88] Santos and NOPSEMA submitted that the construction of the term 'interests' must permit the ready ascertainment of persons who may have those interests. In oral argument, senior counsel for NOPSEMA agreed that persons with "interests" must be "reasonably capable of ascertainment". We accept this later proposition, but we do not consider that this tends against the conclusion we have reached.

[89] Regulation 11A, like most statutory consultation provisions, imposes an obligation that must be capable of practicable and reasonable discharge by the person upon whom it is imposed…

[154] As outline above, there is a separate public comment regime in regs 5C and 11B. This means that a person with no greater interest in the proposed activity than any other member of the public will, to the extent they wish to make comment, be left to this regime. However, reg 11A serves a quite different purpose, and is triggered upon a person or organisation being of a particular type or having a characteristic that is already in existence, being a function, interest or activity (reg 11A(1)(d)), or because the titleholder considers them relevant (reg 11A(1)(e)). At risk of repetition, given the object of the consultation regime, and contrary to submissions of Santos, this does not point to any narrow reading of what constitutes a relevant "interest". Put simply, if an interest (in its usual sense) is readily recognisable to the titleholder as being an existing interest over and above a member of the public at large then there is an "interest" as used in reg 11A(1)(d).

[46] notes that a 'relevant person' is broader than an individual and can comprise an organisation and an authority. This is definition used in this EP.

[88], [89], and [154] relate to relevant persons being reasonably ascertainable, that obligation to consult must be practicable and reasonable to discharge and that an "interest" being an existing interest over and above a member of public at large.

[57] provides the driver for consultation with a relevant person in that the titleholder adopts appropriate measures in response to concerns conveyed to them.

NOPSEMA's Guideline provides the Regulators interpretation of the Decision and the Appeal. It clarifies what are considered to Functions, Activities and Interests under reg 11A(1)(d). These are:

Functions	Refers to "a power or duty to do something".
Activities	to be read broadly and is broader than the definition of 'activity' in regulation 4 of the Environmental Regulations and is likely directed to what the relevant person is already doing
Interests	to be construed as conforming with the accepted concept of "interest" in other areas of public administrative law

Includes "any interest possessed by an individual whether or not the interest amounts to a legal right or is a proprietary or financial interest or relates to reputation"

It should be noted that the Decision and the Appeal define the legal requirements of consulting with relevant persons and take primacy over the NOPSEMA Guidelines.

8.5 Relevant Persons Identification Methodology

8.5.1 Relevant Person Methodology Workflow

Beach has carried out a methodological approach to identifying Relevant Persons in accordance with the Regulations, case law and NOPSEMA guidance. The primary steps of this methodology are summarised in Figure 8-1.

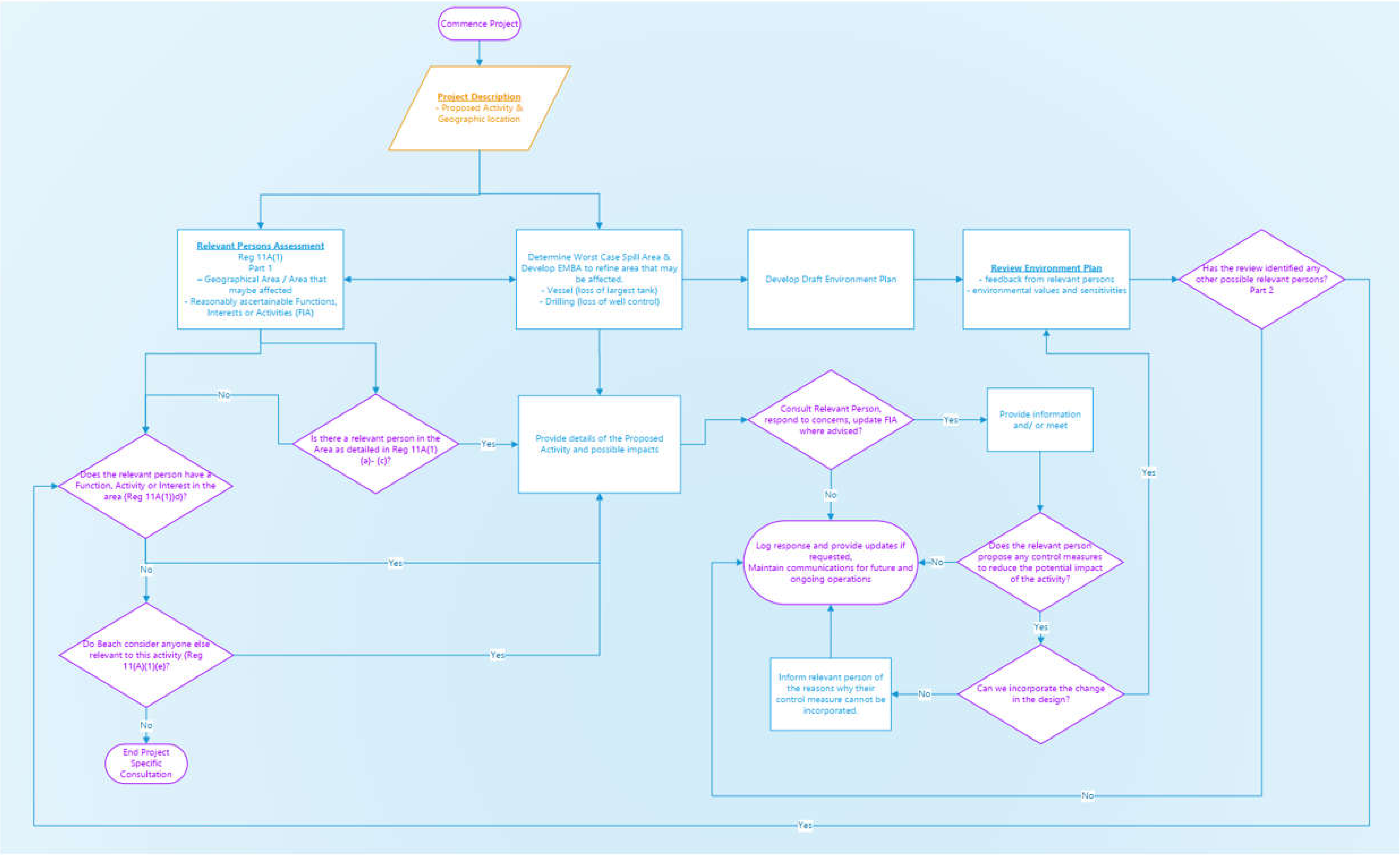


Figure 8-1: Relevant Person Methodology

8.6 Proposed Activity

Section 3 provides details the activity description which covers the operation, inspection, maintenance, and repair (and associated activities) of the offshore assets associated with the Otway Gas Development.

8.7 Spatial Extent of Environment that may be Affected

Section 4 describes the existing environment within the may be affected within the Operational Area and the Planning Area.

Table 8-2 summarises the Operational Area and the Planning Area descriptions, used in the first step in identification of Relevant Person categories that is set out in Table 8-3.

The Operational Area is described in Section 3.2. The Planning Area is a broader area defined for potential impact in the event of an accidental release of condensate or MDO. The defined Planning Area enables the identification and description of the existing environment that may be affected, the values and sensitivities in that environment, and for emergency response management planning.

Table 8-2: Spatial Extent of Environment that may be affected

Environment area	Values and Sensitivities
Operational Area Change to the existing environment may occur due to planned activities.	• Area where the activity will take place: ○ Routine vessel and operational discharges ○ Physical presence ○ Seabed disturbance • Light emissions, distance of impact • Underwater noise, distance of impacts
Planning Area The outer boundary of worst-case spill (condensate and MDO) for assessing impacts and risks, and impacts and emergency response planning.	Modelling of MDO spills and impact assessments defines different hydrocarbon contact values of four phases (surface, dissolved, entrained and accumulated shoreline) that pose different ecological and socio-economic risks.
Regional Environmental Setting	Broad description of the seafloor structure, marine flora and fauna, currents and upwellings.

8.8 Identification of Relevant Person Categories

The defined activities, the environment that may be affected, the relevant values and sensitivities of that environment, identification and assessment of risks and impacts (Section 6) were comprehensively assessed to identify potentially Relevant Person categories (as per reg 11A(1)) for which a person's or organisation's functions, interests or activities may be affected by the activities within the environment plan.

Each category of Relevant Persons was then researched to identify persons and organisations whose functions, interests and activities may be affected by the activity.

Beach Energy participated in the NOPSEMA Relevant Persons Better Practice Workshop held on 8 March 2023. The advice and learnings from this session and meetings with NOPSEMA has further informed our methodology for identifying Relevant Persons.

Table 8-3: Identification of Relevant Persons Categories

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
Conservation Values & Sensitivities			
World Heritage Properties	×	×	NA
Australian Marine Parks: • Apollo • Beagle • Franklin • Zeehan	×	✓	Commonwealth Departments / Agencies First Nations Peoples Academic and Research Organisations Marine Tourism Environmental Conservation Groups
National Heritage Places: Great Ocean Road and Scenic Environs. Western Tasmania Aboriginal Cultural Landscape	×	✓	Recreational Tourism First Nations Peoples Local Government Authorities
Commonwealth Heritage Places: Cape Wickham Lighthouse. Onshore only. Wilsons Promontory Lighthouse. Onshore only.	×	×	NA
Maritime Archaeological Heritage	×	✓	Marine Tourism Environmental Conservation Groups
Wetlands of International Importance Lavinia	×	×	NA
Nationally Important Wetlands: • Aire River/Lower Aire River Wetlands Princetown Wetlands (Victoria) • Princetown	×	✓	State Departments / Agencies First Nations Peoples Academic and Research Organisations Environmental Conservation Groups Tourism Associations
Victorian Marine Protected Areas: • Shallow Inlet Marine and Coastal Park • Twelve Apostles Marine National Park	×	✓	State Departments / Agencies First Nations Peoples

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
• Wilsons Promontory National Park Victorian Terrestrial Protected Areas: • Great Otway National Park • Phillip Island Nature Park • Port Campbell National Park Southern Wilsons Promontory, Wilsons Promontory and Wilson Promontory Islands National Parks			Academic and Research Organisations Recreational Tourism Environmental Conservation Groups
Tasmanian Marine Protected Areas: • Cape Wickham Conservation Area • Cataraqui Point Conservation Area • Porky Beach Conservation Area • Seal Rocks State Reserve • Stokes Point Conservation Area • West Point State Reserve	×	✓	State Departments / Agencies First Nations Peoples Academic and Research Organisations Recreational Tourism Environmental Conservation Groups
Key ecological features: • West Tasmanian Marine Canyons • Shelf Rocky Reefs and Hard Substrates • Bass Cascade	×	✓	Commonwealth Departments / Agencies First Nations Peoples Academic research organisations Environmental Conservation Groups
Ecological Environment			
The ecological and physical environment described in Chapter 4 provides the basis for further assessment of values and sensitivities, along with impact and risk assessments (Chapter 6) from planned and unplanned activities. The ecological and physical environment includes: • Benthic habitats and species assemblages • Soft sediment (habitat for various species) • Seagrass (coastline presence) • Algae (coastline presence) • Coral • Carbonate sands and exposed limestone (habitat for various species) • Basalt rises (habitat for various species) • Plankton • Invertebrates • Fish	✓	✓	Commonwealth Departments / Agencies State Departments / Agencies Commercial Fishing First Nations Peoples Academic and Research Organisations Environmental Conservation Groups

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
• Birds • Marine reptiles • Cetaceans • Pinnipeds			
Threatened Ecological Communities: • Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community • Giant Kelp Marine Forests of South East Australia • Subtropical and Temperate Coastal Saltmarsh	×	✓	Commonwealth Departments / Agencies State Departments / Agencies First Nations Peoples Academic and Research Organisations Environmental Conservation Groups
Socio-economic			
Local Government Areas: • Circular Head • Colac Otway • Corangamite • Glenelg • Glennie Group • King Island • Moyne • Phillip Island • South Gippsland	×	✓	Local Government Authorities First Nations Peoples Tourism & Business Associations Commercial Marine Tourism Recreational Fishing Recreational Users Volunteer Emergency Services
Offshore petroleum industry (non-Beach)	×	✓	Oil and Gas Industry
Other infrastructure	×	×	N/A Marine Based Industries (Telecommunications cable is 19 km away from Operational Area)
Shipping (Operational Area has Petroleum Safety Zones)	✓	✓	Commonwealth Departments / Agencies
Tourism (primarily land-based in Planning Area)	×	✓	Local Government Authorities Tourism & Business Associations Commercial Marine Tourism Recreational Tourism
Recreation (beach walking, fishing, snorkelling, diving, surfing close to coastline)	✓	✓	Recreational Fishing

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
			Recreational Tourism Local Government Authorities
Commercial fisheries: • Commonwealth • Victoria • Tasmania	✓	✓	Commercial Fishing
Seaweed Industry	×	✓	Marine Based Industries
First Nations			
Sea Country Native Title Indigenous Protected Areas Indigenous Land Use Agreements	✓	✓	First Nations Peoples
Impacts			
Light emissions: may attract light-sensitive species to platform and vessels	✓	×	Commonwealth Departments / Agencies Commercial Fishing First Nations Peoples Academic and Research Organisations Environmental Conservation Organisations
Atmospheric emissions: decrease in air quality, greenhouse gas emissions	✓	×	Commonwealth Departments / Agencies Environmental Conservation Organisations
Underwater sound emissions: temporary, during vessel activities, up to 3.65 km	✓	×	Commonwealth Departments / Agencies Commercial Fishing First Nations Peoples Academic and Research Organisations Environmental Conservation Organisations

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
Physical presence: petroleum safety zone and avoidance of vessels	✓	×	Commercial Fishing Marine Based Industries Commonwealth Departments / Agencies
Marine discharge vessels: putrescible waste, sewerage and grey water, cooling and brine water, bilge water and deck drainage. Potential toxicity impacts to marine fauna, increased sea surface temperature and salinity, temporary and localised.	✓	×	Commonwealth Departments / Agencies
Marine discharges operations: hydraulic control fluid, dye, chemicals, MEG. Low toxicity, temporary and localised.	✓	×	Commonwealth Departments / Agencies Commercial Fishing
Risks			
Introduction and establishment of invasive marine species	✓	✓	Commonwealth Departments / Agencies State Departments / Agencies Commercial Fishing First Nations Peoples Academic and Research Organisations Environmental Conservation Organisations
Disturbance to fauna	✓	×	Commonwealth Departments / Agencies
Accidental discharge of hazardous and non-hazardous materials and waste	✓	×	Commonwealth Departments / Agencies Commercial Fishing First Nations Peoples Academic and Research Organisations Environmental Conservation Organisations

Environmental Values and Sensitivities	Operational Area	Planning Area	Relevant Person Categories
Loss of hydrocarbons – diesel or condensate	✓	✓	Commonwealth Departments / Agencies State Departments / Agencies Commercial Fishing First Nations Peoples Local Government Authorities Tourism & Business Associations Commercial Marine Tourism Recreational Tourism Academic and Research Organisations Environmental Conservation Organisations
Hydrocarbon spill response activities	✓	✓	Commonwealth Departments / Agencies State Departments / Agencies

8.9 Relevant Persons Categories – Regulation 11A (1)(a), (b) and (c)

Table 8-4 outlines the government departments and agencies that have been identified as relevant within Regulation 11A (1)(a), (b) and (c), from the assessment of the defined activities, the environment that may be affected (Planning and adjoining areas), the relevant values and sensitivities of that environment, and the identification and assessment of risks and impacts.

Table 8-4: Relevant Person Categories - Regulation 11A (1)(a), (b) and (c)

Organisation Name	Functions, Interests or Activities
1a Department or agency of the Commonwealth	
Australian Border Force - Maritime Border Command	Responsible for maritime security. Deters and prevents illegal activities in the Australian Marine Domain.
Australian Fisheries Management Authority	Responsible for the efficient management and sustainable use of Commonwealth fish resources. Activity is within a Commonwealth fishery area. AFMA expects petroleum operators to consult directly with fishing operators or via their fishing association body about all activities and projects which may affect day to day fishing activities.
Australian Maritime Safety Authority - Joint Rescue Coordination Centre	Responsible for maritime safety and the adherence to advice, protocols, and regulations. Issues radio-navigation warnings.
Department of Agriculture, Fisheries and Forestry - Biosecurity and Marine Pests	Ensuring Australia's agriculture, fisheries, food and forestry industries remain competitive, profitable and sustainable; and enforcing laws relating to pest and disease risks of good, people and vessels arriving in Australia.
Department of Climate Change, Energy, the Environment and Water - Oceans	Responsible for protecting Australia's ocean systems, threatened marine species and coastal blue carbon ecosystems.
Department of Climate Change, Energy, the Environment and Water - Parks Australia (Marine)	Responsible for the management of Australian Marine Parks.
Department of Defence - Australian Hydrographic Office	Department of Defence agency responsible for the publication and distribution of nautical charts and other information required for the safety of ships navigating in Australian waters. The AHO issues fortnightly Notices to Mariners for relevant nautical products.
Department of Defence - Infrastructure Division, Defence Support & Reform Group	Manages the development, maintenance, and disposal of the Defence estate, including unexploded ordinance (UXO).
Department of Industry, Science and Resources	Responsibilities include offshore oil and gas development and safety, and greenhouse gas storage.
Indigenous Land and Sea Corporation	Statutory authority providing assistance for acquiring and managing rights and interests in land, salt water and freshwater country.

Organisation Name	Functions, Interests or Activities
National Offshore Petroleum Safety Environment Management Authority (NOPSEMA)	Regulator for health and safety, structural (well) integrity and environmental management for all offshore oil and gas operations and greenhouse gas storage activities in Commonwealth waters, and in coastal waters where regulatory powers and functions have been conferred.
Victorian Fisheries Authority	Independent statutory authority established to effectively manage Victoria's fisheries resources.
1b Department or agency of a State	
Corangamite Catchment Management Authority	Responsibilities include the protection of estuaries on the southern coast Princetown and Anglesea.
Department for Environment and Water South Australia - Coast Protection Board	Under the Coast Protection Act 1972, the Board's functions include to protect, restore, and develop the coast, report to the Minister and take part in relevant research.
Department of Environment, Land, Water and Planning - Coastcare Victoria	Protecting and enhancing our coastline and its waters to support business, tourism, recreation, wellbeing and biodiversity.
Department of Infrastructure and Transport - Marine Safety SA	Department taking care of boat and marine safety in South Australian ocean and inland waters.
Department of Jobs, Precincts and Regions: Earth Resources Regulation	Regulatory body for oil and gas activities in Victorian waters. Required to be notified of reportable incidents. Commencement and cessation notifications are only required for drilling and seismic surveys.
Department of Natural Resources and Environment Tasmania - Biosecurity	Working to prevent pests and diseases that could cause serious impacts if introduced to Tasmanian waters.
Department of Natural Resources and Environment Tasmania - Conservation	The Conservation Assessment Team provide advice and comment to a range of key regulators and stakeholders on development activities that have the potential to impact on natural values.
Department of Natural Resources and Environment Tasmania - Marine/Fisheries (Fishing Tasmania)	Responsible for commercial and recreational fishing and the protection of the ocean and marine life and Fishing Tasmania.
Department of Natural Resources and Environment Tasmania - Strategic Projects and Policy	Responsible for policy.
Department of Natural Resources and Environment Tasmania - Tasmania Parks and Wildlife Services	Responsible for managing the State's marine reserves.
Department of Premier and Cabinet - Office of Aboriginal Affairs - (Tasmania)	The Office of Aboriginal Affairs is one part of the new Aboriginal Affairs Partnership Division, which sits in the Division of Communities, Partnerships and Priorities within the Department of Premier and Cabinet.

Organisation Name	Functions, Interests or Activities
	The Office of Aboriginal Affairs is the touch point, providing high-level consultation with Tasmania's Aboriginal people, organisations and adviser to the Government on policy issues and impacts affecting Aboriginal people of Tasmania.
Department of Primary Industries and Regions South Australia - Commercial Fishing	Responsible for protecting aquatic environments, licensing and registration of fisheries and fish processors, fisheries management plans, scientific research and innovation and increasing trade and investment in conjunction with industry.
Department of State Growth - Mineral Resources Tasmania	The purpose of MRT is to give effect to government policy in relation to minerals and petroleum resources, and the Division provides essential information for land management in Tasmania. The focus of MRT is to produce and promote up-to-date geoscientific information on Tasmania as an aid to the mineral and petroleum exploration industries, other government agencies and the general public, in order to improve the State's economic position, and to promote sustainable land-use planning and environmental management.
Department of Transport and Planning: Marine Pollution	Ensures Victoria is adequately prepared for and effectively responds to a marine pollution incident in State coastal waters up to three nautical miles (3 nm) offshore.
Environment Protection Authority (EPA) - South Australia	Protects, restores and enhances the environment through risk-based regulation of pollution, waste, noise and radiation.
Environment Protection Authority (EPA) Tasmania	Regulatory body for oil and gas activities in Tasmanian waters. Required to be notified of reportable incidents.
Environment Protection Authority (EPA) Victoria	Independent statutory authority responsible for regulating Victorian Environment Protection legislation. Focused on onshore activities, not offshore.
First Peoples - State Relations (Victoria)	Group within the Department of Premier and Cabinet, responsible for nation-leading work in the areas of cultural rights, self- determination, treaty and truth – an extensive program of priority work with First Peoples. Stated purpose is "Strengthening and engaging communities and managing and protecting cultural heritage".
Marine and Safety Tasmania	Marine and Safety Tasmania (MAST) is a statutory authority responsible for the safe operation of vessels, provide and manage marine facilities and manage environmental issues relating to vessels.
Office of the Minister for Environment	Advises the Victorian Cabinet on matters relating to environment protection.
Parks Victoria	Statutory Authority responsible for management of Marine Protected Areas, Marine National Parks, Marine Sanctuaries, Marine and Coastal Parks, Marine Parks and Marine Reserves.
Transport Safety Victoria - Maritime Safety Victoria	Management of marine safety in Victoria. Relevant in relation to fishers entering PSZ.

Organisation Name	Functions, Interests or Activities
1c Department of the responsible State Minister	
Office of the Minister Energy and Resources	Advises the Victorian Cabinet on matters relating to energy and resources.

8.10 Approach to Identifying Relevant Persons – Regulation 11A (1)(d)

Relevant person categories were identified from the assessment of the environment that may be affected (Planning Area and adjoining areas), the relevant values and sensitivities of that environment, and the identification and assessment of risks and impacts.

Those categories were then extensively researched to identify persons or organisations whose functions, interests or activities may be affected by the activity, using the methods summarised in Table 8-5 and the sections below.

Table 8-5: Research Methodology for identification of Relevant Persons - Regulation 11A (1)(d)

Activity	Detail
Database Review	Beach's stakeholder database (BeachConnect) contains a significant number of organisations and individuals identified since 2014 for almost 20 projects and development of EPs. A comprehensive review was undertaken in November 2022 including the following steps: • Merged several offshore project relevant persons lists to create a consolidated master list. • Reviewed master list of organisations and individuals against relevant person categories identified in assessment of totality of environment values, sensitivities, impacts and risks. • Contacted each organisation or individual where engagements showed no or few responses or where data appeared out of date, verified contact details and if they wished to continue consulting with Beach. Further review was undertaken during January and February 2023 to address further advice relating to Relevant Persons.
Functions, interests or activities	• To ensure a full coverage of scope and associated environmental impacts and risks, identification of potential new relevant persons involved preliminary research into their functions, interests and activities from: ○ readily ascertainable information on internet search engines, social media channels and organisation websites; ○ prior communication with persons and entities registered on the company's external communications register, BeachConnect. • Where direct consultation has been undertaken, Beach sought to clarify and update functions, interests or activities. • Beach creates ongoing opportunities for relevant persons to advise Beach of their functions, interests or activities through: covering email for distribution of information sheets that requests them to advise if they believe the activity may affect their functions interests or activities; a information sheet that sets out in greater detail the purpose of consultation being to assess and reduce impacts on functions, interests and activities; public notice advertisements that also advise this. • Through the consultation process, relevant persons functions, interests or activities are updated in BeachConnect when new information becomes available about any affects from Beach activites or there are changes communicated about a relevant persons' functions, interests or activities.

Activity	Detail
Local knowledge	• Beach's Group Manger Social Performance and Community Relations has carried out wide ranging consultations for offshore and onshore Otway Basin projects since 2014, has extensive knowledge of local community, commercial fishing industry and other relevant persons, and has personally reviewed all Relevant Persons identified for this EP. • Beach also contracted consultants who live in south-west Victoria and have extensive local knowledge of organisations and persons who may be relevant persons, to undertake research into further relevant persons based on the categories identified.
Broad based keyword search	• Searched online for potentially relevant persons using key words including: boat; swim; dive; sail; yacht; fish; marine environment; oceans; marine mammals. • Combined above terms with place-based search terms of: Warrnambool; Peterborough; Port Campbell; Apollo Bay; Portland; Mount Gambier; Port MacDonnell; Beachport; Robe; and King Island. • Investigated media articles identified in the above searches for further relevant persons. • Investigated social media channels identified in the above searches.
Marine Spatial Planning Framework	• Reviewed the submissions to the Marine Spatial Planning Framework being developed in response to the Victorian *Marine and Coastal Act 2018* to identify additional potentially relevant persons. • Contacted organisations to inquire if they wish to be consulted.
Apollo Bay Focus	• Beach has an extensive list of relevant persons in Port Campbell, Peterborough and Timboon with whom engagement has been undertaken for many years. • Whereas relevant persons in Apollo Bay have historically only involved commercial fishers. • For each relevant person newly identified in Apollo Bay, Beach inquired if they could recommend other relevant persons and this approach successfully identified several additional relevant persons. Apollo Bay Chamber of Commerce and Apollo Bay Police helped with further contacts.
King Island Focus	• Extrapolating the types of relevant person organisations identified in the Apollo Bay research, a similar list was drafted for King Island and researched using search engines and social media channels. • Types of organisations included: industry and tourism associations; marine based tourism businesses; coast care groups; fishing industry; and seaweed industry. • King Island Council and King Island Chamber of Commerce also provided additional suggested relevant persons, that Beach contacted.
Warrnambool Focus	• Although Warrnambool is primarily west of the Planning area, Beach leveraged local knowledge to inquire further about organisations based in Warrnambool that may still be relevant persons. • This research enabled updating of existing records but did not identify many additional relevant persons for the Otway Phase 5 project and Otway operations but did identify some new relevant persons for future Beach activities that will have a larger area of potential impacts. • Added Warrnambool Visitor Information (VIC) to the database to receive offshore updates, given the location of the Logans Beach whale nursery and general tourist interest.
South-east Coast of South Australia	• Beach extended consultation to potential Relevant Persons west of Warrnambool and across the state border into South Australia (as far as Robe) who may operate close to the western edge of the planning area. • Types of organisations identified include commercial fishing; recreational fishing; state departments/agencies; ports; marine based tourism; and recreational users. • Contacted organisations to inquire if they wish to be consulted.
Marine Parks	• Contacted Parks Victoria to clarify agency and divisional responsibilities and updated Beach's database with information on the separate teams dedicated to marine parks and sanctuaries in the 12 Apostles and Apollo Bay areas.

Activity	Detail
	• Contacted National Parks to update database records on correct authorities and contacts which resulted in helpful engagement with the Branch Head of Marine and Island Parks
Conservation Groups	• Based on desktop research of media coverage and organisations, identified further regional and national conservation groups, sought direct engagement and commenced consultations with organisations who responded. • Given the nature and scale of the Operations activities, Beach's methodology was evolved to include both regional and national groups focussing on those with a direct interest in the Otway Offshore Oil and Gas industry, groups whose interests are potentially most affected such as marine conservation, and where such consultation could contribute further information that would meet the purpose of consultation to identify concerns and implement mitigations. • National ENGOs were included where a specific interest or campaign on gas development within Victorian or Commonwealth waters could be identified.
Tourism Groups	• Researched marine tourism operators active between Portland and Apollo Bay, and around King Island. Identified several relevant persons offering services such as boat charters, SCUBA diving; equipment hire. • Contacted Great Ocean Road Regional Tourism to identify if the Otway Coast Committee was still operating (now defunct) and any other recommended contacts. • Contacted King Island Tourism & Visitor Centre and obtained the details of the current CEO and further contacts.
Abalone Fishing	• Although the impact assessment for abalone fishing shows little to no impact, given the abalone fishing sector has separated from Seafood Industry Victoria, Beach undertook an extensive review of the different Abalone associations and local fishers, via direct phone contact and meetings.
Commercial Fishers	Full data review of all commercial fishers in BeachConnect including: • Contacted all state licence fishers between Portland and Geelong to confirm if they were still fishing in the operational area and to clarify if local fishing associations were still active. • Archived fishers who had retired or closed business. • Contacted all Commonwealth fishing licence holders to determine if they were still fishing in the Otway Basin. • Reviewed Fisheries Research and Development Corporation website for potential relevant persons. • Contacted SA Department of Primary Industries and Regions – Commercial Fishing
Government	• Contacted local government councils via phone and email to review the correct personnel to liaise with for Beach activity updates and environmental questions or concerns. • Contacted relevant Commonwealth and State departments via phone and email to ensure we had the right department and agency names, and correct contact details following the May 2022 federal election and the November 2022 Victorian election. • Updated MPs in relevant electorates for Victoria, SA and Tasmania state and Federal seats and added new MPs not previously in BeachConnect.

8.10.1 Approach to identifying First Nations Peoples

Beach has relationships with several First Nations groups across Australia. Consultations for a range of agreement making, cultural heritage management and community development initiatives have been led by Beach's Manager First Nations Engagement, a First Nations person who also has completed formal studies in land and sea country management. Beach understands that First Nations peoples have deep connections to, and concerns about the protection of Sea Country, also referred to as Saltwater Country, and is viewed the same way they view their onshore Country, without separation.

Sea Country is an important part of First Nations people's culture and while the many coastal and island First Nations groups around Australia have different languages and their own unique belief systems, ceremonies and relationships with Country, they all regard the estuaries, beaches, bays, and marine areas, or Sea Country, as essential parts of their traditional estates.

First Nations groups who reside along the coasts or on islands believe that Sea Country contains the evidence of creation stories, stories about animals, plants and people, as well as the creation of landscape features such as islands and reefs. Coastal and Islander communities held cultural responsibilities to ensure sea country is cared for and sea country was managed very carefully, and they are playing an increasingly important role to play in the management of this Sea Country, through formalised roles and programs that work alongside various State and Commonwealth government structures.

Values and sensitivities regarding Sea Country may include different features such as:

- Historic and contemporary cultural harvesting of marine fauna and flora.
- Sea and landscape features that hold dreamtime and creation stories, such as offshore islands.
- Different marine and avian species that hold deep connections to lore and represent spiritual emblems.

Given these Sea Country values and sensitivities, there is the potential for some First Nations peoples to be Relevant Persons in relation to the proposed activities set out in this EP.

The method of identifying potential First Nations Peoples that may be Relevant Persons included:

- Assessed the total values and sensitivities of the physical environment that may be affected by the planned and unplanned activities in the EP, including the spatial extent of the activities.
- Carried out desktop research to identify any published Sea Country research that may identify marine and avian species that may represent spiritual emblems, relevant to the activities in the EP.
- Understanding and respecting that it is common for First Nations Peoples to be protective of their cultural sensitivities, and therefore such information may not be published, further research was undertaken to identify First Nations Peoples organisations and persons including:
  - Researched Prescribed Bodies Corporate, Registered Aboriginal Parties, Native Title holders and claimants. This research focussed on Victoria and northern Tasmania given the nature and scale of the planned and unplanned Activities, including the spatial extent of the planning area in the EP.
  - Consulted with First Nations Peoples Legal Research Service to seek their advice on identifying FNP Relevant Persons.
  - Asked each FNP group we engaged with if they wished to advise us of other potential Relevant Persons (organisations or people) who may wish to be consulted.
  - Advertised in the Koori Mail newspaper to invite consultation with any persons who may have a function, interest or activity that may be affected by the activities set out in the EP. This additional step was undertaken to provide an opportunity for any persons

unknowable to Beach, notwithstanding the relevant person identification steps undertaken.

The land and Sea Country adjacent to the Planning Area of activities set out in this EP are the traditional lands of the Eastern Maar peoples which include several ancestral clan groups.

The Eastern Maar Aboriginal Corporation (EMAC) manages native title rights for the Eastern Maar Peoples. EMAC is a Recognised Native Title Body Corporation (RNTBC) and holds the native title rights for the Eastern Maar Peoples. EMAC is also a Registered Aboriginal Party (RAP) which is a Traditional Owner Corporation appointed under the Aboriginal Heritage Act 2006 (Vic) (the Aboriginal Heritage Act) to manage and protect Aboriginal cultural heritage over their Country including coastal and onshore waters. The Aboriginal Heritage Act recognises Recognised Aboriginal Parties as the primary guardians, keepers and knowledge holders of Aboriginal cultural heritage and the primary source of advice and knowledge on matters relating to Aboriginal places or objects in the appointed RAP region. EMAC is currently negotiating a Recognition and Settlement Agreement under the Traditional Owner Settlement Act 2010.

Beach has consulted with Eastern Maar Aboriginal Corporation to understand their particular values and sensitivities of Sea Country. That information is included in the Sensitive Information submitted with this EP.

Notwithstanding the Eastern Maar peoples connection to Sea Country adjacent the Planning Area, Beach also identified other FNP groups who may have an interest in the Otway operations.

The FNP groups immediately east and west of Eastern Maar country include:

- Gunditj Mirring Traditional Owners Aboriginal Corporation
- Wadawurrung Traditional Owners Aboriginal Corporation

Other groups outside of the Planning Area include:

- Bunurong Land Council Aboriginal Corporation
- Boonwarrung Foundation
- Gunaikurnai Land and Waters Aboriginal Corporation
- Tasmanian Aboriginal Centre
- Flinders Island Aboriginal Association Inc

8.10.2 Approach to identifying Commercial Fishers

The primary Relevant Persons that may be directly impacted by the activities in the EP are in the commercial fishing sector. The approach to identifying potentially impacted commercial fishers is as follows:

- Identify and map designated State and Commonwealth fishery areas that may be fished.
- Request fishing data from VFA, Fisheries Tasmania (formerly DPIPWE) and AFMA to verify fishing effort within designated fisheries in the operational area, in order to seek consultation with relevant fishing associations and commercial fishers.
- Provide an information sheet to relevant fishing associations, request direct meetings to provide opportunity for detailed discussion, response to questions, concerns and further

information requests, seek further information on actual fishing effort, and seek support (including costing proposals where applicable) for engagement with their members, either directly or via the association as applicable.

- Provide additional information to interested fishery groups where requested.
- Send follow up emails and phone key associations and fishers who may fish in the operating area.
- Where fishers have identified that they may be potentially impacted by the activity the following is undertaken:
  - For fishers who have contacted their associations, Beach liaises with the association to gather information about the fishers fishing patterns and locations and to establish contact for ongoing consultation throughout the activity.
  - For fishers who have contacted Beach directly, engage with them and gather information about their fishing patterns and locations and to establish contact for ongoing consultation throughout the activity.
  - Where fishers provide Beach with sensitive fishing data, advise the information will be treated as 'sensitive' and not published by NOPSEMA. Provide Beach's privacy policy where requested.
  - Beach has previously and will continue to offer SMS messaging to commercial fishers and their associations to provide updates before, during and after the activity.
  - Beach provides regular updates on the locations that the vessel will be operating in as well as the expected duration so fishers can plan their fishing activities with the least disruption.
- Beach has a stated position that fishers should not suffer an economic loss as a result of our activities. Beach's *Fair Ocean Access – Procedure for Compensation Claims from Commercial Fishers* is explained in clear and simple language in the *Fair Ocean Access Information Sheet* (Appendix D). It summarises Beach's procedures for minimising and mitigating potential impacts to commercial fishing and procedures for compensation claims from commercial fishers. Beach will ensure that the evidence required is not burdensome on the fisher while ensuring genuine claims are processed.

8.11 Relevant Persons – Regulation 11A(1)(d)

Table 8-6 presents the Relevant Persons within Regulation 11A(1)(d) that have been identified from the:

- Assessment of the totality of the relevant environment, values and sensitivities, activity impacts and risk.
- Intersection with their functions, interests or activities that may be affected by the activities in the EP.
- Identification of relevant persons categories.
- Desktop research and direct engagement to identify readily ascertainable persons and organisations within those categories, as summarised in Section 8.10.

Table 8-6: Relevant Person Regulation 11A(1)(d)

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Neighbour			
12 Apostles Helicopters & Port Campbell Heliport	Near Neighbour - Perimeter	Port Campbell based tourism operator that offers helicopter flights over the 12 Apostles area.	Socio-economic and environmental values that may be impacted by activity incidents.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Commercial Fishing			
Atlantis Fisheries Consulting Group	Commonwealth Commercial Fishing	Consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia.	Fishery access and fish health.
Australian Southern Bluefin Tuna Industry Association	Commonwealth Commercial Fishing	Peak body representing Southern Bluefin Tuna companies in Australia. The SBTF overlaps the operational area.	Ecosystem and fish health. No SBTF fishing history in Operational or Planning areas.
Australian Wildcatch Fishing (Corporate Alliance Enterprises)	Commonwealth Commercial Fishing	SESS Fisher	Ecosystem and fish health.
Commonwealth Fisheries Association	Commonwealth Commercial Fishing	Peak incorporated association representing associations for the following Commonwealth fisheries that have catch effort within the Planning Area: SESS (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
		Shark Gillnet Sectors). Southern Squid Jig Fishery.	Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Fishwell Consulting	Commonwealth Commercial Fishing	Research advice and consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia. General interest in Beach activities and service provider to Beach.	Fishery access and fish health.
Matthew Hunt Fishing Services	Commonwealth Commercial Fishing	Fishing charter fishing in Portland and Port Phillip Bay.	Access to fishing areas.
Muollo Fishing	Commonwealth Commercial Fishing	SESS Fisher	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Mures Fishing	Commonwealth Commercial Fishing	SESS Fisher	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Petuna Sealord Deepwater Fishing Pty Ltd	Commonwealth Commercial Fishing	SESS Fisher	Access to fishing areas. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
RHG Fisheries	Commonwealth Commercial Fishing	SESS Fisher	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Richey Fishing Company	Commonwealth Commercial Fishing	Commercial scallop, salmon and squid fisher and marine charter service.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some species impact in the Operational Area, albeit very limited spatially and temporally. Potential for species impact in Planning Area in the event of a loss of containment.
Seafood Industry Australia	Commonwealth Commercial Fishing	The national peak-body representing members from the wildcatch, aquaculture and post-harvest sectors of the Australian seafood industry.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Activity and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
South East Trawl Fishing Industry Association	Commonwealth Commercial Fishing	Incorporated association representing commercial fishers in: Commonwealth South East Trawl Sector; Scalefish Hook Sector; Shark Hook, Shark Gillnet Sectors; small pelagic fishery.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Southern Fishermen's Association Inc.	Commonwealth Commercial Fishing	Represents the interests of Lakes and Coorong commercial fishers and is pro-active in promoting improved environmental management practices in the fishery across a number of areas	Fishery access and fish health.
Southern Shark Industry Alliance (SSIA)	Commonwealth Commercial Fishing	Incorporated association with members from the Southern and Eastern Scalefish and Shark Fishery, Gillnet Hook and Trap, (aligned with SETFIA)	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Sustainable Shark Fishing Association	Commonwealth Commercial Fishing	Represents fishers in the Southern and Eastern Scalefish and Shark Fishery (SESS), Gillnet Hook and Trap fisheries.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Toberfish	Commonwealth Commercial Fishing	Portland based Southern & Eastern Scalefish and Shark fisher.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Tuna Australia	Commonwealth Commercial Fishing	Represents statutory fishing rights for owners, holders, fish processors and sellers, and is an associate member of the Eastern and Western tuna and billfish fisheries.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
ANZT Fishing Company	NSW Commercial Fishing	SESS Fisher	Access to fishing areas. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Coorong Wild Seafood	SA Commercial Fishing	Fisher and processor based in Port Macdonnell that fishes in local waters for Southern Rock Lobster, Ocean Jacket, Southern Bluefin Tuna, Bight Redfish, Flathead, Boarfish, John Dory, Latchet, Knifejaw and Yellowtail Kingfish. Also operates Coorong Wildside Tours.	Access to fishing areas.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Ferguson Australia	SA Commercial Fishing	Fisher and processor based in Port Macdonnell that fishes in local waters for Southern Rock Lobster, Ocean Jacket, Southern Bluefin Tuna, Bight Redfish, Flathead, Boarfish, John Dory, Latchet, Knifejaw and Yellowtail Kingfish.	Access to fishing areas.
Tasmania Salmonid Growers Association	Tasmanian Commercial Fishing	Tasmania's peak body representing salmon growers.	The Planning Area includes the west coast of King Island only, not salmon growing locations.
Tasmanian Abalone Council Ltd	Tasmanian Commercial Fishing	Peak industry body representing divers, processors and quota holders.	The Planning Area includes the west coast of King Island where there may be abalone fishing. Hydrocarbons are not expected to accumulate among benthic sediments due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column.
Tasmanian Rock Lobster Fisherman's Association	Tasmanian Commercial Fishing	Peak body representing licenced Tasmanian rock lobster fishers	The Operational Area does not overlap any Tasmanian fisheries where there is catch effort. Potential for fish species impact in Planning Area in the event of a loss of containment.
Tasmanian Seafood Industry Council	Tasmanian Commercial Fishing	Peak body representing the interests of wild capture fishers, marine farmers and seafood processors in Tasmania.	The Operational Area does not overlap any Tasmanian fisheries where there is catch effort. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Tasmanian Seafoods	Tasmanian Commercial Fishing	Fishes for wild abalone, sea cucumber and other seafoods from around the whole of Tasmania, the south coast of Victoria and Western Australia.	The Planning Area includes the west coast of King Island only, not salmon growing locations.
Abalone Council Australia Ltd	Victorian Commercial Fishing	Peak industry body representing the wild-harvest abalone industry across producing states and overseeing abalone- related national research and development investment.	The Planning Area includes two very small areas within the Victorian Abalone Central Zone. Hydrocarbons are not expected to accumulate among benthic sediments due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column.
Abalone Council Victoria	Victorian Commercial Fishing	The peak body representing interests of abalone divers, quota holders and processors in the Victorian wild harvest abalone fishery.	The Planning Area includes two very small areas within the Victorian Abalone Central Zone. Hydrocarbons are not expected to accumulate among benthic sediments due to the significant mixing of waters and dilution of the low concentration of hydrocarbons in the water column.
Abalone Victoria Central Zone	Victorian Commercial Fishing	Peak body for licenced abalone fishers in the Victorian Central Zone.	The Planning Area includes two very small areas within the Victorian Abalone Central Zone. Hydrocarbons are not expected to accumulate among benthic sediments due to the significant mixing of waters

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			and dilution of the low concentration of hydrocarbons in the water column.
Allfresh Seafood	Victorian Commercial Fishing	A major processor of Southern Rock Lobster from the Port Fairy & Warrnambool waters.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.
Apollo Bay Fisherman's Cooperative	Victorian Commercial Fishing	Local fishers who sell their catch from the local ocean direct to the consumer.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Rock lobster fisher based in Portland. Also an author and content maker in the fishing industry.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Rock lobster fisher active in the Portland area.	Access to fishing areas.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Shark and seine fisher based in San Remo.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Port Fairy cray fisher who sells directly to the public. Co-owns Öff the Boat', selling direct to the public.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Lobster fisher based in Apollo Bay	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Lobster fisher based in Apollo Bay.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Rock lobster fisher based in Warrnambool.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Paaratte Eel Company	Victorian Commercial Fishing	Eel fisher licensed to operate in the Curdies River, Curdies Inlet and Gellibrand River.	Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Lobster fisher based in Port Fairy.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Abalone and shark fisher off Portland.	Access to fishing areas.
Port Campbell Lobster	Victorian Commercial Fishing	Southern Victorian lobster fisher who sells direct to the public.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Port Campbell Professional Fisherman’s Association	Victorian Commercial Fishing	Representing primarily lobster fishers in Port Campbell and Peterborough. Engage via SIV.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Lobster fisher based in Portland.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Port Fairy home port. Fishes Rock Lobster in Apollo Bay region. Fishes shark long line in Western Zone.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Rock lobster fisherman and member of Apollo Bay Fisherman's Co-Op.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.
Seafood Industry Victoria	Victorian Commercial Fishing	Peak body representing professional fishing, seafood processors and exporters in Victoria. SIV primary contact for State fishers. Prefers to and can engage all licence holders rather than direct contact by Beach.	Access to fishing areas. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
South Australian Rock Lobster Advisory Council and South Eastern Professional Fishermen's Association	Victorian Commercial Fishing	Promotes the South Australian Rock Lobster Industry, with strong links to the South Eastern Professional Fishermen’s Association Inc in the Southern Zone Fishery and also the SA Northern Zone Rock Lobster Fishermen's Association Inc in the Northern Zone Fishery. SARLAC is a major stakeholder in Southern Rock Lobster Limited; the national industry body across all of Southern Australia encompassing the relevant fisheries in South Australia, Tasmania and Victoria.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Southern Rock Lobster Limited	Victorian Commercial Fishing	Administers an industry wide levy that funds research, development, and innovation in Australia's Southern rock lobster fishery, underpinning the sustainable harvest of lobsters from the Southern Ocean.	Fishery access and fish health.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Lobster fisher based in Portland.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Trinsand Fisheries	Victorian Commercial Fishing	Squid jig fishing, scallop fishing (in Bass Strait)	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
Victorian Scallop Fishermen's Association	Victorian Commercial Fishing	Represents the interests of scallop fishers operating within the Bass Strait Central Zone Scallop Fishery, the Victorian Scallop Fishery and the Tasmanian Scallop Fishery.	Fishery access and fish health. No scallop fishing in Operational or Planning Areas.
Warrnambool Professional Fishermen's Association	Victorian Commercial Fishing	Members mainly fish for Rock Lobster between Port Fairy and Port Campbell.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area, albeit very limited spatially and temporally.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Potential for fish species impact in Planning Area in the event of a loss of containment.
Name withheld	Victorian Commercial Fishing	Fishers around the Thylacine platform. Commercial Rock Lobster and crab fisher. Stakeholder raised concern about impacts from drill rig program on his fishing in relation to timing and location of the drilling. Basis for determination of relevant persons: Activity is within the Otway area.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Name withheld	Victorian Commercial Fishing	Based in Port MacDonnell. Fishes lobster in Victorian waters from Portland to Cape Otway. Fishes giant crab near King Island.	Access to fishing areas. Assessment of fishing history showed minimal fishing effort in the Operational Area, in particular lobster fishing that concentrates around nearshore reefs and crab fishing that concentrates around the continental shelf. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Potential for some fish species impact in the Operational Area and, albeit very limited spatially and temporally. Potential for fish species impact in Planning Area in the event of a loss of containment.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Indigenous			
Aboriginal Land Council of Tasmania	Indigenous	The statutory body established under Tasmanian law to own and manage land on behalf of Tasmania's Aboriginal Community.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			and creation stories, such as offshore islands.
Boon Wurrung Foundation	Indigenous	Represents the traditional people and custodians of the lands from the Werribee River to Wilson Promontory, proud members of the Kulin People – the Boonwurrung and Woi wurrung, Dja dja warrung, Wadawurrung,Taungurung (not coast).	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country is outside of Planning Area.
Bunurong Land Council Aboriginal Corporation	Indigenous	Registered Aboriginal Party for an on behalf of the Bunurong People, with lands and waters across greater Melbourne, Mornington Peninsula, and the Bass Coast.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country is outside of Planning Area.

Organisation Name	**Subtype**	**Functions, Interests or Activities**	**Environment, Values and Sensitivities**
Eastern Maar Aboriginal Corporation	Indigenous	Registered Aboriginal Party. Native Title Holders along with Gunditj Mirring Traditional Owners Aboriginal Corporation. Eastern Maar Traditional Owner Settlement Agreement claim area includes Sea Country adjacent the Planning Srea. Interests include the protection of Sea Country. However formal Sea Country management activities, alongside government agencies do not currently exist in the Planning Area.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country is adjacent Planning Area.
First Nations Legal & Research Services Ltd	Indigenous	Native Title Service Provider provider for Victorian Traditional Owners.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands.
Flinders Island Aboriginal Association Inc	Indigenous	An Aboriginal Community Controlled Organisation. Established in 1971 by a local Aboriginal group, governed by an Aboriginal Board of Management, elected by the local community.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Sea country may include King Island which is within the Planning Area.
Gunaikurnai Land and Waters Aboriginal Corporation	Indigenous	Recognition and settlement agreement under the Traditional Owner Settlement Act Victoria that does not require recognition or extinguishment of native title under the Native Title Act 1993 (Cth) but provides for the State's recognition of a group of people as the traditional owners for a particular area together with other benefits.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country is outside of Planning Area.
Gunditj Mirring Traditional Owners Aboriginal Corporation	Indigenous	Registered Aboriginal Party. Native Title Holders with Eastern Maar Aboriginal Corporation.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country is outside of the Planning Area.
Land and Sea Aboriginal Corporation Tasmania	Indigenous	Land and Sea Aboriginal Corporation Tasmania	May include cultural significance of various marine species that hold connections to lore and represent

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country may include King Island which is within the Planning Area.
Tasmanian Aboriginal Centre	Indigenous	Represents the political and community development aspirations of the Tasmanian Aboriginal community.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country may include King Island which is within the Planning Area.
Wadawurrung Traditional Owners Aboriginal Corporation	Indigenous	Registered Aboriginal Party for Wadawurrung country ranging from Aireys Inlet to Werribee South.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime

Organisation Name	**Subtype**	**Functions, Interests or Activities**	**Environment, Values and Sensitivities**
			and creation stories, such as offshore islands. Sea country may include King Island which is within the Planning Area.
Name withheld	Indigenous	A Gunditjmara woman, who is part of the Southern Ocean Protection Embassy Collective, led by Gunditjmara Elders and Mob in Protection of The Southern Ocean and Gunditjmara Sea Country.	May include cultural significance of various marine species that hold connections to lore and represent spiritual emblems, cultural harvesting of marine fauna and flora, sea and landscape features that hold dreamtime and creation stories, such as offshore islands. Sea country may include King Island which is within the Planning Area.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Tourism and Business Associations			
Apollo Bay Chamber of Commerce	Business Association	Partners with local businesses to do better business and promote the local area through events and promotion.	General socio-economic and environmental values that may be impacted by activity incidents.
Barwon Heads Association	Business Association	Interested in a wide range of topics including environmental concerns.	Environmental concerns impacting area.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
King Island Chamber of Commerce	Business Association	Supporting local businesses, with the ability to share information to members.	General socio-economic and environmental values that may be impacted by activity incidents.
King Island Regional Development Organisation	Business Association	Supports the development of lifestyle, employment, tourism, and events on King Island.	General socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Progress Association	Business Association	Volunteer group with a focus on local business, sustainable development, and new initiatives.	General socio-economic and environmental values that may be impacted by activity incidents.
Timboon Action Group	Business Association	Volunteer group committed to the promotion and development	General socio-economic and environmental values that may be impacted by activity incidents.
Apollo Bay Visitor Information Centre	Tourism Association	Providing information for tourists to the region.	General socio-economic and environmental values that may be impacted by activity incidents.
Great Ocean Road Regional Tourism	Tourism Association	Independent peak body for tourism operators along the Great Ocean Road and Surf Coast.	General socio-economic and environmental values that may be impacted by activity incidents.
King Island Tourism/Visitor Information Centre	Tourism Association	Providing information for tourists to the region.	General socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Twelve Apostles Tourism and Business Group	Tourism Association	A membership-based organisation that provides leadership for the development and facilitation of local tourism and business initiatives.	General socio-economic and environmental values that may be impacted by activity incidents.
Warrnambool Visitor Information Centre	Tourism Association	Providing information for tourists to the region.	General socio-economic and environmental values that may be impacted by activity incidents.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Recreational Tourism			
Apollo Bay Dive Centre and Surf n Fish	Diving	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
Dive Industry Association of Australia	Diving	Encourages the exchange of ideas and information on diving- related issues; to seek solutions to matters of common concern, and to offer practical advice and support to its constituent membership.	General socio-economic and environmental values that may be impacted by activity incidents.
Portland SCUBA	Diving	Offers open water diving courses around Portland.	Socio-economic and environmental values that may be impacted by activity incidents.
SCUBA Divers Federation of Victoria	Diving	Peak body representing over 25 amateur dive clubs reaching 2500 members	Access to diving locations including reefs and shipwrecks.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
The Dive Dude	Diving	Scuba diver instructor based on King Island.	General socio-economic and environmental values that may be impacted by activity incidents.
TARFish	Fishing	Tasmania recreational fishing peak body. Able to communicate on our behalf to all licensed recreational fishers.	Access to fishing areas. Potential for fish species impact in Planning Area in the event of a loss of containment.
VR Fish	Fishing	Victorian recreational fishing peak body. Able to communicate to all licensed recreational fishers.	Access to fishing areas primarily in nearshore areas. Operational Area subject to PSZ. Tuna fishing interests during season. Planning Area locations show minimal nearshore oil reach from cumulative multiple modelling scenarios.
King Island Boat Club	Recreational	Based at Grassy Harbour, and the finish to the annual Queenscliff to Grassy Yacht Race.	Access to open oceans.
Ocean Racing Club of Victoria	Recreational	Various ocean racing events from Brighton	Access to open oceans.
Port Campbell Visitor Information Centre	Recreational	Providing information for tourists to the region.	General socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Port Fairy Yacht Club	Recreational	The Club conducts yacht racing offshore from Port Fairy and Portland in the Southern Ocean and Bass Strait, including hosting the Ocean Racing Victoria " Queenscliff to Port Fairy. Club members also compete in the Melbourne Hobart and Melbourne King Island races and are involved in the Clean Oceans initiative and therefore have an interest in the area.	Socio-economic and environmental values that may be impacted by activity incidents.
Portland Sport Fishing Club	Recreational	Mainly fish on the open ocean near Portland but also fish the Victorian championships in Gippsland.	Socio-economic and environmental values that may be impacted by activity incidents.
Portland Yacht Club	Recreational	Members sail inside the harbour as well as access ocean sailing in and around Portland Bay.	Socio-economic and environmental values that may be impacted by activity incidents.
Timboon Recreational Fishing Club	Recreational	Regional recreational fishing club accessing the Port Campbell jetty boat launch facility.	Access to fishing areas primarily in nearshore areas. Operational Area subject to PSZ. Tuna fishing interests during season. Planning Area location show minimal nearshore oil reach from cumulative multiple modelling scenarios.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Marine Tourism			

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Apollo Bay Fishing Charters	Commercial Marine Tourism	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
Apollo Bay Surf & Kayak	Commercial Marine Tourism	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
Go Surf School	Commercial Marine Tourism	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
King Island Surf Safaris	Commercial Marine Tourism	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
King Island Tours	Commercial Marine Tourism	Ocean based activities for locals and visitors.	General socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Boat Charters	Commercial Marine Tourism	Fishing and diving charter services. Currently in hiatus but would like to be kept informed of Beach projects.	General socio-economic and environmental values that may be impacted by activity incidents.
Sharkmen Charters	Commercial Marine Tourism	Fishing charter operating tours from Melbourne to Portland.	Access to open oceans.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Environmental Conservation Groups			
Apollo Bay Landcare		The group has a strong focus on local environmental issues such as monitoring the nests of the endangered Hooded Plover.	Socio-economic and environmental values that may be impacted by activity incidents.
Australian Coastal Society - Victorian Chapter		Contributes to several coastal and marine policy reforms happening in Victoria via working groups and submissions.	Socio-economic and environmental values that may be impacted by activity incidents.
Australian Conservation Alliance		The Australian Conservation Alliance (ACA) is an organisation comprised of young professionals who advocate for and advance ambitious market-based climate law and policy.	Advocate for emissions reduction in the Australian political landscape.
Australian Conservation Foundation		The ACF brings people together to have the biggest possible impact for nature and climate solutions. Advocate against drilling and fracking for gas that could destroy sacred sites.	Advocate against drilling and fracking for gas.
Beach Patrol 3280		A volunteer organisation keeping Warrnambool's beaches clean of washed-up plastic and rubbish.	Socio-economic and environmental values that may be impacted by activity incidents.
Environment Tasmania		Work with communities on campaigns and initiatives to protect Tasmania's natural environment.	Impact on climate change from production and use of oil and gas.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
			Environment values that may be impacted by activity incidents.
Environment Victoria		Independent charity funded by donations. A community of 40 grassroots member groups and over 200,000 supporters. Campaigning to solve the climate crisis and build a thriving, sustainable society that protects and values nature.	Impact on climate change from production and use of oil and gas. Environment values that may be impacted by activity incidents.
Friends of Bay of Islands Coastal Park		A community group preserving native vegetation, revegetating, and removal of exotic invasive species.	Socio-economic and environmental values that may be impacted by activity incidents.
International Fund for Animal Welfare		Global non-profit helping animals and people thrive together. Run various programs including marine mammal rescue and research, and marine conservation.	Megafauna protection, regional environmental risks from the activities or loss of containment.
Marine Mammal Foundation		Aims to protect the marine environment- for mammals like Southern Right Whales - through research, community engagement, and education. Supported by the Australian Government.	Megafauna protection, regional environmental risks from the activities or loss of containment.
Otway Climate Emergency Action Network (OCEAN)		Community group against seismic testing and gas exploration in the Otway Basin.	Impact on climate change from production and use of oil and gas. Socio-economic and environment

Organisation Name	**Subtype**	**Functions, Interests or Activities**	**Environment, Values and Sensitivities**
			values that may be impacted by activity incidents.
Penguin Foundation		The Foundation raises funds to enhance Phillip Island’s natural environment and protect native wildlife through research, conservation and education programs. Species supported include Little Penguin, Australian Fur Seal and Short Tailored Shearwater.	Regional environmental risks from the activities or loss of containment.
Port Campbell Community Group		Volunteer group focused on environmental protection of local fauna.	General socio-economic and environmental values that may be impacted by activity incidents.
Surfers For Climate		A sea-roots movement dedicated to positive climate action and heads the campaign 'Don't Drill the Otways'.	Socio-economic and environmental values that may be impacted by activity incidents.
Surfrider Foundation Australia		Not-for-profit dedicated to the protection of Australia’s waves and beaches through conservation, activism, research and education.	Socio-economic and environmental values that may be impacted by activity incidents.
Victorian National Parks Association		VNPA is an independent, non-profit, membership-based group that protects Victoria’s unique natural environment and biodiversity through the establishment and effective management of national parks,	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
		conservation reserves and other measures. Includes marine parks.	
Warrnambool Coastcare Landcare Network		Improving biodiversity in Warrnambool and district and an advocate for the protection of the natural environment.	Socio-economic and environmental values that may be impacted by activity incidents.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: State Departments/Agencies			
Member for Western Victoria		Member of the Victorian Parliament Legislative Council. Electorate includes South West Victoria.	Constituents may have an interest in the project.
Member for Western Victoria		Member of the Victorian Parliament, Legislative Council. Electorate includes South West Victoria.	Constituents may have an interest or be affected by the project
Member for Western Victoria		Member of the Victorian Parliament, Legislative Council. Electorate includes South West Victoria.	Constituents may have an interest in the project.
Member for Northern Victoria		Member of the Victorian Parliament, Legislative Council.	Constituents may have an interest or be affected by the project.
Member for Western Victoria		Member of the Victorian Parliament, Legislative Council. Electorate includes South West Victoria.	Constituents may have an interest in the project.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Victorian Member for Polwarth		Member of the Victorian Parliament, Legislative Assembly. Electorate includes the Otways and Great Ocean Road.	Constituents may have an interest or be affected by the project.
Victorian Member for South-West Coast		Member of the Victorian Parliament, Legislative Assembly. Electorate spans from Portland to Warrnambool.	Constituents may have an interest or be affected by the project.
Member for Western Victoria		Member of the Victorian Parliament, Legislative Council. Electorate includes South West Victoria.	Constituents may have an interest in the project.
State Member for Western Victoria Region		Upper House Member of the Victorian Parliament.	Constituents may have an interest or be affected by the project
State Member for Western Victoria Region		Upper House Member of the Victorian Parliament.	Constituents may have an interest or be affected by the project.
Apollo Bay Police and Ocean Rescue	Emergency	Apollo Bay Police activates the ocean rescue volunteer group.	Socio-economic impacts from activity incidents.
MP		Deputy Premier and Minister for Climate, Environment and Water	Constituents may have an interest or be affected by the project.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Volunteer Emergency Services			
Apollo Bay Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.
Beachport Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Fairy Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.
Portland Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.
Wye River Surf Life Saving Club	Community Group	Responsible for keeping local beaches safe and responding to local rescues.	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Business			
Aventus Consulting	Consultant	Aventus specialises in providing environmental, safety and well integrity approvals and advice, auditing to the upstream petroleum and broader energy industry, covering all onshore and offshore activities.	Environmental consultant
Coastal Planning	Local Business	Specialises in VCAT appeals, development applications, subdivision applications, strategic planning, panel hearing submissions and general statutory planning advice. Services the Great Ocean Road and Otways.	Socio-economic and environmental values that may be impacted by activity incidents.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Academic & Research Organisations			
Blue Whale Study Inc		Primary research into the ecology of endangered pygmy blue whales in south-east Australia. The operational area BIAs for the pygmy blue whale.	Megafauna protection, regional environmental risks from the activities or loss of containment.
Deakin University - Environment and Society		Research interests in various environmental values and sensitivities and support for further research programs with common interests.	Coastal planning, wildlife conservation, pollution or waste management, climate change adaptation.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Deakin University - School of Life and Environmental Sciences		Research interests in various environmental values and sensitivities and support for further research programs with common interests.	May include: continued fossil fuel development; regional environmental risks from the activities or MDO release; concerns about particular species such as whales or seabirds, etc.
Institute for Marine and Antarctic Studies, University of Tasmania		A collaborative research body in marine and Antarctic science between the University of Tasmania, CSIRO Marine and Atmospheric Research, the Australian Antarctic Division and other agencies. Research interests in various environmental values and sensitivities and support for further research programs with common interests.	May include: continued fossil fuel development; regional environmental risks from the activities or loss of containment; concerns about particular species such as whales or seabirds, etc.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Local Authorities			
Circular Head Council	Local Government Authorities	A rural local government body in Tasmania covering the far north-west mainland. Major towns and localities include Arthur River, Marrawah and Stanley, with Smithton being the largest and principal town.	Interested in activities that may impact far North- west mainland.
Colac Otway Shire Council	Local Government Authorities	Services to residential and business rate payers to provide infrastructure and services for economic development, safety and amenity. Management of ports and foreshores. Opposed	Socio-economic contribution by Beach operations. Environment risks that may impact amenity, tourism industry, fishing industry and businesses.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
		to seismic testing for oil and gas in the Otway Basin.	May seek a role in local communications in the event of an loss of containment release that may require shore access restrictions.
Corangamite Shire Council	Local Government Authorities	Services to residential and business rate payers to provide infrastructure and services for economic development, safety and amenity. Management of the use of ports and foreshores.	Socio-economic contribution by Beach operations. Environment risks that may impact amenity, tourism industry, fishing industry and businesses. May seek a role in local communications in the event of a loss of containmnet that may require shore access restrictions. Beach would respond to such request in accordance with OPEP and subject to response Agency event control and directives.
Glenelg Shire Council	Local Government Authorities	A local government area including the towns of Casterton, Heywood, Merino and Portland.	Socio-economic contribution by Beach operations. Environment risks that may impact amenity, tourism industry, fishing industry and businesses.
Great Ocean Road Coast and Parks Authority	Local Government Authorities	Delivers better protection and management of the iconic coast and parks of Victoria's Great Ocean Road.	General socio-economic and environment values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
King Island Council	Local Government Authorities	Services to residential and business rate payers to provide infrastructure and services for economic development, safety and amenity. Management of the use of ports and foreshores.	Socio-economic contribution by Beach operations. Environment risks that may impact amenity, tourism industry, fishing industry and businesses.
Moyne Shire Council	Local Government Authorities	Services to residential and business rate payers to provide infrastructure and services for economic development, safety and amenity. Management of the use of ports and foreshores.	Socio-economic contribution by Beach operations. ALARP and acceptable environment risks that may impact amenity, tourism industry, fishing industry and businesses.
Surf Coast Shire Council	Local Government Authorities	Services to residential and business rate payers to provide infrastructure and services for economic development, safety and amenity. Management of ports and foreshores. Opposed to oil and gas development in the Otway Basin.	Environment risks that may impact amenity, tourism industry, fishing industry and businesses. Impact on climate change from production and use of oil and gas.
Glenelg Hopkins Catchment Management Authority	Water	The Authority managing inland waterways, as well as the health of estuaries in the region– analysing water levels and quality, and weather conditions for potential closures and re-openings.	General socio-economic and environmental values that may be impacted by activity incidents.
Otway Water	Water	Strong interest in groundwater extraction.	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Commonwealth Departments/Agencies			
Federal Member for Wannon		Member of the Australian Parliament, House of Representative. Electorate includes South West Victoria.	Constituents may have an interest or be affected by the project.
Fisheries Research and Development Corporation		A co-funded partnership between the Australian Government and the fishing and aquaculture sectors, to plan and invest in fisheries research, development and extension activities in Australia.	Fishery access and fish health.
Federal Member for Braddon		Member of the Australian Parliament, House of Representatives. Electorate includes King Island.	Constituents may have an interest or be affected by the project.
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Community			
Port Fairy Boardriders	Community Group	A social surfing group that also works on local environmental projects.	Socio-economic and environment values that may be impacted by activity incidents.
Name withheld	Community Member <30km	Lobster fisher.	Access to fishing areas

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1d A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP: Marine Based Industries			
Kelp Industries Pty Ltd	Seaweed Collection	Source Bull Kelp from the shores of King Island and process it at their mill. Most product shipped to Norway where alginates are extracted.	Socio-economic and environmental values that may be impacted by activity incidents.
TasKelp	Seaweed Collection	Source Bull Kelp from the shores of King Island and the West Coast of Tasmania and process it at their mill. Product shipped to Scotland where alginates are extracted.	Socio-economic and environmental values that may be impacted by activity incidents.
King Island Shipping Group	Shipping	A new group of community, industry and government representatives who have an interest in improving King Island's shipping and freight services.	General socio-economic and environmental values that may be impacted by activity incidents.
Port of Port Fairy	Shipping	Operated and managed by Moyne Shire Council, the port is used by commercial fishing enterprises and recreational boaters and anglers. Situated on the Moyne River in Port Fairy.	Socio-economic and environmental values that may be impacted by activity incidents.
Port of Portland	Shipping	Strategically located on the south-west coast between Melbourne and Adelaide, the Port of Portland is Victoria's only naturally deep-water port, providing a logistics gateway to the rest of	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
		Australia and the world, with connectivity to national road and rail networks.	
Tasports	Shipping	Takes care of Tasmania's passenger, cargo and community ports. Also runs Bass Island Line; a dedicated shipping service for the King Island community offering a weekly direct service from Devonport.	Socio-economic and environmental values that may be impacted by activity incidents.
Superloop	Subsea comms cable	Owns the subsea Indigo Central communications fibre cable that connects Singapore to Perth to Sydney.	Seabed disturbance localised within Operational Area. The cable is 19km from the Operational Area.
1e Any other person or organisation that the titleholder considers relevant: Oil and Gas Industry			
3D Oil Ltd		Oil and Gas industry in offshore Otway Basin. Has current permit areas within the Planning Area but no infrastructure or operations.	Risk of displacement of or interference with third- party vessels. Operational Area in PSZ. Must comply with AHO Notices to Mariners.
Australian Petroleum Production and Exploration Association		APPEA is the voice of the oil and gas industry on the issues that matter, working collaboratively with industry and the community.	Broad environment protection and industry reputation values.
CO2CRC		A carbon capture and storage research organisation, with its Otway International Test Centre in Nirranda South.	Broad environment protection and industry reputation values.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
ConocoPhillips		Oil and Gas industry in offshore Otway Basin.	Risk of displacement of or interference with third- party vessels. Operational Area in PSZ. Must comply with AHO Notices to Mariners.
Cooper Energy		Oil and Gas industry in offshore Otway Basin. Has current permit areas within the Planning Area but no infrastructure or operations.	Risk of displacement of or interference with third- party vessels. Operational Area in PSZ. Must comply with AHO Notices to Mariners.
Lochard Energy		Oil and Gas industry in onshore Otway Basin and owns the Iona Gas Plant in Port Campbell.	Broad environment protection and industry reputation values.
Schlumberger Australia Pty Ltd		Seismic survey operations, may occur in Otway Basin	Broad environment protection and industry reputation values.
TGS (previously Spectrum Geo)		Seismic survey operations, may occur in Otway Basin	Broad environment protection and industry reputation values.
1e Any other person or organisation that the titleholder considers relevant: Commonwealth Departments/Agencies			
Australian Communications and Media Authority		Australian government agency responsible for the regulation of broadcasting the internet, radio communications and telecommunications. Relevant stakeholder to obtain information in relation to subsea cables or if predicted impact to subsea cables.	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
1e Any other person or organisation that the titleholder considers relevant: Business			
Australian Oceanographic Services Pty Ltd	Local Business	Services to offshore energy development companies.	Broad environment protection and industry reputation values.
Frying Nemo Fish and Chips	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Grassroots Deli Cafe	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Great Ocean Road Tourist Park	Local Business	Accommodation providers in Peterborough.	Socio-economic and environmental values that may be impacted by activity incidents.
Peterborough General Store and Takeaway Food	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Peterborough Golf Club	Local Business	Golf club for locals and tourists.	Socio-economic and environmental values that may be impacted by activity incidents.
Peterborough House	Local Business	Accommodation services.	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Peterborough Licensed grocers	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Hotel	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Take Away	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Campbell Trading Co.	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Port Central Apartments	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
Port O' Call Motel	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
REAL Pizza Pasta Salads	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
Sea Foam Villas Port Campbell	Local Business	Local tourism trade.	Socio-economic and environmental values that may be impacted by activity incidents.
South West Regional Executive Forum	Local Business	A forum of local business owners and Government leaders who meet monthly.	General socio-economic and environmental values that may be impacted by activity incidents.
Waves Cafe, Bar and Restaurant	Local Business	Local tourism trade.	Socio-economic and environment values that may be impacted by activity incidents.
1e Any other person or organisation that the titleholder considers relevant: Academic & Research Organisations			
CSIRO - Coasts and Ocean Research		Working with indigenous partners and national and international collaborators to solve challenges facing coasts and oceans, and work on solutions that support a sustainable marine future.	Socio-economic and environmental values that may be impacted by activity incidents.
1e Any other person or organisation that the titleholder considers relevant: Community			
Otway Gas Plant Community Reference Group	Beach Reference Group	Ongoing community representation to receive activity updates on Beach's operations and projects, and have the opportunity to ask questions, raise concerns, and seek feedback. The CRG meets every 4 months, Beach tables a report on operations, projects, safety and	Socio-economic contribution of the Otway Gas Plant, its associated projects, and continuity of energy supply to the regional community. Delivery of offshore projects with strong environmental protection and safety

Organisation Name	Subtype	Functions, Interests or Activities	Environment, Values and Sensitivities
		environment performance, and social performance initiatives.	performance and regulatory compliance.
Peterborough Residents Association	Community Group	Volunteer community development and / or environment protection groups in towns adjacent planning area.	General socio-economic and environment values that may be impacted by activity incidents.
Port Campbell Board Riders Association	Community Group	Surfing and advocating for healthy oceans.	Socio-economic and environment values that may be impacted by activity incidents.
Port Campbell Rifle Range	Community Group	Local sporting club.	Socio-economic and environment values that may be impacted by activity incidents.
Name witheld	Community Member <30km	Made a comment during the public comment period for Artisan Drilling EP.	Socio-economic and environmental values that may be impacted by activity incidents.
1e Any other person or organisation that the titleholder considers relevant: State Departments/Agencies			
Tasmanian Member for North West, West Coast and King Island		Member of the Tasmanian Parliament, House of Assembly and Minister for Resources. Electorate includes King Island.	Constituents may have an interest or be affected by the project.
Office of the Minister for Agriculture and Minister for Regional Development		Advises the Victorian Cabinet on matters relating to agriculture and regional development.	Constituents may have an interest or be affected by the project.

8.12 Consultation methodology

The approach Beach has undertaken for consultation for the Beach Otway Offshore Development, including this EP is:

- Review all current Relevant Persons and identify new Relevant Persons as described in Section 8.10).
- Provide a detailed information sheet (Appendix F) and area map via email to commence the consultations (also place on Beach website).
- Provide a table of risks and management measures for those seeking additional information (also placed on Beach website).
- Place public notice advertisements in applicable regional newspapers (see below), include QR code linking to information sheet for easy access to further information, and 1800 phone number for direct consultation.
- Respond to requests for additional information from Relevant Persons who have concerns or interests and offer direct consultation with relevant technical staff where applicable.
- Advertise and conduct regional community information sessions (several have been conducted prior to the Otway Offshore drilling campaign and more recently to provide updates).
- Allow a reasonable period of time for the Relevant Person to review and respond to any information provided, typically four weeks.
- Follow up all Relevant Persons whose functions, interests, or activities may be directly affected by the activities in the EP, via phone, email/s or in person to ensure they have received the information and verify if they have remaining questions or concerns.
- Follow up all Relevant Persons who have raised concerns about the activities in the EP and offer to meet in person or online to discuss their concerns and answer their questions.
- Ensure Relevant Persons were informed about the consultation process and how their feedback, questions and concerns were considered in the EP, including the management of sensitive information.

8.13 Provision of Information

The OPGGS(E) Regulations require titleholders to give each relevant person sufficient information to allow the Relevant Person to make an informed assessment of potential effects on their functions, interests or activities from the activities in the EP. Provision of information is responsive and adaptive the individual needs and circumstances of the Relevant Persons seeking the information. Key approaches to providing sufficient information are set out in Table 8-7.

Table 8-7: Information Provided for Relevant Persons Categories

Category	Description	Information Type
11A(1)(a)(b)(c)	Relevant government departments and agencies	Information Sheet. Provision of further information where requested or required. Meeting or phone call where requested or required.
11A(1)(d)	Organisations or individuals whose functions, interests or activities may be affected by the activity in the EP	Information sheet. Risk and management measures table. Detailed operational area maps overlaid with fishery maps are made available for the commercial fishery sector. Meetings with associations and their members are actively sought out by Beach in the event of fishing displacement or other impacts. Phone calls are actively used where there is little or no response to emails. Provision of further information where requested or required. Advice regarding acceptance of EP by NOPSEMA.
11A(1)(d)	Marine users and other potentially impacted Relevant Persons	Updates to activity timings. Commencement and cessation notices. Public notice advertisements in local newspapers.
11A(1)(e)	Other organisations or individuals who Beach seeks to consult with for proactive community relations	Information Sheet. Community information sessions. Public notice advertisements in local newspapers.

Updates on the Otway Offshore Development, and advice about future activities to connect the Thylacine wells have been provided via email and posted on the Beach website. Key notices were issued on the following dates:

- 1st October 2021.
- 1st November 2021.
- 4th November 2021.
- 12th November 2021.
- 21st December 2021.
- 14th January 2022.
- 28th February 2022.
- 11th April 2022.

- 7th July 2022.
- 18th November 2022.
- 1 December 2022
- 7 February 2023
- 20 February 2023
- 6 March 2023
- 8 March 2023
- 17 March 2023
- 21 March 2023

Copies of these emails (and responses from Relevant Persons) have been either previously provided to NOPSEMA or provided with this EP submission as Sensitive Information under Regulation 9(8) of the OPGGS(E) Regulations.

Community information sessions for the Otway Offshore Development and other Beach projects were held as follows:

- Timboon Recreation Reserve – 4pm to 6pm Wednesday 27 April 2022.
- Port Campbell Surf Life Saving Club - 4pm to 6pm Thursday 28 April 2022.
- Port Campbell Surf Life Saving Club - 3pm to 6pm Wednesday 7 September 2022
- Peterborough Community Hall - 3pm to 6pm Thursday 8 September 2022.

Public notice newspaper advertisements were run as follows:

- Cobden Times: Wednesday 23 November 2022
- King Island Courier: Thursday 24 November 2022
- Warrnambool Standard: Saturday 26 November 2022
- Colac Herald: Monday 28 November 2022
- Koori Mail: Wednesday 30 November 2022
- Cobden Times: 22 February 2023
- Colac Herald: 24 February 2023
- Warrnambool Standard: 25 February 2023
- King Island Courier: 2 March 2023

- Beacon Newsletter: 3 March 2023

- Koori Mail: 8 March 2023

8.14 Measures Implemented in Response to Consultation

8.14.1 Consultation with the Blue Whale Study

One of the key environmental control measures adopted for this activity comes as a result of consultation with Relevant Persons. Beach consulted with the Blue Whale Study on numerous blue whale issues relating to various projects Beach was undertaking or preparing to undertake in the Otway and Bass basins.

The consultation between Beach and the Blue Whale Study ultimately resulted in Beach treating all blue whales present in the Otway Basin as 'foraging' blue whales, regardless of how the biologically important area for blue whales in the area is defined and regardless of any observed behaviour. This results in far more conservative environmental control measures being adopted for underwater sound emissions (see Section 6.4 and 6.5) than would otherwise be adopted.

8.14.2 Consultation with South East Trawl Fishing Industry Association

To ensure that fishing interaction risks are well understood and considered in the design of the subsea facilities, SETFIA were engaged early in the Otway Development to provide advice on commercial fishing activities in the area and characteristics of the associated equipment (current and foreseen).

Based on SETFIA feedback, a protection philosophy was developed by Beach which defined design criteria for the subsea equipment based on:

- Types of fishing permitted / performed in the area (and characteristics of the associated equipment).
- Frequency of activities.
- Potential types of interaction (snagging / hooking of fishing gear and anchors, impact from fishing gear and dropped anchors).

The design criteria for the equipment was derived to ensure that any HS&E risks associated with such interaction are ALARP (with the design of the facilities validated by an independent third party).

As an added layer of protection, a 500m PSZ has been applied to the subsea facilities. This PSZ has been gazetted by NOPSEMA and has been added to navigation charts and Notice to Mariners and has been raised in multiple project updates and directly for the Offshore Otway Operations EP revision to include the Thylacine subsea wells.

In addition to the publication of PSZs, through further consultation with SETFIA regarding communication to their members, Beach has provided SETFIA with a data file that can be uploaded to commercial fishers navigation equipment to display the PSZs for the subsea facilities. Beach will seek feedback from SETFIA regarding the take up and implementation of this navigation aid and will offer to provide this to other commercial fishers accordingly.

8.15 Management of Objections and Claims

If any objections or claims are raised during ongoing consultation these will be substantiated via evidence such as publicly available credible information and/or scientific or fishing data. Where the objection or claim is substantiated, where applicable, it will be assessed as per the Beach risk assessment process and controls applied where appropriate to manage impacts and risks to ALARP and an acceptable level. Relevant Persons will be provided with feedback as to whether their objection or claim was substantiated, and if not why, and if it was substantiated, how it was assessed and if any controls were put in place to manage the impact or risk to ALARP and an acceptable level. If the objection or claim triggers a revision of the EP this will be managed in accordance with Beach Management of Change processes and the Relevant Person will be advised of the process.

8.16 Ongoing Consultation with Relevant Persons

Beach will continue to consult with Relevant Persons to provide activity updates and keep them informed as information becomes available. This will be done via ongoing consultation, including updates in relation to the activity and broader Otway Offshore Development via one-on-one communications, emails, and provision of information on the Beach website. Table 8-8 outlines the ongoing consultation (and timing) requirements for the activity. Records of ongoing Relevant Person engagement are maintained in Beach's database BeachConnect.

Any new Relevant Persons, or changes to existing Relevant Persons, will be identified through ongoing consultation (including peak industry bodies), through the EP review process and in accordance with Section 8.5. Where new Relevant Persons are identified, they will be contacted and provided information about the activity relevant to their functions, interests or activities. Any objections or claims raised will be managed as per Section 8.15.

Table 8-8: Ongoing Consultation Requirements

Relevant Person	Ongoing consultation requirement	Timing
All Relevant Persons	Ongoing consultation including: • Communication of information and addressing queries and concerns via email, phone or meeting. • Activity updates including acceptance of EP and start and completion of activities.	As required
Relevant Persons identified as marine users and relevant government departments and agencies	Notifications of activity commencement, including: • type of activity. • location of activity, coordinates, and map. • timing of activity: expected start and finish date and duration. • sequencing of locations if applicable. • vessel details including call sign and contact. • any safety exclusion zones required. • Beach contact details. Note: coordinates to be provided as degrees and decimal minutes referenced to the WGS 84 datum.	2 weeks prior to activity commencing

Relevant Person	**Ongoing consultation requirement**	**Timing**
AHO	Vessel Contractor to issue notification of activity for publication of notice to mariners, including: • type of activity. • geographical coordinates of activity. • any exclusion zones required. • period that NTM will cover (start and finish date). • vessel details including name, Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone), contact details and call signs. • Beach and vessel Contractor contact details. Update AHO of progress, changes to the intended operations including if activity start or finish date changes.	2 to 4 weeks prior to activity commencing
AMSA - JRCC	Vessel Contractor to issue notification of activity for promulgation of radio navigation warnings, including: • type of activity. • geographical coordinates of activity. • any exclusion zones required. • period that warning will cover (start and finish date). • vessel details including name, call-sign and Maritime Mobile Service Identity (MMSI)), satellite communications details (including INMARSAT-C and satellite telephone numbers), contact details and calls signs. • any other information that may contribute to safety at sea. • Beach and vessel Contractor contact person. Update AMSA JRCC of progress, changes to the intended operations including if activity start or finish date changes.	48 – 24 hrs prior to activity commencing
NOPSEMA	Regulatory notification of start of activity.	10 days prior to activity commencing
Relevant Persons who have requested vessel location information.	SMS or email messaging undertaken where requested by Relevant Person.	During activity
NOPSEMA	Regulatory notification of cessation of activity.	Within 10 days of activity completion

8.17 Summary of Relevant Person Consultation

Table 8-9 provides a summary of consultation for this activity. The summary provides details of the information sent to Relevant Persons and others, and any response received. It also details the assessment undertaken of any objection or claims. Copies of these emails (and responses from Relevant Persons) are provided with this EP submission as Sensitive Information.

Consultation undertaken prior to this time has been reported in other EPs prepared for the Otway Offshore Project, along with all Beach's accepted EPs, and can be viewed on the NOPSEMA website.

Where an objection or claim was raised by a Relevant Person, they were provided feedback as to whether the objection or claim was substantiated, how it was assessed and if any additional controls were required to manage the impact or risk to ALARP and an acceptable level. Where an objection or claim was substantiated via evidence such as publicly available credible information and/or scientific or fishing data, this were assessed as per the risk assessment process detailed in Section 5 and controls applied where appropriate to ensure impacts and risks are managed to ALARP and an acceptable level.

Table 8-9: Summary of Stakeholder Consultation Records and Beach Assessment of Objections and Claims

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1451	12 Apostles Helicopters & Port Campbell Heliport	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected.	6/03/2023
1453	3D Oil Ltd	5	No concerns raised	Request for additional recipient to be added to mailing list.	No concerns raised, continue consultation	Functions, interests or activities not affected. New contact added to database.	24/02/2023
4838	Abalone Council Australia Ltd	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected, given assessment of Environment, values and sensitivities.	6/03/2023
1456	Abalone Council Victoria	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities of members are highly unlikely to be affected, as per impact assessment.	6/03/2023
1457	Abalone Victoria Central Zone	11	No concerns raised	Several engagements via email and phone were undertaken. Explained the history of the Otway Phase 5 Project and the details of this specific activity. Explained the NOPSEMA and EP process and that this is a review and update to an existing operational EP. Explained that there have been other activity specific EPs along the way and took them through the consultation to date. Shared previous info sheets and other relevant data. Abalone Victoria Central Zone are comfortable with the consultation to date and have no comments on this specific EP review. Keen to be involved in consultation on our future work and expressed an interest in better understanding seismic surveys. Appreciation of communication.	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	22/03/2023
239075474	Aboriginal Land Council of Tasmania	8	No concerns raised	Contact made via emails and phone call. Contact has forwarded information to relevant contact within the organisation. No further response.	No concerns raised, continue consultation	Functions, interests or activities unlikely to be affected, as per impact assessment.	21/03/2023
155189264	Allfresh Seafood	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
987	ANZT Fishing Company	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities may be affected as per assessment of potential impacts.	6/03/2023
4194721	Apollo Bay Chamber of Commerce	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
1469	Apollo Bay Dive Centre and Surf n Fish	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
1470	Apollo Bay Fisherman's Cooperative	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075338	Apollo Bay Fishing Charters	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
4194724	Apollo Bay Landcare	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075339	Apollo Bay Police and Ocean Rescue	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected.	6/03/2023
239075341	Apollo Bay Surf & Kayak	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075353	Apollo Bay Surf Life Saving Club	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075342	Apollo Bay Visitor Information Centre	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
4194523	Atlantis Fisheries Consulting Group	2	No concerns raised	Primary engagement is with SETFIA and SSFI both of which are supported by Atlantis Fisheries Consulting Group.	No concerns raised, continue consultation	Refer to assessments for SETFIA and SSFI.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
8388625	Australian Border Force - Maritime Border Command	2	No response received	Follow up email sent	No response, continue consultation	Continue to engage as per Regulation 11(A)(1)(a)	6/03/2023
4949	Australian Coastal Society - Victorian Chapter	5	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
988	Australian Communications and Media Authority	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
268435459	Australian Conservation Alliance	3	No concerns raised	Appreciation of communication. Requested to be added to mailing list. ACA did not follow up on our offer to answer questions or provide more information.	No concerns raised, continue consultation	Ongoing engagement as a national ENGO with a specific interest in gas.	14/03/2023
239075467	Australian Conservation Foundation	5	No response received	Identified in our latest analysis as an ENGO with a specific interest in gas. Several attempts have been made to contact ACF via different email addresses and via the advertised phone number with no response.	No response, continue consultation	Ongoing engagement as a national ENGO with an interest in gas.	21/03/2023
989	Australian Fisheries Management Authority	5	No concerns raised	Standard response received from AFMA where they acknowledged receipt of the information, stated they have specific comment on the proposal, and reiterated that it is important Beach consult with all fishers in proposed area.	No concerns raised, continue consultation	Functions, interests or activities of some Commonwealth fisheries may be affected as per assessment of potential impacts. Beach has previously confirmed we have been consulting with all fishers in proposed area for the last few years. We will continue to advise relevant fishing associations and fishers as we've been doing. No further action.	27/03/2023
1477	Australian Maritime Safety Authority - Joint Rescue Coordination Centre	7	No concerns raised	Acknowledged the project update and appreciated regular updates of Beach's operations. Confirmed the initial advice provided continues to apply.	No concerns raised, continue consultation	Continue to engage as per Regulation 11(A)(1)(a)	1/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4194736	Australian Oceanographic Services Pty Ltd	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1471	Australian Petroleum Production and Exploration Association	1	No response received	Information sheet sent and received. No response received. No further engagement required.	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023
991	Australian Southern Bluefin Tuna Industry Association	4	No response received	Follow up email sent	No response, continue consultation	Assessment of fishing history showed minimal fishing effort in the operational area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Remote likelihood, minor consequence, and low risk to fish from MDO or condensate loss of containment.	6/03/2023
4194356	Australian Wildcatch Fishing (Corporate Alliance Enterprises)	4	No response received	Follow up email sent	No response, continue consultation	Assessment of fishing history showed minimal fishing effort in the operational area. Project activities since 2019 have not caused impacts in the Operational Area, now subject to PSZ exclusion. Remote likelihood, minor consequence, and low risk to fish from MDO or condensate loss of containment.	6/03/2023
4194546	Aventus Consulting	2	No concerns raised	Follow up email sent	No response, continue consultation	Consultant to Beach, included in relevant person updates for reference.	23/02/2023
239075464	Barwon Heads Association	1	No response received	Identified as a potential relevant person. Emailed to ask if they would like to receive information but no response.	No response, discontinue consultation	Functions, interests or activities not affected by activities.	14/02/2023
239075345	Beach Patrol 3280	4	No concerns raised	Emailed information on current activity. They requested information on which specific areas of the EP are likely to be updated. Details of affected chapters was provided by	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	8/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
				Beach. No further response.			
239075490	Beachport Surf Life Saving Club	3	No concerns raised	Potential new relevant person identified. Phone call made and requested to be added to mailing list. Email with info sheet sent.	No concerns raised, continue consultation	Will continue to engage where impacts relevant to SA coastline.	6/03/2023
155189260	Member for Western Victoria	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities may be affected.	6/03/2023
1489	Blue Whale Study Inc	2	No response received	Beach has long standing professional relationship with them, consulting on research and services regarding marine mammal protection.	No response, continue consultation	Functions, interests or activities unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities and mitigations in place.	6/03/2023
4194731	Boon Wurrung Foundation	2	No response received	Engagements via email and phone to establish correct contacts, their interest in Beach projects and consultation.	No concerns raised, continue updates	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	6/03/2023
1496	Bunurong Land Council Aboriginal Corporation	7	No response received	Engagements via email and phone to establish correct contacts, their interest in Beach projects and consultation. Meeting in person, confirmed they have been receiving project updates and appreciated being kept updated on what is happening on Country. Acknowledged the offshore project was on Eastern Maar sea country and asked whether we had been consulting Eastern Maar. Beach confirmed we have been undertaking extensive consultation with Eastern Maar.	No concerns raised, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	4/04/2023
4194404	Burrandies Aboriginal Corporation	12	No concerns raised	Numerous emails, sms and phone calls made. Information sheet shared but have Been unable to set up a meeting to discuss further.	No concerns raised, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	23/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
239075483	Circular Head Council	2	No response received	Potential new relevant person. Emailed to request if would like to receive information. No response.	No response, continue consultation	Functions, interests or activities not affected by activities.	16/02/2023
1497	CO2CRC	6	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075429	Coastal Planning	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075407	Colac Otway Shire Council	11	No concerns raised	Emails to several contacts. Automated responses to generic email address. No further response.	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
994	Commonwealth Fisheries Association	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1508	ConocoPhillips	4	No response received	Information sheet sent and received. No response received. No further engagement required.	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023
1509	Cooper Energy	10	No response received	Information sheet sent and received. No response received. No further engagement required.	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023
239075452	Coorong Wild Seafood	3	No concerns raised	New relevant person identified. Phone call and email/information sheet sent and they are happy to receive information about relevant Beach activities. Contact is involved with Southern Fisherman's Association and agreed to send information to them. Appreciated communication.	No concerns raised, continue consultation	Will continue to engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
71303169	Corangamite Catchment Management Authority	7	No response received	Automated responses to emails. Follow up email sent.	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	23/02/2023
1038	Corangamite Shire Council	35	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
4962	CSIRO - Coasts and Ocean Research	2	No response received	Information sheet sent and received. No response received. No further engagement required.	No response, continue consultation	Functions, interests or activities not affected by activities.	10/11/2022
41943052	Federal Member for Wannon	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4194734	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075431	Deakin University - Environment and Society	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
996	Deakin University - School of Life and Environmental Sciences	15	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075476	Department for Environment and Water South Australia - Coast Protection Board	2	No response received	Potential new relevant person contacted. Acknowledged receipt. Nothing further.	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	15/02/2023
1519	Department of Agriculture, Fisheries and Forestry - Biosecurity and Marine Pests	4	No response received	Follow up email sent.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075405	Department of Climate Change, Energy, the Environment and Water - Oceans	2	No response received	Follow up email sent.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4898	Department of Climate Change, Energy, the Environment and Water - Parks Australia (Marine)	7	Concerns raised	Information sheet emailed. Thanked us for the information and noted that our planned activities do not overlap any Australian Marine Parks. Therefore, there are no authorisation requirements from the DNP. Raised concerns that given the proximity to Zeehan and Apollo marine parks, activities undertaken may affect the values present in these Marine Parks and outlined the relevant BIAs and KEF. Beach responded that as part of developing the EP we are assessing any impacts to protected species, including those with BIAs and KEFs, and will ensure	Concerns resolved, continue consultation	Beach have assessed impacts to protected species, including those with BIAs and KEFs, and will ensure appropriate control measures are in place to manage any potential impacts to AMP marine park values to an acceptable level.	9/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
				appropriate control measures are in place to manage any potential impacts to AMP marine park values to an acceptable level.			
1520	Department of Defence - Australian Hydrographic Office	6	No concerns raised	Information acknowledged.	No concerns raised, continue consultation	Ongoing consultation and sharing of information	21/02/2023
1521	Department of Defence - Infrastructure Division, Defence Support & Reform Group	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075362	Department of Environment, Land, Water and Planning - Coastcare Victoria	6	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4905	Department of Industry, Science and Resources	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
264241159	Department of Infrastructure and Transport - Marine Safety SA	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075477	Department of Infrastructure and Transport South Australia - Marine Safety	3	No response received	Potential new relevant person. Emails sent asking whether they would like to receive information on Beach projects. No response. 2 follow up emails sent.	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
1527	Department of Jobs, Precincts and Regions: Earth Resources Regulation	12	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075420	Department of Natural Resources and Environment Tasmania - Biosecurity	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4194633	Department of Natural Resources and Environment Tasmania - Conservation	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1529	Department of Natural Resources and Environment Tasmania - Marine/Fisheries (Fishing Tasmania)	10	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
268435457	Department of Natural Resources and Environment Tasmania - Strategic Projects and Policy	14	No concerns raised	Department contact advised to liaise with the Strategic Projects and Policy Division. Division requested an extension to the consultation period to 28 March 23 to which Beach agreed and offered to present to the Department to assist. Phone calls and emails exchanged, and a meeting was held on 22 March. Beach presented on the Otway Phase 5 project and the specific activity relating to this consultation. No concerns were raised but the Department expressed they would still like to provide written comment. Written comment received by email 30 March 23 stating no comments or feedback but would like to see a copy of the final EP.	No concerns raised, continue consultation	Will continue to engage with the Strategic Projects and Policy Division and have agreed to provide email updates as key milestones are met and verbal briefings at the request of the Department.	31/03/2023
239075432	Department of Natural Resources and Environment Tasmania - Tasmania Parks and Wildlife Services	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
243269638	Department of Premier and Cabinet - Office of Aboriginal Affairs - (Tasmania)	1	No response received	Information sheet sent and received. No response received. further engagement required.	No response, continue consultation	Will continue to try and engage where our impacts relevant to Tasmania.	2/04/2023
239075500	Department of Primary Industries and Regions South Australia - Commercial Fishing	6	No response received	Four emails and a phone call with contact. Information sheet sent and no response.	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
						affected, as per impact assessment.	
8388638	Department of State Growth - Mineral Resources Tasmania	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
999	Department of Transport and Planning: Marine Pollution	3	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1530	Dive Industry	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
1533	Eastern Maar Aboriginal Corporation	9	No concerns raised	Number of emails, sms and phone calls made. Information acknowledged. Phone call, asked to continue to be kept informed about our activities and will continue to share this amongst the community. Would like to know more information about responses in relation to potential loss of hydrocarbon, interested in any sonar/mapping data of sea bed to understand how EMAC ancestors used sea country prior to sea level rise 17 years ago. Would like to know how we monitor pipeline integrity. Beach provided a detailed response answering their questions raised and proving information that may be of interest.	No concerns raised, continue consultation	Beach provided a detailed response answering EMACs questions raised and providing information that may be of interest. Ongoing consultation and sharing of information.	9/03/2023
79691781	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075480	Environment Protection Authority (EPA) - South Australia	11	No concerns raised	Acknowledged information.	No concerns raised, continue consultation	Will continue to engage where impacts relevant to SA coastline.	8/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1001	Environment Protection Authority (EPA) Tasmania	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1537	Environment Protection Authority (EPA) Victoria	7	No concerns raised	Information acknowledged and confirmation that it has been passed on to the south-west team. No further response.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	7/03/2023
4945	Environment Tasmania	1	No response received	Email sent with info sheet. No response.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1536	Environment Victoria	1	No response received	Email sent with info sheet. No response.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4999	Tasmanian Member for North West, West Coast and King Island	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075454	Ferguson Australia	3	No response received	Potential new relevant person. Emails sent with information. No response	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
4194528	Fisheries Research and Development Corporation	6	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1002	Fishwell Consulting	8	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
4194614	Flinders Island Aboriginal Association Inc	7	No concerns raised	Emails and phone call. Information sheet shared but no further response.	No concerns raised, continue consultation	Will continue to try and engage where impacts relevant to Flinders Island.	27/02/2023
1544	Friends of Bay of Islands Coastal Park	1	No response received	Email sent with info sheet. No response	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
268435460	Friends of the Earth - Melbourne Chapter	7	No concerns raised	Emails and phone call explaining current project and activity specific to this consultation. Foe said that it is unlikely they will ever agree with any of our activities but see benefit in understanding our future plans and any environmental controls we have in place. FoE have no comments on the current activity but would like to meet to discuss Beach's future activities.	No concerns raised, continue consultation	As a National ENGO with a specific interest in gas Beach will continue to engage with the Melbourne chapter around our future Otway and Bass Basin work.	4/04/2023
1545	Frying Nemo Fish and Chips	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
1546	Garry Kerr Fisheries Pty Ltd	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
5004	Federal Member for Braddon	5	No concerns raised	Emails sent. Acknowledged receipt of information.	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
155189270	Member for Western Victoria	3	No concerns raised	Emails sent. Acknowledged receipt of information.	No concerns raised, continue consultation	Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
201326593	Glenelg Hopkins Catchment Management Authority	6	No response received	Potential new relevant person. Attempted to contact several times. 4 emails and 2 phone calls. No response.	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	6/03/2023
239075484	Glenelg Shire Council	1	No response received	Potential new relevant person. Requested permission to provide information on Beach activities. No response.	No response, continue consultation	Will continue to try and engage where impacts relevant to SA coastline. Functions, interests or activities highly unlikely to be affected, as per impact assessment.	16/02/2023
4881	Go Surf School	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1553	Grassroots Deli Cafe	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
1467	Great Ocean Abalone	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
184549378	Great Ocean Road Coast and Parks Authority	3	No concerns raised	Acknowledged receipt of email.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1554	Great Ocean Road Regional Tourism	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities of this organization are not affected.	6/03/2023
1556	Great Ocean Road Tourist Park	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities of this organization are not affected	6/03/2023
268435461	Greenpeace	4	No response received	Acknowledge receipt of email. No further response. Several emails have been sent using different contacts.	No response, continue consultation	As a national ENGO with an interest in gas Beach will continue to try to engage.	21/03/2023
4194613	Gunaikurnai Land and Waters Aboriginal Corporation	6	No response received	Five emails and a phone call. No response	No response, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	28/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4194729	Gunditj Mirring Traditional Owners Aboriginal Corporation	11	No concerns raised	Multiple engagements via email and phone were undertaken to engage. Online meeting set up: Discussed the Otway EP revision, and how required to consult for all activities and we have provided GM with updates of all phases of the activities. GM asked about the forward plan and any upcoming projects. Acknowledged that the project is EMAC Sea Country, however appreciate being kept informed and asked us to continue keeping them updated on projects, noting that this project does not trigger any native title or cultural heritage notifications. GM suggested attending their community sessions if there's room, however these sessions are reserved mostly for native title and heritage and community information and opportunities, and this project does not trigger those. Highlighted sea country plan is to be released as early as next month, there will be recommendations in that that inform offshore activities. Spoke to GM about our community investment partnerships and will send them the application form. Will also send MMO information as they are interested in MMO roles.	No concerns raised, continue consultation	Country and sea country is outside of planning area and are highly unlikely to be affected as per assessment of potential impacts, due to nature and scale of activities, mitigations in place.	23/03/2023
239075406	Indigenous Land and Sea Corporation	2	No concerns raised	Phoned to establish contact details. Appreciative of the call.	No concerns raised, continue updates	Ongoing consultation and sharing of information.	22/02/2023
1564	Institute for Marine and Antarctic Studies,	8	No response received	Follow up email sent.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1565	International Fund for Animal Welfare	1	No response received	Information sheet sent and received. No response received.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075442	Member for Western Victoria	1	No response received	Potential new relevant person. Contacted but no response.	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	15/02/2023
4194371	Member for Northern Victoria	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
239075444	Member for Western Victoria	1	No response received	Potential new relevant person. Contacted but no response received.	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	15/02/2023
239075455	John Lloyd Fisheries	3	No response received	Potential new relevant person. Contacted and information sheet shared. No response	No response, continue consultation	Will continue to try to engage where our impacts relevant to Portland area.	6/03/2023
1580	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
239075456	Kelp Industries Pty Ltd	3	No concerns raised	Phone call with GM. King Island community has concerns about the gas industry and the protection of the environment. Suggested Beach consider setting up some community drop-in sessions during lobster season breaks to discuss future activities. Community is confused about all the different players in the gas exploration space and would be useful to understand the specifics of Beach and our existing infrastructure Said that other gas/oil businesses in the Bass Strait had been vague in their consultation during the past, which led to community frustration. Understands the need for gas development to meet demand. Added to mailing list and receiving information. No response to this specific activity.	No concerns raised, continue consultation	Engagement on future activities is likely more relevant. This activity is highly unlikely to impact them.	6/03/2023
1585	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
5012	King Island Boat Club	2	No response received	Follow up email sent	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	6/03/2023
4720	King Island Chamber of Commerce	4	No response received	Follow up email sent	No response, continue consultation	Will continue to try to engage where impacts relevant to King Island area.	6/03/2023
8388624	King Island Council	4	No response received	Follow up email sent	No response, continue consultation	Will continue to try to engage where impacts relevant to King Island area.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4725	King Island Regional Development Organisation	2	No response received	Phoned to establish contact details, their interest in Beach projects and consultation. Very pleased to receive information and provided us with other local contacts.	No response, continue consultation	Taken their advice on suggested local contacts. Will continue to engage where our impacts relevant to King Island area.	6/03/2023
239075423	King Island Shipping Group	2	No response received	Follow up email sent	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	6/03/2023
4750	King Island Surf Safaris	2	No response received	Follow up email sent	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	6/03/2023
4737	King Island Tourism/Visitor Information Centre	2	No response received	Follow up email sent	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	6/03/2023
4743	King Island Tours	2	No response received	Follow up email sent	No response, continue consultation	Will continue to engage where impacts relevant to King Island area.	6/03/2023
4194605	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
243269640	Land and Sea Aboriginal Corporation Tasmania	1	No response received	Email and info sheet sent. No response.	No response, continue consultation	Ongoing consultation and sharing of information.	27/02/2023
4920	Life Saving Victoria	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1601	Lochard Energy	8	No response received	Emails and info sheet sent to 8 contacts. No response.	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023
1709	MacTaggart Marine	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
8388636	Marine and Safety Tasmania	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075427	Marine Mammal Foundation	2	No response received	Email and info sheet sent. No response.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
239075466	Matthew Hunt Fishing Services	3	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
4194608	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
1204	Moyne Shire Council	13	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1003	Muollo Fishing	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1004	Mures Fishing	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
8388630	National Offshore Petroleum Safety Environment Management Authority (NOPSEMA)	2	No concerns raised	Acknowledged receipt of email and information.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	21/02/2023
264241156	Nelson Coast Care Inc	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1005	Ocean Racing Club of Victoria	6	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
4852	Ocean Road Abalone (Southern Ocean Mariculture)	3	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194372	Office of the Minister Energy and Resources	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
155189273	Office of the Minister for Agriculture and Minister for Regional Development	3	No concerns raised	Acknowledged receipt of email and information.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	7/03/2023
4194732	Office of the Minister for Environment	3	No concerns raised	Information acknowledged.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	23/02/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
4194369	Office of the Minister for Resources	3	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
264241157	Name withheld	1	No response received	Email bounce back. Been unable to find contact details	Discontinue consultation	NA	21/02/2023
4755	Otway Climate Emergency Action Network (OCEAN)	13	Concerns raised	Meeting held with OCEAN on 7 February 2023. OCEAN members and other community members attended. OCEAN are opposed to any gas development of any kind. Heavy focus on seismic surveys which is not relevant to this activity. Beach contacted the OCEAN group to see if they wanted to be included in our stakeholder database and provide information and consultation opportunity regarding our Otway Development. OCEAN appreciated Beach reaching out to them and a meeting was arranged. OCEAN requested information more broadly on Beach's operations in the Otway Basin, therefore Beach also covered the Calico project at a high level. OCEAN quoted a Traditional land owner by printed email who stated that he had not been consulted with and that the Eastern Maar Aboriginal Corporation does not represent him. Beach requested the details of the man. Beach advised that the sound modelling for the project was being completed and that it would be consulting local fishers in the Port Campbell and Peterborough area. Beach attempted to explain the purpose of consultation is for development of its environment plans, for which the regulations require consultation with relevant persons whose functions, interests and activities may be affected by the activities to be carried out under the environment plan Beach also explained the reasons for continued gas development in accordance with petroleum titles released by Commonwealth and State authorities, and activities will be conducted in accordance with strict	Concerns remain, maintain consultation	Post meeting correspondence with OCEAN suggests they do not see value in meeting again. Beach will continue to provide information on activities via email and is open to a meeting again should OCEAN wish to. OCEAN did not provide the details of the quoted traditional owner despite follow up requests.	21/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
				requirements set out in EPs that must be accepted by regulators before the activities commence OCEAN took a vote to say they unanimously oppose seismic surveys and gas development. Beach assured OCEAN that that their opposition to seismic surveys and gas development would be clearly reflected in our engagement records provided to the regulator. Beach committed to providing further information regarding the Calico project. Heavy focus on seismic surveys which is not relevant to this specific activity.			
1633	Otway Gas Plant Community Reference Group	11	No concerns raised	Discussed Beach Projects at regular meeting 29 March 2023. Otway Phase 5 activity update was provided.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4889	Paaratte Eel Company	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1634	Parks Victoria	13	No concerns raised	Information acknowledged. Stated that no comment to make as activity is outside PV estate.	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	23/02/2023
4194609	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
239075465	Penguin Foundation	2	No response received	Potential new relevant person. Requested permission to share information but no response.	No response, continue consultation	Functions, interests or activities not affected by activities.	14/02/2023
239075475	Name withheld	3	No concerns raised	Phone call to see if would like to receive information on Beach activities. Permission granted. Emails and info sheets sent.	No concerns raised, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
1639	Peterborough General Store and Takeaway Food	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1640	Peterborough Golf Club	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1641	Peterborough House	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1642	Peterborough Licensed grocers	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1644	Peterborough Residents Association	8	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075411	Petuna Sealord Deepwater Fishing Pty Ltd	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1648	Port Campbell Board Riders Association	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1649	Port Campbell Boat Charters	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1650	Port Campbell Community Group	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1652	Port Campbell Hotel	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
4768	Port Campbell Lobster	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
205520898	Port Campbell Police	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1653	Port Campbell Professional Fisherman's Association	4	No response received	Follow up email sent	No response, continue consultation	Follow up email sent	6/03/2023
1655	Port Campbell Progress Association	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1656	Port Campbell Rifle Range	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1657	Port Campbell Surf Life Saving Club	8	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1658	Port Campbell Take Away	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1659	Port Campbell Trading Co.	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1660	Port Campbell Visitor Information Centre	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1661	Port Central Apartments	3	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075488	Port Fairy Boardriders	1	No response received	Potential new relevant person. Contacted group but no response.	No response, continue consultation	Functions, interests or activities not affected by activities.	16/02/2023
239075494	Port Fairy Surf Life Saving Club	4	No response received	Potential new relevant persons. 3 emails and 1 phone call but no response.	No response, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
239075495	Port Fairy Yacht Club	5	No concerns raised	Contacted by phone and email. Requested to receive information.	No concerns raised, continue consultation	Will continue to engage where future potential impacts..	6/03/2023
1662	Port O' Call Motel	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075487	Port of Port Fairy	1	No response received	Potential new relevant person. Contacted but no response.	No response, continue consultation	Will continue to engage where future potential impacts.	16/02/2023
239075486	Port of Portland	7	No concerns raised	Contacted via phone and email. Agreed to be added to mailing list and share safety notices with vessels. Emails and information sent on activity.	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
239075492	Portland SCUBA	3	No concerns raised	Phone and email contact. Agreed to receive information. Emails and information sent.	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
239075459	Portland Sport Fishing Club	3	No concerns raised	Contact made via phone and email. Happy to receive info. Emails and info sent.	No concerns raised, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
239075491	Portland Surf Life Saving Club	3	No response received	Potential new relevant person. 3 Emails and info sheet shared but no response	No response, continue consultation	Will continue to engage where future potential impacts.	6/03/2023
239075493	Portland Yacht Club	3	No concerns raised	Phone and emails. Agreed to receive information via email and they would circulate amongst members. They are also the Harbour Master at Port of Portland.	No concerns raised, continue consultation.	Will continue to engage where future potential impacts.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1666	Ray Wicks Fishing Co	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4433	REAL Pizza Pasta Salads	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1681	RHG Fisheries	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194373	Victorian Member for Polwarth	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1694	Richey Fishing Company	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194374	Victorian Member for South-West Coast	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1670	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
4194611	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
239075443	Member for Western Victoria	1	No response received	Potential new relevant person. Contacted by email but no response.	No response, continue consultation	Functions, interests or activities not affected by activities.	15/02/2023
1676	Schlumberger Australia Pty Ltd	1	No response received	Information sheet sent.	No response, continue consultation	Functions, interests or activities not affected by activities.	20/02/2023
1007	SCUBA Divers Federation of Victoria	6	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1679	Sea Foam Villas Port Campbell	4	No concerns raised	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
155189275	Seafood Industry Australia	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1008	Seafood Industry Victoria	14	No concerns raised	Emails and information sheet shared with SIV. Meeting with new CEO on 16 Match 2023. Explained the current details of the activity. SIV have no comments on the current activity and are aware of	No concerns raised, continue consultation	Beach will continue to work with SIV to engage with members.	22/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
				the total engagement to date. SIV have circulated our information sheet to their members.			
4194593	Sharkmen Charters	2	No response received	Emailed to verify correct contact details, interest in Beach projects and consultation.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1009	South Australian Rock Lobster Advisory Council and South Eastern Professional Fishermen's Association	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1010	South East Trawl Fishing Industry Association	9	No concerns raised	Emails and information sheet provided. Have provided further clarity around the specific activity underway. SETFIA flagged that they are overwhelmed with requests for consultation across the energy industry.	No concerns raised, continue consultation	No concerns around this consultation. Beach will continue to work with the industry and commercial fishing sector to explore more efficient ways to engage.	31/03/2023
205520905	South West Regional Executive Forum	18	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075453	Southern Fishermen's Association Inc.	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1011	Southern Rock Lobster Limited	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1689	Southern Shark Industry Alliance (SSIA)	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
155189261	State Member for Western Victoria Region	3	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
155189272	State Member for Western Victoria Region	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
239075433	Superloop	3	No concerns raised	Acknowledged receipt of information.	No concerns raised, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023

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4194587	Surf Coast Shire Council	15	Concerns raised	Acknowledged receipt of information. Council passed a motion on 27 July 2021 opposing all new oil and gas exploration, development and seismic testing in the Otway Basin. This remains Council's position. They requested that their opposition is noted and included in the consultation records provided to NOPSEMA.	Concerns remain, maintain consultation	Beach has included Council's opposition as requested.	21/03/2023
239075460	Surfcoast Anglers	1	No response received	Potential relevant person. Contacted via email with no response.	No response, continue consultation	Functions, interests or activities not affected by activities.	14/02/2023
4830	Surfers For Climate	3	Concerns raised	Acknowledged receipt of information. Acknowledged the past consultation with Beach has been respectful and the project team are knowledgeable. Do not require a further meeting at this time but would like to state for the record that: Surfers For Climate doesn't believe any environmental or climate risk is acceptable.	Concerns remain, maintain consultation	Opposition to project included in records for NOPSEMA.	22/02/2023
79691782	Surfrider Foundation Australia	10	No concerns raised	Information acknowledged.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075478	Deputy Premier of South Australia	5	No concerns raised	Information acknowledged.	No concerns raised, continue consultation	Will continue to try to engage where potential impacts to SA.	24/02/2023
1696	Sustainable Shark Fishing Association	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1015	TARFish	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
239075457	TasKelp	2	No response received	Potential new relevant persons. 2 Phone calls attempted but no response.	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	15/02/2023
4912	Tasmania Salmonid Growers Association	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
1698	Tasmanian Abalone Council Ltd	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
20971523	Tasmanian Aboriginal Centre	3	No response received	Multiple emails were undertaken to follow up project information.	No concerns raised, continue updates	Will continue to try and engage where any future impacts relevant	27/02/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1017	Tasmanian Rock Lobster Fisherman's Association	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant	6/03/2023
1018	Tasmanian Seafood Industry Council	4	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant	6/03/2023
155189276	Tasmanian Seafoods	5	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant	6/03/2023
239075489	Tasports	6	No concerns raised	Acknowledged receipt of information	No concerns raised, continue consultation	Will continue to try and engage where any future impacts relevant	6/03/2023
1699	TGS (previously Spectrum Geo)	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1703	Timboon Action Group	9	No concerns raised	Acknowledged receipt of information.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1708	Timboon Recreational Fishing Club	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194360	Toberfish	2	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1711	Transport Safety Victoria - Maritime Safety Victoria	7	No concerns raised	Acknowledged receipt of information.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1712	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
1023	Trinsand Fisheries	4	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1713	Tuna Australia	6	Concerns raised	Information provided. Tuna Australia responded with their industry position statement for engaging with energy companies seeking consultation advice from stakeholders on environmental plans and project proposals. The position outlines that companies must enter a service agreement with Tuna Australia with a cost associated for consultation.	Concerns remain, maintain consultation	Beach agrees in principle to a service charge from Tuna Australia to assess impacts from our activities where it is required. In this instance, we do not believe assessment is required based on our assessment of tuna fishing in our project area.	20/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1714	Twelve Apostles Tourism and Business Group	6	No concerns raised	Acknowledged information.	No concerns raised, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
1025	Victorian Fisheries Authority	6	No response received	Email sent with information sheet.	No response, continue consultation	VFA have previously been engaged and provided fishing effort data in response to Beach's requests, to enable assessment of potential commercial fishing impacts for the Otway Offshore Project. Continue to engage.	20/02/2023
1718	Victorian National Parks Association	9	No concerns raised	Information sent. Victoria Parks asked us to confirm there is no new major infrastructure, requested more maps, and had questions on the process for the approvals of the new infrastructure.	No concerns raised, continue consultation	All questions and requests were responded to and appreciated by Parks Victoria.	1/03/2023
1721	Victorian Scallop Fishermen's Association	6	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194361	VR Fish	6	No response received	Follow up email sent	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194727	Wadawurrung Traditional Owners Aboriginal Corporation	4	No response received	Multiple emails were undertaken to follow up project information.	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	23/03/2023
1728	Warrnambool City Council	4	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
4814	Warrnambool Coastcare Landcare Network	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
1729	Warrnambool Professional Fishermen's Association	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
4773	Warrnambool Surf Life Saving Club	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
239075413	Warrnambool Visitor Information Centre	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
1478	Warrnambool Volunteer Coast Guard	4	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
4782	Warrnambool Yacht Club	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
1730	Waves Cafe, Bar and Restaurant	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities not affected by activities.	6/03/2023
1733	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
1734	Western Abalone Divers Association	4	No response received	Follow up email sent	No response, continue consultation	Functions, interests or activities are highly unlikely to be affected, as per impact assessment.	6/03/2023
264241161	Wilderness Society Tasmania	5	No concerns raised	Emails and phone message left. Information provided on this activity with no further response.	No concerns raised, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023
1737	Wilderness Society Victoria	3	No response received	Contacted as a national ENGO with an interest in gas. 3 emails to 3 different contacts have been sent along with info sheets. No response.	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	21/03/2023
239075498	Wye River Surf Life Saving Club	5	No response received	Requested to receive information. Information provided with no response.	No response, continue consultation	Ongoing consultation and sharing of information.	6/03/2023
4194726	Name withheld	12	Concerns raised	Multiple emails were undertaken to follow up project information. Online meeting - Advised this consultation is for the revision of the operations EP as per emails sent and thanked her for making time to meet with me to discuss. Raised no concerns regarding the EP and quickly moved the conversation onto seismic. Would like further information on the HDD drilling. Would like information on seismic activities and how we undertake assessments of potential impacts. Expressed an interest in the marine mammal roles	No concerns raised, continue consultation	Questions raised are not relevant to the Operations EP revision but will provide information requested.	3/04/2023

Entity ID	Organisation Name	Number of Engagements	Engagement Status	Engagement Summary	Assessment Summary	Assessment Detail	Last Engagement Date
1741	Name withheld	2	No response received	Follow up email sent	No response, continue consultation	Will continue to try and engage where any future impacts relevant.	6/03/2023

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10 Document information and history

Document custodian group

Title	Name/s
DocCust-OPS-Otway	Kevin Galea, David Ross

Process maintainer

Position	Name
Senior Environmental Advisor	Adrian Cukovski

Document history

Rev	Date	Changes made in document	Reviewer/s	Consolidator	Approver
OEUP-V9000-PLN-ENV-001					
0	21/06/10	Woodside Document revised for Origin and submitted to Tasmanian Department	TN	-	-
1	24/10/10	Updated to include DIER and Department of Primary Industries (DPI) comments, revised for Offshore facilities only and for Origin operation	RT	-	-
2	28/06/13	Revision request from NOPSEMA.	John Brewster	-	-
3	06/12/13	Updated in line with a request for modification from NOPSEMA	John Brewster	Robert Meagher	Mark Sanford
4	04/03/2014	Updated in line with a request for modification from NOPSEMA	Robert Meagher	Scott Cornish	Mark Sanford
5	22/09/2014	Updated in line with a request for modification from NOPSEMA	Tom Hatfield	Scott Cornish John Massey James Boorman	Gary Rooks
CDN/ID 3977021 : VIC-9000-ENV-PLN-00003					
6	15/05/2017	Final – Issued to NOPSEMA and DEDJTR for acceptance	Kristy Presley	Shane Reynolds Kelly Hunt Scott Cornish	Mark Sanford
7	14/08/2017	Revisions made to address NOPSEMA and DEDJTR comments	Kristy Presley	Shane Reynolds Kelly Hunt Scott Cornish	Mark Sanford
8	13/03/2018	Revisions made to reflect DEDJTR and NOPSEMA acceptance and Lattice response dated 3/11/2017 to NOPSEMA RFFI dated 13/09/2017.	Kristy Presley	Shane Reynolds Amanda Keely Kelly Hunt	Mark Sanford

Rev	Date	Changes made in document	Reviewer/s	Consolidator	Approver
8A	21/05/2019	Converted to new Beach Template and updated Section 2.0 with current ownership and contact details and an additional objective outlining the reason for the minor revision. Section 8.14 has been updated with the latest corporate IMS strategies as per NOPSEMA recommendation 2064-07.	Adrian Cukovski Phil Wemyss Tim Flowers	Adrian Cukovski	-
8B	21/09/2020	Corrected cross-references, updated information regarding introduced marine species, added pre-amble regarding ownership, all references to Origin replaced with Beach.	Phil Wemyss	Adrian Cukovski	-
9	31/10/2020	Approved for use	-	-	Frank Groen
9A	27/11/2020	Changes limited to: • OEMS updates • Name changes from Origin to Beach • Operating address updated.	Naz Butler, Adrian Cukovski, Tim Flowers	Naz Butler	-
10	17/12/2020	Approved for use	-	-	Frank Groen
10A	14/06/2021	Updated Project Description to include the current operations; Update of Project Description to include two new wells drilled at Geographe	Kamran Khalfay, Mika Porter, Patrick Flynn, Samantha Nunan, Brad Muir, Frank Groen, Phil Wemyss	Phil Wemyss	-
10B	05/08/2021	Update of the HSEMS section to now reflect Beach's OEMS	Frank Groen, Kevin Galea, Linda French, Phil Wemyss, Adrian Cukovski	Phil Wemyss	-
10C	13/08/2021	Updated environmental description to include information from recent studies undertaken as part of the Otway Drilling Campaign	Frank Groen, Kevin Galea, Linda French, Phil Wemyss	Phil Wemyss	-
11	03/09/2021	Approved for use	-	-	Kevin Galea
12	10/03/2022	Updated as per NOPSEMA OMR	PW	Xodus	Kevin Galea
12a	30/05/2022	Update NOPSEMA RFFWI	PWE	Xodus, PWE	KGA
12b	27/07/2022	NOPSEMA Accepted Version	PWE	Xodus, PWE	KGA

Rev	Date	Changes made in document	Reviewer/s	Consolidator	Approver
13a		Otway Phase 5 revision. Issued for review.	PWE	Xodus, PWE	KGA
13c	01/05/2023	Submission to NOPSEMA	PWE	Xodus	KGA

Appendix A EPBC Act Protected Matters Search Reports

A. 1. Operational Area

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Feb-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	68
Listed Migratory Species:	48

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	80
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	27
Key Ecological Features (Marine):	1
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places

[Resource Information]

Name	State	Legal Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place

Commonwealth Marine Area

[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat likely to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area
FISH		

Scientific Name	Threatened Category	Presence Text
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat may occur within area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area
FROG		
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
MAMMAL		
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Species or species habitat likely to occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat likely to occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
PLANT		
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat likely to occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat likely to occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat likely to occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat may occur within area
REPTILE		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
SHARK		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Centrophorus zeehaani Southern Dogfish, Endeavour Dogfish, Little Gulper Shark [82679]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area
Eubalaena australis as Balaena glacialis australis		
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Isurus oxyrinchus		
Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus		
Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus		
Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae		
Humpback Whale [38]		Species or species habitat likely to occur within area
Orcinus orca		
Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus		
Sperm Whale [59]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Myiagra cyanoleuca		
Satin Flycatcher [612]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat may occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Chalcites osculans as Chrysococcyx osculans		
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Diomedea antipodensis		
Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora		
Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans		
Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi		
Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor		
Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area overfly marine area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Halobaena caerulea		
Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus		
White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat likely to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat likely to occur within area overfly marine area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area

Fish

Scientific Name	Threatened Category	Presence Text
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area
Reptile		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves

[Resource Information]

Protected Area Name	Reserve Type	State
Port Campbell	National Park	VIC

Regional Forest Agreements

[Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State
West Victoria RFA	Victoria

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Controlled action			
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
Otway Development	2002/621	Controlled Action	Post-Approval
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Not controlled action			
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Victorian Generator Project	2005/1984	Not Controlled Action	Completed
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
West Tasmania Canyons	South-east

Biologically Important Areas

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur

Scientific Name	Behaviour	Presence
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur
Eubalaena australis Southern Right Whale [40]	Known core range	Known to occur
Eubalaena australis Southern Right Whale [40]	Migration and resting on migration	Known to occur

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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A. 2. Planning Area

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 09-Mar-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	2
Wetlands of International Importance (Ramsar	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	7
Listed Threatened Species:	120
Listed Migratory Species:	73

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	9
Commonwealth Heritage Places:	2
Listed Marine Species:	120
Whales and Other Cetaceans:	31
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	5
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	96
Regional Forest Agreements:	3
Nationally Important Wetlands:	12
EPBC Act Referrals:	122
Key Ecological Features (Marine):	2
Biologically Important Areas:	36
Bioregional Assessments:	1
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status
Historic		
Great Ocean Road and Scenic Environs	VIC	Listed place
Indigenous		
Western Tasmania Aboriginal Cultural Landscape	TAS	Listed place

Wetlands of International Importance (Ramsar Wetlands) [Resource Information]

Ramsar Site Name	Proximity
Corner inlet	Within 10km of Ramsar site
Lavinia	Within Ramsar site
Western port	Within 10km of Ramsar site

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name
EEZ and Territorial Sea

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area
Natural Damp Grassland of the Victorian Coastal Plains	Critically Endangered	Community may occur within area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area

Community Name	Threatened Category	Presence Text
Tasmanian Forests and Woodlands dominated by black gum or Brookers gum (Eucalyptus ovata / E. brookeriana)	Critically Endangered	Community likely to occur within area
Tasmanian white gum (Eucalyptus viminalis) wet forest	Critically Endangered	Community likely to occur within area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Critically Endangered	Community may occur within area

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text
BIRD		
Acanthiza pusilla magnirostris listed as Acanthiza pusilla archibaldi		
King Island Brown Thornbill, Brown Thornbill (King Island) [91709]	Endangered	Species or species habitat known to occur within area
Acanthornis magna greeniana		
King Island Scrubtit, Scrubtit (King Island) [82329]	Critically Endangered	Species or species habitat known to occur within area
Anthochaera phrygia		
Regent Honeyeater [82338]	Critically Endangered	Foraging, feeding or related behaviour likely to occur within area
Aquila audax fleayi		
Tasmanian Wedge-tailed Eagle, Wedge-tailed Eagle (Tasmanian) [64435]	Endangered	Breeding likely to occur within area
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus		
Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris tenuirostris		
Great Knot [862]	Critically Endangered	Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area
Ceyx azureus diemenensis Tasmanian Azure Kingfisher [25977]	Endangered	Species or species habitat known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Fregetta grallaria grallaria White-bellied Storm-Petrel (Tasman Sea), White-bellied Storm-Petrel (Australasian) [64438]	Vulnerable	Species or species habitat likely to occur within area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Platycercus caledonicus brownii Green Rosella (King Island) [67041]	Vulnerable	Species or species habitat known to occur within area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Pycnoptilus floccosus Pilotbird [525]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area
Strepera fuliginosa colei Black Currawong (King Island) [67113]	Vulnerable	Breeding likely to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area
Tyto novaehollandiae castanops (Tasmanian population) Masked Owl (Tasmanian) [67051]	Vulnerable	Breeding known to occur within area
CRUSTACEAN		
Astacopsis gouldi Giant Freshwater Crayfish, Tasmanian Giant Freshwater Lobster [64415]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Euastacus bispinosus Glenelg Spiny Freshwater Crayfish, Pricklyback [81552]	Endangered	Species or species habitat may occur within area
FISH		
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat may occur within area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area
Rexea solandri (eastern Australian population) Eastern Gemfish [76339]	Conservation Dependent	Species or species habitat likely to occur within area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area
FROG		
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area
INSECT		
Oreisplanus munionga larana Marrawah Skipper, Alpine Sedge Skipper, Alpine Skipper [77747]	Vulnerable	Species or species habitat likely to occur within area
MAMMAL		

Scientific Name	Threatened Category	Presence Text
Antechinus minimus maritimus		
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area
Balaenoptera borealis		
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus		
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus		
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dasyurus maculatus maculatus (SE mainland population)		
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat known to occur within area
Dasyurus maculatus maculatus (Tasmanian population)		
Spotted-tail Quoll, Spot-tailed Quoll, Tiger Quoll (Tasmanian population) [75183]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis		
Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isoodon obesulus obesulus		
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area
Mastacomys fuscus mordicus		
Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area
Miniopterus orianae bassanii		
Southern Bent-wing Bat [87645]	Critically Endangered	Roosting known to occur within area
Neophoca cinerea		
Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Perameles gunnii gunnii Eastern Barred Bandicoot (Tasmania) [66651]	Vulnerable	Species or species habitat likely to occur within area
Perameles gunnii Victorian subspecies Eastern Barred Bandicoot (Mainland) [88020]	Endangered	Translocated population known to occur within area
Petauroides volans Greater Glider (southern and central) [254]	Endangered	Species or species habitat may occur within area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat known to occur within area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat likely to occur within area
Pseudomys shortridgei Heath Mouse, Dayang, Heath Rat [77]	Endangered	Species or species habitat may occur within area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Roosting known to occur within area
Sarcophilus harrisii Tasmanian Devil [299]	Endangered	Species or species habitat likely to occur within area
PLANT		
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Astelia australiana Tall Astelia [10851]	Vulnerable	Species or species habitat may occur within area
Caladenia dienema Windswept Spider-orchid [64858]	Endangered	Species or species habitat known to occur within area
Caladenia hastata Melblom's Spider-orchid [16118]	Endangered	Species or species habitat likely to occur within area
Caladenia orientalis Eastern Spider Orchid [83410]	Endangered	Species or species habitat likely to occur within area
Caladenia tessellata Thick-lipped Spider-orchid, Daddy Long-legs [2119]	Vulnerable	Species or species habitat known to occur within area
Corunastylis brachystachya Short-spiked Midge-orchid, Rocky Cape Midge Orchid [76410]	Endangered	Species or species habitat may occur within area
Diuris lanceolata Snake Orchid [10231]	Endangered	Species or species habitat likely to occur within area
Eucalyptus strzeleckii Strzelecki Gum [55400]	Vulnerable	Species or species habitat known to occur within area
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area
Hiya distans listed as Hypolepis distans Scrambling Ground-fern [92548]	Endangered	Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Ixodia achillaeoides subsp. arenicola Sand Ixodia, Ixodia [21474]	Vulnerable	Species or species habitat likely to occur within area
Leiocarpa gatesii Wrinkled Buttons [76212]	Vulnerable	Species or species habitat likely to occur within area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat may occur within area
Leucochrysum albicans subsp. tricolor Hoary Sunray, Grassland Paper-daisy [89104]	Endangered	Species or species habitat may occur within area
Prasophyllum atratum Three Hummock Leek-orchid [82677]	Critically Endangered	Species or species habitat known to occur within area
Prasophyllum favonium Western Leek-orchid [64949]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum frenchii Maroon Leek-orchid, Slaty Leek-orchid, Stout Leek-orchid, French's Leek-orchid, Swamp Leek-orchid [9704]	Endangered	Species or species habitat known to occur within area
Prasophyllum litorale listed as Prasophyllum littorale Coastal Leek Orchid [55234]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum pulchellum Pretty Leek-orchid [64953]	Critically Endangered	Species or species habitat likely to occur within area
Prasophyllum secutum Northern Leek-orchid [64954]	Endangered	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat likely to occur within area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat known to occur within area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area
Pterostylis ziegeleri Grassland Greenhood, Cape Portland Greenhood [64971]	Vulnerable	Species or species habitat likely to occur within area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area
REPTILE		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
SHARK		
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Centrophorus zeehaani Southern Dogfish, Endeavour Dogfish, Little Gulper Shark [82679]	Conservation Dependent	Species or species habitat likely to occur within area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat likely to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Hydroprogne caspia Caspian Tern [808]		Breeding known to occur within area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area

Scientific Name	Threatened Category	Presence Text
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Migratory Marine Species		
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Breeding known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting known to occur within area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area
Thalasseus bergii Greater Crested Tern [83000]		Breeding known to occur within area
Tringa brevipes Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Scientific Name	Threatened Category	Presence Text
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Commonwealth Land Name	State
Unknown	
Commonwealth Land - [21487]	VIC
Commonwealth Land - [60114]	TAS
Commonwealth Land - [60112]	TAS
Commonwealth Land - [21583]	VIC
Commonwealth Land - [21492]	VIC
Commonwealth Land - [60111]	TAS
Commonwealth Land - [60115]	TAS
Commonwealth Land - [60113]	TAS
Commonwealth Land - [21488]	VIC

Commonwealth Heritage Places [Resource Information]

Name	State	Status
Historic		
Cape Wickham Lighthouse	TAS	Listed place
Wilsons Promontory Lighthouse	VIC	Listed place

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text
Bird		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat known to occur within area

Scientific Name	Threatened Category	Presence Text
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area overfly marine area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat likely to occur within area
Ardenna tenuirostris as Puffinus tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area
Arenaria interpres Ruddy Turnstone [872]		Roosting known to occur within area
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris alba Sanderling [875]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat known to occur within area overfly marine area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area overfly marine area
Calidris tenuirostris Great Knot [862]	Critically Endangered	Roosting known to occur within area overfly marine area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area
Charadrius bicinctus Double-banded Plover [895]		Roosting known to occur within area overfly marine area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat known to occur within area
Charadrius mongolus Lesser Sand Plover, Mongolian Plover [879]	Endangered	Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area overfly marine area
Chroicocephalus novaehollandiae as Larus novaehollandiae Silver Gull [82326]		Breeding known to occur within area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea antipodensis gibsoni as Diomedea gibsoni Gibson's Albatross [82270]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Scientific Name	Threatened Category	Presence Text
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area
Gallinago stenura Pin-tailed Snipe [841]		Roosting known to occur within area overfly marine area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area
Himantopus himantopus Pied Stilt, Black-winged Stilt [870]		Roosting known to occur within area overfly marine area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Hydroprogne caspia as Sterna caspia Caspian Tern [808]		Breeding known to occur within area
Larus dominicanus Kelp Gull [809]		Breeding known to occur within area
Larus pacificus Pacific Gull [811]		Breeding known to occur within area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat known to occur within area overfly marine area
Limicola falcinellus Broad-billed Sandpiper [842]		Roosting known to occur within area overfly marine area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area overfly marine area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat known to occur within area overfly marine area

Scientific Name	Threatened Category	Presence Text
Motacilla flava Yellow Wagtail [644]		Species or species habitat known to occur within area overfly marine area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route known to occur within area overfly marine area
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat known to occur within area overfly marine area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area
Numenius phaeopus Whimbrel [849]		Roosting known to occur within area
Onychoprion fuscatus as Sterna fuscata Sooty Tern [90682]		Breeding known to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Pelagodroma marina White-faced Storm-Petrel [1016]		Breeding known to occur within area

Scientific Name	Threatened Category	Presence Text
Pelecanoides urinatrix Common Diving-Petrel [1018]		Breeding known to occur within area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area overfly marine area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area
Pluvialis fulva Pacific Golden Plover [25545]		Roosting known to occur within area
Pluvialis squatarola Grey Plover [865]		Roosting known to occur within area overfly marine area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Sternula nereis as Sterna nereis Fairy Tern [82949]		Breeding known to occur within area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Scientific Name	Threatened Category	Presence Text
Thalasseus bergii as Sterna bergii		
Greater Crested Tern [83000]		Breeding known to occur within area
Thinornis cucullatus as Thinornis rubricollis		
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis		
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area
Tringa brevipes as Heteroscelus brevipes		
Grey-tailed Tattler [851]		Roosting known to occur within area
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area overfly marine area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area overfly marine area
Xenus cinereus		
Terek Sandpiper [59300]		Roosting known to occur within area overfly marine area
Fish		
Heraldia nocturna		
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus abdominalis		
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area
Hippocampus breviceps		
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus minotaur		
Bullneck Seahorse [66705]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area
Kimblaeus bassensis Trawl Pipefish, Bass Strait Pipefish [66247]		Species or species habitat may occur within area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys mollisoni Mollison's Pipefish [66260]		Species or species habitat may occur within area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area
Syngnathoides biaculeatus Double-end Pipehorse, Double-ended Pipehorse, Alligator Pipefish [66279]		Species or species habitat may occur within area

Scientific Name	Threatened Category	Presence Text
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammal		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Breeding known to occur within area
Neophoca cinerea Australian Sea-lion, Australian Sea Lion [22]	Endangered	Species or species habitat may occur within area
Reptile		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence
Mammal		

Current Scientific Name	Status	Type of Presence
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour likely to occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Hyperoodon planifrons Southern Bottlenose Whale [71]		Species or species habitat may occur within area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat known to occur within area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area
Mesoplodon grayi Gray's Beaked Whale, Scamperdown Whale [75]		Species or species habitat may occur within area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area

Current Scientific Name	Status	Type of Presence
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area
Tasmacetus shepherdi Shepherd's Beaked Whale, Tasman Beaked Whale [55]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area

Australian Marine Parks

[Resource Information]

Park Name	Zone & IUCN Categories
Apollo	Multiple Use Zone (IUCN VI)
Beagle	Multiple Use Zone (IUCN VI)
Franklin	Multiple Use Zone (IUCN VI)

Park Name	Zone & IUCN Categories
Zeehan	Multiple Use Zone (IUCN VI)
Zeehan	Special Purpose Zone (IUCN VI)

Extra Information

State and Territory Reserves [Resource Information]

Protected Area Name	Reserve Type	State
Aire River	Heritage River	VIC
Aire River W.R.	Natural Features Reserve	VIC
Anser Island	Reference Area	VIC
Arthur-Pieman	Conservation Area	TAS
Badger Box Creek	Nature Reserve	TAS
Barham Paradise S.R.	Natural Features Reserve	VIC
Bay of Islands Coastal Park	Conservation Park	VIC
Black Pyramid Rock	Nature Reserve	TAS
Bunurong	Marine National Park	VIC
Cape Liptrap Coastal Park	Conservation Park	VIC
Cape Nelson	State Park	VIC
Cape Wickham	State Reserve	TAS
Cape Wickham	Conservation Area	TAS
Cataraqui Point	Conservation Area	TAS
Christmas Island	Nature Reserve	TAS
City of Melbourne Bay	Conservation Area	TAS
Colliers Forest Reserve	Conservation Covenant	TAS
Colliers Swamp	Conservation Area	TAS
Cone Islet	Conservation Area	TAS

Protected Area Name	Reserve Type	State
Councillor Island	Nature Reserve	TAS
Counsel Hill	Conservation Area	TAS
Currie Lightkeepers Residence	Historic Site	TAS
Curtis Island	Nature Reserve	TAS
Deep Lagoons	Conservation Area	TAS
Devils Tower	Nature Reserve	TAS
Disappointment Bay	State Reserve	TAS
Discovery Bay Coastal Park	Conservation Park	VIC
East Moncoeur Island	Conservation Area	TAS
Eldorado	Conservation Area	TAS
Gentle Annie	Conservation Area	TAS
Great Otway	National Park	VIC
Hogan Group	Conservation Area	TAS
Johanna Falls S.R.	Natural Features Reserve	VIC
Kentford Forest	Conservation Area	TAS
Kentford Forest	Nature Reserve	TAS
Kentford Road	Conservation Covenant	TAS
Kent Group	National Park	TAS
King Island	Conservation Covenant	TAS
Latrobe B.R.	Natural Features Reserve	VIC
Lavinia	State Reserve	TAS
Lily Lagoon	Nature Reserve	TAS
Loorana	Conservation Covenant	TAS
Lymwood	Conservation Covenant	TAS
Marengo N.C.R.	Nature Conservation Reserve	VIC

Protected Area Name	Reserve Type	State
Marengo Reefs	Marine Sanctuary	VIC
Millwood Road	Conservation Covenant	TAS
Muddy Lagoon	Nature Reserve	TAS
New Year Island	Game Reserve	TAS
North East Islet	Nature Reserve	TAS
Nugara	Conservation Covenant	TAS
Parker River	Reference Area	VIC
Pegarah	Private Nature Reserve	TAS
Pegarah Forest	Conservation Covenant	TAS
Petrel Islands	Game Reserve	TAS
Phillip Island Nature Park	Other	VIC
Point Addis	Marine National Park	VIC
Porky Beach	Conservation Area	TAS
Port Campbell	National Park	VIC
Princetown W.R	Natural Features Reserve	VIC
Red Hut Point	Conservation Area	TAS
Red Hut Road #1	Conservation Covenant	TAS
Reekara Road #1	Conservation Covenant	TAS
Reekara Road #2	Conservation Covenant	TAS
Reid Rocks	Nature Reserve	TAS
Rodondo Island	Nature Reserve	TAS
Sandfly Beach	Conservation Covenant	TAS
Sea Elephant	Conservation Area	TAS
Sea Elephant Bootlace	Conservation Covenant	TAS
Sea Elephant River	Conservation Covenant	TAS
Seal Rocks	Conservation Area	TAS

Protected Area Name	Reserve Type	State
Seal Rocks	State Reserve	TAS
Shallow Inlet Marine and Coastal Park	National Parks Act Schedule 4 park or reserve	VIC
Slaves Bay	Conservation Area	TAS
Southern Wilsons Promontory	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Stokes Point	Conservation Area	TAS
Stony Creek (Otways)	Reference Area	VIC
Sugarloaf Rock	Conservation Area	TAS
Tambar	Conservation Covenant	TAS
Tathams Lagoon	Conservation Area	TAS
The Arches	Marine Sanctuary	VIC
Three Hummock Island	State Reserve	TAS
Twelve Apostles	Marine National Park	VIC
Unnamed P0176	Private Nature Reserve	VIC
West Moncoeur Island	Nature Reserve	TAS
West Point	State Reserve	TAS
Wicks Road Nugara	Conservation Covenant	TAS
Wild Dog B.R.	Natural Features Reserve	VIC
Wild Dog Creek SS.R.	Natural Features Reserve	VIC
Wilsons Promontory	Wilderness Zone	VIC
Wilsons Promontory	National Park	VIC
Wilsons Promontory	Marine National Park	VIC
Wilsons Promontory Islands	Remote and Natural Area - Schedule 6, National Parks Act	VIC
Wilsons Promontory Marine Park	National Parks Act Schedule 4 park or reserve	VIC

Protected Area Name	Reserve Type	State
Wilsons Promontory Marine Reserve	National Parks Act Schedule 4 park or reserve	VIC
Wongarra B.R.	Natural Features Reserve	VIC
Yambacoona	Conservation Covenant	TAS

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State
Gippsland RFA	Victoria
Tasmania RFA	Tasmania
West Victoria RFA	Victoria

Nationally Important Wetlands [Resource Information]

Wetland Name	State
Aire River	VIC
Bungaree Lagoon	TAS
Lake Flannigan	TAS
Lavinia Nature Reserve	TAS
Lower Aire River Wetlands	VIC
Pearshape Lagoon 1	TAS
Pearshape Lagoon 2	TAS
Pearshape Lagoon 3	TAS
Pearshape Lagoon 4	TAS
Princetown Wetlands	VIC
Shallow Inlet Marine & Coastal Park	VIC
Western Port	VIC

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status
Apollo Bay to Skenes Creek Coastal Trail	2022/09274		Assessment

Title of referral	Reference	Referral Outcome	Assessment Status
Greater Gippsland Offshore Wind Project	2022/09379		Assessment
Greater Gippsland Offshore Wind Project Initial Marine Field Investigations	2022/09374		Completed
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed
Southern Winds Offshore Wind Project	2022/09435		Referral Decision
Southern Winds Offshore Wind Project Initial Marine Field Investigations	2022/09436		Referral Decision
Spinifex Offshore Surveys	2022/09359		Completed
Controlled action			
Alston-1 petroleum exploration well, permit VIC/P44	2003/1315	Controlled Action	Post-Approval
Bald Hills Wind Farm 80 Turbines	2002/730	Controlled Action	Post-Approval
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval
Dairy Farm expansion on the Woolnorth property	2013/6710	Controlled Action	Completed
Establishment of plantation for use of effluent water	2003/1063	Controlled Action	Completed
Otway Development	2002/621	Controlled Action	Post-Approval
Pacific Hydro (Portland) Wind Farm SW Victoria	2000/18	Controlled Action	Post-Approval
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed
Star of the South Offshore Wind Farm Project	2020/8650	Controlled Action	Guidelines Issued
Strike Oil Gas Exploration Well, Otway Basin (VIC/P44)	2000/97	Controlled Action	Completed
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval
VIC Offshore Windfarm	2021/8966	Controlled Action	Assessment Approach

Title of referral	Reference	Referral Outcome	Assessment Status
Controlled action			
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed
Wind Farm Construction	2000/12	Controlled Action	Post-Approval
Yolla Gas Field (TRL1) Development	2001/321	Controlled Action	Post-Approval
Not controlled action			
2004/2005 drilling program for exploration and production (VIC 01-06, 09-11, 16, 18 & 19 and VIC/RL	2003/1282	Not Controlled Action	Completed
2D seismic survey, Petroleum Exploration Permit Area T/36P	2004/1787	Not Controlled Action	Completed
Amrit-1 exploration well	2004/1572	Not Controlled Action	Completed
Apollo Bay Water Storage Basin, VIC	2012/6484	Not Controlled Action	Completed
Capture of Juvenile Tasmanian Devils for Conservation Purposes	2007/3261	Not Controlled Action	Completed
Capture of Tasmanian Devils from Disease-Free Areas	2007/3883	Not Controlled Action	Completed
Communications tower extension	2003/1099	Not Controlled Action	Completed
construction of pump station for pump diversion from the Barham River	2003/1242	Not Controlled Action	Completed
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed
Ferry Service Infrastructure Development	2001/269	Not Controlled Action	Completed
Gas Field Development	2006/2635	Not Controlled Action	Completed
Gippsland Basin Seismic Programme	2004/1866	Not Controlled Action	Completed
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed
Huxley Hill Wind Farm expansion	2005/2499	Not Controlled Action	Completed

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action			
Huxley Hill Wind Farm Expansion	2002/570	Not Controlled Action	Completed
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed
Installation of optic fibre cable from Inverloch, Victoria to Stanley, Tasmania	2002/906	Not Controlled Action	Completed
Millwood Road Gravel Quarry	2002/602	Not Controlled Action	Completed
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed
Newhaven Yacht Squadron marina extension	2004/1450	Not Controlled Action	Completed
New Water Infrastructure Upgrade, Grassy Dam, King Island	2013/6882	Not Controlled Action	Completed
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed
Proposed replacement of existing road culvert	2013/7077	Not Controlled Action	Completed
Residential/Resort/Golf Course development	2002/907	Not Controlled Action	Completed
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed
Venus Bay Outfall Extension	2004/1555	Not Controlled Action	Completed
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed
Victorian Generator Project	2005/1984	Not Controlled Action	Completed
West Triton Drilling Program - Gippsland Basin	2007/3915	Not Controlled Action	Completed
Not controlled action (particular manner)			

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval
2D Marine Seismic Survey in Permit Areas T/32P and T/33P	2002/845	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2008/4066	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2008/3962	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval
2D Seismic Survey in VIC/P50 and VIC/P46	2004/1810	Not Controlled Action (Particular Manner)	Post-Approval
2D seismic survey VIC/P50	2005/2313	Not Controlled Action (Particular Manner)	Post-Approval
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval
3D Marine Seismic Survey within Torquay Sub-basin off sthn Victoria	2012/6256	Not Controlled Action (Particular Manner)	Post-Approval
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval
Apache 3D seismic exploration survey	2006/3146	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Aroo Chappell 3D seismic survey	2010/5701	Not Controlled Action (Particular Manner)	Post-Approval
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval
Bass Basin 2D and 3D seismic surveys (T/38P & T/37P)	2007/3650	Not Controlled Action (Particular Manner)	Post-Approval
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval
Bream 3D seismic survey	2006/2556	Not Controlled Action (Particular Manner)	Post-Approval
Construct private dwelling	2008/4234	Not Controlled Action (Particular Manner)	Post-Approval
Dalrymple 3D Seismic Survey	2010/5680	Not Controlled Action (Particular Manner)	Post-Approval
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval
Exploration drilling of the Craigow-1 and Tolpuddle-1 wells	2010/5725	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Fuelbreak construction	2009/4915	Not Controlled Action (Particular Manner)	Post-Approval
Gas Pipeline	2000/20	Not Controlled Action (Particular Manner)	Post-Approval
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval
Gippsland 2D Marine Seismic Survey - VIC/P-63, VIC/P-64 and T/46P	2009/5241	Not Controlled Action (Particular Manner)	Post-Approval
Hydrocarbon exploration wells	2003/1062	Not Controlled Action (Particular Manner)	Post-Approval
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval
Inspection of project vessels for presence of invasive marine pests in Commonwealth waters off Victo	2012/6362	Not Controlled Action (Particular Manner)	Post-Approval
Labatt 3D Seismic Survey T/47P Bass Strait	2007/3759	Not Controlled Action (Particular Manner)	Post-Approval
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval
Northern Fields 3D Seismic Survey	2001/140	Not Controlled Action (Particular Manner)	Post-Approval
Origin Energy Silvereye-1 Exploration Drilling Programme	2010/5702	Not Controlled Action (Particular Manner)	Post-Approval
OTE10 2D Marine Seismic Survey	2009/5223	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval
Remove silt build up on existing swales around the perimeter of the Three Hummo	2010/5676	Not Controlled Action (Particular Manner)	Post-Approval
Santos 2D Seismic Survey VIC/P44 & VIC/P51	2003/1213	Not Controlled Action (Particular Manner)	Post-Approval
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval
Seismic Survey	2001/206	Not Controlled Action (Particular Manner)	Post-Approval
Shearwater 2D and 3D marine seismic survey	2005/2180	Not Controlled Action (Particular Manner)	Post-Approval
Silvereye 3D Seismic Survey	2007/3551	Not Controlled Action (Particular Manner)	Post-Approval
Southern Flanks 2D Marine Seismic Survey	2010/5288	Not Controlled Action (Particular Manner)	Post-Approval
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval
Southern Margins T/35P and T/36P 3D Seismic Surveys	2007/3817	Not Controlled Action (Particular Manner)	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval
Surface Geochemical Exploration Program, TAS	2010/5780	Not Controlled Action (Particular Manner)	Post-Approval
Tap Oil Ltd Molson 2D Seismic Survey T47P	2008/3967	Not Controlled Action (Particular Manner)	Post-Approval
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval
Torquay Sub-basin (VIC/P62) OTE12-3D Seismic Survey	2012/6655	Not Controlled Action (Particular Manner)	Post-Approval
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval
Vic-P51 and Vic-P52 3D seismic survey	2002/799	Not Controlled Action (Particular	Post-Approval

Title of referral	Reference	Referral Outcome	Assessment Status
Not controlled action (particular manner)			
		Manner)	
Wolseley 3D seismic acquisition survey	2010/5703	Not Controlled Action (Particular Manner)	Post-Approval
Referral decision			
2D & 3D Seismic Surveys - Permit Area - VIC/P50	2008/4517	Referral Decision	Completed
3D Marine Seismic Survey	2011/6156	Referral Decision	Completed
3D Seismic Survey	2008/4014	Referral Decision	Completed
All actions taken in response to the current severe bushfires in Victoria.	2009/4787	Referral Decision	Completed
Darymple 3D Seismic Survey, Petroleum Exploration Permit T/41P	2010/5322	Referral Decision	Completed
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed
Wolseley 3D Seismic Acquisition Survey in Permit T/32P	2010/5291	Referral Decision	Completed

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region
Bonney Coast Upwelling	South-east
West Tasmania Canyons	South-east

Biologically Important Areas

Scientific Name	Behaviour	Presence
Seabirds		
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur

Scientific Name	Behaviour	Presence
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Breeding	Known to occur
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur
Eudyptula minor Little Penguin [1085]	Breeding	Known to occur
Eudyptula minor Little Penguin [1085]	Foraging	Known to occur
Morus serrator Australasian Gannet [1020]	Aggregation	Known to occur
Morus serrator Australasian Gannet [1020]	Foraging	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Breeding	Known to occur
Pelagodroma marina White-faced Storm-petrel [1016]	Foraging	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Breeding	Known to occur
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Breeding	Known to occur

Scientific Name	Behaviour	Presence
Phalacrocorax fuscescens Black-faced Cormorant [59660]	Foraging	Known to occur
Pterodroma mollis Soft-plumaged Petrel [1036]	Foraging	Known to occur
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur
Sharks		
Carcharodon carcharias White Shark [64470]	Breeding (nursery area)	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur
Carcharodon carcharias White Shark [64470]	Foraging	Known to occur
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur
Whales		
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur

Scientific Name	Behaviour	Presence
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Known Foraging Area	Known to occur
Eubalaena australis Southern Right Whale [40]	Aggregation	Known to occur
Eubalaena australis Southern Right Whale [40]	Connecting habitat	Known to occur
Eubalaena australis Southern Right Whale [40]	Known core range	Known to occur
Eubalaena australis Southern Right Whale [40]	Migration and resting on migration	Known to occur

Bioregional Assessments

SubRegion	BioRegion	Website
Gippsland	Gippsland Basin	BA website

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

A. 3. Light EMBA – 20 km

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 22-Feb-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	5
Listed Threatened Species:	78
Listed Migratory Species:	55

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	87
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	10
Regional Forest Agreements:	1
Nationally Important Wetlands:	1
EPBC Act Referrals:	53
Key Ecological Features (Marine):	1
Biologically Important Areas:	20
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In feature area

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In feature area
Grassy Eucalypt Woodland of the Victorian Volcanic Plain	Critically Endangered	Community likely to occur within area	In buffer area only
Natural Temperate Grassland of the Victorian Volcanic Plain	Critically Endangered	Community may occur within area	In buffer area only
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Anthochaera phrygia Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Grantiella picta Painted Honeyeater [470]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pedionomus torquatus Plains-wanderer [906]	Critically Endangered	Species or species habitat likely to occur within area	In buffer area only
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In feature area
FISH			
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
FROG			
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In feature area
MAMMAL			
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat likely to occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In feature area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Roosting known to occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat known to occur within area	In feature area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pseudomys fumeus Smoky Mouse, Konoom [88]	Endangered	Species or species habitat may occur within area	In buffer area only
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Dianella amoena Matted Flax-lily [64886]	Endangered	Species or species habitat may occur within area	In buffer area only
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lepidium aschersonii Spiny Pepper-cress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Lepidium hyssopifolium Basalt Pepper-cress, Peppercress, Rubble Pepper-cress, Pepperweed [16542]	Endangered	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In feature area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In feature area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Delma impar Striped Legless Lizard, Striped Snake-lizard [1649]	Vulnerable	Species or species habitat may occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

SHARK

Scientific Name	Threatened Category	Presence Text	Buffer Status
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Centrophorus zeehaani Southern Dogfish, Endeavour Dogfish, Little Gulper Shark [82679]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species [Resource Information]

Migratory Marine Birds

Scientific Name	Threatened Category	Presence Text	Buffer Status
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area

Migratory Terrestrial Species

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Breeding likely to occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area
Calidris canutus			
Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea			
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos			
Pectoral Sandpiper [858]		Species or species habitat known to occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans			
Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius leschenaultii			
Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Breeding known to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat known to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area overfly marine area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat known to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thinornis cucullatus as Thinornis rubricollis			
Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In feature area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis			
Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Tringa nebularia			
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			
Heraldia nocturna			
Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis			
Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps			
Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii			
Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus			
Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus			
Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus			
Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Solegnathus spinosissimus			
Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus			
Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra			
Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus			
Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris			
Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer			
Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi			
Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus			
Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri			
Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus			
Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans

[Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves

[Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Bay of Islands Coastal Park	Conservation Park	VIC	In buffer area only
Cooriemungle	Reference Area	VIC	In buffer area only
Cooriemungle Creek F.R	Nature Conservation Reserve	VIC	In buffer area only

Protected Area Name	Reserve Type	State	Buffer Status
Curdie Vale N.C.R.	Natural Features Reserve	VIC	In buffer area only
Great Otway	National Park	VIC	In buffer area only
Port Campbell	National Park	VIC	In feature area
Princetown W.R	Natural Features Reserve	VIC	In buffer area only
The Arches	Marine Sanctuary	VIC	In buffer area only
Timboon I1 B.R	Natural Features Reserve	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In feature area

Nationally Important Wetlands [Resource Information]

Wetland Name	State	Buffer Status
Princetown Wetlands	VIC	In buffer area only

EPBC Act Referrals [Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Controlled action				
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
Twelve Apostles Saddle Lookout	2019/8571	Controlled Action	Post-Approval	In buffer area only
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
CO2 geosequestration - Otway Basin Pilot Project	2006/2699	Not Controlled Action	Completed	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In feature area
Exploration drilling for liquid/gaseous hydrocarbons	2004/1681	Not Controlled Action	Completed	In buffer area only
Gas Field Development	2006/2635	Not Controlled Action	Completed	In buffer area only
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Henry-1 Exploration Well, Petroleum Permit Area VIC/P44	2005/2147	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Nirranda South Wind Farm Pty Ltd	2002/763	Not Controlled Action	Completed	In buffer area only
Offshore exploration drilling within permit area VIC/P 37(v)	2004/1466	Not Controlled Action	Completed	In buffer area only
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
VIC-P44 Stage 2 Gas Field Development	2007/3767	Not Controlled Action	Completed	In buffer area only
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In feature area
Wind Farm Construction and Operation	2001/471	Not Controlled Action	Completed	In buffer area only
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
2D Marine Seismic Survey	2005/2295	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
2D Seismic Survey	2003/1214	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
BHPBilliton Otway 3D Seismic Survey	2007/3443	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Santos Otway 3d Seismic VIC/P44	2007/3367	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Southern Gas Pipeline Project	2002/619	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Speculant 3D Transition Zone Seismic Survey	2010/5558	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
VIC P44 Gas Exploration Wells	2002/662	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Vic-P51 and Vic-P52 2D seismic survey	2002/811	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area
Eubalaena australis Southern Right Whale [40]	Known core range	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Eubalaena australis			
Southern Right Whale [40]	Migration and resting on migration	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 06-Apr-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	72
Listed Migratory Species:	48

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	80
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	2
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	30
Key Ecological Features (Marine):	1
Biologically Important Areas:	19
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places [Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In feature area

Commonwealth Marine Area [Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In feature area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat likely to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat likely to occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat may occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata Diamond Firetail [59398]	Vulnerable	Species or species habitat may occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Breeding likely to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In feature area
FISH			
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat may occur within area	In feature area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat may occur within area	In feature area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
FROG			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Litoria raniformis			
Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In feature area
MAMMAL			
Antechinus minimus maritimus			
Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In feature area
Balaenoptera borealis			
Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus			
Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus			
Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population)			
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area	In feature area
Eubalaena australis			
Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isoodon obesulus obesulus			
Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In feature area
Mastacomys fuscus mordicus			
Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area	In feature area
Miniopterus orianae bassanii			
Southern Bent-wing Bat [87645]	Critically Endangered	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area	In feature area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
PLANT			
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat may occur within area	In feature area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In feature area
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thelymitra epipactoides			
Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In feature area
Xerochrysum palustre			
Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			
Caretta caretta			
Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas			
Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea			
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Lissolepis coventryi			
Swamp Skink, Eastern Mourning Skink [84053]	Endangered	Species or species habitat known to occur within area	In feature area
SHARK			
Carcharodon carcharias			
White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Centrophorus uyato listed as Centrophorus zeehaani			
Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus			
School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bubulcus ibis as Ardea ibis Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In feature area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat likely to occur within area overfly marine area	In feature area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area	In feature area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In feature area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves

[Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Port Campbell	National Park	VIC	In feature area
The Arches	Marine Sanctuary	VIC	In buffer area only

Regional Forest Agreements

[Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In feature area

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area
Controlled action				
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In feature area
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action				
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			

Scientific Name	Behaviour	Presence	Buffer Status
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			

Scientific Name	Behaviour	Presence	Buffer Status
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area
Eubalaena australis Southern Right Whale [40]	Known core range	Known to occur	In feature area
Eubalaena australis Southern Right Whale [40]	Migration and resting on migration	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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A. 5. Sound Behaviour EMBA – 7.5 km

Australian Government

Department of Climate Change, Energy, the Environment and Water

EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected. Please see the caveat for interpretation of information provided here.

Report created: 19-Mar-2023

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	1
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	1
Listed Threatened Ecological Communities:	3
Listed Threatened Species:	73
Listed Migratory Species:	55

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	87
Whales and Other Cetaceans:	28
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	3
Regional Forest Agreements:	1
Nationally Important Wetlands:	None
EPBC Act Referrals:	36
Key Ecological Features (Marine):	1
Biologically Important Areas:	20
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

National Heritage Places

[Resource Information]

Name	State	Legal Status	Buffer Status
Historic			
Great Ocean Road and Scenic Environs	VIC	Listed place	In feature area

Commonwealth Marine Area

[Resource Information]

Approval is required for a proposed activity that is located within the Commonwealth Marine Area which has, will have, or is likely to have a significant impact on the environment. Approval may be required for a proposed action taken outside a Commonwealth Marine Area but which has, may have or is likely to have a significant impact on the environment in the Commonwealth Marine Area.

Feature Name	Buffer Status
EEZ and Territorial Sea	In feature area

Listed Threatened Ecological Communities

[Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Assemblages of species associated with open-coast salt-wedge estuaries of western and central Victoria ecological community	Endangered	Community likely to occur within area	In buffer area only
Giant Kelp Marine Forests of South East Australia	Endangered	Community may occur within area	In feature area
Subtropical and Temperate Coastal Saltmarsh	Vulnerable	Community likely to occur within area	In buffer area only

Listed Threatened Species

[Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Anthochaera phrygia			
Regent Honeyeater [82338]	Critically Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area	In feature area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Callocephalon fimbriatum Gang-gang Cockatoo [768]	Endangered	Species or species habitat known to occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area	In feature area
Limosa lapponica baueri Nunivak Bar-tailed Godwit, Western Alaskan Bar-tailed Godwit [86380]	Vulnerable	Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma leucoptera leucoptera Gould's Petrel, Australian Gould's Petrel [26033]	Endangered	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Species or species habitat known to occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus cucullatus Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area	In feature area
FISH			
Galaxiella pusilla Eastern Dwarf Galaxias, Dwarf Galaxias [56790]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Hoplostethus atlanticus Orange Roughy, Deep-sea Perch, Red Roughy [68455]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Nannoperca obscura Yarra Pygmy Perch [26177]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Prototroctes maraena Australian Grayling [26179]	Vulnerable	Species or species habitat known to occur within area	In feature area
Seriolella brama Blue Warehou [69374]	Conservation Dependent	Species or species habitat known to occur within area	In feature area
Thunnus maccoyii Southern Bluefin Tuna [69402]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
FROG			
Litoria raniformis Growling Grass Frog, Southern Bell Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat known to occur within area	In feature area
MAMMAL			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Antechinus minimus maritimus Swamp Antechinus (mainland) [83086]	Vulnerable	Species or species habitat known to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Dasyurus maculatus maculatus (SE mainland population) Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll (southeastern mainland population) [75184]	Endangered	Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isoodon obesulus obesulus Southern Brown Bandicoot (eastern), Southern Brown Bandicoot (south-eastern) [68050]	Endangered	Species or species habitat known to occur within area	In feature area
Mastacomys fuscus mordicus Broad-toothed Rat (mainland), Tooarrana [87617]	Vulnerable	Species or species habitat known to occur within area	In feature area
Miniopterus orianae bassanii Southern Bent-wing Bat [87645]	Critically Endangered	Species or species habitat likely to occur within area	In feature area
Petaurus australis australis Yellow-bellied Glider (south-eastern) [87600]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Potorous tridactylus trisulcatus Long-nosed Potoroo (southern mainland) [86367]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Pseudomys novaehollandiae New Holland Mouse, Pookila [96]	Vulnerable	Species or species habitat may occur within area	In feature area
Pteropus poliocephalus Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
PLANT			
Amphibromus fluitans River Swamp Wallaby-grass, Floating Swamp Wallaby-grass [19215]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Glycine latrobeana Clover Glycine, Purple Clover [13910]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Haloragis exalata subsp. exalata Wingless Raspwort, Square Raspwort [24636]	Vulnerable	Species or species habitat known to occur within area	In feature area
Lepidium aschersonii Spiny Peppercress [10976]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Prasophyllum spicatum Dense Leek-orchid [55146]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pterostylis chlorogramma Green-striped Greenhood [56510]	Vulnerable	Species or species habitat may occur within area	In feature area
Pterostylis cucullata Leafy Greenhood [15459]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterostylis tenuissima Swamp Greenhood, Dainty Swamp Orchid [13139]	Vulnerable	Species or species habitat known to occur within area	In feature area
Senecio psilocarpus Swamp Fireweed, Smooth-fruited Groundsel [64976]	Vulnerable	Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thelymitra epipactoides Metallic Sun-orchid [11896]	Endangered	Species or species habitat known to occur within area	In feature area
Thelymitra matthewsii Spiral Sun-orchid [4168]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Xerochrysum palustre Swamp Everlasting, Swamp Paper Daisy [76215]	Vulnerable	Species or species habitat likely to occur within area	In feature area
REPTILE			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
SHARK			
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Centrophorus uyato listed as Centrophorus zeehaani Little Gulper Shark [68446]	Conservation Dependent	Species or species habitat likely to occur within area	In feature area
Galeorhinus galeus School Shark, Eastern School Shark, Snapper Shark, Tope, Soupfin Shark [68453]	Conservation Dependent	Species or species habitat may occur within area	In feature area

Listed Migratory Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Ardenna carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna tenuirostris Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Sternula albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Migratory Marine Species			
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Carcharodon carcharias White Shark, Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area	In feature area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area
Eubalaena australis as Balaena glacialis australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Isurus oxyrinchus Shortfin Mako, Mako Shark [79073]		Species or species habitat likely to occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat likely to occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Migratory Terrestrial Species			
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area	In buffer area only
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Tringa nebularia			
Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area	In feature area

Other Matters Protected by the EPBC Act

Listed Marine Species

[Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Bird			
Actitis hypoleucos			
Common Sandpiper [59309]		Species or species habitat known to occur within area	In feature area
Apus pacificus			
Fork-tailed Swift [678]		Species or species habitat likely to occur within area overfly marine area	In feature area
Ardenna carneipes as Puffinus carneipes			
Flesh-footed Shearwater, Fleshy-footed Shearwater [82404]		Foraging, feeding or related behaviour likely to occur within area	In feature area
Ardenna grisea as Puffinus griseus			
Sooty Shearwater [82651]		Species or species habitat may occur within area	In feature area
Ardenna tenuirostris as Puffinus tenuirostris			
Short-tailed Shearwater [82652]		Breeding known to occur within area	In buffer area only
Bubulcus ibis as Ardea ibis			
Cattle Egret [66521]		Species or species habitat may occur within area overfly marine area	In feature area
Calidris acuminata			
Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area overfly marine area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area overfly marine area	In feature area
Chalcites osculans as Chrysococcyx osculans Black-eared Cuckoo [83425]		Species or species habitat likely to occur within area overfly marine area	In feature area
Charadrius leschenaultii Greater Sand Plover, Large Sand Plover [877]	Vulnerable	Species or species habitat may occur within area	In buffer area only
Diomedea antipodensis Antipodean Albatross [64458]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea epomophora Southern Royal Albatross [89221]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea exulans Wandering Albatross [89223]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Eudyptula minor Little Penguin [1085]		Breeding known to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat known to occur within area overfly marine area	In feature area
Gallinago megala Swinhoe's Snipe [864]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only
Gallinago stenura Pin-tailed Snipe [841]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area	In feature area
Halobaena caerulea Blue Petrel [1059]	Vulnerable	Species or species habitat may occur within area	In feature area
Hirundapus caudacutus White-throated Needletail [682]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Lathamus discolor Swift Parrot [744]	Critically Endangered	Species or species habitat may occur within area overfly marine area	In feature area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area	In feature area
Macronectes giganteus Southern Giant-Petrel, Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area	In feature area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area overfly marine area	In feature area
Monarcha melanopsis Black-faced Monarch [609]		Species or species habitat may occur within area overfly marine area	In buffer area only
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area overfly marine area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat known to occur within area overfly marine area	In feature area
Neophema chrysogaster Orange-bellied Parrot [747]	Critically Endangered	Migration route likely to occur within area overfly marine area	In feature area
Neophema chrysostoma Blue-winged Parrot [726]		Species or species habitat known to occur within area overfly marine area	In feature area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat known to occur within area	In feature area
Numenius minutus Little Curlew, Little Whimbrel [848]		Foraging, feeding or related behaviour likely to occur within area overfly marine area	In buffer area only
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area	In feature area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area	In buffer area only

Scientific Name	Threatened Category	Presence Text	Buffer Status
Phalacrocorax fuscescens Black-faced Cormorant [59660]		Breeding known to occur within area	In feature area
Phoebetria fusca Sooty Albatross [1075]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Pterodroma mollis Soft-plumaged Petrel [1036]	Vulnerable	Species or species habitat may occur within area	In feature area
Rhipidura rufifrons Rufous Fantail [592]		Species or species habitat likely to occur within area overfly marine area	In feature area
Rostratula australis as Rostratula benghalensis (sensu lato) Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area overfly marine area	In feature area
Stercorarius skua as Catharacta skua Great Skua [823]		Species or species habitat may occur within area	In feature area
Sternula albifrons as Sterna albifrons Little Tern [82849]		Species or species habitat may occur within area	In feature area
Thalassarche bulleri Buller's Albatross, Pacific Albatross [64460]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche bulleri platei as Thalassarche sp. nov. Northern Buller's Albatross, Pacific Albatross [82273]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche carteri Indian Yellow-nosed Albatross [64464]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Thalassarche cauta Shy Albatross [89224]	Endangered	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche chrysostoma Grey-headed Albatross [66491]	Endangered	Species or species habitat may occur within area	In feature area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche salvini Salvin's Albatross [64463]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable	Foraging, feeding or related behaviour known to occur within area	In feature area
Thinornis cucullatus as Thinornis rubricollis Hooded Plover, Hooded Dotterel [87735]		Species or species habitat known to occur within area overfly marine area	In feature area
Thinornis cucullatus cucullatus as Thinornis rubricollis rubricollis Eastern Hooded Plover, Eastern Hooded Plover [90381]	Vulnerable	Species or species habitat known to occur within area overfly marine area	In feature area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area overfly marine area	In feature area
Fish			

Scientific Name	Threatened Category	Presence Text	Buffer Status
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area	In feature area
Hippocampus abdominalis Big-belly Seahorse, Eastern Potbelly Seahorse, New Zealand Potbelly Seahorse [66233]		Species or species habitat may occur within area	In feature area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area	In feature area
Histiogamphelus briggsii Crested Pipefish, Briggs' Crested Pipefish, Briggs' Pipefish [66242]		Species or species habitat may occur within area	In feature area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area	In feature area
Hypselognathus rostratus Knifesnout Pipefish, Knife-snouted Pipefish [66245]		Species or species habitat may occur within area	In feature area
Kaupus costatus Deepbody Pipefish, Deep-bodied Pipefish [66246]		Species or species habitat may occur within area	In feature area
Leptoichthys fistularius Brushtail Pipefish [66248]		Species or species habitat may occur within area	In feature area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area	In feature area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area	In feature area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Mitotichthys semistriatus Halfbanded Pipefish [66261]		Species or species habitat may occur within area	In feature area
Mitotichthys tuckeri Tucker's Pipefish [66262]		Species or species habitat may occur within area	In feature area
Notiocampus ruber Red Pipefish [66265]		Species or species habitat may occur within area	In feature area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area	In feature area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area	In feature area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area	In feature area
Solegnathus robustus Robust Pipehorse, Robust Spiny Pipehorse [66274]		Species or species habitat may occur within area	In feature area
Solegnathus spinosissimus Spiny Pipehorse, Australian Spiny Pipehorse [66275]		Species or species habitat may occur within area	In feature area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish, Peacock Pipefish [66276]		Species or species habitat may occur within area	In feature area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area	In feature area
Stipecampus cristatus Ringback Pipefish, Ring-backed Pipefish [66278]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area	In feature area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area	In feature area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area	In feature area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area	In feature area
Mammal			
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area	In feature area
Arctocephalus pusillus Australian Fur-seal, Australo-African Fur-seal [21]		Species or species habitat may occur within area	In feature area
Reptile			
Caretta caretta Loggerhead Turtle [1763]	Endangered	Breeding likely to occur within area	In feature area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat may occur within area	In feature area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Breeding likely to occur within area	In feature area

Whales and Other Cetaceans [Resource Information]

Current Scientific Name	Status	Type of Presence	Buffer Status
Mammal			
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Balaenoptera bonaerensis Antarctic Minke Whale, Dark-shoulder Minke Whale [67812]		Species or species habitat likely to occur within area	In feature area
Balaenoptera borealis Sei Whale [34]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Balaenoptera musculus Blue Whale [36]	Endangered	Foraging, feeding or related behaviour known to occur within area	In feature area
Balaenoptera physalus Fin Whale [37]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area	In feature area
Berardius arnuxii Arnoux's Beaked Whale [70]		Species or species habitat may occur within area	In feature area
Caperea marginata Pygmy Right Whale [39]		Foraging, feeding or related behaviour may occur within area	In feature area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area	In feature area
Eubalaena australis Southern Right Whale [40]	Endangered	Species or species habitat known to occur within area	In feature area
Globicephala macrorhynchus Short-finned Pilot Whale [62]		Species or species habitat may occur within area	In feature area
Globicephala melas Long-finned Pilot Whale [59282]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area	In feature area
Kogia breviceps Pygmy Sperm Whale [57]		Species or species habitat may occur within area	In feature area
Kogia sima as Kogia simus Dwarf Sperm Whale [85043]		Species or species habitat may occur within area	In feature area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat likely to occur within area	In feature area
Lissodelphis peronii Southern Right Whale Dolphin [44]		Species or species habitat may occur within area	In feature area
Megaptera novaeangliae Humpback Whale [38]		Species or species habitat likely to occur within area	In feature area
Mesoplodon bowdoini Andrew's Beaked Whale [73]		Species or species habitat may occur within area	In feature area
Mesoplodon densirostris Blainville's Beaked Whale, Dense-beaked Whale [74]		Species or species habitat may occur within area	In feature area
Mesoplodon hectori Hector's Beaked Whale [76]		Species or species habitat may occur within area	In feature area
Mesoplodon layardii Strap-toothed Beaked Whale, Strap-toothed Whale, Layard's Beaked Whale [25556]		Species or species habitat may occur within area	In feature area
Mesoplodon mirus True's Beaked Whale [54]		Species or species habitat may occur within area	In feature area

Current Scientific Name	Status	Type of Presence	Buffer Status
Orcinus orca Killer Whale, Orca [46]		Species or species habitat likely to occur within area	In feature area
Physeter macrocephalus Sperm Whale [59]		Species or species habitat may occur within area	In feature area
Pseudorca crassidens False Killer Whale [48]		Species or species habitat likely to occur within area	In feature area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area	In feature area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area	In feature area
Ziphius cavirostris Cuvier's Beaked Whale, Goose-beaked Whale [56]		Species or species habitat may occur within area	In feature area

Extra Information

State and Territory Reserves

[Resource Information]

Protected Area Name	Reserve Type	State	Buffer Status
Port Campbell	National Park	VIC	In feature area
The Arches	Marine Sanctuary	VIC	In buffer area only
Twelve Apostles	Marine National Park	VIC	In buffer area only

Regional Forest Agreements

[Resource Information]

Note that all areas with completed RFAs have been included.

RFA Name	State	Buffer Status
West Victoria RFA	Victoria	In feature area

EPBC Act Referrals

[Resource Information]

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Otway Astrolabe 3D Marine Seismic Survey, Otway Basin	2012/6421		Completed	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Controlled action				
Casino Gas Field Development	2003/1295	Controlled Action	Post-Approval	In feature area
Otway Development	2002/621	Controlled Action	Post-Approval	In feature area
Schomberg 3D Marine Seismic Survey	2007/3754	Controlled Action	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/4075	Controlled Action	Completed	In feature area
Not controlled action				
Enterprise 1 Exploration Drilling Program, near Port Campbell, Vic	2019/8438	Not Controlled Action	Completed	In feature area
Gas Fields Development	2011/5879	Not Controlled Action	Completed	In buffer area only
Halladale and Speculant Gas Pipeline Project, North of Port Campbell, Vic	2015/7551	Not Controlled Action	Completed	In buffer area only
Improving rabbit biocontrol: releasing another strain of RHDV, sthrn two thirds of Australia	2015/7522	Not Controlled Action	Completed	In feature area
INDIGO Central Submarine Telecommunications Cable	2017/8127	Not Controlled Action	Completed	In feature area
Minerva Cut Back Project, Vic	2017/8036	Not Controlled Action	Completed	In buffer area only
Newfield wind farm	2007/3226	Not Controlled Action	Completed	In buffer area only
Port Campbell Headland Walking Trail Realignment	2012/6676	Not Controlled Action	Completed	In buffer area only
Track construction - Great Ocean Walk	2002/793	Not Controlled Action	Completed	In buffer area only
Victorian Generator Project	2005/1984	Not Controlled Action	Completed	In feature area
Not controlled action (particular manner)				
'Moonlight Head' 3D seismic survey, VIC/P38(V), VIC/P43 and VIC/RL8	2005/2236	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
3D marine seismic survey near King Island	2004/1461	Not Controlled Action (Particular Manner)	Post-Approval	In feature area

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
3D seismic program VIC/P38(v), VIC/P43 and VIC/RL8	2003/1137	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Astrolabe 3D Marine Seismic Survey	2011/6048	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Deepwater Sorell Basin 2001 Non-Exclusive 2D Seismic Survey	2001/156	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Drill and Profile Exploration Well Somerset 1, License Area T34P	2009/5037	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Enterprise Three-dimensional Transition Zone Seismic Survey, Victoria	2016/7800	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Geographe-A gas exploration well	2000/82	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
INDIGO Marine Cable Route Survey (INDIGO)	2017/7996	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
La Bella 3D Marine Seismic Survey, Otway Basin, VIC	2012/6683	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Otway Basin Exploration Drilling Campaign, Vic	2011/6125	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Schomberg 3D Marine Seismic survey	2007/3868	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
SEA Gas Project transmission pipeline	2001/513	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
Shaw River Power Station construct gas pipeline and associated infrastructure	2009/5089	Not Controlled Action (Particular	Post-Approval	In buffer area only

Title of referral	Reference	Referral Outcome	Assessment Status	Buffer Status
Not controlled action (particular manner)				
		Manner)		
Strike Oil NL Seismic Surveys	2000/107	Not Controlled Action (Particular Manner)	Post-Approval	In buffer area only
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, Vic	2012/6565	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Thylacine-A Exploration Well	2000/81	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Undertake a three dimensional marine seismic survey	2010/5700	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Vic/P37(v) and Vic/P44 3D marine seismic survey	2003/1102	Not Controlled Action (Particular Manner)	Post-Approval	In feature area
Referral decision				
The Enterprise 3D Seismic Acquisition Survey, Otway Basin, VIC	2012/6545	Referral Decision	Completed	In feature area
VICP61 2D Marine Seismic Survey	2008/3975	Referral Decision	Completed	In feature area

Key Ecological Features [Resource Information]

Key Ecological Features are the parts of the marine ecosystem that are considered to be important for the biodiversity or ecosystem functioning and integrity of the Commonwealth Marine Area.

Name	Region	Buffer Status
West Tasmania Canyons	South-east	In feature area

Biologically Important Areas

Scientific Name	Behaviour	Presence	Buffer Status
Seabirds			
Ardenna pacifica Wedge-tailed Shearwater [84292]	Breeding	Known to occur	In buffer area only
Ardenna pacifica Wedge-tailed Shearwater [84292]	Foraging	Likely to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Ardenna tenuirostris Short-tailed Shearwater [82652]	Foraging	Known to occur	In feature area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Foraging	Known to occur	In feature area
Diomedea exulans antipodensis Antipodean Albatross [82269]	Foraging	Known to occur	In feature area
Pelecanoides urinatrix Common Diving-petrel [1018]	Foraging	Known to occur	In feature area
Thalassarche bulleri Bullers Albatross [64460]	Foraging	Known to occur	In feature area
Thalassarche cauta cauta Shy Albatross [82345]	Foraging likely	Likely to occur	In feature area
Thalassarche chlororhynchos bassi Indian Yellow-nosed Albatross [85249]	Foraging	Known to occur	In feature area
Thalassarche melanophris Black-browed Albatross [66472]	Foraging	Known to occur	In feature area
Thalassarche melanophris impavida Campbell Albatross [82449]	Foraging	Known to occur	In feature area
Sharks			
Carcharodon carcharias White Shark [64470]	Distribution	Known to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Distribution (low density)	Likely to occur	In feature area
Carcharodon carcharias White Shark [64470]	Known distribution	Known to occur	In feature area
Whales			
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Distribution	Known to occur	In feature area

Scientific Name	Behaviour	Presence	Buffer Status
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging	Likely to be present	In feature area
Balaenoptera musculus brevicauda Pygmy Blue Whale [81317]	Foraging (annual high use area)	Known to occur	In feature area
Eubalaena australis Southern Right Whale [40]	Known core range	Known to occur	In feature area
Eubalaena australis Southern Right Whale [40]	Migration and resting on migration	Known to occur	In feature area

Caveat

1 PURPOSE

This report is designed to assist in identifying the location of matters of national environmental significance (MNES) and other matters protected by the Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC Act) which may be relevant in determining obligations and requirements under the EPBC Act.

The report contains the mapped locations of:

- World and National Heritage properties;
- Wetlands of International and National Importance;
- Commonwealth and State/Territory reserves;
- distribution of listed threatened, migratory and marine species;
- listed threatened ecological communities; and
- other information that may be useful as an indicator of potential habitat value.

2 DISCLAIMER

This report is not intended to be exhaustive and should only be relied upon as a general guide as mapped data is not available for all species or ecological communities listed under the EPBC Act (see below). Persons seeking to use the information contained in this report to inform the referral of a proposed action under the EPBC Act should consider the limitations noted below and whether additional information is required to determine the existence and location of MNES and other protected matters.

Where data are available to inform the mapping of protected species, the presence type (e.g. known, likely or may occur) that can be determined from the data is indicated in general terms. It is the responsibility of any person using or relying on the information in this report to ensure that it is suitable for the circumstances of any proposed use. The Commonwealth cannot accept responsibility for the consequences of any use of the report or any part thereof. To the maximum extent allowed under governing law, the Commonwealth will not be liable for any loss or damage that may be occasioned directly or indirectly through the use of, or reliance

3 DATA SOURCES

Threatened ecological communities

For threatened ecological communities where the distribution is well known, maps are generated based on information contained in recovery plans, State vegetation maps and remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species

Threatened, migratory and marine species distributions have been discerned through a variety of methods. Where distributions are well known and if time permits, distributions are inferred from either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc.) together with point locations and described habitat; or modelled (MAXENT or BIOCLIM habitat modelling) using

Where little information is available for a species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc.).

In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More detailed distribution mapping methods are used to update these distributions

4 LIMITATIONS

The following species and ecological communities have not been mapped and do not appear in this report:

- threatened species listed as extinct or considered vagrants;
- some recently listed species and ecological communities;
- some listed migratory and listed marine species, which are not listed as threatened species; and
- migratory species that are very widespread, vagrant, or only occur in Australia in small numbers.

The following groups have been mapped, but may not cover the complete distribution of the species:

- listed migratory and/or listed marine seabirds, which are not listed as threatened, have only been mapped for recorded
- seals which have only been mapped for breeding sites near the Australian continent

The breeding sites may be important for the protection of the Commonwealth Marine environment.

Refer to the metadata for the feature group (using the Resource Information link) for the currency of the information.

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact us page.

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Appendix B Environmental Survey – Otway Basin

SUPPLIER DOCUMENT COVER PAGE

Project Title	Beach Otway Offshore Wellsite Survey Services		
Supplier Name	Ramboll		
Contract/PO No	TBC		
Document Title	Infauna Laboratory Testing and Factual Report		
Fugro Document Number	135846-V01-05-REP-001	**Revision**	B
Client Document Number	S4100RU718410	**Revision**	A
Supplier Document Number	3180000803	**Revision**	B
Sub-Supplier Document Number		**Revision**	
VDRL Code			
Tag No			

Supplier/Contractor Internal Approvals (Supplier/Contractor use only)

Date	Rev	Reason for Issue	Prepared By	Checked By	Supplier/Contractor Approval
17/03/20	A	Issued for Review	E Jones	D McClary	J Miragliotta
23/04/20	B	Issued for Review	E Jones	D McClary	J Miragliotta

Review Status (Fugro use only)

Tick Box	Code	Review Status Description
☐	Code 1	Approved – Certified Final
☐	Code 2	Approved as noted – Revise and resubmit as final revision, work may/may not proceed
☐	Code 3	Not accepted – Revise and resubmit for review
☐	Code 4	Information only – Review not required
☐	Code 5	No Comments – Submit certified final
☐	Code 6	As Built

Acceptance in any of these categories in no way relieves the Supplier/Contractor of their responsibility for the due and proper performance of the works in accordance with the Contract/Purchase Order with Fugro.

Fugro Approval

Name	
Signature	
Date	

Intended for

Fugro Australia Pty Ltd

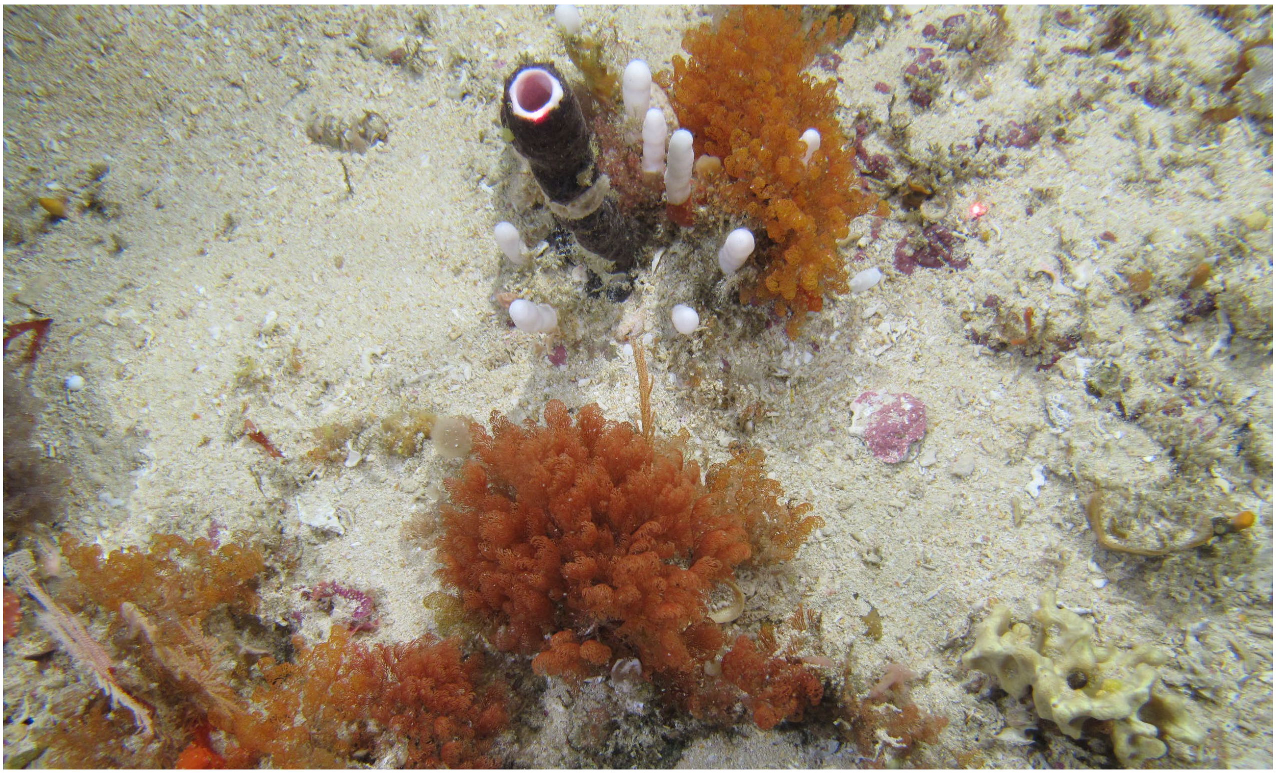
Document type

Report

Date

March 2020

ENVIRONMENTAL SURVEY
OTWAY BASIN



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ENVIRONMENTAL SURVEY
OTWAY BASIN

Project name	**Beach Energy Otway Basin Survey**
Project no.	**318000803**
Recipient	**Chris Henderson**
Document type	**Report**
Version	**Rev B**
Date	**17/03/2020**
Prepared by	**Emily Jones**
Checked by	**Dan McClary**
Approved by	**John Miragliotta**
Description	**Results of the environmental survey at Otway Basin for Beach Energy**

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1. INTRODUCTION

1.1 Background

This report presents the results of the environmental survey of offshore gas fields in Otway Basin for Beach Energy. Beach Energy is planning further development of the Otway offshore natural gas reserves within existing Commonwealth offshore exploration permits and production licenses. The offshore Otway Basin gas exploration and development program may include drilling up to nine wells using a contracted semi-submersible drill rig, over a 12- to 18-month period. Additional seabed infrastructure would also be installed to tie-in new wells after the drilling phase.

As part of this plan, Fugro Australia Marine Pty Ltd (Fugro) carried out offshore geophysical and geotechnical surveys and Ramboll Australia Pty Ltd (Ramboll) were contracted by Fugro to carry out the environmental survey. These activities were in Commonwealth waters approximately 32 to 80 km from Port Campbell and in water depths ranging from 70 to 104 m.

1.2 Objective

The objective of the seabed site assessments was to determine suitable locations for anchoring and rig placement for drilling operations and the installation of infrastructure to connect new production wells to the existing platform or pipeline. Several different investigation techniques were used to examine and describe the seabed, as well as identify possible hazards from man-made, natural and geological features.

1.3 Report Scope

The scope of the environmental survey carried out in Otway Basin included investigations of:
- Water quality;
- Sediment quality;
- Benthic infauna; and
- Benthic epifauna.

Water quality assessments included laboratory analyses for:
- Suspended solids
- Nutrients
- Chlorophyll *a*
- Metals/metalloids
- Hydrocarbons

Sediment quality assessments included laboratory analyses for:
- Sediment particle size
- Total organic carbon
- Nutrients
- Metals/metalloids

Infauna were microscopically examined to determine taxonomic identification to Family level and morpho-species, and abundance was recorded. The composition and percent cover of epifauna was determined from seabed photographs.

2. SURVEY LOCATIONS

These investigations were based around five survey areas including:

- Thylacine;
- Artisan;
- La Bella;
- Geographe; and
- Hercules.

Other survey areas included two Hot Tap sites identified as HTX and HTY, and five routes selected for cone penetration tests (CPT) as part of the geotechnical survey plan identified as ARGE (Artisan to Geographe), ARHTX (Artisan to HTX), ARHTY (artisan to HTY), ARLB (Artisan to La Bella) and LBGE (La Bella to Geographe).

The collection of water and sediment/infauna samples for environmental assessment was cancelled by the client for the La Bella, Geographe and Hercules survey areas. Therefore, the collection of water and sediment/infauna samples for environmental assessment occurred only at the Thylacine and Artisan survey areas. Seabed photographs were taken as planned for all survey areas and routes. It is also noted that all survey areas were largely composed of outcropping rock with or without patches of uncemented sediments. Sampling of uncemented sediments was only possible with the grab sampler (as opposed to other devices) and of limited recovery because of the limited thickness of the surficial uncemented sediments.

The survey extent within Otway Basin, including these survey areas, hot taps and survey routes, is shown Figure 1. Environmental sampling sites were located in proximity to the proposed drilling rig mooring locations. The proposed anchor points for the drilling rig are listed in Table 1. The depth at each proposed mooring location was measure at the intersection of the anchor lines (Table 1). Sampling locations are listed in Section 3 for the relevant sampling methods.

Table 1 Location of proposed anchor points (GDA94 UTM 54 S) and water depth for drilling rig sites.

Survey Area	Anchor Point	Depth at Intersection (m LAT)	Easting	Northing
Thylacine	Thylacine 1	99	661398	5657534
	Thylacine 2		662879	5658389
	Thylacine 3		662361	5659286
	Thylacine 4		660880	5658431
	Thylacine 5	104	658235	5656067
	Thylacine 6		659717	5656923
	Thylacine 7		659198	5657820
	Thylacine 8		657717	5656965
Artisan	Artisan 1	70	662783	5692700
	Artisan 2		664261	5693554
	Artisan 3		663741	5694456
	Artisan 4		662262	5693602
Geographe	Geographe 1	83	668221	5668522
	Geographe 2		669699	5669374
	Geographe 3		669179	5670278
	Geographe 4		667700	5669424
La Bella	La Bella 1	93	647914	5681579
	La Bella 2		645915	5681579
	La Bella 3		647319	5682496
	La Bella 4		646437	5680702
Hercules	Hercules 1	73	664065	5688642
	Hercules 2		662065	5688638
	Hercules 3		663547	5689516
	Hercules 4		662596	5687757

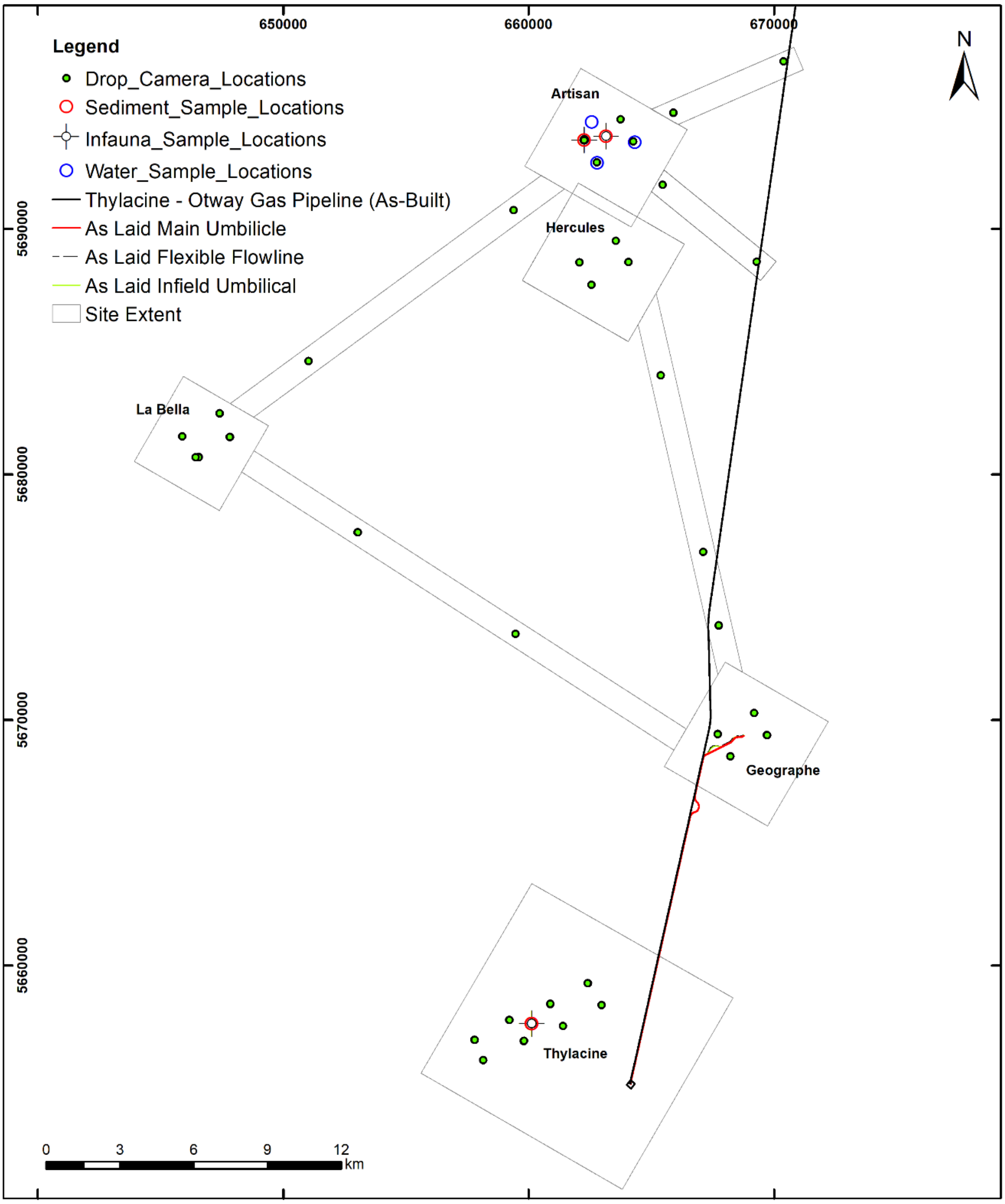


Figure 1 Locations of environmental survey site extents in Otway Basin. Provided by Fugro, April 2020.

3. METHOD

3.1 Survey Operations

The environmental survey was undertaken during several deployments from November 2019 to January 2020. The survey was carried out from the 60 m offshore supply ship *VOS SHINE*. The vessel mobilised from Portland, Victoria.

3.2 Water Quality

3.2.1 Sample Collection

Water quality samples were collected using a 2.2 L Van Dorn Beta water sampler. This sampler was used to obtain water samples from selected water depths. The sampler consisted of an open-ended, clear plastic cylinder with a rubber cap attached at each end. Before deployment, the end caps were held open, under tension, by triggers on the side of the cylinder. The sampler was attached to a rope and lowered by hand over the side of the vessel to the desired depth. A messenger weight attached to the rope was then released to trigger the end caps to close as the messenger contacted the sampler, sealing the water sample inside the cylinder. The sampler was then raised to the surface where the water sample was processed and stored for laboratory analysis.

On retrieval at the surface, the water sampler was inspected against the following sample acceptability criteria:

1. The sample bottle was full; and
2. Both end caps are fully closed; and
3. There was no obvious contamination (e.g. grease or paint chips on, or inside, the sampler).

Any sample that did not comply with these criteria was discarded and another sample was collected at the same site. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

Water samples were collected at two of the survey areas – at Artisan and Thylacine on 22 November 2019. Three replicate water samples were collected at each of the survey areas. The locations for water sample collection are listed in Table 2 and shown in Figure 2. Note that there is only one sampling site indicated for the Thylacine field as all samples were collected in close proximity (Figure 2 left). The process described above was carried out at each site and water samples were collected from a depth equal to half of the total water depth at that site.

Table 2 Location (GDA94 UTM 54 S) and depth of water sample collection sites.

Survey Area	Location	Replicate Sample Name	Easting	Northing	Water Depth (m)	Sample Depth (m)	Met Acceptability Criteria
Thylacine	1	1	660119	5657621	104	52	Yes
	1	2	660121	5657619	104	52	Yes
	1	3	660122	5657619	105	52.5	Yes
Artisan	1	1	662936	5692724	66	33	No
	1	2	662782	5692683	66	33	Yes
	2	1	664317	5693523	66	33	Yes
	5	1	662563	5694337	66	33	Yes

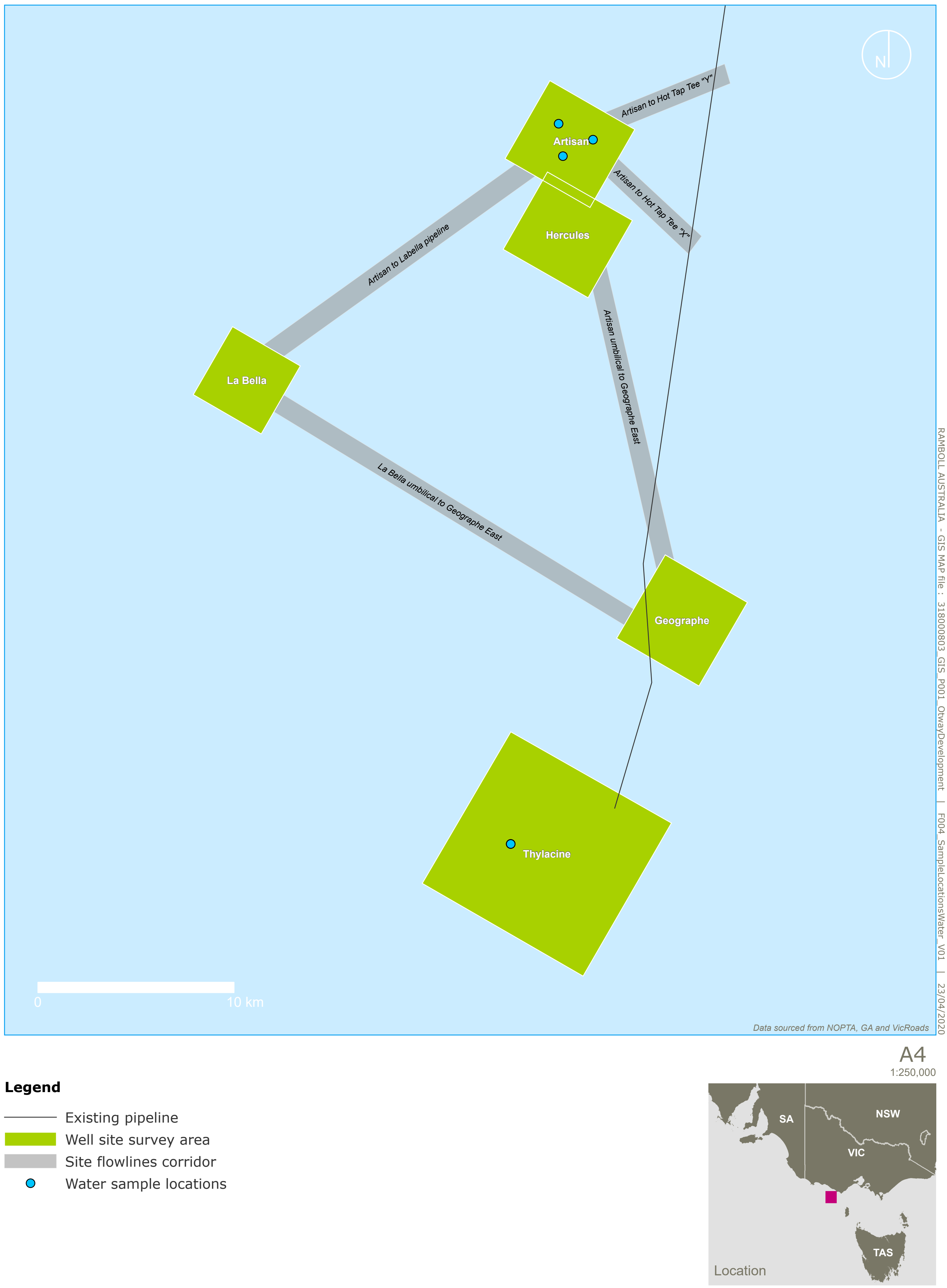


FIGURE 2 | Water sampling locations for Thylacine and Artisan survey areas.

3.2.2 Sample Processing and Analysis

Once a sample was confirmed to be acceptable for analysis, the subsamples were extracted from the water sampler and stored in pre-labelled sample jars provided by the analytical laboratory, Eurofins. The analytical laboratory was NATA accredited and accredited for compliance with ISO/IEC 17025 – Testing.

The water samples were subsampled as follows:

- 1 x 500 mL plastic bottle with no preservative
- 1 x 200 mL glass bottle with no preservative
- 1 x 60 mL plastic bottle with sulphuric acid
- 1 x 60 mL plastic bottle with nitric acid
- 2 x 40 mL glass vials with hydrogen chloride

All samples were stored in a cool, dark location prior to transfer to the laboratory.

One litre of the remaining water sample was then processed for chlorophyll analysis. A simple filtering system was set up which included a Büchner funnel with a rubber seal placed in the mouth of a conical flask and a rubber hose and vacuum hand pump attached to the side arm of the flask. Filter paper (11 µm particle retention at 98% efficiency) was used placed in the funnel and the 1L subsample was suctioned through the filtering system. The filter paper was carefully removed from the funnel using forceps, wrapped in aluminium foil, stored in a labelled sealable plastic bag and frozen prior to transfer to the laboratory.

The following measurements were then taken using a YSI EcoSense handheld meter from the remaining water sample:

- pH
- Dissolved oxygen (DO)
- Oxidation-reduction potential (ORP)
- Temperature (˚C)

Sample information was recorded on the Environmental Sample Log (Appendix 1). All sample collection and processing equipment was then rinsed in sterile demineralised water before the next sample was collected.

All water quality subsamples were recorded on the Ramboll Chain of Custody (COC) form. These subsamples were then transferred to the laboratory on the vessel’s return to shore. The water quality samples were delivered to the Eurofins laboratory in Melbourne on 26 November 2019.

The water samples were analysed for the presence and concentration of these analytes:

- Total suspended solids (TSS);
- Nutrients including total nitrogen (N), total Kjeldahl nitrogen (TKN), nitrogen oxides (NOx), nitrate (NO^-_3), ammonia (NH_3), total phosphorus (TP), and total reactive phosphorus (TRP);
- Chlorophyll *a*;
- Metals/metalloids including arsenic (As), cadmium (Cd), cobolt (Co), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn); and
- Hydrocarbons including total recoverable hydrogens (TRH), benzene, toluene, ethylbenzene and xylene compounds (BTEX), and polycyclic aromatic hydrocarbons (PAH).

The analytical methods for these analytes are included in the laboratory reports in Appendix 2.

3.3 Sediment Quality

3.3.1 Sample Collection

Seabed sediment samples were collected using a Double Van Veen grab sampler. The Double Van Veen grab is designed for sampling the top layer of consolidated sediment consisting of silt and/or sand. The capacity of each grab bucket is ~12 L. The double grab allows for comparable sampling where samples for sediment and biological analysis are required from the same location.

Prior to deployment, the jaws of both grabs were opened and fixed into position using a tension-based catch. The grab sampler was then winched over the stern of the vessel and lowered at a slow, steady rate to prevent the catch from being released too early. When the jaws made contact with the bottom, the release of tension caused the catch to be tripped, allowing the jaws to quickly close to capture the surface sediment. The quantity and quality of the sample was related to the compactness of the sediment whereby the grab sampler returned less sample content from more compacted sediments.

On retrieval at the surface, the grab sampler was inspected against the following sample acceptability criteria:

1. The jaws of the grab are closed; and
2. The surface of the sediment sample covers at least 70% of the grab; and
3. The surface of the sediment sample is undisturbed; and
4. There is no evidence of the sample being washed out; and
5. The sample is at least 20cm deep.

Samples that did not comply with these criteria were typically discarded and another sample was collected at the same site. However, some exceptions to these criteria were allowed on agreement with the client in order to obtain samples for analysis, given the difficulty of obtaining grab samples from the hard seabed substrate. Such instances are noted in the description of results in Section 4. At some sample locations a composite sample was made from several grab drops (up to three drops) to provide enough material for one sample. In these instances, the samples did not achieve a depth of 20 cm. The first sample replicate collected from the Thylacine survey area (Thylacine_1_1) was 15 cm deep and therefore did not meet the acceptance criteria; however, given the difficulty in obtaining suitable samples (owing to the hard seabed), this sample was retained for analysis as all other criteria were met and it was considered to be a useful sample by the field personnel. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

Sediment samples were collected at two of the survey areas – at Artisan and Thylacine on 22 November 2019. Three replicate sediment samples were to be collected at each of the survey areas, however, this was not always possible because of the compacted substrate. The resulting samples included four replicate samples from Thylacine and two replicate samples from Artisan. The locations for successful sediment sample collection are listed in Table 3 and shown in Figure 3. Note that there is only one sampling site indicated for the Thylacine field as all samples were collected in close proximity (Figure 3 left). Grab sample positions were provided by Fugro from the marine survey using Ultra Short Base Line positioning systems.

FIGURE 3 | Grab sample locations for sediment and infauna for Thylacine and Artisan survey areas.

Table 3 Location (GDA94 UTM 54 S) and depth of sediment sample collection sites.

Survey Area	Location	Sample Replicate Name	Easting	Northing	Water Depth (m)	Met Acceptability Criteria
Thylacine	1	0	660119	5657621	104	Sample was 15 cm deep, therefore not within acceptance criteria but considered suitable by field personnel. Incorrectly recorded in lab report as Location 2.
	1	1	660121	5657619	104	Yes
	1	2	660122	5657619	105	Yes
	1	3	660120	5657622	104	Yes
Artisan	1	1	663155	5693762	72	This sample was a composite of replicate samples 1, 3, 4 and 6 taken at the same location. Listed as Artisan_GS_A in lab report.
	1	2	663155	5693762	72	No
	1	3	663155	5693762	72	Composite as above.
	1	4	663155	5693762	72	Composite as above.
	1	5	663155	5693762	72	No
	1	6	663155	5693762	72	Composite as above.
	3	1	662264	5693604	75	No
	3	2	662264	5693604	72	No
	3	3	662265	5693604	73	Yes. Listed as Artisan_GS3 in lab report.
	3	4	662265	5693605	74	No sediment sample, infauna sample only.

3.3.2 Sample Processing and Analysis

Once a sample was confirmed to be acceptable for analysis, the sample was photographed, visual observations were recorded, and subsamples were extracted from the sample and stored in pre-labelled sample jars provided by the analytical laboratory.

All sediment grab samples were photographed with a sample identity plate. Notes of the uniformity of the surface, Munsell colour and odour were then recorded. The redox (reduction–oxidation reaction) potential depth (RPD) was measured using a YSI EcoSense handheld meter and probe. Redox potential is a measure of the tendency of a chemical species to acquire electrons from or lose electrons to an electrode and thereby be reduced or oxidised, respectively. Redox potential is measured in millivolts (mV). The redox potential of the sample was measured from the surface and at 10 mm increments to a depth of up to 110 mm, or until resistance was encountered when inserting the probe. The probe was rinsed in fresh water between each sample. Sample information was recorded on the Environmental Sample Log (Appendix 1).

Sediment was then extracted from one grab bucket for sediment quality sampling (with the contents of the other grab bucket being used for infauna sampling). Subsamples were collected by releasing the sample into a collection bin below the sampler. The entire sample was homogenised using a plastic scoop.

Two subsamples were stored in pre-labelled 250 mL glass sample jars for the analysis of contaminants and particle size distribution. All samples were stored in a cool, dark location prior to transfer to the laboratory. All sample collection and processing equipment was then rinsed in fresh water before the next sample was collected.

All sediment quality subsamples were recorded on the Ramboll COC form. These subsamples were then transferred to the laboratory on the vessel's return to shore. The sediment quality samples were delivered to the Eurofins laboratory in Melbourne on 26 November 2019.

The sediment samples were analysed for the presence and concentration of these analytes:

- Sediment particle size as clay-size fraction, silt and sand;
- Total organic carbon (TOC);
- Nutrients including nitrate and nitrite, TKN, total nitrogen, phosphorus, and silicon;
- Metals/metalloids including cadmium (Cd), chromium (Cr), copper (Cu), lead (Pb), mercury (Hg), nickel (Ni), tin (Sn), and zinc (Zn).
- Hydrocarbons including Total Petroleum Hydrocarbons (TPH) , total polycyclic aromatic hydrocarbons (PAH) and BTEX (benzene, toluene, ethylbenzene and xylenes, PCBs.

The analytical methods for these analytes are included in the laboratory reports in Appendix 3.

3.4 Infauna Ecology

3.4.1 Sample Collection

Seabed sediment samples for infauna were collected using a Double Van Veen grab sampler, as described in Section 3.2.1 and at the locations presented in Table 4 and Figure 3. The critiera for accepting grab samples for infauna analysis were as described in Section 3.2.1. All samples were recorded on the Environmental Sampling Log (Appendix 1) as per 135846-V01-01-PLA-001 Infauna Lab Testing & Reporting Plan.

3.4.2 Sample Processing and Analysis

Once a sample was confirmed to be acceptable for analysis, the sample was photographed with a sample identity plate. Sediment was then extracted from one grab bucket for infauna sampling (with the contents of the other grab bucket being used for sediment quality sampling). The entire sample was released into a collection bin below the sampler and then transferred to a sample washing system where the sample was placed in a perforated bin to be mixed and rinsed with seawater. The liquified sample was then passed through a series of sieves of 1mm mesh size (top) and 500 µm mesh size (bottom). The remaining infauna and debris were then rinsed into a labelled container and preserved in ethanol at a dilution factor of 2:1 to sample volume. Where a full grab sample was collected, the contents were subsampled to a 6L sample volume to limit the time required for infauna sample processing in the laboratory.

All samples were stored in a chemical locker and were recorded on the Ramboll COC form. These samples were then transferred to the taxonomic analyst on the vessel's return to shore. The laboratory in Gladstone, Queensland received the infauna samples in December 2019.

Infauna organisms present in the samples were identified and counted to Family morpho-species or genus level where possible. Descriptive statistics (e.g., species richness, organism abundance, diversity indices) were used to summarise the seabed biota present. This information is assessed and discussed in the context of the known communities present in the wider Otway Basin, noting the presence of any habitats/species of relevance to the EPBC Act. Multivariate measures were not used in the assessment because of the small dataset and paucity of organisms found in the samples.

Table 4 Location (GDA94 UTM 54 S) and depth of infauna sample collection sites.

Survey Area	Location	Sample Replicate Name	Easting	Northing	Water Depth (m)	Met Acceptability Criteria
Thylacine	1*	0	660119	5657621	104	Sample was 15 cm deep, therefore not within acceptance criteria but considered suitable by field personnel. Incorrectly recorded in lab report as Location 2.
	1	1	660121	5657619	104	Yes
	1	2	660122	5657619	105	Yes
	1	3	660120	5657622	104	Yes
Artisan	1	1	663155	5693762	72	No
	1	2	663155	5693762	72	No
	1	3	663155	5693762	72	No
	1	4	663155	5693762	72	Yes
	1	5	663155	5693762	72	No
	1	6	663155	5693762	72	No
	3	1	662264	5693604	75	No
	3	2	662264	5693604	72	No
	3	3	662265	5693604	73	Yes
	3	4	662265	5693605	74	Sample was 7 cm deep, therefore not within acceptance criteria but considered suitable by field personnel.

3.5 Epibenthic Ecology

3.5.1 Sample Collection

The composition and percent coverage of epifauna was assessed from photographs of the seafloor taken with the Fugro drop camera system. The drop camera system was fitted with a 14.7 megapixel (MP) Canon PowerShot G10 digital camera and a low latency, live video recorder. The system was equipped with twin lasers aimed within the camera field of view to enable calibration of the image size. The lasers were calibrated to a distance of 15 cm. The camera housing was an aluminium enclosure for use in water depths up to 300 m. A mini beacon was attached to the drop camera to accurately track locations during deployment.

The drop camera was deployed via a winch over the stern of the vessel. All data was transferred directly to the surface unit and saved into a dedicated Fugro server. A real-time video feed to the surface enabled preliminary observations of benthic fauna and substrate type to be made during operation.

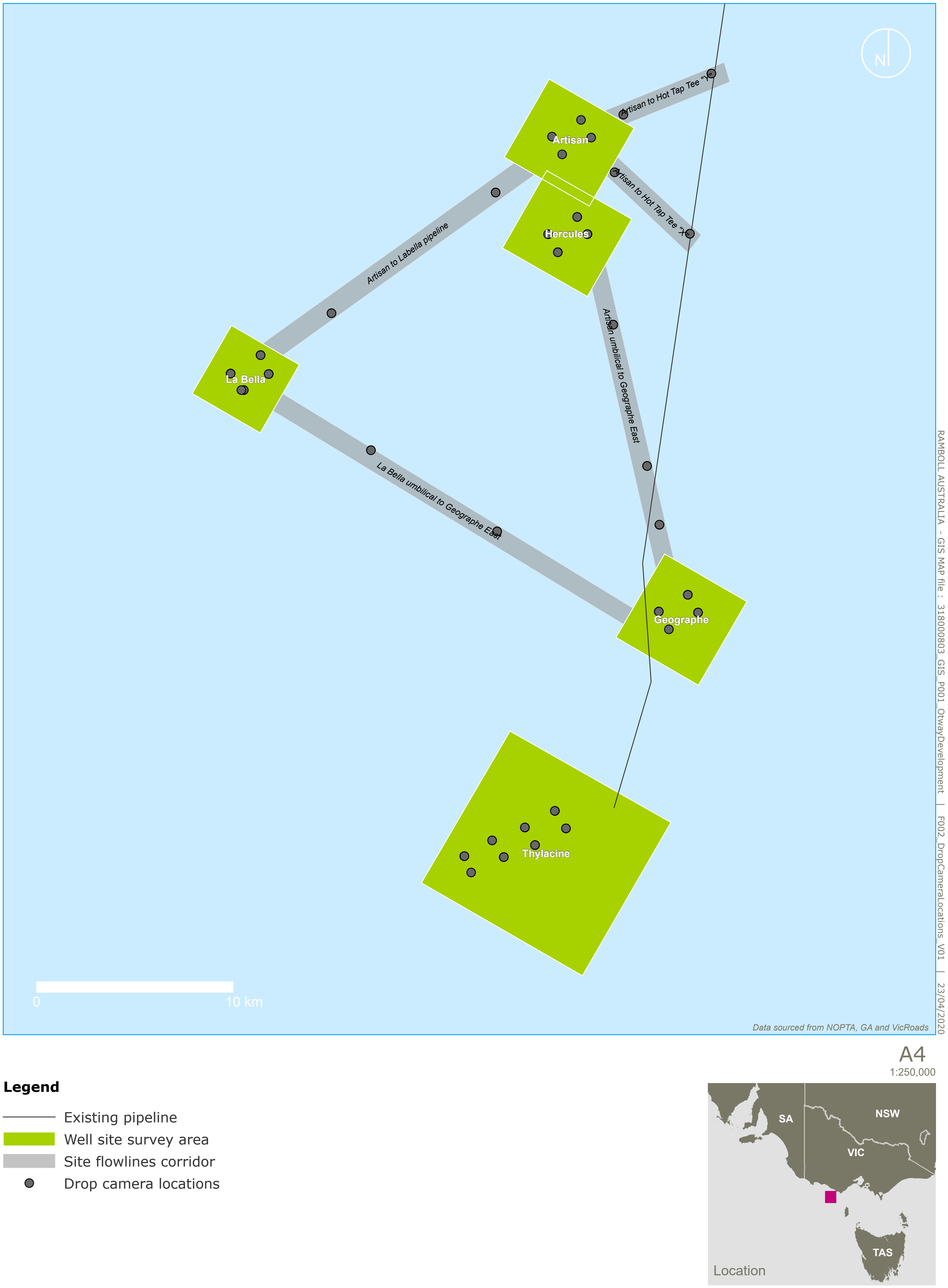
At each sampling site the camera was lowered and then to three locations approximately 1-2 m apart to obtain a collection of representative samples. At least five photographs were taken at each location to provide a selection of photographs for analysis. Drop camera sites are listed in Appendix 4. Drop camera photographs were taken at all anchor points, hot tap sites and along CPT routes as shown in Figure 4. The average area of seabed in each photograph was 0.5 m^2.

3.5.2 Sample Processing and Analysis

All seafloor photographs were examined to determine their suitability for analysis, with photographs being excluded for the assessment based on the following reasons:

- Poor resolution or blurred image;
- Sediment blow out obscuring the image;
- More than a quarter of the image was in shadow or had poor lighting;
- Images were overlapping (in which case the best quality image was chosen); or
- Images were taken at oblique angles.

For each photograph, the percent coverage of epifauna was estimated and individual, mobile organisms were counted. Photographs were examined to provide a qualitative description of the epifauna communities. Sediment type and percent coverage was also estimated for each photograph.



Data sourced from NOPTA, GA and VicRoads

RAMBOLL AUSTRALIA - GIS MAP file : 318000803_GIS_P001_OtwayDevelopment | F002_DropCameraLocations_V01 | 23/04/2020

FIGURE 4 | Drop camera locations for all survey areas.

4. RESULTS

4.1 Water Quality

Measurements made *insitu* for water samples collected from the Thylacine and Artisan survey areas are presented in Table 5. Dissolved oxygen (DO) and pH were assessed against the default trigger values for physical and chemical stressors for south-east Australia for slightly disturbed ecosystems set out in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000). Trigger values are used to assess risk of adverse effects due to nutrients, biodegradable organic matter and pH in various ecosystem types.

Dissolved oxygen was between the lower and upper limits of 90 and 110% saturation for marine waters in all samples. Likewise, pH was between the lower and upper limits of 8.0 and 8.4 for all samples. The range of ORP measurements indicated a well oxygenated, ecologically healthy environment.

Table 5 Measurements made *insitu* for water samples at Thylacine and Artisan survey areas.

Sample Name	pH	DO (% saturation)	ORP (mV)
Thylacine_1_1	8.19	94.3	215.0
Thylacine_1_2	8.24	95.2	211.4
Thylacine_1_3	8.33	95.2	98.1
Artisan_1_2	8.16	94.0	172.7
Artisan_2_1	8.08	93.1	211.4
Artisan_5_1	8.34	93.8	164.5

The results of laboratory analyses for water samples from the Thylacine and Artisan survey areas are presented in Tables 6 to 11.

The analytes were compared to the relevant ANZECC (2000) – the default trigger values for physical and chemical stressors for nutrient analytes and the trigger values for toxicants at alternative levels of protection for all other analytes.

The concentration of ammonia, nitrite and reactive phosphorus was at or below LOR for all samples. Only one sample contained a concentration of nitrate-nitrite, NO^{-}_{3}, TKN and TN above the LOR. This was replicate Thylacine_1_3; however, none of the measurements exceeded ANZECC trigger values. Concentrations of TP were recorded in all samples, but all measurements were well below ANZECC trigger values. TSS was typically within the range expected for unmodified[1] marine ecosystems.

The concentrations of Cd, Cr, Co, Pb, Hg, and Ni were at or below LOR in all samples. The concentration of Cu was below, at or very close to the LOR for all samples.

The concentration of Zn against ANZECC protection level (or trigger values) is shown in Figure 5. All concentrations were below the 90% protection level but concentrations variously exceeded 95 or 99% protection levels. This result is consistent with a slightly disturbed marine system which is described in (ANZECC 2000) as an ecosystem in which biodiversity may have been affected to a

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[1] Unmodified is a descriptive term used in reference to the quality of the environment and is used in the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC 2000). Effectively unmodified ecosystems, typically (but not always) occur in remote and/or inaccessible locations. While there are no aquatic ecosystems in Australia that are entirely without some human influence, the ecological integrity of unmodified ecosystems is regarded as intact.

small degree by human activity. Therefore, this result is likely reflective of the human activities occurring within and around the study area and the levels of environmental Zn are with a reasonable level of species protection for such an environment.

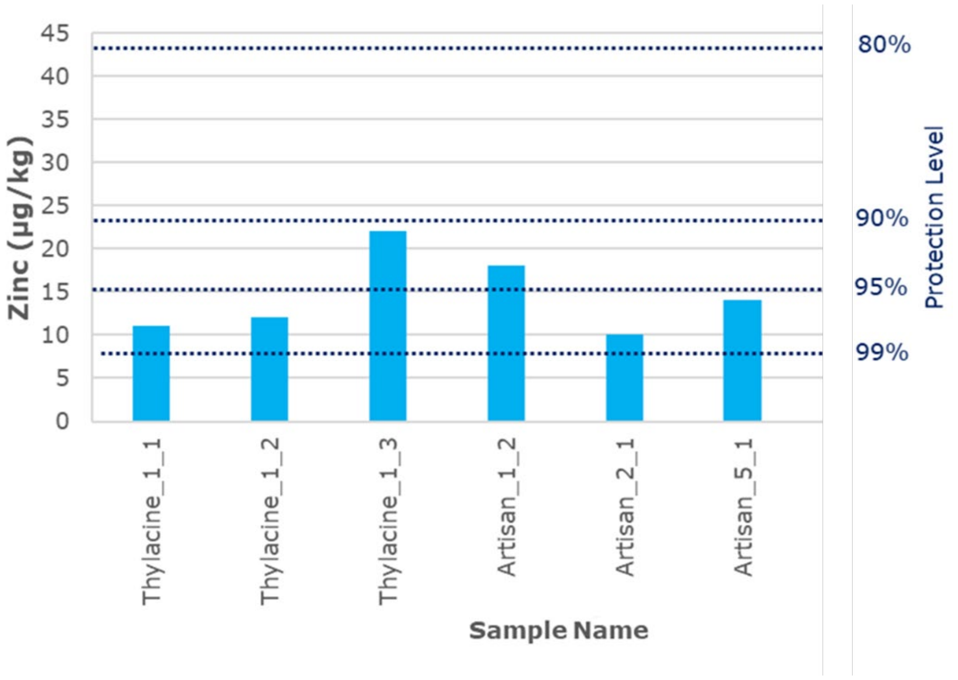

Figure 5 Concentration of Zn in water samples from Thylacine and Artisan survey areas.

BTEXs and PAHs were below the detection limit in all water samples. Very low traces of TRHs were detected in the Thylacine_1_2 water sample but were at levels of no concern. TRHs were below detection limits in all other samples. The level of chlorophyll *a* in filtered samples was below the detection level.

Table 6 Nutrients in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L								
	NH_3	Nitrate-Nitrite	NO^-_3	Nitrite	TP	RP	TKN	TN	TSS
Thylacine_1_1	< 0.01	< 0.05	0.03	< 0.02	0.03	< 0.01	< 0.2	< 0.2	3.4
Thylacine_1_2	< 0.01	< 0.05	0.02	< 0.02	0.02	< 0.01	< 0.2	< 0.2	9.7
Thylacine_1_3	< 0.01	0.10	0.10	< 0.02	0.02	< 0.01	2.4	2.5	2.4
Artisan_1_2	< 0.01	< 0.05	< 0.02	< 0.02	0.02	< 0.01	< 0.2	< 0.2	5.9
Artisan_2_1	< 0.01	< 0.05	< 0.02	< 0.02	0.01	0.01	< 0.2	< 0.2	4.6
Artisan_5_1	< 0.01	< 0.05	< 0.02	< 0.02	0.01	< 0.01	< 0.2	< 0.2	5.2

Table 7 Metals and metalloids in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L								
	Ar	Cd	Cr	Co	Cu	Pb	Hg	Ni	Zn
Thylacine_1_1	0.001	< 0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	0.011
Thylacine_1_2	0.004	< 0.0002	< 0.001	< 0.001	< 0.001	< 0.001	< 0.0001	< 0.001	0.012
Thylacine_1_3	0.002	< 0.0002	< 0.001	< 0.001	0.002	< 0.001	< 0.0001	0.001	0.022
Artisan_1_2	0.003	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.018
Artisan_2_1	0.005	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.01
Artisan_5_1	0.010	< 0.0002	< 0.001	< 0.001	0.001	< 0.001	< 0.0001	< 0.001	0.014

Table 8 Polycyclic Aromatic Hydrocarbons (PAH) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L					
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(b&j)fluoranthene
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Sample Name	mg/L					
	Benzo(g.h.i)perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene	Fluorene
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001

Sample Name	mg/L					p-Terphenyl-d14 (%)	2-Fluorobiphenyl (%)
	Indeno(1.2.3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH		
Thylacine_1_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	134	111
Thylacine_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	145	107
Thylacine_1_3	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	138	109
Artisan_1_2	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	93	109
Artisan_2_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	102	114
Artisan_5_1	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	101	117

Table 9 Total Recoverable Hydrocarbons (1999 NEPM Fractions) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L				
	TRH C10-C14	TRH C10-C36 (Total)	TRH C15-C28	TRH C29-C36	TRH C6-C9
Thylacine_1_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Thylacine_1_2	0.05	0.15	0.1	< 0.1	< 0.02
Thylacine_1_3	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_1_2	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_2_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02
Artisan_5_1	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02

Table 10 Total Recoverable Hydrocarbons (2013 NEPM Fractions) in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L							
	Naphthalene	TRH >C10-C16	TRH >C10-C16 less Naphthalene (F2)	TRH >C10-C40 (total)*	TRH >C16-C34	TRH >C34-C40	TRH C6-C10	TRH C6-C10 less BTEX (F1)
Thylacine_1_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Thylacine_1_2	< 0.01	0.07	0.07	0.17	0.1	< 0.1	< 0.02	< 0.02
Thylacine_1_3	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_1_2	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_2_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02
Artisan_5_1	< 0.01	< 0.05	< 0.05	< 0.1	< 0.1	< 0.1	< 0.02	< 0.02

Table 11 BTEX in water samples at Thylacine and Artisan survey areas.

Sample Name	mg/L						4-Bromofluoro-benzene (%)
	Benzene	Ethylbenzene	m&p-Xylenes	o-Xylene	Toluene	Xylenes - Total	
Thylacine_1_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	106
Thylacine_1_2	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	94
Thylacine_1_3	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	107
Artisan_1_2	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	94
Artisan_2_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	102
Artisan_5_1	< 0.001	< 0.001	< 0.002	< 0.001	< 0.001	< 0.003	100

4.2 Sediment Quality

The particle size distribution of marine sediments in each sample is shown in Figure 6 with data recorded in Appendix 3. The particle size is <2 µm for the clay-size fraction, 2-20 µm for the silt fraction and 20-2000 µm for the sand fraction. Note that the sample for Artisan 1_1 was a composite of up to three drops of the grab sampler. The sediment within all samples and, therefore at both survey areas, was predominantly sand with a range of 95-97% as a proportion of each sample. There was very little silt and a maximum of 4.7% for the clay-size fraction. There were no discernible trends based on the location of sample collection. The Munsell colour of all samples as 10YR 8/4.

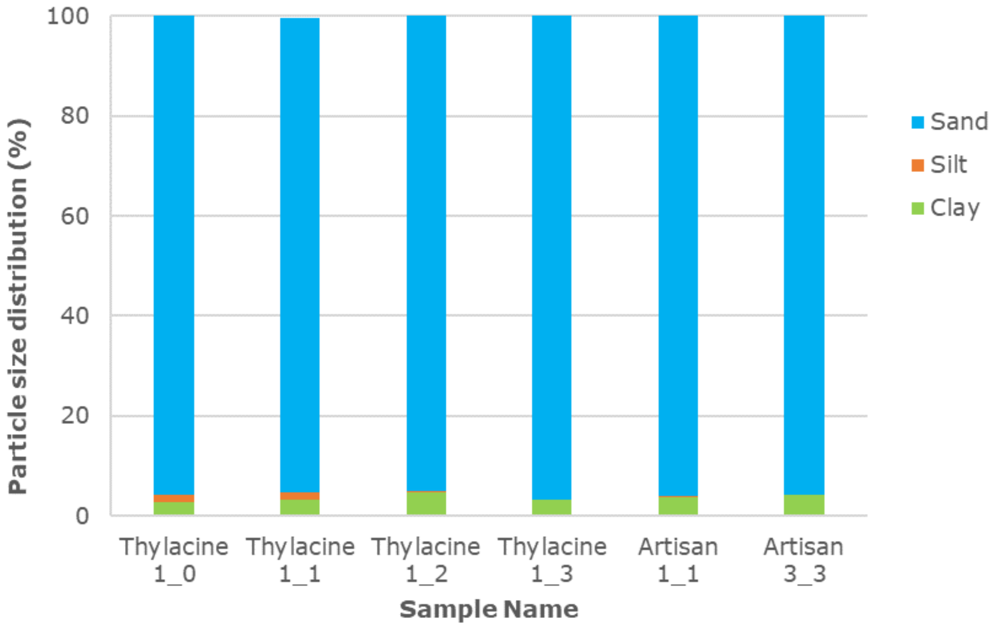

Figure 6 Particle size distribution (%) in sediment samples collected at Thylacine and Artisan survey areas.

The ORP (oxidation-reduction potential) or redox potential of sediments within the samples was measured and the results are presented in Table 12. Note that the measurement probe was inserted into the sediment until resistance prevented further insertion. Given that the substrate was predominantly sand, the probe was typically only inserted to 1-2 cm and no more than 3 cm into the sediment sample. The anoxic layer with low ORP was not detected in any of the sediments analysed and the range of measurements indicated that these sediments maintain a well oxygenated, unmodifed environment.

Table 12 Measurement of oxidation reduction potential in sediment samples at Thylacine and Artisan survey areas.

Sample Name	ORP Measurement Depth (mV)		
	1 cm	2 cm	3 cm
Thylacine_1_0	211	211	No further penetration
Thylacine_1_1	252.7	No further penetration	-
Thylacine_1_2	242.7	No further penetration	-
Thylacine_1_3	225.5	223	216.7
Artisan_1_1	Composite sample; measurement not possible		
Artisan_3_3	242.1	217.3	No further penetration

The results of nutrient analyses are shown in Table 13, Figure 7 and Figure 8. Nitrate-nitrite was not detected in any samples. There was a notable degree of variability in the samples collected in the Thylacine field, however the small number of samples means that a trend or pattern is not discernible. TOC and detectable nitrogen concentrations were slightly higher in the Artisan samples compared to the Thylacine samples. Generally, the concentrations of nutrients in the marine sediments were to be expected for this environment and type of sediment.

Table 13 Nutrients in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg					Total Organic Carbon (%)
	Phosphorus	Silicon	Nitrate-Nitrite	Total Kjeldahl Nitrogen	Total Nitrogen	
Thylacine_1_0	750	850	< 5	230	230	1.3
Thylacine_1_1	620	1000	< 5	190	190	0.9
Thylacine_1_2	400	950	< 5	130	130	0.5
Thylacine_1_3	< 200	460	< 5	180	180	< 0.1
Average (± S.D.)	467.5 (± 284)	815 (± 245)	NA	183 (± 41)	183 (± 41)	1.0 (± 0.5)
Artisan_1_1	620	570	< 5	310	310	1.6
Artisan_3_3	530	810	< 5	270	270	2.4
Average (± S.D.)	575 (± 64)	690 (± 170)	NA	290 (± 28)	290 (± 28)	2.0 (± 1.0)

Level of Reporting (LOR): phosphorus 200 mg/kg; silicon 5 mg/kg; nitrate-nitrite 5 mg/kg; TKN 10 mg/kg; TN 10 mg/kg; TOC 0.1%.

S.D. = standard deviation. Note that average (± S.D.) calculations are made with half LOR where the sample result was < LOR.

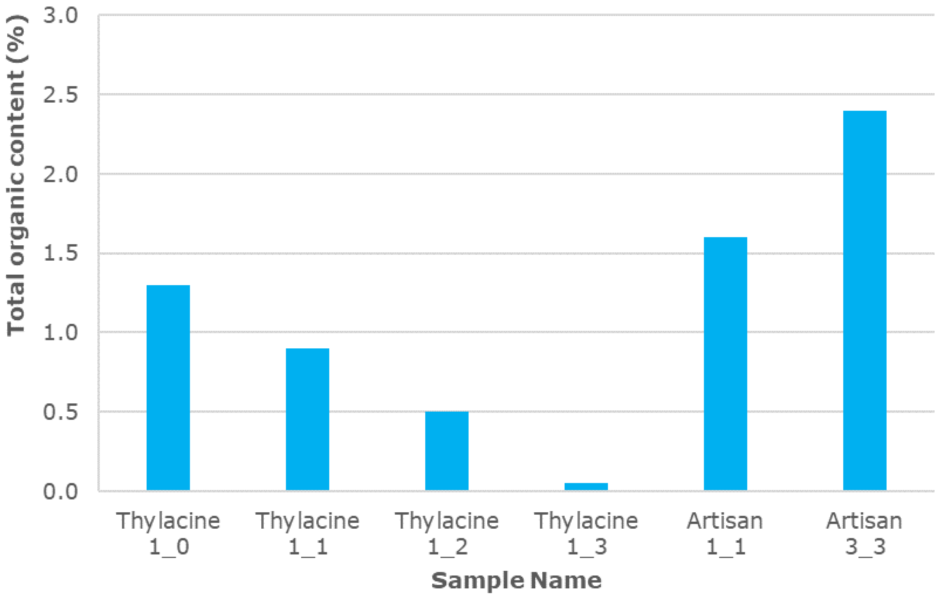

Figure 7 Total organic content (%) in sediment samples collected at Thylacine and Artisan survey areas.

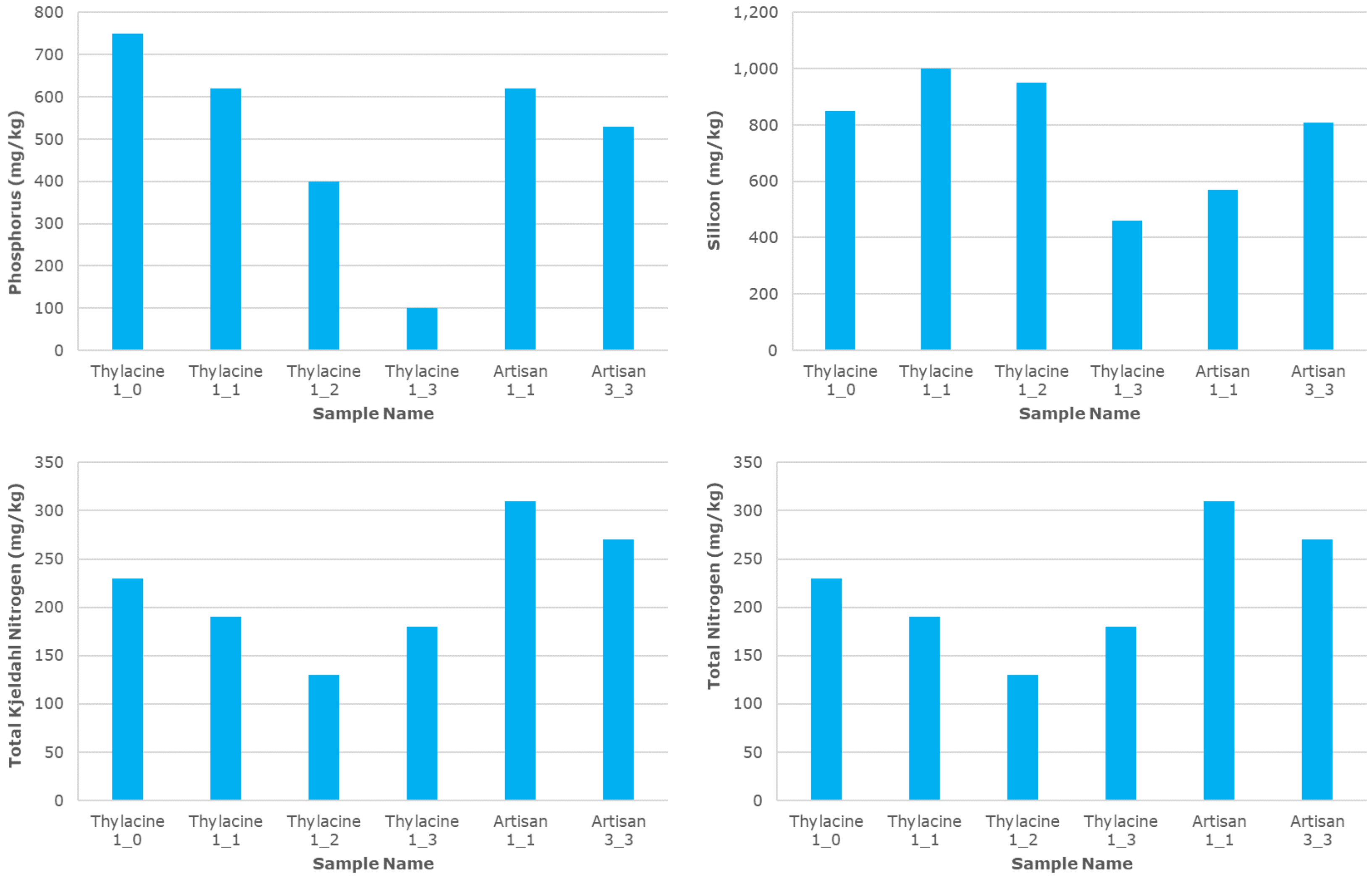

Figure 8 Nutrient concentrations (mg/kg) in sediment samples collected at Thylacine and Artisan survey areas, including phosphorus (top left), silicon (top right), total Kjeldahl nitrogen (bottom left) and total nitrogen (bottom right).

Table 14 presents the results of the analysis for metal compounds in the sediment samples. Of the inorganic compounds tested, Cd, Cu, Pb, Hg, Ni and Sn were below the detection limits (LOR) in all sediment samples. The concentration of Cr in sediments was low, and well below the Interim Sediment Quality Guidelines (ISQG) low trigger value of 80 mg/kg from the recommended sediment quality guidelines set out in ANZECC (2000). The concentration of Cr was slightly higher in the samples from Artisan than those from Thylacine. Zn was detected in two of the six samples (one sample from each field) and was well below the ISQC-Low trigger value of 200 mg/kg.

Table 14 Metals in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg							
	Cd	Cr	Cu	Pb	Hg	Ni	Sn	Zn
Thylacine_1_0	< 0.4	6.2	< 5	< 5	< 0.1	< 5	< 10	7.2
Thylacine_1_1	< 0.4	6.6	< 5	< 5	< 0.1	< 5	< 10	< 5
Thylacine_1_2	< 0.4	6.4	< 5	< 5	< 0.1	< 5	< 10	< 5
Thylacine_1_3	< 0.4	< 5.0	< 5	< 5	< 0.1	< 5	< 10	< 5
Artisan_1_1	< 0.4	11	< 5	< 5	< 0.1	< 5	< 10	9.4
Artisan_3_3	< 0.4	8.1	< 5	< 5	< 0.1	< 5	< 10	< 5

Level of Reporting (LOR): Cd 0.4 mg/kg; Cr 5 mg/kg; Cu 5 mg/kg; Pb 5 mg/kg; Hg 0.1 mg/kg; Ni 5 mg/kg; Sn 10 mg/kg; Zn 5 mg/kg.

The results of laboratory analyses for hydrocarbons in sediment samples from the Thylacine and Artisan survey areas are presented in Tables 15 to 19. BTEXs, PAHs, PCBs and TRHs were either below the LOR or at levels of no concern.

Table 15 Polycyclic Aromatic Hydrocarbons (PAH) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg						
	Acenaphthene	Acenaphthylene	Anthracene	Benz(a)anthracene	Benzo(a)pyrene	Benzo(a)pyrene TEQ (lower bound)	Benzo(a)pyrene TEQ (medium bound)
Thylacine_1_0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Thylacine_1_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Artisan_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6
Artisan_3_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.6

Sample Name	mg/kg						
	Benzo(a)pyrene TEQ (upper bound)	Benzo(b&j) fluoranthene	Benzo(g.h.i) perylene	Benzo(k)fluoranthene	Chrysene	Dibenz(a.h)anthracene	Fluoranthene
Thylacine_1_0	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_1	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_2	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Thylacine_1_3	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Artisan_1_1	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Artisan_3_3	1.2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

Sample Name	mg/kg						p-Terphenyl-d14 (%)	2-Fluorobiphenyl (%)
	Fluorene	Indeno(1.2.3-cd)pyrene	Naphthalene	Phenanthrene	Pyrene	Total PAH*		
Thylacine_1_0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	83	79
Thylacine_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	121	92
Thylacine_1_2	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	137	87
Thylacine_1_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	118	97
Artisan_1_1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	59	60
Artisan_3_3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	147	58

Table 16 Total Recoverable Hydrocarbons (1999 NEPM Fractions) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg				
	TRH C10-C14	TRH C10-C36 (Total)	TRH C15-C28	TRH C29-C36	TRH C6-C9
Thylacine_1_0	< 20	< 50	< 50	< 50	< 20
Thylacine_1_1	< 20	< 50	< 50	< 50	< 20
Thylacine_1_2	< 20	< 50	< 50	< 50	< 20
Thylacine_1_3	< 20	< 50	< 50	< 50	< 20
Artisan_1_1	< 20	< 50	< 50	< 50	< 20
Artisan_3_3	< 20	< 50	< 50	< 50	< 20

Table 17 Total Recoverable Hydrocarbons (2013 NEPM Fractions) in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg							
	Naphthalene	TRH >C10-C16	TRH >C10-C16 less Naphthalene (F2)	TRH >C10-C40 (total)*	TRH >C16-C34	TRH >C34-C40	TRH C6-C10	TRH C6-C10 less BTEX (F1)
Thylacine_1_0	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_1	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_2	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Thylacine_1_3	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Artisan_1_1	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20
Artisan_3_3	< 0.5	< 50	< 50	< 100	< 100	< 100	< 20	< 20

Table 18 BTEX in sediment samples at Thylacine and Artisan survey areas.

Sample Name	mg/kg						4-Bromofluoro-benzene (%)
	Benzene	Ethylbenzene	m&p-Xylenes	o-Xylene	Toluene	Xylenes - Total	
Thylacine_1_0	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	55
Thylacine_1_1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	104
Thylacine_1_2	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	110
Thylacine_1_3	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	106
Artisan_1_1	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	62
Artisan_3_3	< 0.1	< 0.1	< 0.2	< 0.1	< 0.1	< 0.3	106

Table 19 Polychlorinated Biphenyls in sediment samples at Thylacine and Artisan survey areas

Sample Name	mg/kg								Dibutylchlorendate (%)	Tetrachloro-m-xylene (%)
	Aroclor-1016	Aroclor-1221	Aroclor-1232	Aroclor-1242	Aroclor-1248	Aroclor-1254	Aroclor-1260	Total PCB*		
Thylacine_1_0	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	105	86
Thylacine_1_1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	132	77
Thylacine_1_2	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	139	80
Thylacine_1_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	78	77
Artisan_1_1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	73	64
Artisan_3_3	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	115	54

4.3 Infauna Ecology

The benthic infauna recorded from the grab samples are presented in Table 20. The benthic infauna identified and counted from samples collected at the Thylacine and Artisan sites were relatively depauperate in both abundance and diversity. A total of 22 morpho-species were identified, from a total of 45 organisms collected from the grab samples. The samples Thylacine_1_1 and Artisan_1_4 had the greatest infauna abundance with nine organisms in each sample (Figure 9). The samples Artisan_1_4 and Artisan_3_4 had the greatest diversity with eight morpho-species) (Figure 10), most of which were polychaete worms or crustaceans (Figure 11).

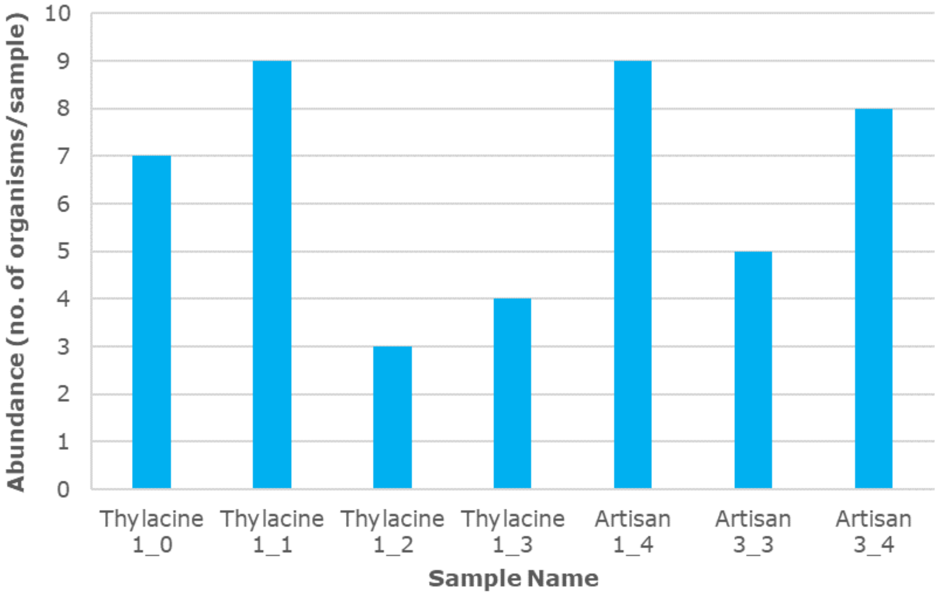

Figure 9 Abundance of benthic infauna in grab samples at Thylacine and Artisan survey areas.

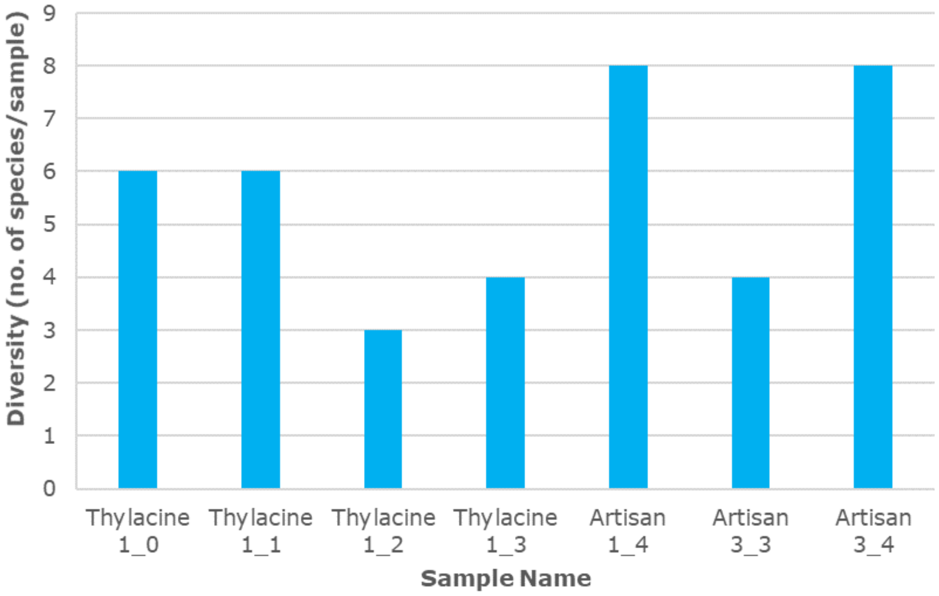

Figure 10 Diversity of benthic infauna in grab samples at Thylacine and Artisan survey areas.

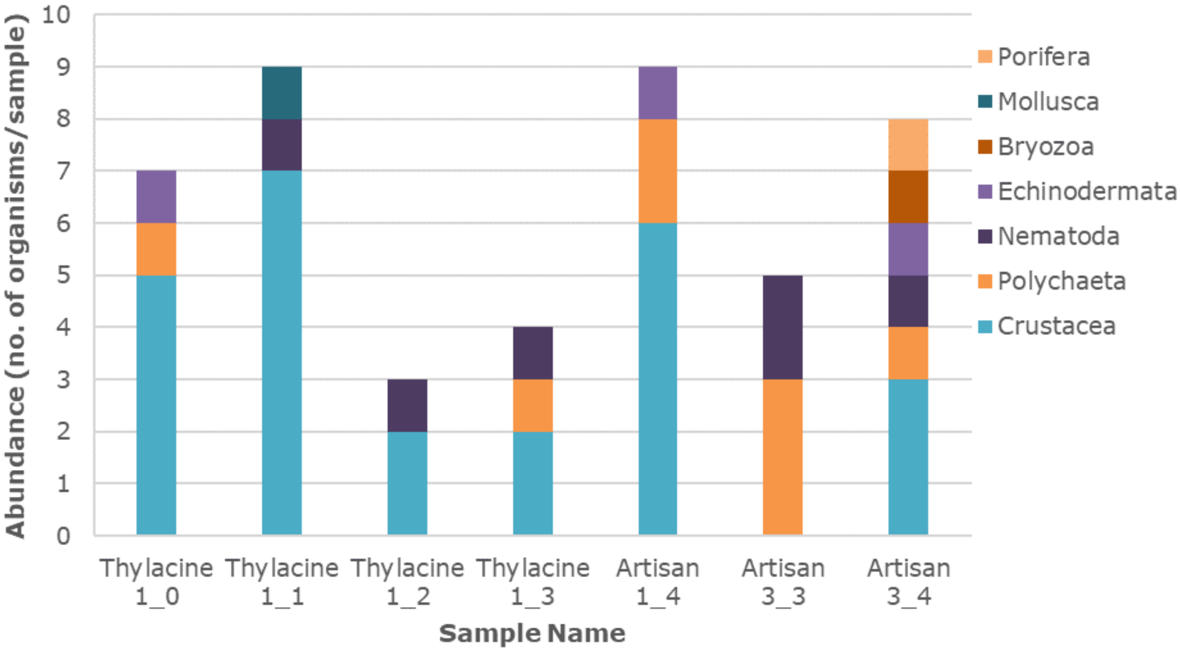

Figure 11 Abundance of benthic infauna by taxonomic group in grab samples at Thylacine and Artisan survey areas.

These results are reflective of the sedimentary environment at the Thylacine and Artisan survey areas, as described in Section 4.2. All sites were dominated by sand, which typically have a lower abundance and diversity of infauna given that this abrasive type of substrate tends to be more easily subjected to hydrodynamic conditions that move the sediment more dynamically than muddy substrates. The consequence of this is a physical environment that is not favourable for filter feeding and burrowing infauna species to inhabit. The observed species typically have a higher tolerance for dynamic environments.

There were no discernible spatial trends in the distribution of sediment particle size. Likewise, there were no clear trends in the abundance, diversity or composition of benthic infauna.

Table 20 Benthic infauna present in sediment samples collected at Thylacine and Artisan survey areas.

Phylum	Class/ Order	Family	Morpho-species	Thylacine				Artisan		
				1_0	1_1	1_2	1_3	1_4	3_3	3_4
Annelida	Polychaeta	Glyceridae	Glyceridae sp.	1			1	1	1	
		Goniadidae	Goniadidae sp.							1
		Pisionidae	Pisionidae sp.					1		
		Spionidae	Spionidae sp.						1	
		Syllidae	Syllidae sp.						1	
Crustacea	Amphipoda	Ampeliscidae	Ampeliscidae sp.		2	1				
		Ischyroceridae	Ischyroceridae sp.					1		1
		Lysianassidae	Lysianassidae sp.	2						
		Oedicerotidae	Oedicerotidae sp.		2					
		Phoxocephalidae	Phoxocephalidae sp.	1			1			
		Platyischnopidae	Platyischnopidae sp.	1		1				1
		Podoceridae	Podoceridae sp.					1		
Crustacea	Caridea	Pasiphaeidae	Pasiphaeidae sp.					1		
	Copepoda	Copepoda	Copepoda sp.					1		
	Cumacea	Bodotriidae	Bodotriidae sp.				1	2		
	Ostracoda	Ostracoda	Ostracoda sp.	1	2					
	Tanaidacea	Tanidae	Tanidae sp.		1					1
Echinodermata	Ophiuroidea	Ophiuroidea	Ophiuroidea sp.	1				1		1
Ectoprocta	Bryozoa	Bryozoa	Branching-sp.2							1
Mollusca	Gastropoda	Rissoidae	Rissoidae sp.		1					
Nematoda	Nematoda	Nematoda	Nematoda		1	1	1		2	1
Porifera	Porifera	Porifera	Solitary-Fan							1

4.4 Epibenthic Ecology

A total of 821 photographs were taken of the seafloor with the survey areas in Otway Basin. A total of 442 photographs used in this assessment (Appendix 5), with the remaining images excluded for the reasons as listed in Section 3.5.2. An average of 56 photographs were taken per survey area, 17 photographs per Hot Tap location and 15 photographs per umbilical route. Table 21 provides a summary of the number of photograph replicate samples used for the visual assessment, average (± standard deviation) for percent cover of epifauna, and total abundance of individual (and often mobile) epifauna organisms. Two example images from each survey area, Hot Tap and umbilical route are included in Appendix 6.

Figure 12 shows the average (± S.D.) percent cover of epifauna at each of the drop camera locations. Percent cover ranged from 0 to 80% of the sample photograph for all samples but on average the percent cover was typically no more than 37% cover. The seabed at Hot Tap X had the greatest average coverage of epibiota while the lowest coverage of epibiota was recorded along the CPT route between Artisan and Hot Tap Y (ARHTY) (Figure 12). Artisan and Hercules survey areas had a slighted greater coverage of epifauna, while the CPT routes between survey areas and Hot Tap Y had the least coverage of epifauna.

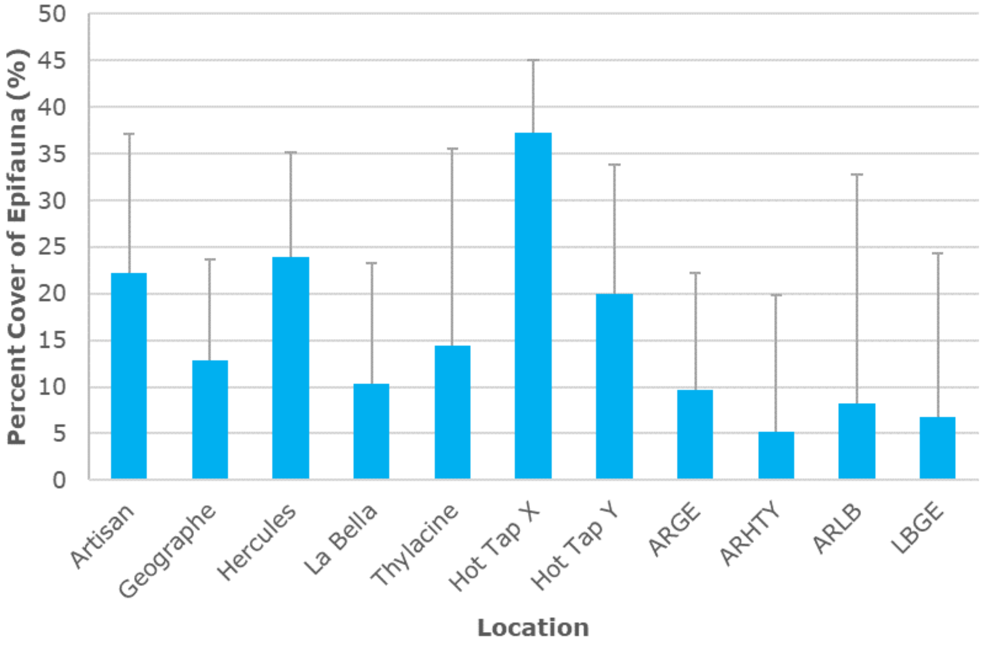

Figure 12 Percent cover of epifauna at drop camera location in Otway Basin.

Figure 13 provides information of the percent cover of epifauna at each drop camera site within these locations and shows the high variability of smaller-scale variability between drop camera sites. For example, the coverage of epifauna at most Thylacine drop camera sites was no more than 16% while at Thylacine 1 the percent cover was up 43% on average.

Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crionids (featherstars) were the most abundant (Table 21). Figure 14 shows an example of the seabed at Thylacine 1 (TH1) with a high percent cover of epifauna and a relatively high abundance of crinoids. Further examples are included in Appendix 6.

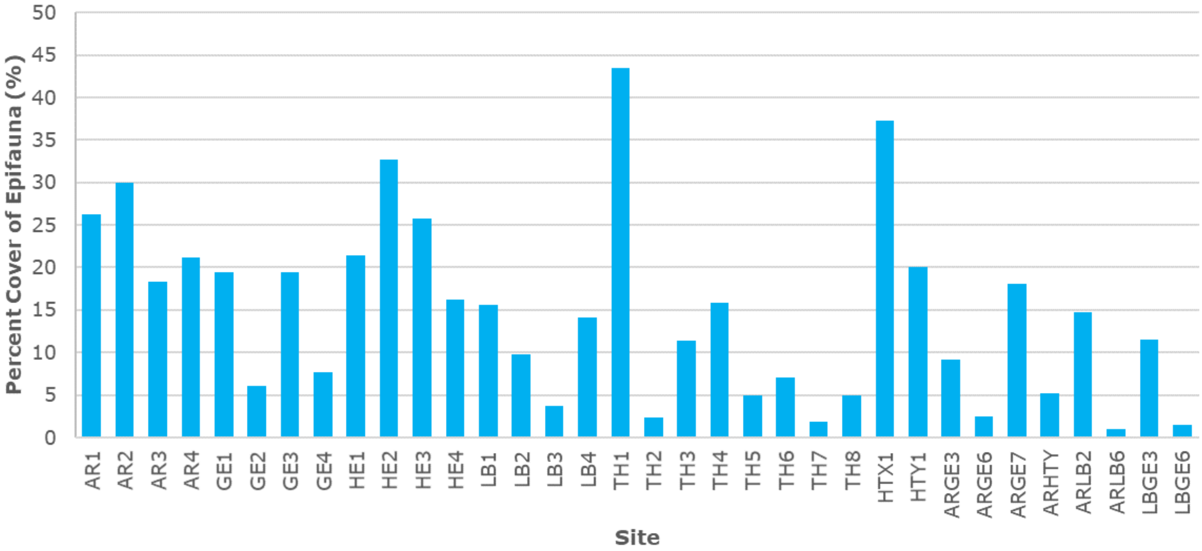

Figure 13 Percent cover of epifauna at drop camera sites in Otway Basin.

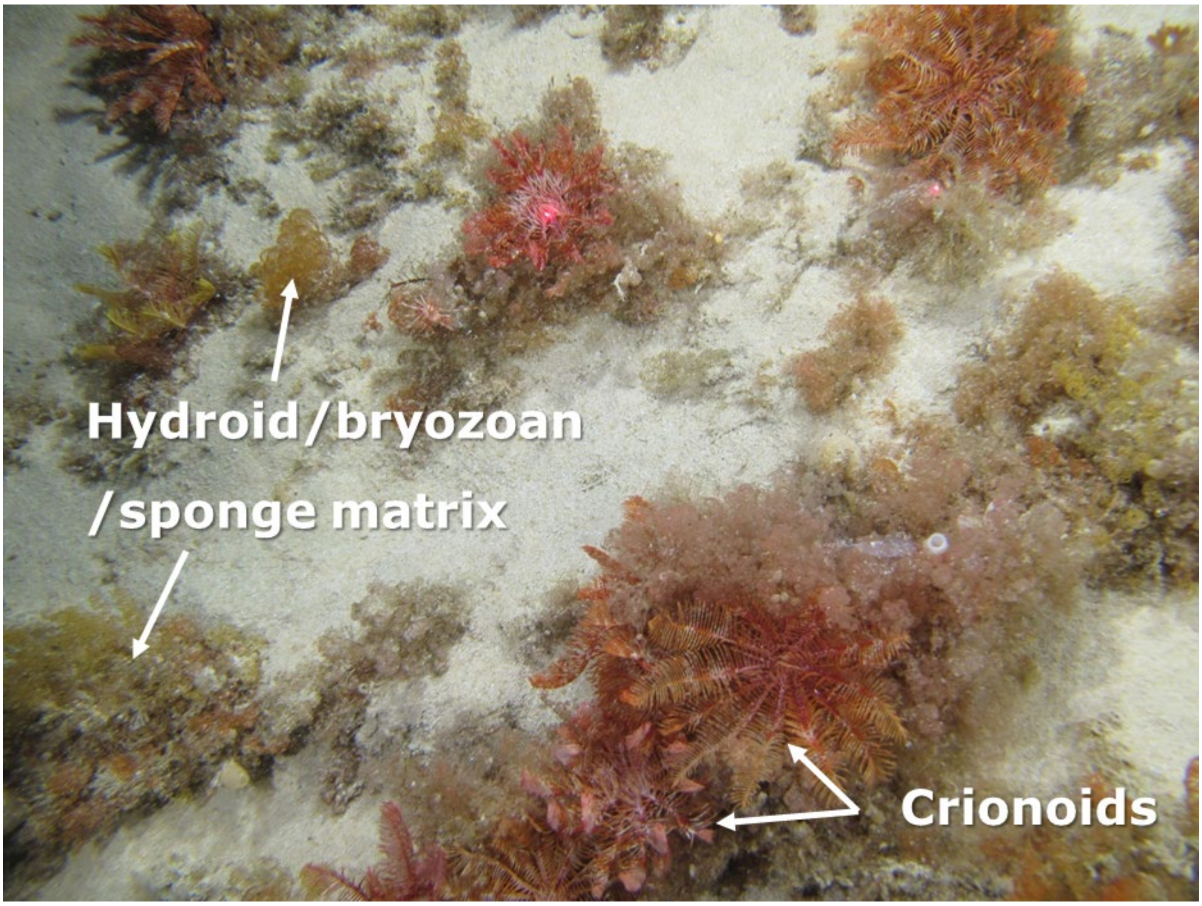

Figure 14 Example of the typical seabed epifauna with high percent cover at Thylacine 1 (TH1).

Table 21 Percent cover and total abundance of epibiota at drop camera sites.

Location	*n*	Percent cover of epifauna (%)		Total abundance of individual organisms								
				Crinoidea	Gastropoda spp.					Nudibranchia	Polychaeta	Teleostei
		Average	S.D.		Sp. 1	Sp. 2	Sp. 3	Sp. 4	Sp. 5			
AR1	4	26	15			4						
AR2	4	30	11			1						
AR3	9	18	11			1						
AR4	13	21	13			14						
GE1	9	19	21		2	2						
GE2	9	6	8		1							
GE3	9	19	14			1						
GE4	11	8	13			1						
HE1	14	21	15					2				
HE2	15	33	24		1	1		1				
HE3	14	26	18	1		2	1					
HE4	16	16	12		1							
LB1	9	16	10			1						
LB2	18	10	10									
LB3	15	4	2			4						
LB4	17	14	15			2		1				
TH1	16	43	14	40						1		
TH2	15	2	3		1	1						
TH3	21	11	7	8		7			2			
TH4	18	16	8	24								

Location	***n***	**Percent cover of epifauna (%)**		**Total abundance of individual organisms**								
				Crinoidea	**Gastropoda spp.**					**Nudibranchia**	**Polychaeta**	**Teleostei**
		Average	**S.D.**		**Sp. 1**	**Sp. 2**	**Sp. 3**	**Sp. 4**	**Sp. 5**			
TH5	1	5	-									
TH6	5	7	4									
TH7	8	2	3			1						
TH8	11	5	2			1						
HTX1	9	37	14		2	1		1				
HTY1	18	20	8			7		1	1			
ARGE3	12	9	8			6	1				1	
ARGE6	20	3	3			1						1
ARGE7	18	18	10			3		1				1
ARHTY	21	5	11	1	1	1				1		1
ARLB2	17	15	9			5	1					
ARLB6	15	1	2			7		1				
LBGE3	16	12	17			4						
LBGE6	14	1	2			1		1				

A composite, qualitative sample of epifauna from the Artisan field as examined and identified by the Benthic Australia invertebrate laboratory, with the results presented in Table 22. This epifauna was collected from grab samples at Artisan 1. This analysis shows that much of the epifauna is comprised of branching bryozoans, feather-like gorgonian cnidarians and sponges. This complex of encrusting/branching fauna provides refuge for macrofauna such as amphipods, isopods, polychaete worms and molluscs.

Table 22 Epifauna present in grab samples collected at the Artisan field.

Phylum	Class/ Order	Family	Morpho-species	Artisan_1_Epifauna
Annelida	Polychaeta	Amphinomidae	Hermodice spp.	1
		Eunicidae	Eunice spp.	1
		Phyllodocidae	Phyllodocidae sp.	1
		Syllidae	Syllidae sp.	2
		Terebellidae	Terebellidae sp.	1
Cnidaria	Alcyonacea	Alcyonacea	Gorgonian-Feather sp.	1
Crustacea	Amphipoda	Dexaminidae	Dexaminidae sp.	10
		Eusiridae	Eusiridae sp.	2
		Ischyroceridae	Ischyroceridae sp.	2
		Maeridae	Maeridae sp.1	3
			Maeridae sp.2	3
		Stegocephalidae	Stegocephalidae sp.	2
Crustacea	Isopoda	Valvifera	Valvifera sp.	1
Echinodermata	Ophiuroidea	Ophiuroidea	Ophiuroidea sp.	4
Ectoprocta	Bryozoa	Bryozoa	Branching-sp.1	7
			Branching-sp.2	2
Mollusca	Bivalvia	Glycymerididae	Glycymerididae sp.	1
	Gastropoda	c.f.Olividae	c.f.Olividae sp.	1
Porifera	Porifera	Porifera	Conglomerate-Branching sp.	3
			Conglomerate-Bulbous sp.1	4
			Conglomerate-Bulbous sp.2	2
			Solitary-Fan	4

5. DISCUSSION

The survey was conducted over in the Otway Basin covering five survey areas, two hot taps and five routes between those locations. The survey areas were located in offshore Commonwealth waters at 32 to 80 km from Port Campbell. Water depth ranged from 70 to 104 m.

The water quality at the Thylacine and Artisan survey areas indicated an undisturbed mid-depth environment, based on the six samples collected during the survey. There were low or undetectable levels of nutrients, metals/metalloids, BTEXs, PAHs and TRHs in the seawater samples. Metal and metalloids measurements were generally below ANZECC trigger values and within the range expected for unmodified, marine waters. The range of ORP measurements indicated a well oxygenated, ecologically healthy environment.

The sandy substrates described for Thylacine and Artisan survey areas are consistent with the reported description for the area of unconsolidated seabed sediments made up of carbonate sands (Barton et al., 2012; Murray-Wallace and Woodroffe, 2014). The sediment quality results were also consistent with Jones and Davies (1983) who described the grain size distribution as sand and gravel covering the entire shelf except for areas of silty sand in central Bass Strait and other locations more remote from the survey area. The authors noted a regional trend of ‘reverse grading’ whereby sediment tended to become coarser with distance from shore. Fine sand was reported to be the predominant sediment type along the inner shelf of Victoria and off much of Tasmania, grading seawards into medium-grain sand, and locally into coarse sand at the edge of the shelf (Jones and Davies, 1983). While the gravel fraction was not assessed, it is likely that some gravel occurs within the sediment as shown by some larger shell fragments observed in seabed photographs. Sediments had a high ORP and low or undetectable levels of toxicants indicating an unmodified seabed environment.

The Otway Basin is part of the Southeast Marine Bioregion which extends from the far south coast of New South Wales to Kangaroo Island (Commonwealth of Australia, 2015). Significant variation in seafloor features and water depth contribute to the high level of species diversity in the Region and the shelf habitats are reported to support a diverse range of species from a broad range of taxonomic groups (Commonwealth of Australia, 2015). However, there is no readily-available literature describing the seabed fauna of Otway Basin, meaning it is not possible to make a comparison of infauna and epifauna communities detected to prior studies. Most descriptions of the ecological values of the Basin or the Bioregion are at a broad scale and focus of key features such as cetaceans, birds, fisheries and macroalgae habitats (Commonwealth of Australia, 2015).

Based on the assessment of epifauna using seabed photographs, the general impression of the seafloor is of a unmodifed marine environment that supports a patchy complex of branching epibiota (i.e., bryozoans, gorgonian cnidarians and sponges). This complex was highly patchy, covering 0.25 m^2 on average but could be found in patches of at least 0.4 m^2.

A microscopic examination of a qualitative sample of this epibiota indicated that this complex of fauna provide microhabitat for a range of macrofauna such as amphipods, isopods, polychaete worms and molluscs. Such epifaunal habitats are known to provide refuge and other resources for benthic species (Jones, 2006). By comparison, there was a low abundance and diversity of infauna living within the sediment which reflects the coarse nature of the substrate. This type of substrate is highly mobile making it difficult for filter feeders and soft bodies invertebrates to survive and establish significant populations.

In summary, the epibiota on the seabed in the vicinity of the Thylacine and Artisan survey areas is representative of what is expected at depths around 70-100 m. The infauna was of relatively low abundance and diversity as expected for coarse sand substrates. No species or ecological communities listed as threatened under the Environmental Protection and Biodiversity Conservation Act 1999 (the EPBC Act) were observed.

6. REFERENCES

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Murray-Wallace, C.V.; Woodroffe, C.D. (2014) Quaternary sea-level changes: a global perspective. Cambridge University Press, Cambridge 484 p.

APPENDIX 1
ENVIRONMENTAL SAMPLE LOGS

SAMPLE MANAGEMENT ROUTINES

Project Code: 318000803	**Project Name: Otway Offshore Development**	
Vessel: Vos Shine **Location: Artisan and Thylacine, Otway Basin**	**Sampling Team: Irene Middleton** **Sampling Gear: Van Dorn 2.4L and Van Veen Double benthic grab sampler**	**Date: 22/11/2019**

☑	**All samples are stored on board as required for the analysis**	
☒	**Once ashore samples are transported by air with the sampling team to Perth**	**Not required, samples sent directly from port to lab.**
☑	**All Chain of Costody (COC) forms are copied and saved to cloud storage prior to sample dispatch**	
☑	**Samples for contaminants analyses (metals, metalloids, hydrocarbons) are shipped by courier to EUROFINS in Melbourne with COC documentation**	
☑	**Samples for infaunal analysis are shipped via courier to Benthic Australia, Gladstone, QLD with COC documentation**	
☑	**Image data is saved in its entireity to two separate storage drives, each transported by a different team member to Ramboll's office (holding a relevant COC)**	**Only one team member transported storage drives as only one enviro team member on board at one time. Additional image data sent to Ramboll by Fugro via sercure file transfer.**
☑	**Image data is saved in its entireity to Ramboll's secure servers once back in the office (noted on COC when complete)**	

Comments:

SAMPLING LOG

Project Code: 318000803	**Project Name: Otway Offshore Development**

Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Artisan	**Sampling Gear: Van Dorn 2.4L water sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	**Local Time**	**Sample No.**	**Replicate No.**	**Image ID**	**Sample Acceptable?**	**pH**	**ORP (mV)**	**Temperature (°C)**	**Dissolved oxygen (%/ppb)**	**Conductivity (uS/cm)**	**Visual Contamination**
AR 2	6:21	2	1	N/A	YES, Sampler A	8.08	172.1	13.6	93.1/7.78	497679	None
AR 1a	6:49	1	1	N/A	NO, sample rejected	-	-	-	-	-	-
AR 1b	7:11	1	2	N/A	YES, Sampler A	8.16	172.7	13.9	93.8/7.89	50112	None
AR 5	7:26	1	1	N/A	YES, Sampler A	8.34	164.5	13.4	93.8/7.89	50502	None

Comments: Sampler B was contaminated by a greasy hand print so all samples came from Sampler A. Blank samples were collected from Sampler A (labelled Blank A) and Sampler B (labelled Blank B).

SAMPLING LOG

Project Code: 318000803		**Project Name: Otway Offshore Development**	
Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Artisan	**Sampling Gear: Van Veen Double benthic grab sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	Local Time	Sample No.	Replicate No.	Image ID	Sample Acceptable?	Munsell Colour	ORP (mV)	Texture / Surface or Vertical Structure	Odour (describe)	Visual Contamination	Organic Fragments /Bioturbation /other Fauna
AR_GS-1	8:36	1	1	1-5	NO, not enough material	7.5YR 8/4	-	Sand and epibenthos/sponges	None	None	Sponges, bryozoans, ascidians
AR_GS-1	9:12	1	2	-	NO, grab not triggered	-	-	-	-	-	-
AR_GS-1	9:40	1	3	6-10	YES, small sample used for composite sample	10YR 8/4	Not able to be measured for small sample	Sand, some sponge	None	None	Sponge, coral fragments and tubeworms
AR_GS-1	10:05	1	4	11-13	YES, small sample (3 cm deep) used for composite sample	10YR 8/4	176.4 at 2 cm	Sand	None	None	No sponges, just shell
AR_GS-1	10:39	1	5	14-15	NO	-	-	Only some epifauna retained for examination	None	None	Sponges and bryozoans
AR_GS-1	10:56	1	6	16-19	YES, small sample used for composite sediment sample, no infauna sampled	10YR 8/4	176.3 at 1 cm	Sand	None	None	Bryozoans and corals
AR4_GS-3_1	12:25	3	1	-	NO, grab not triggered	-	-	-	-	-	-
AR4_GS-3_2	12:45	3	2	20-21	NO, small sample (3 cm deep) for sediment only. Infauna grab not triggered	10YR 8/4	217.3 at 2 cm	Shelly sand	None	None	-

AR4_GS-3_3	13:20	3	3	22-24	YES, good sample	10YR 8/4	241.2 at 1 cm	Shelly sand	None	None	-
AR4_GS-3_4	13:30	3	4	25-26	YES, infauna only, 7 cm deep	10YR 8/4	202.3 at 1 cm	Shell coarse hash	None	None	None

Comments: Sample quality was variable and did not always meet the acceptability criteria but allowances were made to get some material for processing.

SAMPLING LOG

Project Code: 318000803	**Project Name: Otway Offshore Development**

Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Thylacine	**Sampling Gear: Van Veen Double benthic grab sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	Local Time	Sample No.	Replicate No.	Image ID	Sample Acceptable?	Munsell Colour	ORP (mV)	Texture / Surface or Vertical Structure	Odour (describe)	Visual Contamination	Organic Fragments /Bioturbation /other Fauna
TH_GS1	17:12	1	0	27-30	YES, 15 cm deep	10YR 8/4	216.7 at 3 cm	Shelly and	None	None	Shell coarse, sand
TH_GS1_1	17:42	1	1	31-33	YES	10YR 8/4	211.0 at 2 cm	Shelly sand	None	None	Shell coarse, sand
TH_GS1_2	18:04	1	2	34-36	YES	10YR 8/4	252.7 at 1 cm	Shelly sand	None	None	Shell coarse, sand
TH_GS1_3	18:26	1	3	37-40	YES	10YR 8/4	242.7 at 1cm	Shelly sand	None	None	Shell coarse, sand

Comments:

SAMPLING LOG

Project Code: 318000803	**Project Name: Otway Offshore Development**

Vessel: VOS Shine	**Sampling Team: Irene Middleton**	**Sky/Wind: 20 knots**	**Date: 22/11/2019**
Location: Artisan and Thylacine	**Sampling Gear: Van Dorn 2.4L water sampler**	**Sea State: 2 m swell**	**Shift: 04:00-20:00**

Site No.	**Local Time**	**Sample No.**	**Replicate No.**	**Image ID**	**Sample Acceptable?**	**pH**	**ORP (mV)**	**Temperature (°C)**	**Dissolved oxygen (%/ppb)**	**Conductivity (uS/cm)**	**Visual Contamination**
TH_GS1	19:13	1	1	N/A	YES, Sampler A	8.19	215	13.4	94.3/8.07	No clear/steady reading	None
TH_GS1	19:30	1	2	N/A	YES, Sampler A	8.24	211.4	13.2	95.2/8.33	No clear/steady reading	None
TH_GS1	19:40	1	3	N/A	YES, Sampler A	8.33	198.1	13.2	95.2/8.16	No clear/steady reading	None

Comments:

SAMPLING LOG _REDOX MEASUREMENTS

Project Code: 318000803

Project Name: Otway Offshore Development

Recorder: Irene Middleton

Sample Acceptable: Only acceptable samples used

Date: 22/11/2019

Time (local): 0400-2000

ORP Reading Depth (mm)

Site No.	Sample No.	Replicate No.	Surface	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
Artisan GS	1	4	No surface measurements as hard sand surface gave indeterminate readings	176.2	176.4	No further penetration															
Artisan GS	1	6		176.3	No further penetration																
Artisan GS 3	2	1	As above	242.1	217.3	No further penetration															
Artisan GS 3	2	2	As above	241.2	No further penetration																
Artisan GS 3	2	3	As above	202.3	No further penetration																
Thylacine GS 2	1	1	As above	225.5	223.0	216.7	No further penetration														
Thylacine GS 1	1	1	As above	211.0	211.0	No further penetration															
Thylacine GS 1	1	1	As above	252.7	No further penetration																
Thylacine GS 1	1	1	As above	242.7	No further penetration																

Comments:

APPENDIX 2
WATER QUALITY LABORATORY REPORT

eurofins

Environment Testing

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Attention: **Dan McClary**

Report **690395-W**
Project name OTWAY OFFSHORE EBS
Project ID 318000803
Received Date Dec 04, 2019

Client Sample ID			**THYLACINE_GS1_1**	**THYLACINE_GS1_2**	**THYLACINE_G1_3**	**ARTISON_1**
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**M19-No38322**	**M19-No38323**	**M19-No38324**	**M19-No38325**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1	0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1	0.15	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	106	94	107	94
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	0.07	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	0.07	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1	0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1	0.17	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001

Client Sample ID			THYLACINE_GS1_1	THYLACINE_GS1_2	THYLACINE_G1_3	ARTISON_1
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**M19-No38322**	**M19-No38323**	**M19-No38324**	**M19-No38325**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	111	107	109	109
p-Terphenyl-d14 (surr.)	1	%	134	145	138	93
Ammonia (as N)	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Chlorophyll a	5	ug/L	< 10	< 10	< 10	< 10
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	0.10	< 0.05
Nitrate (as N)	0.02	mg/L	0.03	0.02	0.10	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Phosphate total (as P)	0.01	mg/L	0.03	0.02	0.02	0.02
Phosphorus reactive (as P)	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	2.4	< 0.2
Total Nitrogen (as N)*	0.2	mg/L	< 0.2	< 0.2	2.5	< 0.2
Total Suspended Solids Dried at 103–105°C	1	mg/L	3.4	9.7	2.4	5.9
Heavy Metals						
Arsenic	0.001	mg/L	0.001	0.004	0.002	0.003
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Copper	0.001	mg/L	< 0.001	< 0.001	0.002	0.001
Lead	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	< 0.001	< 0.001	0.001	< 0.001
Zinc	0.005	mg/L	0.011	0.012	0.022	0.018

Client Sample ID			ARTISON_2	ARTISON_5	BLANK A	BLANK B
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**M19-No38326**	**M19-No38327**	**M19-No38328**	**M19-No38329**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH C10-C14	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH C15-C28	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C29-C36	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH C10-C36 (Total)	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
BTEX						
Benzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Toluene	0.001	mg/L	< 0.001	< 0.001	0.003	< 0.001
Ethylbenzene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
m&p-Xylenes	0.002	mg/L	< 0.002	< 0.002	< 0.002	< 0.002
o-Xylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Xylenes - Total	0.003	mg/L	< 0.003	< 0.003	< 0.003	< 0.003
4-Bromofluorobenzene (surr.)	1	%	102	100	96	92

Client Sample ID			**ARTISON_2**	**ARTISON_5**	**BLANK A**	**BLANK B**
Sample Matrix			**Water**	**Water**	**Water**	**Water**
Eurofins Sample No.			**M19-No38326**	**M19-No38327**	**M19-No38328**	**M19-No38329**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.01	mg/L	< 0.01	< 0.01	< 0.01	< 0.01
TRH C6-C10	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH C6-C10 less BTEX (F1)[N04]	0.02	mg/L	< 0.02	< 0.02	0.03	< 0.02
TRH >C10-C16	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C10-C16 less Naphthalene (F2)[N01]	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
TRH >C16-C34	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C34-C40	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
TRH >C10-C40 (total)*	0.1	mg/L	< 0.1	< 0.1	< 0.1	< 0.1
Polycyclic Aromatic Hydrocarbons						
Acenaphthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Acenaphthylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benz(a)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(a)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(b&j)fluoranthene[N07]	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(g.h.i)perylene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Benzo(k)fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Chrysene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Dibenz(a.h)anthracene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluoranthene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Fluorene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Indeno(1.2.3-cd)pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Naphthalene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Phenanthrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Pyrene	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Total PAH*	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
2-Fluorobiphenyl (surr.)	1	%	114	117	97	56
p-Terphenyl-d14 (surr.)	1	%	102	101	52	67
Ammonia (as N)	0.01	mg/L	< 0.01	< 0.01	0.03	< 0.01
Chlorophyll a	5	ug/L	< 10	< 10	-	-
Nitrate & Nitrite (as N)	0.05	mg/L	< 0.05	< 0.05	< 0.05	< 0.05
Nitrate (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Nitrite (as N)	0.02	mg/L	< 0.02	< 0.02	< 0.02	< 0.02
Phosphate total (as P)	0.01	mg/L	0.01	0.01	< 0.01	< 0.01
Phosphorus reactive (as P)	0.01	mg/L	0.01	< 0.01	< 0.01	< 0.01
Total Kjeldahl Nitrogen (as N)	0.2	mg/L	< 0.2	< 0.2	< 0.2	< 0.2
Total Nitrogen (as N)*	0.2	mg/L	< 0.2	< 0.2	< 0.2	< 0.2
Total Suspended Solids Dried at 103–105°C	1	mg/L	4.6	5.2	< 1	3.1
Heavy Metals						
Arsenic	0.001	mg/L	0.005	0.010	0.001	0.001
Cadmium	0.0002	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002
Chromium	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Cobalt	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Copper	0.001	mg/L	0.001	0.001	< 0.001	0.040
Lead	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Mercury	0.0001	mg/L	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Nickel	0.001	mg/L	< 0.001	< 0.001	< 0.001	< 0.001
Zinc	0.005	mg/L	0.010	0.014	0.021	0.032

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Eurofins | mgt Suite B4			
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Melbourne	Dec 06, 2019	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Dec 06, 2019	7 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Dec 09, 2019	
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P			
Ammonia (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4200 Ammonia by Discrete Analyser			
Nitrate & Nitrite (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrate (as N)	Melbourne	Dec 09, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Nitrite (as N)	Melbourne	Dec 09, 2019	2 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Phosphate total (as P)	Melbourne	Dec 09, 2019	28 Days
- Method: APHA 4500-P E. Phosphorus			
Phosphorus reactive (as P)	Melbourne	Dec 09, 2019	2 Days
- Method: APHA 4500-P			
Total Kjeldahl Nitrogen (as N)	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-INO-4310 TKN in Waters & Soils by FIA			
Chlorophyll a	Melbourne	Dec 06, 2019	2 Days
- Method: LTM-INO-4340 Chlorophyll a in Waters			
Total Suspended Solids Dried at 103–105°C	Melbourne	Dec 09, 2019	7 Days
- Method: LTM-INO-4070 Analysis of Suspended Solids in Water by Gravimetry			
Heavy Metals	Sydney	Dec 11, 2019	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 690395
Phone: 08 9225 5199
Fax:

Received: Dec 4, 2019 10:56 AM
Due: Dec 11, 2019
Priority: 5 Day
Contact Name: ALL INVOICES

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Arsenic	Cadmium	Chlorophyll a	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Pheophytin*	Total Suspended Solids Dried at 103–105°C	Zinc	Eurofins | mgt Suite B4	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P
Melbourne Laboratory - NATA Site # 1254 & 14271								X							X	X		X	X
Sydney Laboratory - NATA Site # 18217 & 14271						X	X		X	X	X	X	X	X			X		
Brisbane Laboratory - NATA Site # 20794 & 14271																			
Perth Laboratory - NATA Site # 23736 & 14271																			
External Laboratory																			
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**														
1	THYLACINE_GS1_1	Nov 22, 2019		Water	M19-No38322	X	X	X	X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_GS1_2	Nov 22, 2019		Water	M19-No38323	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_G1_3	Nov 22, 2019		Water	M19-No38324	X	X	X	X	X	X	X	X	X	X	X	X	X	X
4	ARTISON_1	Nov 22, 2019		Water	M19-No38325	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5	ARTISON_2	Nov 22, 2019		Water	M19-No38326	X	X	X	X	X	X	X	X	X	X	X	X	X	X
6	ARTISON_5	Nov 22, 2019		Water	M19-No38327	X	X	X	X	X	X	X	X	X		X	X	X	X
7	BLANK A	Nov 22, 2019		Water	M19-No38328	X	X	X	X	X	X	X	X	X		X	X	X	X
8	BLANK B	Nov 22, 2019		Water	M19-No38329	X	X	X	X	X	X	X	X	X		X	X	X	X

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 690395
Phone: 08 9225 5199
Fax:

Received: Dec 4, 2019 10:56 AM
Due: Dec 11, 2019
Priority: 5 Day
Contact Name: ALL INVOICES

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail	Arsenic	Cadmium	Chlorophyll a	Chromium	Cobalt	Copper	Lead	Mercury	Nickel	Pheophytin*	Total Suspended Solids Dried at 103–105°C	Zinc	Eurofins | mgt Suite B4	Eurofins | mgt Suite B19E: Total N, TKN, NOx, NO2, NO3, NH3, Total P, Reactive P
Melbourne Laboratory - NATA Site # 1254 & 14271			X							X	X		X	X
Sydney Laboratory - NATA Site # 18217 & 14271	X	X		X	X	X	X	X	X			X		
Brisbane Laboratory - NATA Site # 20794 & 14271														
Perth Laboratory - NATA Site # 23736 & 14271														
Test Counts	8	8	8	8	8	8	8	8	8	5	8	8	8	8

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

mg/L: milligrams per litre

ug/L: micrograms per litre

ppm: Parts per million

ppb: Parts per billion

%: Percentage

org/100mL: Organisms per 100 millilitres

NTU: Nephelometric Turbidity Units

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/L	< 0.02			0.02	Pass	
TRH C10-C14	mg/L	< 0.05			0.05	Pass	
TRH C15-C28	mg/L	< 0.1			0.1	Pass	
TRH C29-C36	mg/L	< 0.1			0.1	Pass	
Method Blank							
BTEX							
Benzene	mg/L	< 0.001			0.001	Pass	
Toluene	mg/L	< 0.001			0.001	Pass	
Ethylbenzene	mg/L	< 0.001			0.001	Pass	
m&p-Xylenes	mg/L	< 0.002			0.002	Pass	
o-Xylene	mg/L	< 0.001			0.001	Pass	
Xylenes - Total	mg/L	< 0.003			0.003	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/L	< 0.01			0.01	Pass	
TRH C6-C10	mg/L	< 0.02			0.02	Pass	
TRH >C10-C16	mg/L	< 0.05			0.05	Pass	
TRH >C16-C34	mg/L	< 0.1			0.1	Pass	
TRH >C34-C40	mg/L	< 0.1			0.1	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/L	< 0.001			0.001	Pass	
Acenaphthylene	mg/L	< 0.001			0.001	Pass	
Anthracene	mg/L	< 0.001			0.001	Pass	
Benz(a)anthracene	mg/L	< 0.001			0.001	Pass	
Benzo(a)pyrene	mg/L	< 0.001			0.001	Pass	
Benzo(b&j)fluoranthene	mg/L	< 0.001			0.001	Pass	
Benzo(g.h.i)perylene	mg/L	< 0.001			0.001	Pass	
Benzo(k)fluoranthene	mg/L	< 0.001			0.001	Pass	
Chrysene	mg/L	< 0.001			0.001	Pass	
Dibenz(a.h)anthracene	mg/L	< 0.001			0.001	Pass	
Fluoranthene	mg/L	< 0.001			0.001	Pass	
Fluorene	mg/L	< 0.001			0.001	Pass	
Indeno(1.2.3-cd)pyrene	mg/L	< 0.001			0.001	Pass	
Naphthalene	mg/L	< 0.001			0.001	Pass	
Phenanthrene	mg/L	< 0.001			0.001	Pass	
Pyrene	mg/L	< 0.001			0.001	Pass	
Method Blank							
Ammonia (as N)	mg/L	< 0.01			0.01	Pass	
Nitrate & Nitrite (as N)	mg/L	< 0.05			0.05	Pass	
Nitrate (as N)	mg/L	< 0.02			0.02	Pass	
Nitrite (as N)	mg/L	< 0.02			0.02	Pass	
Phosphate total (as P)	mg/L	< 0.01			0.01	Pass	
Phosphorus reactive (as P)	mg/L	< 0.01			0.01	Pass	
Total Kjeldahl Nitrogen (as N)	mg/L	< 0.2			0.2	Pass	
Total Suspended Solids Dried at 103–105°C	mg/L	< 1			1	Pass	
Method Blank							
Heavy Metals							
Arsenic	mg/L	< 0.001			0.001	Pass	
Cadmium	mg/L	< 0.0002			0.0002	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium	mg/L	< 0.001			0.001	Pass	
Cobalt	mg/L	< 0.001			0.001	Pass	
Copper	mg/L	< 0.001			0.001	Pass	
Lead	mg/L	< 0.001			0.001	Pass	
Mercury	mg/L	< 0.0001			0.0001	Pass	
Nickel	mg/L	< 0.001			0.001	Pass	
Zinc	mg/L	< 0.005			0.005	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	94			70-130	Pass	
TRH C10-C14	%	115			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	92			70-130	Pass	
Toluene	%	79			70-130	Pass	
Ethylbenzene	%	83			70-130	Pass	
m&p-Xylenes	%	76			70-130	Pass	
Xylenes - Total	%	78			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	77			70-130	Pass	
TRH C6-C10	%	94			70-130	Pass	
TRH >C10-C16	%	107			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	87			70-130	Pass	
Acenaphthylene	%	85			70-130	Pass	
Anthracene	%	72			70-130	Pass	
Benz(a)anthracene	%	99			70-130	Pass	
Benzo(a)pyrene	%	72			70-130	Pass	
Benzo(b&j)fluoranthene	%	72			70-130	Pass	
Benzo(g.h.i)perylene	%	75			70-130	Pass	
Benzo(k)fluoranthene	%	98			70-130	Pass	
Chrysene	%	99			70-130	Pass	
Dibenz(a.h)anthracene	%	80			70-130	Pass	
Fluoranthene	%	85			70-130	Pass	
Fluorene	%	100			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	98			70-130	Pass	
Naphthalene	%	86			70-130	Pass	
Phenanthrene	%	95			70-130	Pass	
Pyrene	%	86			70-130	Pass	
LCS - % Recovery							
Ammonia (as N)	%	100			70-130	Pass	
Nitrate & Nitrite (as N)	%	101			70-130	Pass	
Nitrate (as N)	%	101			70-130	Pass	
Nitrite (as N)	%	106			70-130	Pass	
Phosphate total (as P)	%	95			70-130	Pass	
Phosphorus reactive (as P)	%	95			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	%	84			70-130	Pass	
Total Suspended Solids Dried at 103–105°C	%	98			70-130	Pass	
LCS - % Recovery							
Heavy Metals							
Arsenic	%	90			70-130	Pass	
Cadmium	%	92			70-130	Pass	

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Chromium			%	98			70-130	Pass	
Cobalt			%	100			70-130	Pass	
Copper			%	100			70-130	Pass	
Lead			%	101			70-130	Pass	
Mercury			%	96			70-130	Pass	
Nickel			%	99			70-130	Pass	
Zinc			%	98			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C10-C14	M19-De05914	NCP	%	111			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
TRH >C10-C16	M19-De05914	NCP	%	104			70-130	Pass	
Spike - % Recovery									
				Result 1					
Ammonia (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrate & Nitrite (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrate (as N)	M19-De03315	NCP	%	97			70-130	Pass	
Nitrite (as N)	B19-De03253	NCP	%	106			70-130	Pass	
Total Kjeldahl Nitrogen (as N)	N19-De04634	NCP	%	91			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					
Acenaphthene	M19-No38324	CP	%	84			70-130	Pass	
Acenaphthylene	M19-No38324	CP	%	85			70-130	Pass	
Anthracene	M19-No38324	CP	%	74			70-130	Pass	
Benz(a)anthracene	M19-No38324	CP	%	72			70-130	Pass	
Benzo(a)pyrene	M19-No38324	CP	%	82			70-130	Pass	
Benzo(b&j)fluoranthene	M19-No38324	CP	%	79			70-130	Pass	
Benzo(g.h.i)perylene	M19-No38324	CP	%	89			70-130	Pass	
Benzo(k)fluoranthene	M19-No38324	CP	%	113			70-130	Pass	
Chrysene	M19-No38324	CP	%	106			70-130	Pass	
Dibenz(a.h)anthracene	M19-No38324	CP	%	83			70-130	Pass	
Fluoranthene	M19-No38324	CP	%	89			70-130	Pass	
Fluorene	M19-No38324	CP	%	101			70-130	Pass	
Indeno(1.2.3-cd)pyrene	M19-No38324	CP	%	82			70-130	Pass	
Naphthalene	M19-No38324	CP	%	81			70-130	Pass	
Phenanthrene	M19-No38324	CP	%	93			70-130	Pass	
Pyrene	M19-No38324	CP	%	94			70-130	Pass	
Spike - % Recovery									
				Result 1					
Phosphate total (as P)	M19-No38324	CP	%	92			70-130	Pass	
Spike - % Recovery									
Heavy Metals				Result 1					
Arsenic	M19-No38329	CP	%	95			70-130	Pass	
Cadmium	M19-No38329	CP	%	94			70-130	Pass	
Chromium	M19-No38329	CP	%	87			70-130	Pass	
Cobalt	M19-No38329	CP	%	88			70-130	Pass	
Copper	M19-No38329	CP	%	84			70-130	Pass	
Lead	M19-No38329	CP	%	90			70-130	Pass	
Mercury	M19-No38329	CP	%	80			70-130	Pass	
Nickel	M19-No38329	CP	%	85			70-130	Pass	
Zinc	M19-No38329	CP	%	88			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	B19-De02116	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH C10-C14	M19-De05913	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH C15-C28	M19-De05913	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
TRH C29-C36	M19-De05913	NCP	mg/L	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Toluene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Ethylbenzene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
m&p-Xylenes	B19-De02116	NCP	mg/L	< 0.002	< 0.002	<1	30%	Pass	
o-Xylene	B19-De02116	NCP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Xylenes - Total	B19-De02116	NCP	mg/L	< 0.003	< 0.003	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	B19-De02116	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
TRH C6-C10	B19-De02116	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
TRH >C10-C16	M19-De05913	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
TRH >C16-C34	M19-De05913	NCP	mg/L	< 0.1		<1	30%	Pass	
TRH >C34-C40	M19-De05913	NCP	mg/L	< 0.1		<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
Ammonia (as N)	B19-De03253	NCP	mg/L	< 0.01	< 0.01	<1	30%	Pass	
Chlorophyll a	M19-De06051	NCP	ug/L	28	34	21	30%	Pass	
Nitrate & Nitrite (as N)	B19-De03253	NCP	mg/L	< 0.05	< 0.05	<1	30%	Pass	
Nitrate (as N)	B19-De03253	NCP	mg/L	0.04	0.05	34	30%	Fail	Q15
Nitrite (as N)	B19-De03253	NCP	mg/L	< 0.02	< 0.02	<1	30%	Pass	
Phosphate total (as P)	M19-De05566	NCP	mg/L	0.91	0.88	4.0	30%	Pass	
Total Kjeldahl Nitrogen (as N)	M19-De03633	NCP	mg/L	79	77	2.8	30%	Pass	
Total Suspended Solids Dried at 103–105°C	M19-De06128	NCP	mg/L	230	230	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Arsenic	M19-No38322	CP	mg/L	0.001	0.001	2.0	30%	Pass	
Cadmium	M19-No38322	CP	mg/L	< 0.0002	< 0.0002	<1	30%	Pass	
Chromium	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Cobalt	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Copper	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Lead	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Mercury	M19-No38322	CP	mg/L	< 0.0001	< 0.0001	<1	30%	Pass	
Nickel	M19-No38322	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Zinc	M19-No38322	CP	mg/L	0.011	0.012	9.0	30%	Pass	
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Acenaphthylene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benz(a)anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(a)pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(b&j)fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(g.h.i)perylene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Benzo(k)fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Chrysene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Dibenz(a.h)anthracene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Fluoranthene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Fluorene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Naphthalene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Phenanthrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	
Pyrene	M19-No38323	CP	mg/L	< 0.001	< 0.001	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Robert Johnston	Analytical Services Manager
Gabriele Cordero	Senior Analyst-Metal (NSW)
Harry Bacalis	Senior Analyst-Volatile (VIC)
Joseph Edouard	Senior Analyst-Organic (VIC)
Julie Kay	Senior Analyst-Inorganic (VIC)

Glenn Jackson
General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

Ramboll Australia Pty Ltd
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WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

WORLD RECOGNISED ACCREDITATION

Attention: **Dan McClary**

Report **690387-A**
Project name OTWAY OFFSHORE EBS
Project ID 318000803
Received Date Dec 04, 2019

Client Sample ID			**ARTISON-1**	**ARTISON-5**	**ARTISON-2**	**THYLACINE GS1_3**
Sample Matrix			**Filter paper**	**Filter paper**	**Filter paper**	**Filter paper**
Eurofins Sample No.			**M19-No38257**	**M19-No38258**	**M19-No38259**	**M19-No38260**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Chlorophyll a	10	ug/L	< 10	< 10	< 10	< 10

Client Sample ID			**THYLACINE GS1_1**	**THYLACINE GS1_2**
Sample Matrix			**Filter paper**	**Filter paper**
Eurofins Sample No.			**M19-No38261**	**M19-No38262**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit		
Chlorophyll a	10	ug/L	< 10	< 10

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Chlorophyll a	Melbourne	Nov 27, 2019	2 Days
- Method:			

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Order No.:
Report #: 690387
Phone: 08 9225 5199
Fax:

Received: Dec 4, 2019 1:54 PM
Due: Dec 5, 2019
Priority: 7 Day
Contact Name: ALL INVOICES

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
External Laboratory																					
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																
1	THYLACINE_ GS1_3_MET1	Nov 22, 2019		Soil	M19-No38233	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_ GS1_3_MET2	Nov 22, 2019		Soil	M19-No38234	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_ GS1_3_PSD1	Nov 22, 2019		Soil	M19-No38235	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	THYLACINE_ GS1_MET2	Nov 22, 2019		Soil	M19-No38236	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	THYLACINE_ GS-1_MET1	Nov 22, 2019		Soil	M19-No38237	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	THYLACINE_	Nov 22, 2019		Soil	M19-No38238	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Dec 4, 2019 1:54 PM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS-1_PSD1																				
7	THYLACINE_ GS1-2_PSD1	Nov 22, 2019		Soil	M19-No38239	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
8	THYLACINE_ GS1-2_MET1	Nov 22, 2019		Soil	M19-No38240	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
9	THYLACINE_ GS1-2_MET2	Nov 22, 2019		Soil	M19-No38241	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
10	THYLACINE_ GS2_PSD1	Nov 22, 2019		Soil	M19-No38242	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
11	THYLACINE_ GS2_MET1	Nov 22, 2019		Soil	M19-No38243	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
12	THYLACINE_ GS2_MET2	Nov 22, 2019		Soil	M19-No38244	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
13	ARTISON-	Nov 22, 2019		Soil	M19-No38245	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 690387
Phone: 08 9225 5199
Fax:

Received: Dec 4, 2019 1:54 PM
Due: Dec 5, 2019
Priority: 7 Day
Contact Name: ALL INVOICES

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS_A_PAR 4																				
14	ARTISON-GS_A_PAR 3	Nov 22, 2019		Soil	M19-No38246	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
15	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M19-No38247	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
16	ARTISON-GSA_PAR1	Nov 22, 2019		Soil	M19-No38248	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
17	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M19-No38249	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
18	ARTISON-GSA_PAR2	Nov 22, 2019		Soil	M19-No38250	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
19	ARTISON-GS3_PAR1	Nov 22, 2019		Soil	M19-No38251	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
20	ARTISON-	Nov 22, 2019		Soil	M19-No38252	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Received: Dec 4, 2019 1:54 PM
Due: Dec 5, 2019
Priority: 7 Day
Contact Name: ALL INVOICES

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS3_MET1																				
21	ARTISON-GS3_PAR 4	Nov 22, 2019		Soil	M19-No38253	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
22	ARTISON-GS3_PAR 2	Nov 22, 2019		Soil	M19-No38254	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
23	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M19-No38255	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
24	ARTISON-GS3_PAR 3	Nov 22, 2019		Soil	M19-No38256	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
25	ARTISON-1	Nov 22, 2019		Filter paper	M19-No38257					X											
26	ARTISON-5	Nov 22, 2019		Filter paper	M19-No38258					X											
27	ARTISON-2	Nov 22, 2019		Filter paper	M19-No38259					X											
28	THYLACINE GS1_3	Nov 22, 2019		Filter paper	M19-No38260					X											

Company Name:	Ramboll Australia Pty Ltd	**Order No.:**		**Received:**	Dec 4, 2019 1:54 PM
Address:	Suite 3, Level 2, 200 Adelaide Terrace East Perth WA 6004	**Report #:**	690387	**Due:**	Dec 5, 2019
		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
29	THYLACINE GS1_1	Nov 22, 2019		Filter paper	M19-No38261					X											
30	THYLACINE GS1_2	Nov 22, 2019		Filter paper	M19-No38262					X											
Test Counts						24	24	24	24	6	24	24	24	24	24	24	24	24	24	24	24

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Authorised By

Robert Johnston	Analytical Services Manager
Julie Kay	Senior Analyst-Inorganic (VIC)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson

General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

APPENDIX 3
SEDIMENT QUALITY LABORATORY REPORT

Certificate of Analysis

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

NATA
WORLD RECOGNISED ACCREDITATION

Attention:	**Dan McClary**
Report	**690387-S**
Project name	OTWAY OFFSHORE EBS
Project ID	318000803
Received Date	Dec 04, 2019

Client Sample ID			**THYLACINE_GS1_3_MET1**	**THYLACINE_GS1_3_MET2**	**THYLACINE_GS1_3_PSD1**	**THYLACINE_GS1_MET2**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38233**	**M19-No38234**	**M19-No38235**	**M19-No38236**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	4.7	3.1	3.3	3.7
% Sand		%	95	95	97	96
% Silt		%	< 1	1.6	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	130	71	110	160
Total Nitrogen (as N)*	10	mg/kg	130	71	110	160
Total Organic Carbon	0.1	%	0.5	1.8	2.7	4.8
Phosphorus	5	mg/kg	400	660	740	610
Silicon (Aqua regia extractable)	5	mg/kg	950	750	630	970
% Moisture	1	%	37	34	37	36
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.4	5.7	5.6	6.7
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	7.8	< 5

Client Sample ID			**THYLACINE_GS-1_MET1**	**THYLACINE_GS-1_PSD1**	**THYLACINE_GS1-2_PSD1**	**THYLACINE_GS1-2_MET1**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38237**	**M19-No38238**	**M19-No38239**	**M19-No38240**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	2.8	1.7	4.4	3.1
% Sand		%	96	98	96	95
% Silt		%	1.4	< 1	< 1	1.5
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	230	210	310	190
Total Nitrogen (as N)*	10	mg/kg	230	210	310	190
Total Organic Carbon	0.1	%	1.3	0.4	1.9	0.9

Client Sample ID			THYLACINE_GS-1_MET1	THYLACINE_GS-1_PSD1	THYLACINE_GS1-2_PSD1	THYLACINE_GS1-2_MET1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38237**	**M19-No38238**	**M19-No38239**	**M19-No38240**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Phosphorus	5	mg/kg	750	870	550	620
Silicon (Aqua regia extractable)	5	mg/kg	850	940	890	1000
% Moisture	1	%	34	35	37	38
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.2	5.7	5.2	6.6
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	7.2	< 5	< 5	< 5

Client Sample ID			THYLACINE_GS1-2_MET2	THYLACINE_GS2_PSD1	THYLACINE_GS2_MET1	THYLACINE_GS2_MET2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38241**	**M19-No38242**	**M19-No38243**	**M19-No38244**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
% Clay	1	%	3.9	2.5	3.3	2.9
% Sand		%	96	98	97	97
% Silt		%	< 1	< 1	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	260	290	180	220
Total Nitrogen (as N)*	10	mg/kg	260	290	180	220
Total Organic Carbon	0.1	%	1.4	1.7	< 0.1	0.5
Phosphorus	5	mg/kg	630	830	< 200	500
Silicon (Aqua regia extractable)	5	mg/kg	980	700	460	600
% Moisture	1	%	38	39	35	38
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	5.1	5.7	< 5	6.3
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	< 5	< 5

Client Sample ID			ARTISON-GS_A_PAR 4	ARTISON-GS_A_PAR 3	ARTISON-GSA_MET1	ARTISON-GSA_PAR1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38245**	**M19-No38246**	**M19-No38247**	**M19-No38248**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	< 1	< 1	3.6	3.1
% Sand		%	100	97	96	95
% Silt		%	< 1	2.9	< 1	1.5
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	340	370	310	250
Total Nitrogen (as N)*	10	mg/kg	340	370	310	250
Total Organic Carbon	0.1	%	< 0.1	< 0.1	1.6	0.4
Phosphorus	5	mg/kg	< 200	860	620	440
Silicon (Aqua regia extractable)	5	mg/kg	490	630	570	580
% Moisture	1	%	34	34	37	29
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	8.0	7.4	11	6.9
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	5.2	9.0	9.4	< 5

Client Sample ID			ARTISON-GSA_MET2	ARTISON-GSA_PAR2	ARTISON-GS3_PAR1	ARTISON-GS3_MET1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38249**	**M19-No38250**	**M19-No38251**	**M19-No38252**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	3.7	3.0	3.9	4.1
% Sand		%	96	97	96	96
% Silt		%	< 1	< 1	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	370	340	440	270
Total Nitrogen (as N)*	10	mg/kg	370	340	440	270
Total Organic Carbon	0.1	%	< 0.1	1.1	< 0.1	2.4
Phosphorus	5	mg/kg	460	< 200	730	530
Silicon (Aqua regia extractable)	5	mg/kg	600	520	770	810
% Moisture	1	%	34	34	36	35
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	6.0	6.4	6.6	8.1
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	6.9	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	25	5.4	< 5	< 5

Client Sample ID			**ARTISON-GS3_PAR 4**	**ARTISON-GS3_PAR 2**	**ARTISON-GS3_MET 2**	**ARTISON-GS3_PAR 3**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M19-No38253**	**M19-No38254**	**M19-No38255**	**M19-No38256**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
% Clay	1	%	4.8	3.5	3.6	4.0
% Sand		%	95	95	96	96
% Silt		%	< 1	1.8	< 1	< 1
Nitrate & Nitrite (as N)	5	mg/kg	< 5	< 5	< 5	< 5
Total Kjeldahl Nitrogen (as N)	10	mg/kg	310	270	150	310
Total Nitrogen (as N)*	10	mg/kg	310	270	150	310
Total Organic Carbon	0.1	%	0.6	4.9	1.6	1.8
Phosphorus	5	mg/kg	570	400	390	480
Silicon (Aqua regia extractable)	5	mg/kg	830	520	650	640
% Moisture	1	%	36	35	34	34
Heavy Metals						
Cadmium	0.4	mg/kg	< 0.4	< 0.4	< 0.4	< 0.4
Chromium	5	mg/kg	9.0	8.1	9.5	8.0
Copper	5	mg/kg	< 5	< 5	< 5	< 5
Lead	5	mg/kg	< 5	< 5	< 5	< 5
Mercury	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Nickel	5	mg/kg	< 5	< 5	< 5	< 5
Tin	10	mg/kg	< 10	< 10	< 10	< 10
Zinc	5	mg/kg	< 5	< 5	< 5	< 5

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
% Clay	Brisbane	Dec 13, 2019	0 Days
- Method: LTM-GEN-7040			
% Sand	Brisbane	Dec 09, 2019	0 Days
- Method: LTM-GEN-7040			
% Silt	Brisbane	Dec 09, 2019	0 Days
- Method: LTM-GEN-7040			
Total Organic Carbon	Melbourne	Dec 16, 2019	28 Days
- Method: LTM-INO-4060 Total Organic Carbon in water and soil			
Silicon (Aqua regia extractable)	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon and Phosphorus by ICP-AES			
Heavy Metals	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3040 Metals in Waters, Soils & Sediments by ICP-MS			
Total Nitrogen Set (as N)			
Nitrate & Nitrite (as N)	Melbourne	Dec 06, 2019	28 Days
- Method: LTM-INO-4120 Analysis of NOx NO2 NH3 by FIA			
Total Kjeldahl Nitrogen (as N)	Melbourne	Dec 06, 2019	28 Days
- Method: LTM-INO-4310 TKN in Waters & Soils by FIA			
Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P			
Phosphorus	Melbourne	Dec 06, 2019	180 Days
- Method: LTM-MET-3010 Alkali Metals Sulfur Silicon and Phosphorus by ICP-AES			
% Moisture	Melbourne	Nov 27, 2019	14 Days
- Method: LTM-GEN-7080 Moisture			

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		Phone:	08 9225 5199	**Priority:**	7 Day
		Fax:		**Contact Name:**	ALL INVOICES
Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
External Laboratory																					
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**																
1	THYLACINE_GS1_3_MET1	Nov 22, 2019		Soil	M19-No38233	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
2	THYLACINE_GS1_3_MET2	Nov 22, 2019		Soil	M19-No38234	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
3	THYLACINE_GS1_3_PSD1	Nov 22, 2019		Soil	M19-No38235	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
4	THYLACINE_GS1_MET2	Nov 22, 2019		Soil	M19-No38236	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
5	THYLACINE_GS-1_MET1	Nov 22, 2019		Soil	M19-No38237	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
6	THYLACINE_	Nov 22, 2019		Soil	M19-No38238	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS-1_PSD1																				
7	THYLACINE_ GS1-2_PSD1	Nov 22, 2019		Soil	M19-No38239	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
8	THYLACINE_ GS1-2_MET1	Nov 22, 2019		Soil	M19-No38240	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
9	THYLACINE_ GS1-2_MET2	Nov 22, 2019		Soil	M19-No38241	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
10	THYLACINE_ GS2_PSD1	Nov 22, 2019		Soil	M19-No38242	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
11	THYLACINE_ GS2_MET1	Nov 22, 2019		Soil	M19-No38243	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
12	THYLACINE_ GS2_MET2	Nov 22, 2019		Soil	M19-No38244	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
13	ARTISON-	Nov 22, 2019		Soil	M19-No38245	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS_A_PAR 4																				
14	ARTISON-GS_A_PAR 3	Nov 22, 2019		Soil	M19-No38246	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
15	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M19-No38247	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
16	ARTISON-GSA_PAR1	Nov 22, 2019		Soil	M19-No38248	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
17	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M19-No38249	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
18	ARTISON-GSA_PAR2	Nov 22, 2019		Soil	M19-No38250	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
19	ARTISON-GS3_PAR1	Nov 22, 2019		Soil	M19-No38251	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
20	ARTISON-	Nov 22, 2019		Soil	M19-No38252	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X

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Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
	GS3_MET1																				
21	ARTISON-GS3_PAR 4	Nov 22, 2019		Soil	M19-No38253	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
22	ARTISON-GS3_PAR 2	Nov 22, 2019		Soil	M19-No38254	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
23	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M19-No38255	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
24	ARTISON-GS3_PAR 3	Nov 22, 2019		Soil	M19-No38256	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
25	ARTISON-1	Nov 22, 2019		Filter paper	M19-No38257					X											
26	ARTISON-5	Nov 22, 2019		Filter paper	M19-No38258					X											
27	ARTISON-2	Nov 22, 2019		Filter paper	M19-No38259					X											
28	THYLACINE GS1_3	Nov 22, 2019		Filter paper	M19-No38260					X											

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Project Name:	OTWAY OFFSHORE EBS				
Project ID:	318000803				

Eurofins Analytical Services Manager : Swati Shahaney

Sample Detail						% Clay	% Sand	% Silt	Cadmium	Chlorophyll a	Chromium	Copper	Lead	Mercury	Nickel	Silicon (Aqua regia extractable)	Tin	Total Organic Carbon	Zinc	Moisture Set	Eurofins | mgt Suite B19A: Total N (TKN, NOx), Total P
Melbourne Laboratory - NATA Site # 1254 & 14271									X	X	X	X	X	X	X	X	X	X	X	X	X
Sydney Laboratory - NATA Site # 18217																					
Brisbane Laboratory - NATA Site # 20794						X	X	X													
Perth Laboratory - NATA Site # 23736																					
29	THYLACINE GS1_1	Nov 22, 2019		Filter paper	M19-No38261					X											
30	THYLACINE GS1_2	Nov 22, 2019		Filter paper	M19-No38262					X											
Test Counts						24	24	24	24	6	24	24	24	24	24	24	24	24	24	24	24

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram	**mg/L:** milligrams per litre	**ug/L:** micrograms per litre
ppm: Parts per million	**ppb:** Parts per billion	**%:** Percentage
org/100mL: Organisms per 100 millilitres	**NTU:** Nephelometric Turbidity Units	**MPN/100mL:** Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test			Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank									
% Clay			%	< 1			1	Pass	
Nitrate & Nitrite (as N)			mg/kg	< 5			5	Pass	
Total Kjeldahl Nitrogen (as N)			mg/kg	< 10			10	Pass	
Total Organic Carbon			%	< 0.1			0.1	Pass	
Method Blank									
Heavy Metals									
Cadmium			mg/kg	< 0.4			0.4	Pass	
Chromium			mg/kg	< 5			5	Pass	
Copper			mg/kg	< 5			5	Pass	
Lead			mg/kg	< 5			5	Pass	
Mercury			mg/kg	< 0.1			0.1	Pass	
Nickel			mg/kg	< 5			5	Pass	
Tin			mg/kg	< 10			10	Pass	
Zinc			mg/kg	< 5			5	Pass	
LCS - % Recovery									
% Clay			%	93			70-130	Pass	
Total Organic Carbon			%	107			70-130	Pass	
LCS - % Recovery									
Heavy Metals									
Cadmium			%	101			80-120	Pass	
Chromium			%	117			80-120	Pass	
Copper			%	118			80-120	Pass	
Lead			%	114			80-120	Pass	
Mercury			%	112			75-125	Pass	
Nickel			%	114			80-120	Pass	
Tin			%	112			80-120	Pass	
Zinc			%	116			80-120	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Spike - % Recovery									
Heavy Metals				Result 1					
Cadmium	M19-No38239	CP	%	94			75-125	Pass	
Chromium	M19-No38239	CP	%	83			75-125	Pass	
Copper	M19-No38239	CP	%	84			75-125	Pass	
Lead	M19-No38239	CP	%	87			75-125	Pass	
Mercury	M19-No38239	CP	%	101			70-130	Pass	
Nickel	M19-No38239	CP	%	85			75-125	Pass	
Tin	M19-No38239	CP	%	87			75-125	Pass	
Zinc	M19-No38239	CP	%	83			75-125	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M19-De07683	NCP	%	3.0	3.0	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Clay	M19-Oc40940	NCP	%	5.0	6.3	22	30%	Pass	
% Sand	M19-Oc40940	NCP	%	91	90	1.0	30%	Pass	
% Silt	M19-Oc40940	NCP	%	3.8	3.8	<1	30%	Pass	
Nitrate & Nitrite (as N)	M19-No38234	CP	mg/kg	< 5	< 5	<1	30%	Pass	

Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38238	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38238	CP	mg/kg	5.7	5.8	1.0	30%	Pass	
Copper	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38238	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38238	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38238	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38239	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38239	CP	mg/kg	5.2	5.5	6.0	30%	Pass	
Copper	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38239	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38239	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38239	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Duplicate									
Heavy Metals				Result 1	Result 2	RPD			
Cadmium	M19-No38248	CP	mg/kg	< 0.4	< 0.4	<1	30%	Pass	
Chromium	M19-No38248	CP	mg/kg	6.9	6.8	1.0	30%	Pass	
Copper	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Lead	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Mercury	M19-No38248	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Nickel	M19-No38248	CP	mg/kg	< 5	< 5	<1	30%	Pass	
Tin	M19-No38248	CP	mg/kg	< 10	< 10	<1	30%	Pass	
Zinc	M19-No38248	CP	mg/kg	< 5	6.3	54	30%	Fail	Q15
Duplicate									
				Result 1	Result 2	RPD			
Total Organic Carbon	M19-No38249	CP	%	< 0.1	< 0.1	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	Yes
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
Q15	The RPD reported passes Eurofins Environment Testing's QC - Acceptance Criteria as defined in the Internal Quality Control Review and Glossary page of this report.

Authorised By

Robert Johnston	Analytical Services Manager
Emily Rosenberg	Senior Analyst-Metal (VIC)
Jonathon Angell	Senior Analyst-Inorganic (QLD)
Julie Kay	Senior Analyst-Inorganic (VIC)
Scott Beddoes	Senior Analyst-Inorganic (VIC)

Glenn Jackson

General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

eurofins | Environment Testing

Certificate of Analysis

NATA Accredited
Accreditation Number 1261
Site Number 1254

Accredited for compliance with ISO/IEC 17025 – Testing
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.

Ramboll Australia Pty Ltd
Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Attention:	**Serena Orr**
Report	**700321-S**
Project name	OTWAY OFFSHORE EBS
Project ID	318000803
Received Date	Feb 05, 2020

Client Sample ID			**THYLACINE_GS1_3_MET1**	**THYLACINE_GS1_3_MET2**	**THYLACINE_GS1_MET2**	**THYLACINE_GS-1_MET1**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05003**	**M20-Fe05004**	**M20-Fe05005**	**M20-Fe05006**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	106	86	112	104
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5

Client Sample ID			THYLACINE_GS1_3_MET1	THYLACINE_GS1_3_MET2	THYLACINE_GS1_MET2	THYLACINE_GS-1_MET1
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05003**	**M20-Fe05004**	**M20-Fe05005**	**M20-Fe05006**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Polycyclic Aromatic Hydrocarbons						
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	97	54	83	92
p-Terphenyl-d14 (surr.)	1	%	118	81	103	121
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	78	99	78	132
Tetrachloro-m-xylene (surr.)	1	%	77	51	55	77
% Moisture	1	%	33	35	36	32

Client Sample ID			THYLACINE_GS1-2_MET1	THYLACINE_GS1-2_MET2	THYLACINE_GS2_MET1	THYLACINE_GS2_MET2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05007**	**M20-Fe05008**	**M20-Fe05009**	**M20-Fe05010**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	110	62	55	61

Client Sample ID			THYLACINE_GS1-2_MET1	THYLACINE_GS1-2_MET2	THYLACINE_GS2_MET1	THYLACINE_GS2_MET2
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05007**	**M20-Fe05008**	**M20-Fe05009**	**M20-Fe05010**
Date Sampled			Nov 22, 2019	Nov 22, 2019	Nov 22, 2019	Nov 22, 2019
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	87	75	79	91
p-Terphenyl-d14 (surr.)	1	%	137	88	83	57
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	139	112	105	64
Tetrachloro-m-xylene (surr.)	1	%	80	90	86	75
% Moisture	1	%	37	35	33	35

Client Sample ID			**ARTISON-GSA_MET1**	**ARTISON-GSA_MET2**	**ARTISON-GS3_MET1**	**ARTISON-GS3_MET 2**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05011**	**M20-Fe05012**	**M20-Fe05013**	**M20-Fe05014**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Total Recoverable Hydrocarbons - 1999 NEPM Fractions						
TRH C6-C9	20	mg/kg	< 20	< 20	< 20	< 20
TRH C10-C14	20	mg/kg	< 20	< 20	< 20	< 20
TRH C15-C28	50	mg/kg	< 50	< 50	< 50	< 50
TRH C29-C36	50	mg/kg	< 50	< 50	< 50	< 50
TRH C10-C36 (Total)	50	mg/kg	< 50	< 50	< 50	< 50
BTEX						
Benzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Toluene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Ethylbenzene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
m&p-Xylenes	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2
o-Xylene	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Xylenes - Total	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3
4-Bromofluorobenzene (surr.)	1	%	62	57	106	55
Total Recoverable Hydrocarbons - 2013 NEPM Fractions						
Naphthalene[N02]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
TRH C6-C10	20	mg/kg	< 20	< 20	< 20	< 20
TRH C6-C10 less BTEX (F1)[N04]	20	mg/kg	< 20	< 20	< 20	< 20
TRH >C10-C16	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C10-C16 less Naphthalene (F2)[N01]	50	mg/kg	< 50	< 50	< 50	< 50
TRH >C16-C34	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C34-C40	100	mg/kg	< 100	< 100	< 100	< 100
TRH >C10-C40 (total)*	100	mg/kg	< 100	< 100	< 100	< 100
Polycyclic Aromatic Hydrocarbons						
Benzo(a)pyrene TEQ (lower bound) *	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene TEQ (medium bound) *	0.5	mg/kg	0.6	0.6	0.6	0.6
Benzo(a)pyrene TEQ (upper bound) *	0.5	mg/kg	1.2	1.2	1.2	1.2
Acenaphthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Acenaphthylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benz(a)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(a)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(b&j)fluoranthene[N07]	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(g.h.i)perylene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Benzo(k)fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Chrysene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Dibenz(a.h)anthracene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluoranthene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Fluorene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Indeno(1.2.3-cd)pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Naphthalene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Phenanthrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Pyrene	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Total PAH*	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
2-Fluorobiphenyl (surr.)	1	%	60	77	58	67
p-Terphenyl-d14 (surr.)	1	%	59	125	147	56

Client Sample ID			**ARTISON-GSA_MET1**	**ARTISON-GSA_MET2**	**ARTISON-GS3_MET1**	**ARTISON-GS3_MET 2**
Sample Matrix			**Soil**	**Soil**	**Soil**	**Soil**
Eurofins Sample No.			**M20-Fe05011**	**M20-Fe05012**	**M20-Fe05013**	**M20-Fe05014**
Date Sampled			**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**	**Nov 22, 2019**
Test/Reference	LOR	Unit				
Polychlorinated Biphenyls						
Aroclor-1016	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1221	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1232	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1242	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1248	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1254	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Aroclor-1260	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Total PCB*	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1
Dibutylchlorendate (surr.)	1	%	73	89	115	110
Tetrachloro-m-xylene (surr.)	1	%	64	88	54	72
% Moisture	1	%	33	30	34	34

Sample History

Where samples are submitted/analysed over several days, the last date of extraction and analysis is reported.
A recent review of our LIMS has resulted in the correction or clarification of some method identifications. Due to this, some of the method reference information on reports has changed. However, no substantive change has been made to our laboratory methods, and as such there is no change in the validity of current or previous results.

If the date and time of sampling are not provided, the Laboratory will not be responsible for compromised results should testing be performed outside the recommended holding time.

Description	Testing Site	Extracted	Holding Time
Total Recoverable Hydrocarbons - 1999 NEPM Fractions	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Total Recoverable Hydrocarbons - 2013 NEPM Fractions	Melbourne	Feb 05, 2020	
- Method: LTM-ORG-2010 TRH C6-C40			
BTEX	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2010 TRH C6-C40			
Polycyclic Aromatic Hydrocarbons	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-ORG-2130 PAH and Phenols in Soil and Water			
Polychlorinated Biphenyls	Melbourne	Feb 05, 2020	28 Days
- Method: LTM-ORG-2220 OCP & PCB in Soil and Water (USEPA 8082)			
% Moisture	Melbourne	Feb 05, 2020	14 Days
- Method: LTM-GEN-7080 Moisture			

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
East Perth
WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 700321
Phone: 08 9225 5199
Fax:

Received: Feb 5, 2020 3:36 AM
Due: Feb 12, 2020
Priority: 5 Day
Contact Name: Serena Orr

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Polycyclic Aromatic Hydrocarbons	Polychlorinated Biphenyls	BTEX	Moisture Set	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
External Laboratory										
No	**Sample ID**	**Sample Date**	**Sampling Time**	**Matrix**	**LAB ID**					
1	THYLACINE_ GS1_3_MET1	Nov 22, 2019		Soil	M20-Fe05003	X	X	X	X	X
2	THYLACINE_ GS1_3_MET2	Nov 22, 2019		Soil	M20-Fe05004	X	X	X	X	X
3	THYLACINE_ GS1_MET2	Nov 22, 2019		Soil	M20-Fe05005	X	X	X	X	X
4	THYLACINE_ GS-1_MET1	Nov 22, 2019		Soil	M20-Fe05006	X	X	X	X	X
5	THYLACINE_ GS1-2_MET1	Nov 22, 2019		Soil	M20-Fe05007	X	X	X	X	X
6	THYLACINE_ GS1-2_MET2	Nov 22, 2019		Soil	M20-Fe05008	X	X	X	X	X

Company Name: Ramboll Australia Pty Ltd
Address: Suite 3, Level 2, 200 Adelaide Terrace
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WA 6004

Project Name: OTWAY OFFSHORE EBS
Project ID: 318000803

Order No.:
Report #: 700321
Phone: 08 9225 5199
Fax:

Received: Feb 5, 2020 3:36 AM
Due: Feb 12, 2020
Priority: 5 Day
Contact Name: Serena Orr

Eurofins Analytical Services Manager : Robert Johnston

Sample Detail						Polycyclic Aromatic Hydrocarbons	Polychlorinated Biphenyls	BTEX	Moisture Set	Total Recoverable Hydrocarbons
Melbourne Laboratory - NATA Site # 1254 & 14271						X	X	X	X	X
Sydney Laboratory - NATA Site # 18217										
Brisbane Laboratory - NATA Site # 20794										
Perth Laboratory - NATA Site # 23736										
7	THYLACINE_ GS2_MET1	Nov 22, 2019		Soil	M20-Fe05009	X	X	X	X	X
8	THYLACINE_ GS2_MET2	Nov 22, 2019		Soil	M20-Fe05010	X	X	X	X	X
9	ARTISON-GSA_MET1	Nov 22, 2019		Soil	M20-Fe05011	X	X	X	X	X
10	ARTISON-GSA_MET2	Nov 22, 2019		Soil	M20-Fe05012	X	X	X	X	X
11	ARTISON-GS3_MET1	Nov 22, 2019		Soil	M20-Fe05013	X	X	X	X	X
12	ARTISON-GS3_MET 2	Nov 22, 2019		Soil	M20-Fe05014	X	X	X	X	X
Test Counts						12	12	12	12	12

Internal Quality Control Review and Glossary

General

1. Laboratory QC results for Method Blanks, Duplicates, Matrix Spikes, and Laboratory Control Samples follows guidelines delineated in the National Environment Protection (Assessment of Site Contamination) Measure 1999, as amended May 2013 and are included in this QC report where applicable. Additional QC data may be available on request.
2. All soil/sediment/solid results are reported on a dry basis, unless otherwise stated.
3. All biota/food results are reported on a wet weight basis on the edible portion, unless otherwise stated.
4. Actual LORs are matrix dependant. Quoted LORs may be raised where sample extracts are diluted due to interferences.
5. Results are uncorrected for matrix spikes or surrogate recoveries except for PFAS compounds.
6. SVOC analysis on waters are performed on homogenised, unfiltered samples, unless noted otherwise.
7. Samples were analysed on an 'as received' basis.
8. Information identified on this report with blue colour, indicates data provided by customer, that may have an impact on the results.
9. This report replaces any interim results previously issued.

Holding Times

Please refer to 'Sample Preservation and Container Guide' for holding times (QS3001).

For samples received on the last day of holding time, notification of testing requirements should have been received at least 6 hours prior to sample receipt deadlines as stated on the SRA.

If the Laboratory did not receive the information in the required timeframe, and regardless of any other integrity issues, suitably qualified results may still be reported.

Holding times apply from the date of sampling, therefore compliance to these may be outside the laboratory's control.

For VOCs containing vinyl chloride, styrene and 2-chloroethyl vinyl ether the holding time is 7 days however for all other VOCs such as BTEX or C6-10 TRH then the holding time is 14 days.

****NOTE:** pH duplicates are reported as a range NOT as RPD

Units

mg/kg: milligrams per kilogram

ppm: Parts per million

org/100mL: Organisms per 100 millilitres

mg/L: milligrams per litre

ppb: Parts per billion

NTU: Nephelometric Turbidity Units

ug/L: micrograms per litre

%: Percentage

MPN/100mL: Most Probable Number of organisms per 100 millilitres

Terms

Dry	Where a moisture has been determined on a solid sample the result is expressed on a dry basis.
LOR	Limit of Reporting.
SPIKE	Addition of the analyte to the sample and reported as percentage recovery.
RPD	Relative Percent Difference between two Duplicate pieces of analysis.
LCS	Laboratory Control Sample - reported as percent recovery.
CRM	Certified Reference Material - reported as percent recovery.
Method Blank	In the case of solid samples these are performed on laboratory certified clean sands and in the case of water samples these are performed on de-ionised water.
Surr - Surrogate	The addition of a like compound to the analyte target and reported as percentage recovery.
Duplicate	A second piece of analysis from the same sample and reported in the same units as the result to show comparison.
USEPA	United States Environmental Protection Agency
APHA	American Public Health Association
TCLP	Toxicity Characteristic Leaching Procedure
COC	Chain of Custody
SRA	Sample Receipt Advice
QSM	US Department of Defense Quality Systems Manual Version 5.3
CP	Client Parent - QC was performed on samples pertaining to this report
NCP	Non-Client Parent - QC performed on samples not pertaining to this report, QC is representative of the sequence or batch that client samples were analysed within.
TEQ	Toxic Equivalency Quotient

QC - Acceptance Criteria

RPD Duplicates: Global RPD Duplicates Acceptance Criteria is 30% however the following acceptance guidelines are equally applicable:

Results <10 times the LOR : No Limit

Results between 10-20 times the LOR : RPD must lie between 0-50%

Results >20 times the LOR : RPD must lie between 0-30%

Surrogate Recoveries: Recoveries must lie between 20-130% Phenols & 50-150% PFASs

PFAS field samples that contain surrogate recoveries in excess of the QC limit designated in QSM 5.3 where no positive PFAS results have been reported have been reviewed and no data was affected.

WA DWER (n=10): PFBA, PFPeA, PFHxA, PFHpA, PFOA, PFBS, PFHxS, PFOS, 6:2 FTSA, 8:2 FTSA

QC Data General Comments

1. Where a result is reported as a less than (<), higher than the nominated LOR, this is due to either matrix interference, extract dilution required due to interferences or contaminant levels within the sample, high moisture content or insufficient sample provided.
2. Duplicate data shown within this report that states the word "BATCH" is a Batch Duplicate from outside of your sample batch, but within the laboratory sample batch at a 1:10 ratio. The Parent and Duplicate data shown is not data from your samples.
3. Organochlorine Pesticide analysis - where reporting LCS data, Toxaphene & Chlordane are not added to the LCS.
4. Organochlorine Pesticide analysis - where reporting Spike data, Toxaphene is not added to the Spike.
5. Total Recoverable Hydrocarbons - where reporting Spike & LCS data, a single spike of commercial Hydrocarbon products in the range of C12-C30 is added and it's Total Recovery is reported in the C10-C14 cell of the Report.
6. pH and Free Chlorine analysed in the laboratory - Analysis on this test must begin within 30 minutes of sampling.Therefore laboratory analysis is unlikely to be completed within holding time. Analysis will begin as soon as possible after sample receipt.
7. Recovery Data (Spikes & Surrogates) - where chromatographic interference does not allow the determination of Recovery the term "INT" appears against that analyte.
8. Polychlorinated Biphenyls are spiked only using Aroclor 1260 in Matrix Spikes and LCS.
9. For Matrix Spikes and LCS results a dash " -" in the report means that the specific analyte was not added to the QC sample.
10. Duplicate RPDs are calculated from raw analytical data thus it is possible to have two sets of data.

Quality Control Results

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Method Blank							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	mg/kg	< 20			20	Pass	
TRH C10-C14	mg/kg	< 20			20	Pass	
TRH C15-C28	mg/kg	< 50			50	Pass	
TRH C29-C36	mg/kg	< 50			50	Pass	
Method Blank							
BTEX							
Benzene	mg/kg	< 0.1			0.1	Pass	
Toluene	mg/kg	< 0.1			0.1	Pass	
Ethylbenzene	mg/kg	< 0.1			0.1	Pass	
m&p-Xylenes	mg/kg	< 0.2			0.2	Pass	
o-Xylene	mg/kg	< 0.1			0.1	Pass	
Xylenes - Total	mg/kg	< 0.3			0.3	Pass	
Method Blank							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	mg/kg	< 0.5			0.5	Pass	
TRH C6-C10	mg/kg	< 20			20	Pass	
TRH >C10-C16	mg/kg	< 50			50	Pass	
TRH >C16-C34	mg/kg	< 100			100	Pass	
TRH >C34-C40	mg/kg	< 100			100	Pass	
Method Blank							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	mg/kg	< 0.5			0.5	Pass	
Acenaphthylene	mg/kg	< 0.5			0.5	Pass	
Anthracene	mg/kg	< 0.5			0.5	Pass	
Benz(a)anthracene	mg/kg	< 0.5			0.5	Pass	
Benzo(a)pyrene	mg/kg	< 0.5			0.5	Pass	
Benzo(b&j)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Benzo(g.h.i)perylene	mg/kg	< 0.5			0.5	Pass	
Benzo(k)fluoranthene	mg/kg	< 0.5			0.5	Pass	
Chrysene	mg/kg	< 0.5			0.5	Pass	
Dibenz(a.h)anthracene	mg/kg	< 0.5			0.5	Pass	
Fluoranthene	mg/kg	< 0.5			0.5	Pass	
Fluorene	mg/kg	< 0.5			0.5	Pass	
Indeno(1.2.3-cd)pyrene	mg/kg	< 0.5			0.5	Pass	
Naphthalene	mg/kg	< 0.5			0.5	Pass	
Phenanthrene	mg/kg	< 0.5			0.5	Pass	
Pyrene	mg/kg	< 0.5			0.5	Pass	
Method Blank							
Polychlorinated Biphenyls							
Aroclor-1016	mg/kg	< 0.1			0.1	Pass	
Aroclor-1221	mg/kg	< 0.1			0.1	Pass	
Aroclor-1232	mg/kg	< 0.1			0.1	Pass	
Aroclor-1242	mg/kg	< 0.1			0.1	Pass	
Aroclor-1248	mg/kg	< 0.1			0.1	Pass	
Aroclor-1254	mg/kg	< 0.1			0.1	Pass	
Aroclor-1260	mg/kg	< 0.1			0.1	Pass	
Total PCB*	mg/kg	< 0.1			0.1	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 1999 NEPM Fractions							
TRH C6-C9	%	96			70-130	Pass	

Test	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
TRH C10-C14	%	85			70-130	Pass	
LCS - % Recovery							
BTEX							
Benzene	%	100			70-130	Pass	
Toluene	%	98			70-130	Pass	
Ethylbenzene	%	91			70-130	Pass	
m&p-Xylenes	%	93			70-130	Pass	
Xylenes - Total	%	94			70-130	Pass	
LCS - % Recovery							
Total Recoverable Hydrocarbons - 2013 NEPM Fractions							
Naphthalene	%	120			70-130	Pass	
TRH C6-C10	%	91			70-130	Pass	
TRH >C10-C16	%	81			70-130	Pass	
LCS - % Recovery							
Polycyclic Aromatic Hydrocarbons							
Acenaphthene	%	109			70-130	Pass	
Acenaphthylene	%	117			70-130	Pass	
Anthracene	%	124			70-130	Pass	
Benz(a)anthracene	%	120			70-130	Pass	
Benzo(a)pyrene	%	96			70-130	Pass	
Benzo(b&j)fluoranthene	%	108			70-130	Pass	
Benzo(g.h.i)perylene	%	90			70-130	Pass	
Benzo(k)fluoranthene	%	86			70-130	Pass	
Chrysene	%	95			70-130	Pass	
Dibenz(a.h)anthracene	%	103			70-130	Pass	
Fluoranthene	%	120			70-130	Pass	
Fluorene	%	119			70-130	Pass	
Indeno(1.2.3-cd)pyrene	%	99			70-130	Pass	
Naphthalene	%	107			70-130	Pass	
Phenanthrene	%	110			70-130	Pass	
Pyrene	%	120			70-130	Pass	
LCS - % Recovery							
Polychlorinated Biphenyls							
Aroclor-1260	%	105			70-130	Pass	

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Spike - % Recovery									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1					
TRH C6-C9	N20-Fe00759	NCP	%	89			70-130	Pass	
TRH C10-C14	N20-Fe03039	NCP	%	79			70-130	Pass	
Spike - % Recovery									
BTEX				Result 1					
Benzene	N20-Fe00759	NCP	%	93			70-130	Pass	
Toluene	N20-Fe00759	NCP	%	93			70-130	Pass	
Ethylbenzene	N20-Fe00759	NCP	%	84			70-130	Pass	
m&p-Xylenes	N20-Fe00759	NCP	%	86			70-130	Pass	
o-Xylene	N20-Fe00759	NCP	%	91			70-130	Pass	
Xylenes - Total	N20-Fe00759	NCP	%	88			70-130	Pass	
Spike - % Recovery									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1					
Naphthalene	N20-Fe00759	NCP	%	100			70-130	Pass	
TRH C6-C10	N20-Fe00759	NCP	%	87			70-130	Pass	
TRH >C10-C16	N20-Fe03039	NCP	%	77			70-130	Pass	
Spike - % Recovery									
Polycyclic Aromatic Hydrocarbons				Result 1					

Test	Lab Sample ID	QA Source	Units	Result 1			Acceptance Limits	Pass Limits	Qualifying Code
Acenaphthene	S20-Ja29582	NCP	%	87			70-130	Pass	
Acenaphthylene	S20-Ja29582	NCP	%	91			70-130	Pass	
Anthracene	S20-Ja29582	NCP	%	94			70-130	Pass	
Benz(a)anthracene	S20-Ja29582	NCP	%	87			70-130	Pass	
Benzo(a)pyrene	S20-Ja29582	NCP	%	113			70-130	Pass	
Benzo(b&j)fluoranthene	S20-Ja29582	NCP	%	102			70-130	Pass	
Benzo(g.h.i)perylene	S20-Ja29582	NCP	%	101			70-130	Pass	
Benzo(k)fluoranthene	S20-Ja29582	NCP	%	84			70-130	Pass	
Chrysene	S20-Ja29582	NCP	%	95			70-130	Pass	
Dibenz(a.h)anthracene	S20-Ja29582	NCP	%	105			70-130	Pass	
Fluoranthene	S20-Ja29582	NCP	%	90			70-130	Pass	
Fluorene	S20-Ja29582	NCP	%	95			70-130	Pass	
Indeno(1.2.3-cd)pyrene	S20-Ja29582	NCP	%	112			70-130	Pass	
Naphthalene	S20-Ja29582	NCP	%	128			70-130	Pass	
Phenanthrene	S20-Ja29582	NCP	%	85			70-130	Pass	
Pyrene	S20-Ja29582	NCP	%	86			70-130	Pass	
Spike - % Recovery									
Polychlorinated Biphenyls				Result 1					
Aroclor-1016	M20-Ja30810	NCP	%	88			70-130	Pass	
Aroclor-1260	M20-Ja30810	NCP	%	90			70-130	Pass	
Test	**Lab Sample ID**	**QA Source**	**Units**	**Result 1**			**Acceptance Limits**	**Pass Limits**	**Qualifying Code**
Duplicate									
Polycyclic Aromatic Hydrocarbons				Result 1	Result 2	RPD			
Acenaphthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Acenaphthylene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benz(a)anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(a)pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(b&j)fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(g.h.i)perylene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Benzo(k)fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Chrysene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Dibenz(a.h)anthracene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluoranthene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Fluorene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Indeno(1.2.3-cd)pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Naphthalene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Phenanthrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Pyrene	M20-Fe03903	NCP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
Duplicate									
				Result 1	Result 2	RPD			
% Moisture	M20-Fe05006	CP	%	32	32	<1	30%	Pass	
Duplicate									
Polychlorinated Biphenyls				Result 1	Result 2	RPD			
Aroclor-1016	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1221	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1232	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1242	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1248	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1254	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Aroclor-1260	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Total PCB*	S20-Fe01881	NCP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C6-C9	M20-Fe05012	CP	mg/kg	< 20	< 20	<1	30%	Pass	

Duplicate									
BTEX				Result 1	Result 2	RPD			
Benzene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Toluene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Ethylbenzene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
m&p-Xylenes	M20-Fe05012	CP	mg/kg	< 0.2	< 0.2	<1	30%	Pass	
o-Xylene	M20-Fe05012	CP	mg/kg	< 0.1	< 0.1	<1	30%	Pass	
Xylenes - Total	M20-Fe05012	CP	mg/kg	< 0.3	< 0.3	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
Naphthalene	M20-Fe05012	CP	mg/kg	< 0.5	< 0.5	<1	30%	Pass	
TRH C6-C10	M20-Fe05012	CP	mg/kg	< 20	< 20	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 1999 NEPM Fractions				Result 1	Result 2	RPD			
TRH C10-C14	M20-Fe05014	CP	mg/kg	< 20	< 20	<1	30%	Pass	
TRH C15-C28	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH C29-C36	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
Duplicate									
Total Recoverable Hydrocarbons - 2013 NEPM Fractions				Result 1	Result 2	RPD			
TRH >C10-C16	M20-Fe05014	CP	mg/kg	< 50	< 50	<1	30%	Pass	
TRH >C16-C34	M20-Fe05014	CP	mg/kg	< 100	< 100	<1	30%	Pass	
TRH >C34-C40	M20-Fe05014	CP	mg/kg	< 100	< 100	<1	30%	Pass	

Comments

Sample Integrity

Custody Seals Intact (if used)	N/A
Attempt to Chill was evident	Yes
Sample correctly preserved	Yes
Appropriate sample containers have been used	Yes
Sample containers for volatile analysis received with minimal headspace	Yes
Samples received within HoldingTime	No
Some samples have been subcontracted	No

Qualifier Codes/Comments

Code	Description
N01	F2 is determined by arithmetically subtracting the "naphthalene" value from the ">C10-C16" value. The naphthalene value used in this calculation is obtained from volatiles (Purge & Trap analysis).
N02	Where we have reported both volatile (P&T GCMS) and semivolatile (GCMS) naphthalene data, results may not be identical. Provided correct sample handling protocols have been followed, any observed differences in results are likely to be due to procedural differences within each methodology. Results determined by both techniques have passed all QAQC acceptance criteria, and are entirely technically valid.
N04	F1 is determined by arithmetically subtracting the "Total BTEX" value from the "C6-C10" value. The "Total BTEX" value is obtained by summing the concentrations of BTEX analytes. The "C6-C10" value is obtained by quantitating against a standard of mixed aromatic/aliphatic analytes.
N07	Please note:- These two PAH isomers closely co-elute using the most contemporary analytical methods and both the reported concentration (and the TEQ) apply specifically to the total of the two co-eluting PAHs

Authorised By

Robert Johnston	Analytical Services Manager
Harry Bacalis	Senior Analyst-Volatile (VIC)
Joseph Edouard	Senior Analyst-Organic (VIC)

Glenn Jackson

General Manager

Final report - this Report replaces any previously issued Report

- Indicates Not Requested

* Indicates NATA accreditation does not cover the performance of this service

Measurement uncertainty of test data is available on request or please click here.

APPENDIX 4
DROP CAMERA SITES (GDA94 UTM 54 S)

Date	Site	Easting	Northing	Depth (m LAT)
31/10/2019	DC_AR2	664260	5693556	69.5
	DC_AR3	663741	5694457	69.6
	DC_AR4	662262	5693605	70.8
	DC_AR1	662782	5692701	70.9
20/11/2019	DC_TH5	658145	5656139	107.1
21/11/2019	DC_TH8	657791	5656967	104.9
	DC_TH8_4m	657796	5656969	104.9
	DC_TH8_8m	657800	5656972	104.9
	DC_TH6	659801	5656919	101.9
	DC_TH6_4m	659810	5656925	101.9
	DC_TH6_8m	659810	5656923	101.9
	DC_TH7	659211	5657774	103.5
	DC_TH7_4m	659213	5657774	103.5
9/12/2019	DC_TH4	660880	5658431	98.9
	DC_TH4_2m	660880	5658428	98.9
	DC_TH4_5m	660881	5658432	98.9
	DC_TH1	661398	5657534	96.8
	DC_TH1_2m	661397	5657532	96.8
	DC_TH1_5m	661397	5657539	96.8
	DC_TH2	662970	5658384	96.9
	DC_TH2_2m	662972	5658383	96.9
	DC_TH2_5m	662975	5658387	96.9
	DC_TH3	662409	5659275	98.2
	DC_TH3_2m	662412	5659274	98.2
	DC_TH3_5m	662406	5659277	98.2
25/12/2019	DC_GE1	668217	5668519	85.6
	DC_GE2	669700	5669375	85.0
	DC_GE2_2m	669703	5669375	85.0
	DC_GE2_5m	669704	5669377	85.0
	DC_GE3	669179	5670280	82.3
	DC_GE3_2m	669180	5670279	82.3
	DC_GE3_5m	669184	5670277	82.3
	DC_GE4	667699	5669424	83.4
	DC_GE4_2m	667700	5669424	83.4
	DC_GE4_5m	667704	5669422	83.4
28/12/2019	DC_LB1	647832	5681521	92.5
	DC_LB1_2m	647831	5681519	92.5
	DC_LB1_5m	647831	5681516	92.5
	DC_LB4	646558	5680703	97.8
	DC_LB4_2m	646560	5680702	97.8

Date	Site	Easting	Northing	Depth (m LAT)
	DC_LB4_5m	646560	5680700	97.8
	DC_LB4_Extra	646438	5680699	97.8
21/01/2020	DC_LB2R	645891	5681544	93.1
	DC_LB2R_2m	645889	5681543	93.1
	DC_LB2R_5m	645891	5681541	93.1
	DC_LB3R	647415	5682484	93.6
	DC_LB3R_2m	647415	5682479	93.6
	DC_LB3R_5m	647418	5682479	93.6
	DC_HE4R	662560	5687719	74.3
	DC_HE4R_1m	662560	5687719	74.3
	DC_HE4R_3m	662557	5687717	74.3
	DC_HE2	662068	5688635	74.3
	DC_HE2_1m	662066	5688636	74.3
	DC_HE2_3m	662064	5688637	74.3
	DC_HE1	664068	5688640	73.4
	DC_HE1_1m	664068	5688643	73.4
	DC_HE1_3m	664066	5688641	73.4
	DC_HE3	663548	5689514	73.8
	DC_HE3_1m	663548	5689515	73.8
	DC_HE3_3m	663544	5689514	73.8
	DC_HTX1R	669286	5688662	72.9
	DC_HTX1R_1m	669286	5688661	72.9
	DC_HTX1R_2m	669290	5688661	72.9
22/01/2020	DC_ARHTX1R	665451	5691790	70.5
	DC_ARHTX1R_2m	665452	5691788	70.5
	DC_ARHTX1R_5m	665452	5691788	70.5
29/01/2020	DC_ARHTY1R	665896	5694722	69.3
	DC_ARHTY1R_B	665895	5694725	69.3
	DC_ARHTY1R_C	665899	5694726	69.3
	DC_HTY1R_A	670385	5696817	67.9
	DC_HTY1R_B	670382	5696816	67.9
	DC_HTY1R_C	670384	5696816	67.9
	DC_ARGE3R_A	665383	5684033	76.4
	DC_ARGE3R_B	665383	5684033	76.8
	DC_ARGE3R_C	665382	5684030	76.7
	DC_ARGE3R_D	665381	5684028	76.2
	DC_ARGE6R_A	667106	5676840	76.9
	DC_ARGE6R_B	667108	5676837	74.7
	DC_ARGE6R_C	667109	5676835	77.6
	DC_ARGE7R_A	667735	5673842	79.4

Date	Site	Easting	Northing	Depth (m LAT)
30/01/2020	DC_ARGE7R_B	667735	5673845	79.4
	DC_ARGE7R_C	667736	5673849	79.4
	DC_ARLB2R_A	659391	5690760	73.6
	DC_ARLB2R_B	659390	5690760	73.6
	DC_ARLB2R_C	659391	5690757	73.6
	DC_ARLB6R_A	651030	5684616	87.1
	DC_ARLB6R_B	651030	5684615	87.1
	DC_ARLB6R_C	651031	5684613	87.1
	DC_LBGE3R_A	653038	5677641	98.5
	DC_LBGE3R_B	653039	5677640	98.5
	DC_LBGE3R_C	653040	5677638	98.5
	DC_LBGE6R_A	659466	5673506	88.2
	DC_LBGE6R_B	659467	5673504	88.2
	DC_LBGE6R_C	659468	5673503	88.2

APPENDIX 5
SEABED PHOTOGRAPH ASSESSMENT DATA

Location	**Image Name**	**Percnet coverage of epifauna (%)**	**Gastropoda sp. 1**	**Gastropoda sp. 2**	**Gastropoda sp. 3**	**Gastropoda sp. 4**	**Gastropoda sp. 5**	**Crinoidea**	**Polychaeta**	**Nudibranchia**	**Teleostei**
ARGE	Routes_ARGE_ARGE3R_A_00001	20									
ARGE	Routes_ARGE_ARGE3R_A_00002	10							1		
ARGE	Routes_ARGE_ARGE3R_A_00005	15		5	1						
ARGE	Routes_ARGE_ARGE3R_A_00006	25									
ARGE	Routes_ARGE_ARGE3R_A_00007	5		1							
ARGE	Routes_ARGE_ARGE3R_B_00005	15									
ARGE	Routes_ARGE_ARGE3R_B_00006	5									
ARGE	Routes_ARGE_ARGE3R_B_00007	5									
ARGE	Routes_ARGE_ARGE3R_C_00001	0									
ARGE	Routes_ARGE_ARGE3R_C_00003	5									
ARGE	Routes_ARGE_ARGE3R_C_00004	0									
ARGE	Routes_ARGE_ARGE3R_C_00005	5									
ARGE	Routes_ARGE_ARGE6R_A_00001	0									
ARGE	Routes_ARGE_ARGE6R_A_00002	0									
ARGE	Routes_ARGE_ARGE6R_A_00003	5									
ARGE	Routes_ARGE_ARGE6R_A_00004	0									
ARGE	Routes_ARGE_ARGE6R_A_00005	0									
ARGE	Routes_ARGE_ARGE6R_A_00006	0									
ARGE	Routes_ARGE_ARGE6R_A_00007	5									
ARGE	Routes_ARGE_ARGE6R_B_00001	0									
ARGE	Routes_ARGE_ARGE6R_B_00002	5									
ARGE	Routes_ARGE_ARGE6R_B_00003	5									
ARGE	Routes_ARGE_ARGE6R_B_00005	5									
ARGE	Routes_ARGE_ARGE6R_B_00006	5									
ARGE	Routes_ARGE_ARGE6R_B_00007	5									
ARGE	Routes_ARGE_ARGE6R_B_00008	0									
ARGE	Routes_ARGE_ARGE6R_B_00009	5									
ARGE	Routes_ARGE_ARGE6R_C_00001	5									
ARGE	Routes_ARGE_ARGE6R_C_00002	0									
ARGE	Routes_ARGE_ARGE6R_C_00003	5									
ARGE	Routes_ARGE_ARGE6R_C_00004	0									1
ARGE	Routes_ARGE_ARGE6R_C_00005	0		1							
ARGE	Routes_ARGE_ARGE7R_A_00001	5									
ARGE	Routes_ARGE_ARGE7R_A_00002	15									
ARGE	Routes_ARGE_ARGE7R_A_00004	10									
ARGE	Routes_ARGE_ARGE7R_A_00005	25		1							
ARGE	Routes_ARGE_ARGE7R_B_00004	5									
ARGE	Routes_ARGE_ARGE7R_B_00005	10									
ARGE	Routes_ARGE_ARGE7R_B_00006	20									
ARGE	Routes_ARGE_ARGE7R_B_00007	15									
ARGE	Routes_ARGE_ARGE7R_B_00008	20									
ARGE	Routes_ARGE_ARGE7R_B_00009	20									
ARGE	Routes_ARGE_ARGE7R_B_00011	25		1							
ARGE	Routes_ARGE_ARGE7R_B_00012	15				1					

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
ARGE	Routes_ARGE_ARGE7R_B_00015	25									
ARGE	Routes_ARGE_ARGE7R_C_00001	35									
ARGE	Routes_ARGE_ARGE7R_C_00002	10									
ARGE	Routes_ARGE_ARGE7R_C_00004	35									
ARGE	Routes_ARGE_ARGE7R_C_00005	5									1
ARGE	Routes_ARGE_ARGE7R_C_00006	30		1							
ARHTY	Routes_ARHTY_ARHTYR1_A_00001	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00002	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00003	20									
ARHTY	Routes_ARHTY_ARHTYR1_A_00004	25									
ARHTY	Routes_ARHTY_ARHTYR1_A_00005	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00006	0									
ARHTY	Routes_ARHTY_ARHTYR1_A_00008	0									1
ARHTY	Routes_ARHTY_ARHTYR1_A_00009	0						1			
ARHTY	Routes_ARHTY_ARHTYR1_B_00001	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00003	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00004	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00005	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00006	0									
ARHTY	Routes_ARHTY_ARHTYR1_B_00008	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00001	40	1								
ARHTY	Routes_ARHTY_ARHTYR1_C_00002	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00004	20									
ARHTY	Routes_ARHTY_ARHTYR1_C_00006	5									
ARHTY	Routes_ARHTY_ARHTYR1_C_00007	0		1							
ARHTY	Routes_ARHTY_ARHTYR1_C_00008	0									
ARHTY	Routes_ARHTY_ARHTYR1_C_00009	0								1	
ARLB	Routes_ARLB_ARLB2R_A_00001	20									
ARLB	Routes_ARLB_ARLB2R_A_00005	20									
ARLB	Routes_ARLB_ARLB2R_A_00006	20									
ARLB	Routes_ARLB_ARLB2R_A_00007	30									
ARLB	Routes_ARLB_ARLB2R_A_00008	15		1							
ARLB	Routes_ARLB_ARLB2R_A_00009	20									
ARLB	Routes_ARLB_ARLB2R_A_00010	20									
ARLB	Routes_ARLB_ARLB2R_B_00001	5									
ARLB	Routes_ARLB_ARLB2R_B_00002	20									
ARLB	Routes_ARLB_ARLB2R_B_00003	20		2	1						
ARLB	Routes_ARLB_ARLB2R_B_00004	20									
ARLB	Routes_ARLB_ARLB2R_B_00005	20									
ARLB	Routes_ARLB_ARLB2R_C_00001	5		1							
ARLB	Routes_ARLB_ARLB2R_C_00003	5									
ARLB	Routes_ARLB_ARLB2R_C_00004	0									
ARLB	Routes_ARLB_ARLB2R_C_00005	5									
ARLB	Routes_ARLB_ARLB2R_C_00006	5		1							

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
ARLB	Routes_ARLB_ARLB6R_A_00002	0									
ARLB	Routes_ARLB_ARLB6R_A_00003	5				1					
ARLB	Routes_ARLB_ARLB6R_A_00004	0									
ARLB	Routes_ARLB_ARLB6R_A_00005	5		1							
ARLB	Routes_ARLB_ARLB6R_B_00001	0									
ARLB	Routes_ARLB_ARLB6R_B_00002	0									
ARLB	Routes_ARLB_ARLB6R_B_00004	0									
ARLB	Routes_ARLB_ARLB6R_B_00005	0									
ARLB	Routes_ARLB_ARLB6R_B_00006	0		3							
ARLB	Routes_ARLB_ARLB6R_C_00001	0									
ARLB	Routes_ARLB_ARLB6R_C_00002	0									
ARLB	Routes_ARLB_ARLB6R_C_00003	0									
ARLB	Routes_ARLB_ARLB6R_C_00004	0									
ARLB	Routes_ARLB_ARLB6R_C_00005	0		1							
ARLB	Routes_ARLB_ARLB6R_C_00007	5		2							
Artisan	Artisan_AR1_00015	30									
Artisan	Artisan_AR1_00017	5									
Artisan	Artisan_AR1_00029	40		3							
Artisan	Artisan_AR1_00035	30		1							
Artisan	Artisan_AR2_00007	35									
Artisan	Artisan_AR2_00008	15									
Artisan	Artisan_AR2_00011	40									
Artisan	Artisan_AR2_00012	30		1							
Artisan	Artisan_AR3_00004	20									
Artisan	Artisan_AR3_00006	15									
Artisan	Artisan_AR3_00008	5									
Artisan	Artisan_AR3_00015	40									
Artisan	Artisan_AR3_00017	25									
Artisan	Artisan_AR3_00018	20		1							
Artisan	Artisan_AR3_00019	10									
Artisan	Artisan_AR3_00022	5									
Artisan	Artisan_AR3_00023	25									
Artisan	Artisan_AR4_00004	30		3							
Artisan	Artisan_AR4_00005	5									
Artisan	Artisan_AR4_00007	20		2							
Artisan	Artisan_AR4_00009	10									
Artisan	Artisan_AR4_00012	45									
Artisan	Artisan_AR4_00013	30									
Artisan	Artisan_AR4_00016	10		1							
Artisan	Artisan_AR4_00017	30		1							
Artisan	Artisan_AR4_00018	20		1							
Artisan	Artisan_AR4_00019	5		1							
Artisan	Artisan_AR4_00025	15		2							
Artisan	Artisan_AR4_00031	15		3							

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Artisan	Artisan_AR4_00034	40									
Geographe	Geographe_GE1_A_00004	55									
Geographe	Geographe_GE1_A_00007	35									
Geographe	Geographe_GE1_A_00008	45		2							
Geographe	Geographe_GE1_B_00001	0									
Geographe	Geographe_GE1_B_00002	0	1								
Geographe	Geographe_GE1_B_00004	5									
Geographe	Geographe_GE1_B_00005	5									
Geographe	Geographe_GE1_C_00001	5									
Geographe	Geographe_GE1_C_00005	25	1								
Geographe	Geographe_GE2_A_00001	5									
Geographe	Geographe_GE2_A_00002	5									
Geographe	Geographe_GE2_A_00003	10	1								
Geographe	Geographe_GE2_A_00005	25									
Geographe	Geographe_GE2_B_00002	5									
Geographe	Geographe_GE2_B_00003	5									
Geographe	Geographe_GE2_C_00002	0									
Geographe	Geographe_GE2_C_00004	0									
Geographe	Geographe_GE2_C_00005	0									
Geographe	Geographe_GE3_A_00001	5									
Geographe	Geographe_GE3_A_00003	5									
Geographe	Geographe_GE3_A_00005	25									
Geographe	Geographe_GE3_B_00001	5									
Geographe	Geographe_GE3_B_00003	20									
Geographe	Geographe_GE3_B_00005	30									
Geographe	Geographe_GE3_C_00002	35									
Geographe	Geographe_GE3_C_00005	40		1							
Geographe	Geographe_GE3_C_00006	10									
Geographe	Geographe_GE4_A_00002	35									
Geographe	Geographe_GE4_A_00004	5									
Geographe	Geographe_GE4_A_00005	30									
Geographe	Geographe_GE4_A_00006	0		1							
Geographe	Geographe_GE4_B_00002	5									
Geographe	Geographe_GE4_B_00003	5									
Geographe	Geographe_GE4_B_00005	0									
Geographe	Geographe_GE4_C_00001	5									
Geographe	Geographe_GE4_C_00002	0									
Geographe	Geographe_GE4_C_00003	0									
Geographe	Geographe_GE4_C_00005	0									
Hercules	Hercules_HE1_A_00002	20									
Hercules	Hercules_HE1_A_00003	0									
Hercules	Hercules_HE1_A_00004	35									
Hercules	Hercules_HE1_A_00005	0									
Hercules	Hercules_HE1_A_00006	35									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Hercules	Hercules_HE1_B_00001	45									
Hercules	Hercules_HE1_B_00002	35									
Hercules	Hercules_HE1_B_00004	15									
Hercules	Hercules_HE1_B_00005	5									
Hercules	Hercules_HE1_C_00001	5									
Hercules	Hercules_HE1_C_00002	20									
Hercules	Hercules_HE1_C_00005	25									
Hercules	Hercules_HE1_C_00006	30				1					
Hercules	Hercules_HE1_C_00007	30				1					
Hercules	Hercules_HE2_A_00001	30				1					
Hercules	Hercules_HE2_A_00002	5									
Hercules	Hercules_HE2_A_00003	30	1								
Hercules	Hercules_HE2_A_00004	5									
Hercules	Hercules_HE2_A_00005	60									
Hercules	Hercules_HE2_A_00006	25									
Hercules	Hercules_HE2_B_00002	60									
Hercules	Hercules_HE2_B_00004	80									
Hercules	Hercules_HE2_B_00005	25		1							
Hercules	Hercules_HE2_B_00006	75									
Hercules	Hercules_HE2_C_00002	5									
Hercules	Hercules_HE2_C_00003	25									
Hercules	Hercules_HE2_C_00004	20									
Hercules	Hercules_HE2_C_00007	20									
Hercules	Hercules_HE2_C_00009	25									
Hercules	Hercules_HE3_A_00001	50									
Hercules	Hercules_HE3_A_00003	45									
Hercules	Hercules_HE3_A_00005	40		1							
Hercules	Hercules_HE3_B_00001	30									
Hercules	Hercules_HE3_B_00002	40									
Hercules	Hercules_HE3_B_00004	15									
Hercules	Hercules_HE3_B_00005	25									
Hercules	Hercules_HE3_B_00006	30		1							
Hercules	Hercules_HE3_C_00001	5									
Hercules	Hercules_HE3_C_00002	40									
Hercules	Hercules_HE3_C_00003	0						1			
Hercules	Hercules_HE3_C_00005	35			1						
Hercules	Hercules_HE3_C_00007	0									
Hercules	Hercules_HE3_C_00008	5									
Hercules	Hercules_HE4_A_00001	5									
Hercules	Hercules_HE4_A_00002	25									
Hercules	Hercules_HE4_A_00004	15									
Hercules	Hercules_HE4_A_00005	0									
Hercules	Hercules_HE4_B_00001	30									
Hercules	Hercules_HE4_B_00003	15									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Hercules	Hercules_HE4_B_00004	40									
Hercules	Hercules_HE4_B_00005	15									
Hercules	Hercules_HE4_B_00008	15									
Hercules	Hercules_HE4_B_00009	20									
Hercules	Hercules_HE4_B_00010	25									
Hercules	Hercules_HE4_C_00001	30									
Hercules	Hercules_HE4_C_00002	0									
Hercules	Hercules_HE4_C_00003	0	1								
Hercules	Hercules_HE4_C_00004	20									
Hercules	Hercules_HE4_C_00005	5									
Hot Tap X	HotTap_HTX_HTX1R_A_00006	40									
Hot Tap X	HotTap_HTX_HTX1R_B_00004	25		1							
Hot Tap X	HotTap_HTX_HTX1R_B_00005	15									
Hot Tap X	HotTap_HTX_HTX1R_B_00007	50	1								
Hot Tap X	HotTap_HTX_HTX1R_C_00002	30	1								
Hot Tap X	HotTap_HTX_HTX1R_C_00003	45									
Hot Tap X	HotTap_HTX_HTX1R_C_00005	55									
Hot Tap X	HotTap_HTX_HTX1R_C_00006	50				1					
Hot Tap X	HotTap_HTX_HTX1R_C_00007	25									
Hot Tap Y	HotTap_HTY_HTY1R_A_00001	25				1					
Hot Tap Y	HotTap_HTY_HTY1R_A_00004	20									
Hot Tap Y	HotTap_HTY_HTY1R_A_00005	25									
Hot Tap Y	HotTap_HTY_HTY1R_A_00007	40					1				
Hot Tap Y	HotTap_HTY_HTY1R_A_00009	15									
Hot Tap Y	HotTap_HTY_HTY1R_A_00010	15									
Hot Tap Y	HotTap_HTY_HTY1R_A_00013	20									
Hot Tap Y	HotTap_HTY_HTY1R_A_00014	35									
Hot Tap Y	HotTap_HTY_HTY1R_B_00001	25		1							
Hot Tap Y	HotTap_HTY_HTY1R_B_00004	20									
Hot Tap Y	HotTap_HTY_HTY1R_B_00006	10		1							
Hot Tap Y	HotTap_HTY_HTY1R_B_00008	10		5							
Hot Tap Y	HotTap_HTY_HTY1R_B_00009	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00001	25									
Hot Tap Y	HotTap_HTY_HTY1R_C_00002	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00004	15									
Hot Tap Y	HotTap_HTY_HTY1R_C_00005	20									
Hot Tap Y	HotTap_HTY_HTY1R_C_00006	10									
La Bella	LaBella_LB1_A_00001	30		1							
La Bella	LaBella_LB1_A_00004	5									
La Bella	LaBella_LB1_A_00006	30									
La Bella	LaBella_LB1_B_00008	5									
La Bella	LaBella_LB1_B_00009	5									
La Bella	LaBella_LB1_B_00013	15									
La Bella	LaBella_LB1_C_00001	15									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
La Bella	LaBella_LB1_C_00003	15									
La Bella	LaBella_LB1_C_00004	20									
La Bella	LaBella_LB2_A_00014	15									
La Bella	LaBella_LB2_A_00017	10									
La Bella	LaBella_LB2_A_00021	0									
La Bella	LaBella_LB2_A_00024	10									
La Bella	LaBella_LB2_A_00026	0									
La Bella	LaBella_LB2_A_00028	0									
La Bella	LaBella_LB2_B_00029	35									
La Bella	LaBella_LB2_B_00030	20									
La Bella	LaBella_LB2_B_00033	20									
La Bella	LaBella_LB2_B_00035	15									
La Bella	LaBella_LB2_B_00036	25									
La Bella	LaBella_LB2_B_00040	5									
La Bella	LaBella_LB2_B_00041	5									
La Bella	LaBella_LB2_C_00043	5									
La Bella	LaBella_LB2_C_00044	5									
La Bella	LaBella_LB2_C_00045	0									
La Bella	LaBella_LB2_C_00047	0									
La Bella	LaBella_LB2_C_00048	5									
La Bella	LaBella_LB3_A_00001	5									
La Bella	LaBella_LB3_A_00003	0		1							
La Bella	LaBella_LB3_A_00005	5									
La Bella	LaBella_LB3_A_00007	5									
La Bella	LaBella_LB3_A_00009	5									
La Bella	LaBella_LB3_A_00010	0									
La Bella	LaBella_LB3_B_00002	5									
La Bella	LaBella_LB3_B_00004	5		1							
La Bella	LaBella_LB3_B_00006	5		1							
La Bella	LaBella_LB3_B_00007	5									
La Bella	LaBella_LB3_B_00009	0									
La Bella	LaBella_LB3_C_00002	5		1							
La Bella	LaBella_LB3_C_00003	5									
La Bella	LaBella_LB3_C_00005	5									
La Bella	LaBella_LB3_C_00007	0									
La Bella	LaBella_LB4_A_00001	0									
La Bella	LaBella_LB4_A_00003	0				1					
La Bella	LaBella_LB4_A_00005	5									
La Bella	LaBella_LB4_B_00004	5									
La Bella	LaBella_LB4_B_00005	0									
La Bella	LaBella_LB4_C_00001	0		1							
La Bella	LaBella_LB4_C_00004	0									
La Bella	LaBella_LB4_C_00005	5									
La Bella	LaBella_LB4_C_00006	0									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
La Bella	LaBella_LB4_D_00001	35									
La Bella	LaBella_LB4_D_00002	25									
La Bella	LaBella_LB4_D_00003	30									
La Bella	LaBella_LB4_D_00004	15									
La Bella	LaBella_LB4_D_00005	20									
La Bella	LaBella_LB4_D_00006	25									
La Bella	LaBella_LB4_D_00007	35									
La Bella	LaBella_LB4_D_00008	40		1							
LBGE	Routes_LBGE_LBGE3R_A_00001	40									
LBGE	Routes_LBGE_LBGE3R_A_00002	45		2							
LBGE	Routes_LBGE_LBGE3R_A_00004	5									
LBGE	Routes_LBGE_LBGE3R_A_00005	5									
LBGE	Routes_LBGE_LBGE3R_A_00006	15									
LBGE	Routes_LBGE_LBGE3R_A_00008	45		1							
LBGE	Routes_LBGE_LBGE3R_B_00001	15									
LBGE	Routes_LBGE_LBGE3R_B_00002	5									
LBGE	Routes_LBGE_LBGE3R_B_00003	0									
LBGE	Routes_LBGE_LBGE3R_B_00004	0									
LBGE	Routes_LBGE_LBGE3R_B_00005	10		1							
LBGE	Routes_LBGE_LBGE3R_C_00001	0									
LBGE	Routes_LBGE_LBGE3R_C_00002	0									
LBGE	Routes_LBGE_LBGE3R_C_00003	0									
LBGE	Routes_LBGE_LBGE3R_C_00004	0									
LBGE	Routes_LBGE_LBGE3R_C_00005	0									
LBGE	Routes_LBGE_LBGE6R_A_00002	0									
LBGE	Routes_LBGE_LBGE6R_A_00003	5									
LBGE	Routes_LBGE_LBGE6R_A_00004	0									
LBGE	Routes_LBGE_LBGE6R_A_00005	5				1					
LBGE	Routes_LBGE_LBGE6R_A_00006	0									
LBGE	Routes_LBGE_LBGE6R_B_00001	0									
LBGE	Routes_LBGE_LBGE6R_B_00003	5		1							
LBGE	Routes_LBGE_LBGE6R_B_00004	5									
LBGE	Routes_LBGE_LBGE6R_B_00005	0									
LBGE	Routes_LBGE_LBGE6R_C_00001	0									
LBGE	Routes_LBGE_LBGE6R_C_00002	0									
LBGE	Routes_LBGE_LBGE6R_C_00003	0									
LBGE	Routes_LBGE_LBGE6R_C_00004	0									
LBGE	Routes_LBGE_LBGE6R_C_00005	0									
Thylacine	Thylacine_TH1_A_00002	65									
Thylacine	Thylacine_TH1_A_00003	55						9			
Thylacine	Thylacine_TH1_A_00006	25									
Thylacine	Thylacine_TH1_A_00007	20						2		1	
Thylacine	Thylacine_TH1_A_00008	30						6			
Thylacine	Thylacine_TH1_A_00009	30						3			

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH1_B_00015	45						3			
Thylacine	Thylacine_TH1_B_00016	55						3			
Thylacine	Thylacine_TH1_B_00017	60						1			
Thylacine	Thylacine_TH1_B_00018	60						5			
Thylacine	Thylacine_TH1_B_00021	55						2			
Thylacine	Thylacine_TH1_B_00023	45									
Thylacine	Thylacine_TH1_C_00028	40									
Thylacine	Thylacine_TH1_C_00029	45						3			
Thylacine	Thylacine_TH1_C_00031	25						1			
Thylacine	Thylacine_TH1_C_00033	40						2			
Thylacine	Thylacine_TH2_A_00001	0									
Thylacine	Thylacine_TH2_A_00003	0									
Thylacine	Thylacine_TH2_A_00005	5									
Thylacine	Thylacine_TH2_A_00009	5									
Thylacine	Thylacine_TH2_B_00010	5									
Thylacine	Thylacine_TH2_B_00011	0									
Thylacine	Thylacine_TH2_B_00012	0									
Thylacine	Thylacine_TH2_B_00013	5	1								
Thylacine	Thylacine_TH2_B_00014	5									
Thylacine	Thylacine_TH2_C_00015	0									
Thylacine	Thylacine_TH2_C_00016	5									
Thylacine	Thylacine_TH2_C_00017	0									
Thylacine	Thylacine_TH2_C_00018	5		1							
Thylacine	Thylacine_TH2_C_00019	0									
Thylacine	Thylacine_TH2_C_00021	0									
Thylacine	Thylacine_TH3_A_00001	15		2							
Thylacine	Thylacine_TH3_A_00003	10									
Thylacine	Thylacine_TH3_A_00004	30						4			
Thylacine	Thylacine_TH3_A_00005	25									
Thylacine	Thylacine_TH3_A_00007	20		1				1			
Thylacine	Thylacine_TH3_A_00009	20		1							
Thylacine	Thylacine_TH3_A_00010	5									
Thylacine	Thylacine_TH3_A_00011	5		2							
Thylacine	Thylacine_TH3_A_00014	10		1							
Thylacine	Thylacine_TH3_B_00015	10									
Thylacine	Thylacine_TH3_B_00018	10									
Thylacine	Thylacine_TH3_B_00020	10						1			
Thylacine	Thylacine_TH3_B_00022	10									
Thylacine	Thylacine_TH3_C_00023	15						2			
Thylacine	Thylacine_TH3_C_00024	5					1				
Thylacine	Thylacine_TH3_C_00025	5									
Thylacine	Thylacine_TH3_C_00026	10					1				
Thylacine	Thylacine_TH3_C_00027	5									
Thylacine	Thylacine_TH3_C_00030	5									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH3_C_00031	5									
Thylacine	Thylacine_TH3_C_00033	10									
Thylacine	Thylacine_TH4_A_00005	15						3			
Thylacine	Thylacine_TH4_A_00007	15						2			
Thylacine	Thylacine_TH4_A_00008	10						1			
Thylacine	Thylacine_TH4_A_00009	10						1			
Thylacine	Thylacine_TH4_A_00010	15									
Thylacine	Thylacine_TH4_A_00011	15						4			
Thylacine	Thylacine_TH4_B_00016	30						5			
Thylacine	Thylacine_TH4_B_00018	25									
Thylacine	Thylacine_TH4_B_00019	30						3			
Thylacine	Thylacine_TH4_B_00020	20						2			
Thylacine	Thylacine_TH4_B_00022	10									
Thylacine	Thylacine_TH4_C_00023	10									
Thylacine	Thylacine_TH4_C_00024	25						1			
Thylacine	Thylacine_TH4_C_00025	15									
Thylacine	Thylacine_TH4_C_00028	20						2			
Thylacine	Thylacine_TH4_C_00029	5									
Thylacine	Thylacine_TH4_C_00030	5									
Thylacine	Thylacine_TH4_C_00033	10									
Thylacine	Thylacine_TH5_00014	5									
Thylacine	Thylacine_TH6_00003	5									
Thylacine	Thylacine_TH6_00005	5									
Thylacine	Thylacine_TH6_00006	5									
Thylacine	Thylacine_TH6_00011	5									
Thylacine	Thylacine_TH6_00016	15									
Thylacine	Thylacine_TH7_00009	0									
Thylacine	Thylacine_TH7_00012(2)	5		1							
Thylacine	Thylacine_TH7_00013(2)	5									
Thylacine	Thylacine_TH7_00014(2)	5									
Thylacine	Thylacine_TH7_00015	0									
Thylacine	Thylacine_TH7_00017	0									
Thylacine	Thylacine_TH7_00018	0									
Thylacine	Thylacine_TH7_00022	0									
Thylacine	Thylacine_TH8_00009	5									
Thylacine	Thylacine_TH8_00011	5		1							
Thylacine	Thylacine_TH8_00013	5									
Thylacine	Thylacine_TH8_00015	10									
Thylacine	Thylacine_TH8_00019	5									
Thylacine	Thylacine_TH8_00021	5									
Thylacine	Thylacine_TH8_00022	5									
Thylacine	Thylacine_TH8_00025	0									
Thylacine	Thylacine_TH8_00027	5									
Thylacine	Thylacine_TH8_00028	5									

Location	Image Name	Percnet coverage of epifauna (%)	Gastropoda sp. 1	Gastropoda sp. 2	Gastropoda sp. 3	Gastropoda sp. 4	Gastropoda sp. 5	Crinoidea	Polychaeta	Nudibranchia	Teleostei
Thylacine	Thylacine_TH8_00030	5									

APPENDIX 6
EXAMPLE SEABED PHOTOGRAPHS


Artisan – AR4


Artisan – AR4


Geographe – GE2


Geographe – GE4


Hercules – HE1


Hercules – HE3


La Bella – LB2


La Bella – LB4 Extra DC


Thylacine – TH2

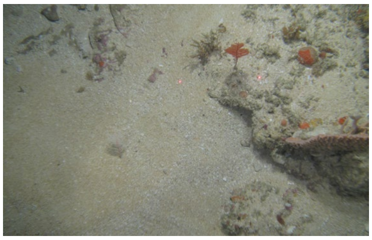

Thylacine – TH4


Thylacine – TH6


Thylacine – TH8


Hot Tap – HTX – HTX1R


Hot Tap – HTX – HTX1R


Hot Tap – HTY – HTY1R

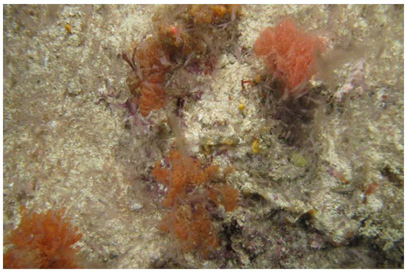

Hot Tap – HTY – HTY1R


Routes – ARGE – ARGE3R


Routes – ARGE – ARGE6R


Routes – ARGE – ARGE7R


Routes – ARHTX – ARHTX1R


Routes – ARHTX – ARHTX1R


Routes – ARHTY – ARHTY1R


Routes – ARHTY – ARHTY1R


Routes – ARLB – ARLB2R


Routes – ARLB – ARLB6R


Routes – LBGE – LBGE3R


Routes – LBGE – LBGE6R

Appendix C Acoustic Modelling Report

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TECHNICAL ADDENDUM

DATE: 23 July 2021
FROM: Matthew Koessler, Craig McPherson (JASCO Applied Sciences (Australia) Pty Ltd)
TO: Phil Wemyss (Beach Energy)

SUBJECT: Beach Otway Project: Additional and Revised Modelling Study

1. Summary

JASCO Applied Sciences (JASCO) performed modelling study of underwater sound levels associated with the Beach Energy Otway Development, to supplement drilling and construction results previously presented in Koessler et al. (2020), Matthews et al. (2020) and Matthews et al. (2021).

The results have been revised due to better understanding of the propagation loss in the region gained through the validation monitoring of drilling operations at Artisan-1 McPherson et al. (2021). A significant finding of this study was lack of a thin layer of sand overlying the carbonate seabed structure near Artisan-1, which has a significant influence on propagation loss.

This monitoring project also characterised Monopole Source Levels (MSL) for project vessels (during transit and under dynamic positioning (DP)) and the *Ocean Onyx* Mobile Offshore Drilling Unit (MODU). These source levels are considered in the revised modelling.

Estimated underwater acoustic levels are presented as sound pressure levels (SPL, L_p), and as accumulated sound exposure levels (SEL, L_E) as appropriate for non-impulsive (continuous) noise sources. For the non-time dependent scenarios, the modelled maximum and 95th percentile distances to the marine mammal behavioural threshold based on the current interim NOAA (2019) criterion for marine mammals of 120 dB re 1 µPa (SPL; L_p) for non-impulsive sound sources are summarised in Table 1.

For the time-dependent scenarios, the modelled maximum distances to permanent threshold shift (PTS) and temporary threshold shift (TTS) criteria for low-frequency cetaceans (NMFS 2018), which are based on SEL accumulated over a period of time are summarised in Table 2.

Table 1. Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenario. MCR: Maximum Continuous Rating, MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, ROV: Remotely Operated Vehicle.

Scenario number	Well Area	Description	R_{max} (km)	$R_{95\%}$ (km)
A1	Thylacine North-1	MODU Drilling	1.24	1.12
A2		OSV under DP	7.1	6.5
A3		OSV Standby Transit	0.38	0.35
A4	Thylacine A	Platform Operations	0.20	0.19
A5	Thylacine North-1	MODU Drilling + OSV resupply	7.89	6.56
A7		MODU Drilling + OSV Standby Transit	1.32	1.19
1	Thylacine A	Platform Operations + OSV resupply	7.28	6.56
5		Platform Operations + OSV Standby	0.45	0.43
7	Thylacine North-1	Pipelay Vessel stationary (June), operating at 20% MCR	2.71	2.57
8		Pipelay Vessel stationary (November), operating at 20% MCR	2.70	2.55
11	Artisan-1	Pipelay Vessel stationary (June), operating at 20% MCR	2.27	2.09
12		Pipelay Vessel stationary (November), operating at 20% MCR	2.26	2.02
15	Thylacine North-1 + Geographe-4	Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (June)	2.98	2.76
16		Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (November)	2.97	2.73
17	Artisan-1 + Geographe-4	Vessel stationary, operating at 20% MCR (Artsian-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (June)	2.98	2.75
18		Vessel stationary, operating at 20% MCR (Artsian-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (November)	2.97	2.72
19	Thylacine North-1 + Thylacine A	MODU Drilling + Platform + OSV resupply	7.90	6.65
21		MODU Drilling + Platform + Skid installation	4.85	4.29

Table 2. Summary: Maximum (R_{max}) horizontal distances (in km) and ensonified area (km^2) for the frequency-weighted LF-cetacean SEL_{24h} TTS thresholds based on NMFS (2018) from the most appropriate location for considered sources per scenario. MCR: Maximum Continuous Rating, MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, ROV: Remotely Operated Vehicle.

Scenario number	Well Area	Description	R_{max} (km)	Area (km^2)
A1	Thylacine North-1	MODU Drilling	0.39	0.33
A2		OSV under DP	0.95	2.33
A3		OSV Standby Transit	–	–
A4	Thylacine A	Platform Operations	0.04	0.004
A5	Thylacine North-1	MODU Drilling + 4h OSV resupply	1.06	2.49
A6		MODU Drilling + 8h OSV resupply	1.31	4.39
A7		MODU Drilling + OSV Standby Transit	0.39	0.33
1	Thylacine A	Platform + 2h OSV resupply	0.75	1.31
2		Platform + 4h OSV resupply	0.95	2.30
3		Platform + 6h OSV resupply	1.11	3.15
4		Platform + 8h OSV resupply	1.25	4.01
5		Platform 8h + OSV Standby	0.04	0.004
6		Platform + 24h OSV Standby	0.04	0.004
7	Thylacine North-1	Pipelay Vessel stationary (June), operating at 20% MCR	0.60	1.04
8		Pipelay Vessel stationary (November), operating at 20% MCR	0.59	1.04
9		Pipelay Vessel laying pipe (June), operating at 20% MCR	1.18	13.62
10		Pipelay Vessel laying pipe (November), operating at 20% MCR	1.17	13.53
11	Artisan-1	Pipelay Vessel stationary (June), operating at 20% MCR	0.67	1.14
12		Pipelay Vessel stationary (November), operating at 20% MCR	0.67	1.12
13		Pipelay Vessel laying pipe (June), operating at 20% MCR	0.90	10.76
14		Pipelay Vessel laying pipe (November), operating at 20% MCR	0.90	10.69
15	Thylacine North-1 + Geographe-4	Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (June)	0.66	1.35
16		Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (November)	0.66	1.34
17	Artisan-1 + Geographe-4	Vessel stationary, operating at 20% MCR (Artsian-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (June)	0.67	1.35
18		Vessel stationary, operating at 20% MCR (Artsian-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4) (November)	0.67	1.33
19	Thylacine North-1 + Thylacine A	MODU Drilling + Platform + 4h OSV resupply	0.95	2.31
20		MODU Drilling + Platform + 8h OSV resupply	1.23	4.03
21		MODU Drilling + Platform + Skid installation	0.65	1.10

2. Introduction

JASCO Applied Sciences (JASCO) performed modelling study of underwater sound levels associated with the Beach Energy Otway Development, to supplement drilling and construction results previously presented in Koessler et al. (2020), Matthews et al. (2020) and Matthews et al. (2021).

The results have been revised due to better understanding of the propagation loss in the region gained through the validation monitoring of drilling operations at Artisan-1 McPherson et al. (2021) as described in Section 2.1. An overview of the modelling scenarios considered is provided in Section 2.2, with results presented in Section 4, and briefly discussed in Section 5.

For noise effect criteria and explanations on methodologies applied, refer to Koessler et al. (2020), Matthews et al. (2020), Matthews et al. (2021) and McPherson et al. (2021).

2.1. Validation Monitoring Study Summary

The monitoring study (McPherson et al. 2021) was completed in relation to the exploration drilling activities at the Artisan-1 well with the aim of completing an acoustic characterisation of the drilling and associated vessel activity within the Otway Basin. Through this characterisation, validation of the modelling predictions used in Beach Energy Otway Environment Plans (EPs) for the development drilling activities was required.

The exploration well Artisan-1, drilled by the *Ocean Onyx*, was selected for the monitoring program because the predicted distances to thresholds for effects on marine mammals, including pygmy blue whales, were farthest at this location in the modelling study used for the EP (Koessler et al. 2020), as well as because it was the first well in the Otway drilling campaign.

Four JASCO Autonomous Multichannel Acoustic Recorders (AMARs) in C-lander moorings were deployed in February and retrieved in early April. Stations 1 through 4 were deployed at distances of 0.336, 1.13, 5.11, and 25 km from the *Ocean Onyx*. The AMARs recorded continuously at 24-bit resolution and 64 kHz sample rate for the entire deployment. The three stations closest to the *Ocean Onyx* were configured with a single hydrophone, whilst the station 25 km away was configured with three hydrophones to provide directional processing of received sounds.

To assist in the characterisation of *Ocean Onyx* and attendant support vessels, the vessels conducted specific activities under dynamic positioning and followed a nominated transit track between the *Ocean Onyx* and Geelong Supply Base. No specific operational requests were made of the *Ocean Onyx* and vessels during normal drilling activities due to the complexity of operationally meeting any requests. Over the course of the monitoring program, the MODU and support vessels engaged in different operational states with different uncontrollable contributors, such as variable drilling operations, resupply and support operations, weather conditions, and merchant shipping.

A summary of the findings of the monitoring study are described in the following sections.

Source Levels

The Monopole Source Levels determined through the measurement study differed from those either estimated for use in the modelling study or those determined using proxy sources. The key differences are as follows:

- The support vessels are quieter than estimated when they are under slow transit speeds, such as 7 knots.
- The support vessels are louder than estimated when they are travelling at faster transit speeds, with 9 knots used to represent these speeds and the associated MSL.
- The support vessels are louder than estimated when holding station or moving under dynamic positioning.
- The drilling operations of the *Ocean Onyx* are both louder at some frequencies and quieter at others than those for the proxy rig the *Polar Pioneer* (Austin et al. 2018), although the results presented for the *Polar*

Pioneer did not examine the changes in level with increased drilling depth (over time) as completed within this study.

Comparison of Results

The results from the measurement study could not be directly compared to the modelling presented in Koessler et al. (2020) due to the differences in actual events compared to the nominal representative scenarios developed and evaluated as part of the EP assessment process. Additionally, the measurements were obtained at a receiver located 1.2 m off the seafloor, which is not the maximum-over-depth results reported in the modelling study. The ranges obtained from the measurement study were reported in relation to the Artisan-1 well location, and thus the centre of the *Ocean Onyx*. The ranges in project related modelling studies are reported from a range of locations, including the centroids of multiple sources, thus it was not possible to report the measurement results in a similar fashion using the small number of recording locations used in this study.

Geological Environment Representation

Previous modelling studies for Beach Energy, Koessler et al. (2020), Matthews et al. (2020) and Matthews et al. (2021), used MONM with the assumption of a 1 m thick layer of sand overlaying the carbonate seabed structure at the Artisan-1 well location. This assumption was made due to the lack of available information, and is similar to other inshore work in the Otway Basin, such as (Duncan et al. 2012), who represented the shelf as two zones, an in-shore zone out to a water depth of about 70 m in which the sand layer has a thickness of between 4–10 m, and an off-shore zone of effectively bare calcarenite probably due to scouring by current and swell. The transition between these two zones is ill-defined due to a lack of datapoints, and lies close to the Artisan-1 location, and a balanced approach of assuming 1 m thick layer of sand overlaying the carbonate seabed structure was judged to be appropriate given available information.

The measurement study has increased the understanding of the geological environment in the region and indicates that the sand overlay is thinner (or non-existent) at shallower water depths. The different environment required the use of an alternate configuration of numerical models to represent the propagation loss.

Propagation Loss

The accuracy of the broadband calculated propagation loss for the Otway Basin continental shelf environment depends significantly upon the frequency content of the radiating sound source together with thickness of the sand layer on carbonate seabed (calcarenite) likely to occur within the region. In general, the thinner the sand layer, the greater the overall propagation loss.

When comparing SPL data fits for Stations 1–3 in McPherson et al. (2021), the loss rate is higher than what would have been expected in this environment, considering the higher monopole source levels for the support vessel on DP derived from trial measurements. The differences are likely attributable to the potential absence of a sand veneer.

Comparisons were conducted using JASCO's Marine Operations Noise Model (MONM), a wide-angle parabolic equation model which applies the BELLHOP Gaussian beam acoustic ray-trace model at higher frequencies, and JASCO's wavenumber integration model (VSTACK) which can fully account for the elasto-acoustic properties of the sub-bottom. The agreement between the models was excellent when only a comparatively thin (1 m thick) layer of sand overlies the carbonate seabed structure. In an environment such as this, MONM could have been used without correction. However, the comparisons indicate a much higher rates of loss, as would be expected if no (or only a very thin) sand layer were present.

A better understanding of the propagation loss environment, and the revision of the representation and treatment of it through the measurement study, enabled the modelling scenarios for the activities at Artisan-1 presented in Koessler et al. (2020) to be recalculated (Section 6.3 in McPherson et al. (2021)).

2.2. Scenario Details

The scenarios considered within this assessment are detailed below and in Table 3, with the associated modelling sites provided in Table 4. An overview of the scenarios is as follows:

1. Otway Offshore Project Development Drilling Campaign, Thylacine North-1 Operations:
    a. Mobile Offshore Drilling Unit (MODU) conducting normal drilling operations
    b. MODU with Offshore Supply Vessel (OSV) in attendance, standing by and conducting resupply operations under Dynamic Positioning (DP)
2. Otway Offshore Project Operations scenarios:
    1. Operations of the Thylacine platform (at Thylacine-A)
    2. OSV vessel resupply at Thylacine platform for periods of 2, 4, 6 and 8 hrs.
    3. OSV vessel on standby at Thylacine platform for periods of 8 and 24 hrs
4. Otway Offshore Project Construction scenarios: A single nominated pipelay/construction vessel, the Skandi Singapore, was considered for these scenarios. Each scenario was considered with a sound speed profiles for the ‘worst case over the year’ and for the period pygmy blue whales are present in the region, between November and January:
    a. Pipelay vessel (PLV) both stationary and laying pipe at Thylacine North-1 and Artisan-1 operating at 20% of its Maximum Continuous Rating (MCR).
    b. Pipelay vessel operating a Remotely Operated Vehicle (ROV) and cutting tool at Geographe-4. The vessel at Geographe-4 was also modelled operating at 20% of its Maximum Continuous Rating (MCR).
    c. Quantitively assess the combined sound levels of drilling activities and the construction vessel(s) at the emerging SRW aggregation area at Port Campbell. This scenario considered the drilling activities at Thylacine North-1 presented in Koessler et al. (2020) and the nominated construction vessel (Skandi Singapore) operating at Geographe-4.
5. Simultaneous assessment for drilling, operations and construction operations were considered for key scenarios:
    a. Drilling at Thylacine while doing Thylacine platform resupply
    b. Drilling at Thylacine while doing installation of Thylacine skid near Thylacine platform.

Table 3. Description of modelled scenarios. MCR: Maximum Continuous Rating, MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, ROV: Remotely Operated Vehicle.

Scenario number	Well Name	Description	SSP Month	Modelled sites
A1	Thylacine North-1	MODU Drilling	June	1
A2		OSV under DP	June	2
A3		OSV Standby Transit	June	3
A4	Thylacine A	Platform Operations	June	4
A5	Thylacine North-1	MODU Drilling + 4h OSV resupply	June	1,2,3
A6		MODU Drilling + 8h OSV resupply	June	1,2,3
A7		MODU Drilling + OSV Standby Transit	June	1,3
1	Thylacine A	Platform + 2h OSV resupply	June	4,5
2		Platform + 4h OSV resupply	June	4,5
3		Platform + 6h OSV resupply	June	4,5
4		Platform + 8h OSV resupply	June	4,5
5		Platform 8h + OSV Standby	June	3,5
6		Platform + 24h OSV Standby	June	3,5
7	Thylacine North-1	Pipelay Vessel stationary, operating at 20% MCR	June	6
8		Pipelay Vessel stationary, operating at 20% MCR	November	6
9		Pipelay Vessel laying pipe, operating at 20% MCR	June	6
10		Pipelay Vessel laying pipe, operating at 20% MCR	November	6
11	Artisan-1	Pipelay Vessel stationary, operating at 20% MCR	June	7
12		Pipelay Vessel stationary, operating at 20% MCR	November	7
13		Pipelay Vessel laying pipe, operating at 20% MCR	June	7
14		Pipelay Vessel laying pipe, operating at 20% MCR	November	7
15	Thylacine North-1 + Geographe-4	Pipelay Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	June	6,8,9
16		Pipelay Vessel stationary, operating at 20% MCR (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	November	6,8,9

Scenario number	Well Name	Description	SSP Month	Modelled sites
17	Artisan-1 + Geographe-4	Pipelay Vessel stationary, operating at 20% MCR (Artsian-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	June	7,8,9
18	Artisan-1 + Geographe-4	Vessel stationary, operating at 20% MCR (Pipelay Vessel -1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	November	7,8,9
19	Thylacine North-1 + Thylacine A	MODU Drilling + Platform + 4h OSV resupply	June	1,4,5
20		MODU Drilling + Platform + 8h OSV resupply	June	1,4,5
21		MODU Drilling + Platform + Skid installation	June	1,4,6
22	Thylacine North-1 + Geographe-4	MODU Drilling + 8h OSV resupply (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	June	1,2,3,8,9

Table 4. Location details for the modelled sites. MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, PLV: Pipelay Vessel, ROV: Remotely Operated Vehicle, WHP: Well Head Platform

Well	Site	Source	Latitude (S)	Longitude (E)	MGA Zone 54 (GDA94)		Water depth (m)
					X (m)	*Y* (m)	
Thylacine North-1	1	MODU	39° 12.51001'	142° 52.49601'	661882	5658411	99.1
	2	OSV	39° 12.48903'	142° 53.88508'	663882	5658408	99.1
	3	OSV standby	39° 12.50986'	142° 52.54039'	661946	5658410	99.2
Thylacine A	4	WHP	39° 14.40200'	142° 54.60100'	664838	5654848	102.4
	5	OSV	39° 14.40059'	142° 54.64574'	664902	5654849	102.3
Thylacine North-1	6	PLV	39° 12.51001'	142° 52.49601'	661882	5658411	99.1
Artisan-1	7	PLV	38° 53.45684'	142° 52.97408'	663300	5693640	71.5
Geographe-4	8	PLV	39° 6.49400'	142° 57.06700'	668700	5669400	85.0
	9	*ROV Cutting Tool*	39° 6.49400'	142° 57.06700'	668700	5669400	85.0
Thylacine North-1	10	OSV	39° 14.40200'	142° 54.60100'	664838	5654848	102.4

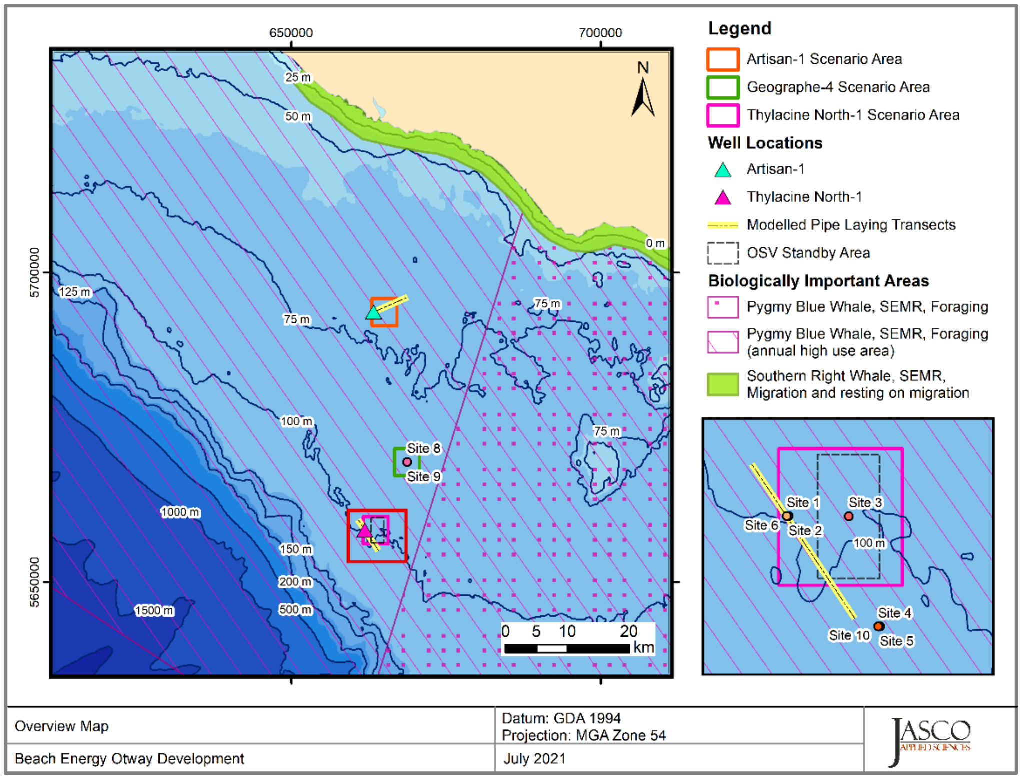

Figure 1. Overview of the modelled area (focus on Thylacine North-1 Scenario Area) and local features within the South East Marine Region (SEMR).

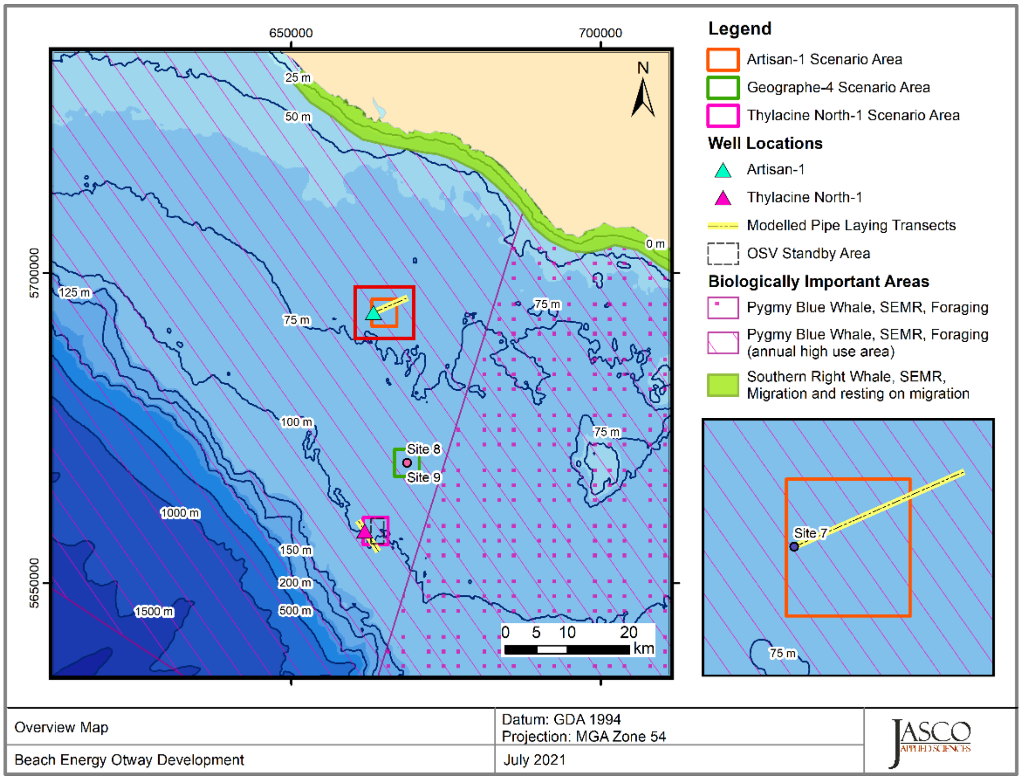

Figure 2. Overview of the modelled area (focus on Artisan-1 Scenario Area) and local features within the South East Marine Region (SEMR).

3. Methods and Parameters

A details description of the employed modelling method and input parameters can be found in refer to Koessler et al. (2020), Matthews et al. (2020), Matthews et al. (2021), Connell et al. (2021) and McPherson et al. (2021). A brief a summary of key elements used in this addendum are provided as follows.

The measured monopole source levels (MSLs) and spectra for the MODU and OSV were used here from McPherson et al. (2021):

- For the MODU drilling, mean levels from Section 5.5.1 in McPherson et al. (2021) were used.
- For scenarios where the OSV was under dynamic positioning (DP) the average spectrum from Section 5.5.2 in McPherson et al. (2021) was used.
- For scenarios where the OSV was transiting or standing by the average slow transit (7 knots) spectrum in McPherson et al. (2021) was used.

For the construction phase scenarios, estimates of the energy source levels (ESLs) for the pipelay/construction vessel were based on the specifications of the *Skandi Singapore* and a ESL derived from recordings of the TechnipFMC flexible lay and construction vessel *Deep Orient*. The specifications of proxy vessel and details on scaling can be found in Matthews et al. (2020), Matthews et al. (2021) and Connell et al. (2021).

Fixed structures such as the WHP have lower radiated sound levels than floating platforms (Spence et al. 2007). Equipment operating onboard floating platforms can contribute to marine environment sound however, airborne and structure-borne (vibration) pathways are considered more significant on these facilities, where equipment can be located below the water line. Underwater noise produced from platforms standing on metal jack-up legs is relatively low given the small surface areas available for sound transmission and also given the location of machinery above the waterline. It is therefore expected that the dominant pathway for sound generation is structure-borne (i.e., vibration from machinery passing through the legs) (Spence et al. 2007).

A study involving the Endeavour Jack-up Rig, operating in Cook Inlet, was conducted by Illingworth and Rodkin (2014) during drilling activities. The results from the sound source verification indicated that sound generated from drilling or generators were below ambient sound levels. The generators used on the Endeavour are mounted on pedestals specifically to reduce sound transfer through the infrastructure, and they are enclosed in an insulated engine room, which may have reduced further underwater sound transmission to levels below those generated by the Spartan 151. The sound source verification revealed that the submersed deep-well pumps that charge the fire-suppression system and cool the generators (in a closed water system) were the most likely dominant contributor the sound field. The measurements are reported as near-source levels recorded close to the bow leg pump system (at 10 m range) (Figure 3-5 in Illingworth and Rodkin Inc. (2014). These were backpropagated using spherical spreading to determine an energy source level (ESL) spectrum. Considering the similarities between a Jack-up Rig and a static WHP the decidecade band spectrum is shown in Figure 3 was used in modelling noise emissions from the Thylacine-A platform.

Furthermore, as discussed by (McPherson et al. 2021) and discussed above in Section 2.1, significant rates of propagation loss were found when analysing the data from the measurement study. As part of the model-measurement validation an adjustment factor was applied broadband received level predictions to account for the loss associated with a cemented limestone seabed (calcarenite) (Section 6.2 in McPherson et al. (2021)). A similar adjustment, which only differed by accounting for sources in different water depths, was applied to broadband level predictions in this addendum as a very similar type of seabed environment is expected at the Thylacine scenario area

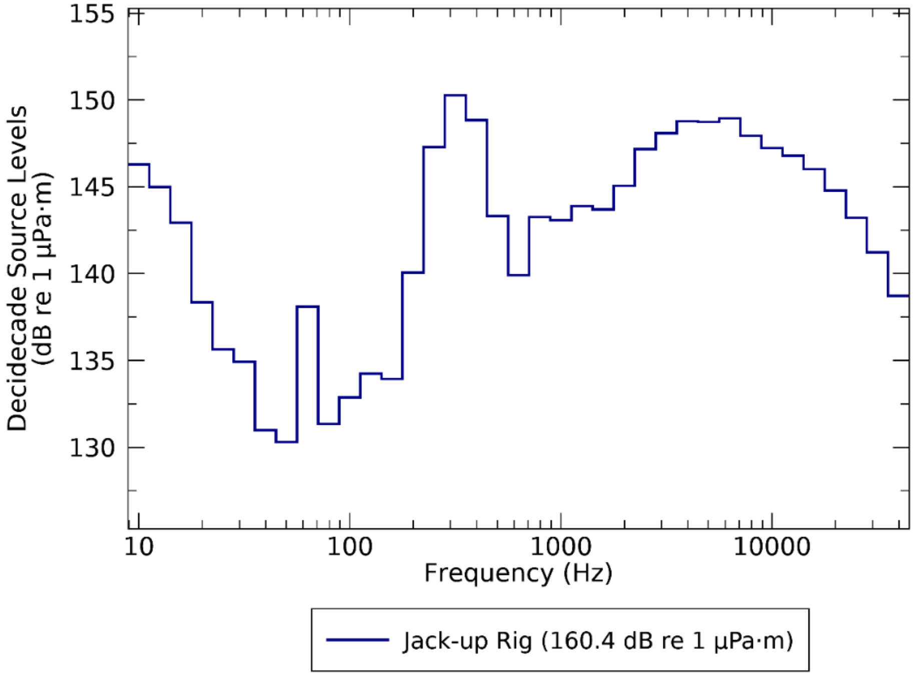

Figure 3. Energy source level (ESL) spectra (in decidecade frequency-band) for the Jack-up Rig considered as a proxy source for the Thylacine WHP.

4. Results

For the considered scenarios (described in Section 2.2), the maximum-over-depth sound fields for the modelled scenarios are presented below in two formats: as tables of distances to sound levels and, where the distances are long enough, as contour maps showing the directivity and distance to various sound levels. Distances to isopleths/thresholds were reported from either the centroid of several sources or from the most dominant single source. When an isopleth completely envelopes multiple sources the centroid was used. When several closed isopleths exist the most dominant source was used.

Tables 5–7 present the maximum and 95% distances (defined in Appendix B.1) to SPL isopleths. Since the SPL metric does not depend on the duration of the operation, these estimates are valid for both, stationary and non-stationary scenarios. Tables 9–14 present the distances to frequency-weighted SEL_{24h} threshold, as well as the total ensonified area for all scenarios.

The maximum-over-depth sound fields for nine scenarios (described in Section were extracted at the emerging SRW aggregation area at Port Campbell, and can be compared to the 120 dB re 1 µPa threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

4.1. Tabulated Results

Table 5. *Scenarios A1–A7:* Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenarioA dash indicates the level was not reached within the limits of the modelling resolution (20 m). MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, DP: Dynamic Positioning.

SPL (L_p; dB re 1 µPa)	**MODU Drilling (Scenario A1)**		**OSV under DP (Scenario A2)**		**OSV Standby Transit (Scenario A3)**		**Platform (Scenario A4)**		**MODU Drilling and OSV Resupply (Scenario A5)**		**MODU Drilling and OSV Standby (Scenario A7)**	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	0.05	0.05	–	–
170[A]	–	–	–	–	–	–	–	–	0.05	0.05	–	–
160	–	–	0.08	0.08	–	–	–	–	0.11	0.10	–	–
158[B]	–	–	0.13	0.12	–	–	–	–	0.15	0.15	–	–
150	–	–	0.32	0.31	–	–	–	–	0.36	0.31	–	–
140	0.09	0.09	0.87	0.81	–	–	–	–	0.88	0.82	0.09	0.09
130	0.38	0.35	2.3	2.15	0.17	0.16	–	–	2.51	2.18	0.38	0.35
120[C]	1.24	1.12	7.10	6.50	0.38	0.35	0.20	0.19	7.89	6.56	1.32	1.19
110	3.90	3.53	21.1	17.6	1.03	0.97	0.57	0.54	21.1	17.8	4.96	4.45

[A] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).

[B] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).

[C] Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

Table 6. *Scenarios 1–11:* Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenario. A dash indicates the level was not reached within the limits of the modelling resolution (20 m). OSV: Offshore Supply Vessel, PLV: Pipelay Vessel.

SPL (L_p; dB re 1 µPa)	**Platform and OSV resupply (Scenario 1)**		**Platform and OSV standby (Scenario 5)**		**PLV stationary, Thylacine**				**PLV stationary, Artisan**			
					June (Scenario 7)		**November (Scenario 8)**		**June (Scenario 11)**		**November (Scenario 12)**	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	–	–	–	–
170[A]	–	–	–	–	–	–	–	–	–	–	–	–
160	0.08	0.08	–	–	–	–	–	–	–	–	–	–
158[B]	0.14	0.09	–	–	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
150	0.28	0.27	–	–	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
140	0.85	0.80	–	–	0.33	0.32	0.33	0.32	0.29	0.29	0.29	0.29
130	2.48	2.18	0.17	0.16	0.95	0.85	0.94	0.84	0.87	0.80	0.87	0.80
120[C]	7.31	6.56	0.45	0.43	2.71	2.57	2.70	2.55	2.27	2.09	2.26	2.02
110	21.2	17.6	1.02	0.98	8.29	6.72	8.29	6.55	4.95	4.67	4.91	4.65

[A] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).

[B] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).

[C] Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

Table 7. *Scenarios 15–21:* Maximum (R_{max}) and 95% ($R_{95\%}$) horizontal distances (in km) to sound pressure level (SPL) from the most appropriate location for considered sources per scenario. A dash indicates the level was not reached within the limits of the modelling resolution (20 m). MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel, PLV: Pipelay Vessel, ROV: Remotely Operated Vehicle.

SPL (L_p; dB re 1 µPa)	**PLV stationary, at Thylacine and ROV Operations at Geographe-4**				**PLV stationary, at Artisan and ROV Operations at Geographe-4**				**MODU Drilling, Platform and OSV resupply**		**MODU Drilling, Platform and Skid Installation**	
	June (Scenario 15)		**November (Scenario 16)**		**June (Scenario 17)**		**November (Scenario 18)**		**(Scenario 19)**		**(Scenario 21)**	
	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)	R_{max} (km)	$R_{95\%}$ (km)
180	–	–	–	–	–	–	–	–	–	–	–	–
170[A]	–	–	–	–	–	–	–	–	–	–	–	–
160	–	–	–	–	–	–	–	–	0.08	0.08	–	–
158[B]	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.14	0.09	0.04	0.04
150	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.28	0.27	0.09	0.09
140	0.32	0.31	0.32	0.31	0.32	0.31	0.32	0.31	0.85	0.80	0.31	0.30
130	0.91	0.86	0.91	0.84	0.91	0.86	0.91	0.84	2.48	2.18	0.85	0.83
120[C]	2.98	2.76	2.97	2.73	2.98	2.75	2.97	2.72	7.90	6.65	4.85	4.29
110	11.3	8.64	11.3	8.70	7.14	6.14	7.11	6.01	21.2	17.7	9.42	7.80

[A] 48 h threshold for recoverable injury for fish with a swim bladder involved in hearing (Popper et al. 2014).

[B] 12 h threshold for TTS for fish with a swim bladder involved in hearing (Popper et al. 2014).

[C] Threshold for marine mammal behavioural response to continuous noise (NOAA 2019).

Table 8. Received SPL at the Port Campbell SRW receiver for relevant scenarios.

Scenario	**Description**	**Location(s)**	**SPL (Lp; dB re 1 µPa) at Port Campbell SRW Receiver**
22	MODU Drilling + 8h OSV resupply (Thylacine North-1) + Vessel stationary, operating at 20% MCR + ROV cutting tool (Geographe-4)	Thylacine North-1 + Geographe-4	93.8

Table 9. *Scenarios A1-A7:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m). MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel.

Hearing group	**SEL_{24h} threshold** ($L_{E,24h}$; dB re 1 µPa²·s)†	**MODU Drilling (Scenario A1)**		**OSV under DP (Scenario A2)**		**OSV Standby Transit (Scenario A3)**		**Platform (Scenario A4)**		**MODU Drilling and 4h OSV resupply (Scenario A5)**		**MODU Drilling and 8h OSV resupply (Scenario A6)**		**MODU Drilling and OSV Standby Transit (Scenario A7)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS															
LF cetaceans	199	0.03	0.004	0.09	0.03	–	–	0.02	0.001	0.12	0.03	0.18	0.08	0.06	0.004
MF cetaceans	198	0.02	0.001	0.02	0.001	–	–	0.02	0.001	0.05	0.002	0.05	0.002	0.04	0.001
HF cetaceans	173	0.23	0.16	0.06	0.01	–	–	0.03	0.004	0.26	0.16	0.26	0.17	0.26	0.16
Phocid seals	201	0.02	0.001	0.03	0.003	–	–	0.02	0.001	0.05	0.004	0.07	0.01	0.04	0.001
Otariid seals	219	–	–	–	–	–	–	–	–	0.03	0.001	0.05	0.001	–	–
Turtles	220	–	–	0.02	0.001	–	–	–	–	0.05	0.002	0.05	0.002	–	–
TTS															
LF cetaceans	179	0.39	0.33	0.95	2.33	–	–	0.04	0.004	1.06	2.49	1.31	4.39	0.39	0.33
MF cetaceans	178	0.13	0.06	0.06	0.01	–	–	0.03	0.003	0.16	0.06	0.16	0.07	0.13	0.06
HF cetaceans	153	1.12	3.22	0.47	0.69	–	–	0.30	0.28	1.16	3.71	1.16	3.99	1.12	3.22
Phocid seals	181	0.12	0.04	0.28	0.24	–	–	0.03	0.00	0.32	0.27	0.46	0.55	0.12	0.04
Otariid seals	199	0.02	0.001	0.04	0.01	–	–	0.02	0.001	0.07	0.01	0.09	0.01	0.02	0.001
Turtles	200	0.02	0.002	0.07	0.02	–	–	0.02	0.001	0.10	0.02	0.16	0.06	0.02	0.002

Table 10. *Scenarios 1–6:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL$_{24h}$ PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m), OSV: Offshore Supply Vessel.

Hearing group	**SEL$_{24h}$ threshold** ($L_{E,24h}$; dB re 1 µPa²·s)†	**Platform and OSV resupply 2 h (Scenario 1)**		**Platform and OSV resupply 4 h (Scenario 2)**		**Platform and OSV resupply 6 h (Scenario 3)**		**Platform and OSV resupply 8 h (Scenario 4)**		**Platform and OSV 8h standby (Scenario 5)**		**Platform and OSV 24h standby (Scenario 6)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS													
LF cetaceans	199	0.10	0.02	0.12	0.03	0.14	0.04	0.18	0.07	0.02	0.001	0.02	0.001
MF cetaceans	198	0.05	0.001	0.05	0.001	0.05	0.002	0.05	0.002	0.02	0.001	0.02	0.001
HF cetaceans	173	0.08	0.01	0.09	0.02	0.10	0.02	0.11	0.02	0.03	0.004	0.03	0.004
Phocid seals	201	0.05	0.002	0.06	0.004	0.06	0.01	0.08	0.01	0.02	0.001	0.02	0.001
Otariid seals	219	–	–	–	–	–	–	–	–	–	–	–	–
Turtles	220	–	–	–	–	0.04	0.001	0.04	0.001	–	–	–	–
TTS													
LF cetaceans	179	0.75	1.31	0.95	2.30	1.11	3.15	1.25	4.01	0.04	0.004	0.04	0.004
MF cetaceans	178	0.06	0.01	0.08	0.01	0.09	0.02	0.10	0.02	0.03	0.003	0.03	0.003
HF cetaceans	153	0.45	0.60	0.52	0.79	0.60	1.05	0.63	1.17	0.30	0.28	0.30	0.28
Phocid seals	181	0.23	0.12	0.30	0.24	0.37	0.36	0.43	0.46	0.03	0.00	0.03	0.00
Otariid seals	199	0.06	0.004	0.07	0.01	0.08	0.01	0.08	0.01	0.02	0.001	0.02	0.001
Turtles	200	0.08	0.01	0.10	0.02	0.11	0.02	0.17	0.04	0.02	0.001	0.02	0.001

Table 11. *Scenarios 7–10:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m), PLV: Pipelay Vessel.

Hearing group	**SEL_{24h} threshold** ($L_{E,24h}$; dB re 1 µPa²·s)†	**PLV stationary, at Thylacine**				**PLV laying pipe, at Thylacine**			
		June (Scenario 7)		**November (Scenario 8)**		**June (Scenario 9)**		**November (Scenario 10)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS									
LF cetaceans	199	0.06	0.01	0.06	0.01	0.02	0.21	0.02	0.21
MF cetaceans	198	0.02	0.001	0.02	0.001	0.01	0.02	0.01	0.02
HF cetaceans	173	0.09	0.03	0.09	0.03	0.03	0.37	0.03	0.36
Phocid seals	201	0.02	0.001	0.02	0.001	0.01	0.14	0.01	0.14
Otariid seals	219	–	–	–	–	–	–	–	–
Turtles	220	0.02	0.001	0.02	0.001	–	–	–	–
TTS									
LF cetaceans	179	0.60	1.04	0.59	1.04	1.18	13.62	1.17	13.53
MF cetaceans	178	0.07	0.02	0.07	0.02	0.02	0.22	0.02	0.22
HF cetaceans	153	0.84	2.02	0.70	1.36	1.19	15.04	1.46	16.02
Phocid seals	181	0.19	0.12	0.19	0.12	0.13	1.54	0.13	1.54
Otariid seals	199	0.02	0.001	0.02	0.001	0.01	0.15	0.01	0.15
Turtles	200	0.08	0.02	0.08	0.02	0.02	0.27	0.02	0.27

Table 12. *Scenarios 11–14:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL$_{24h}$ PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m), PLV: Pipelay Vessel.

Hearing group	**SEL$_{24h}$ threshold** ($L_{E,24h}$; dB re $1\ \mu Pa^2\cdot s$)†	**PLV stationary, at Artisan**				**PLV laying pipe, at Artisan**			
		June (Scenario 11)		**November (Scenario 12)**		**June (Scenario 13)**		**November (Scenario 14)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS									
LF cetaceans	199	0.06	0.01	0.06	0.01	0.02	0.25	0.02	0.25
MF cetaceans	198	0.01	0.001	0.01	0.001	–	–	–	–
HF cetaceans	173	0.09	0.03	0.09	0.03	0.03	0.37	0.03	0.37
Phocid seals	201	0.02	0.001	0.02	0.001	0.02	0.13	0.02	0.13
Otariid seals	219	–	–	–	–	–	–	–	–
Turtles	220	0.01	0.001	0.01	0.001	–	–	–	–
TTS									
LF cetaceans	179	0.67	1.14	0.67	1.12	0.90	10.76	0.90	10.69
MF cetaceans	178	0.07	0.02	0.07	0.02	0.03	0.30	0.03	0.30
HF cetaceans	153	0.77	1.60	0.62	1.18	0.95	11.92	0.91	10.68
Phocid seals	181	0.19	0.11	0.19	0.11	0.12	1.36	0.12	1.36
Otariid seals	199	0.02	0.001	0.02	0.001	0.02	0.22	0.02	0.22
Turtles	200	0.07	0.02	0.07	0.02	0.03	0.29	0.03	0.29

Table 13. *Scenarios 15–18:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m), PLV: Pipelay Vessel, ROV: Remotely Operated Vehicle.

Hearing group	**SEL_{24h} threshold** ($L_{E,24h}$; dB re 1 µPa²·s)†	**PLV stationary, at Thylacine and ROV Operations at Geographe-4**				**PLV stationary, at Artisan and ROV Operations at Geographe-4**			
		June (Scenario 15)		**November (Scenario 16)**		**June (Scenario 17)**		**November (Scenario 18)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS									
LF cetaceans	199	0.06	0.01	0.06	0.01	0.06	0.01	0.06	0.01
MF cetaceans	198	0.02	0.001	0.02	0.001	0.02	0.001	0.02	0.001
HF cetaceans	173	0.12	0.04	0.11	0.04	0.12	0.04	0.11	0.04
Phocid seals	201	0.02	0.001	0.02	0.001	0.02	0.001	0.02	0.001
Otariid seals	219	0.01	0.001	0.01	0.001	0.01	0.001	0.01	0.001
Turtles	220	0.02	0.001	0.02	0.001	0.01	0.001	0.01	0.001
TTS									
LF cetaceans	179	0.66	1.35	0.66	1.34	0.67	1.35	0.67	1.33
MF cetaceans	178	0.09	0.03	0.09	0.03	0.09	0.03	0.09	0.03
HF cetaceans	153	0.87	2.37	0.83	1.93	0.87	2.37	0.83	1.93
Phocid seals	181	0.19	0.12	0.19	0.12	0.19	0.11	0.19	0.11
Otariid seals	199	0.02	0.001	0.02	0.001	0.02	0.001	0.02	0.001
Turtles	200	0.08	0.02	0.08	0.02	0.08	0.02	0.08	0.02

Table 14. *Scenarios 19–21:* Maximum (R_{max}) horizontal distances (in km) to frequency-weighted SEL_{24h} PTS and TTS thresholds based on NMFS (2018) and Finneran et al. (2017) from the most appropriate location for considered sources per scenario, and ensonified area (km^2). A dash indicates the level was not reached within the limits of the modelling resolution (20 m). MODU: Mobile Offshore Drilling Unit, OSV: Offshore Supply Vessel.

Hearing group	**SEL_{24h} threshold** ($L_{E,24h}$; dB re 1 µPa²·s)†	**MODU Drilling, Platform and 4 h OSV resupply (Scenario 19)**		**MODU Drilling, Platform and 8 h OSV resupply (Scenario 20)**		**MODU Drilling, Platform and Skid Installation (Scenario 21)**	
		R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)	R_{max} (km)	Area (km^2)
PTS							
LF cetaceans	199	0.09	0.03	0.15	0.07	0.06	0.01
MF cetaceans	198	0.04	0.001	0.04	0.001	0.04	0.001
HF cetaceans	173	0.26	0.16	0.26	0.16	0.26	0.16
Phocid seals	201	0.04	0.004	0.05	0.008	0.04	0.001
Otariid seals	219	–	–	–	–	–	–
Turtles	220	–	–	0.03	0.001	0.03	0.001
TTS							
LF cetaceans	179	0.95	2.31	1.23	4.03	0.65	1.10
MF cetaceans	178	0.16	0.06	0.16	0.06	0.16	0.06
HF cetaceans	153	1.15	3.25	1.15	3.26	1.15	3.26
Phocid seals	181	0.28	0.24	0.41	0.46	0.18	0.09
Otariid seals	199	0.04	0.005	0.06	0.011	0.04	0.001
Turtles	200	0.08	0.02	0.15	0.04	0.08	0.02

4.2. Sound Field Maps

4.2.1. SPL Maps

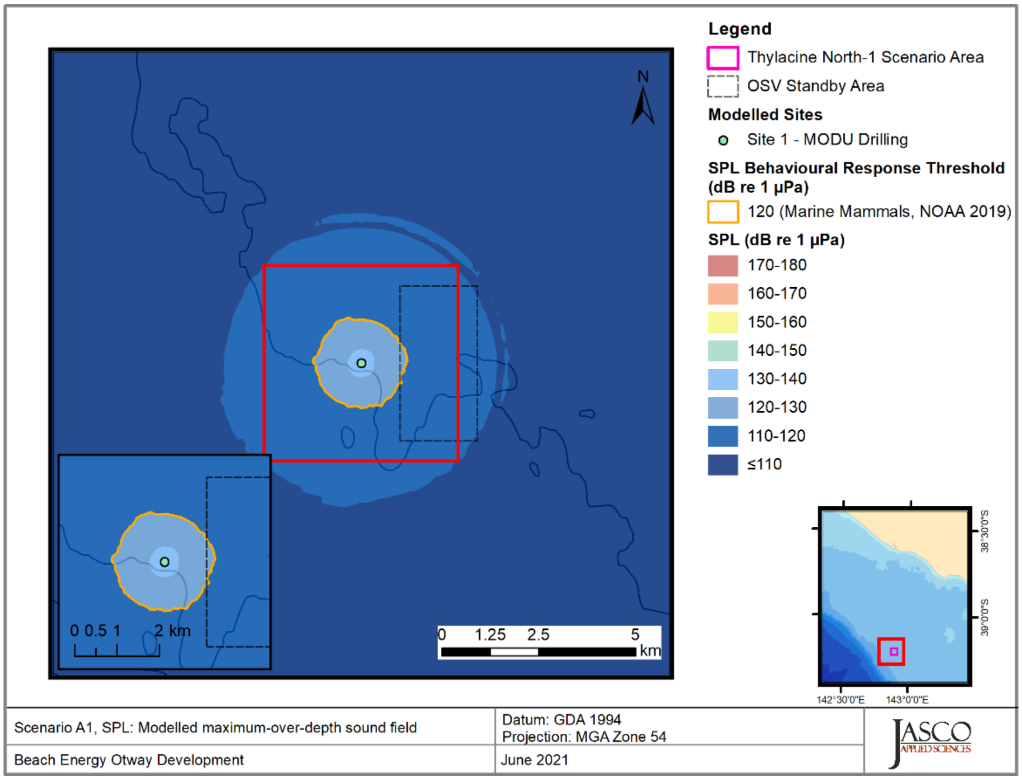

Figure 4. *Thylacine North-1, MODU Drilling (Scenario A1) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

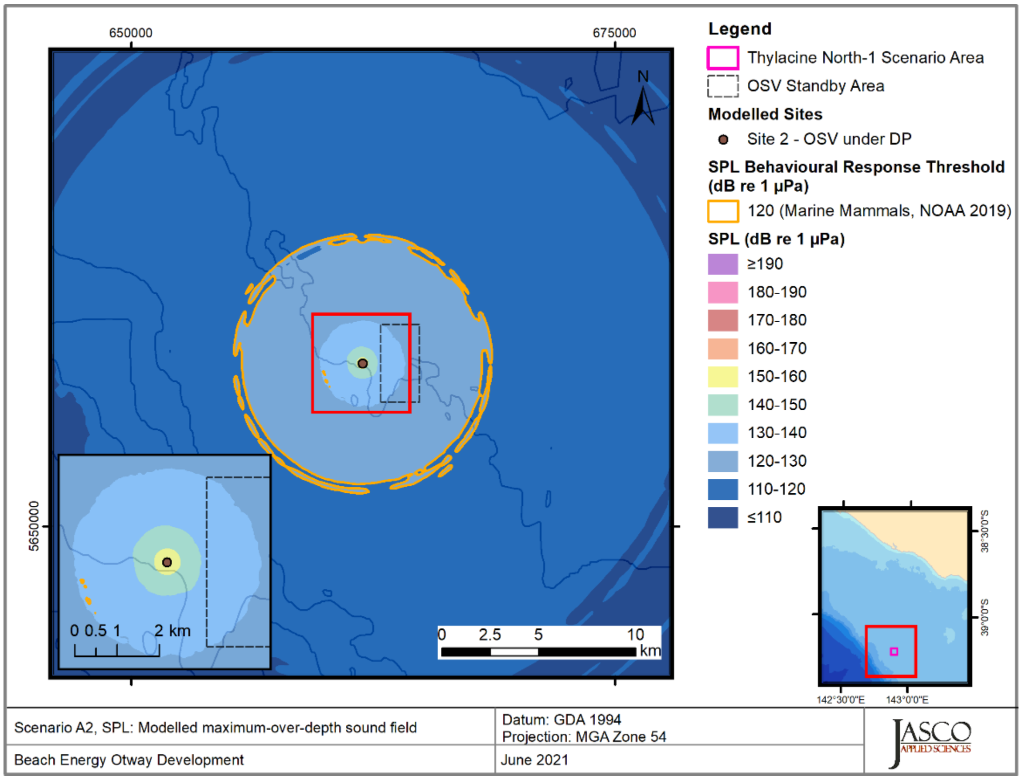

Figure 5. *Thylacine North-1, OSV on DP (Scenario A2) :* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

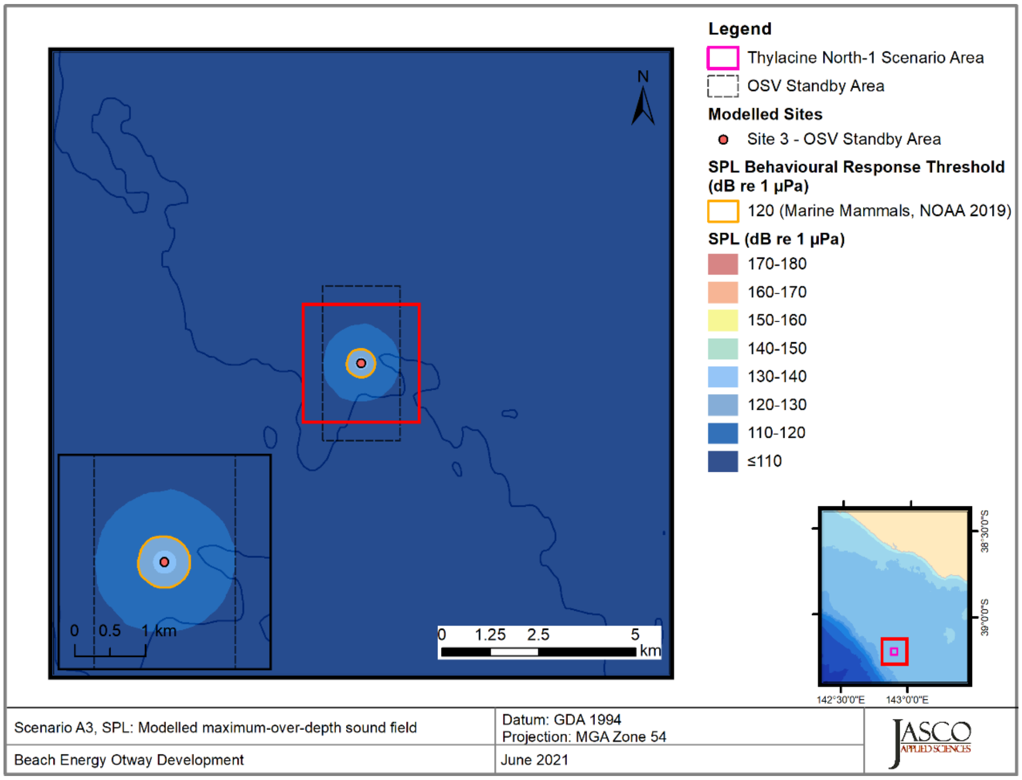

Figure 6. *Thylacine North-1, OSV Standby (Scenario A3) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

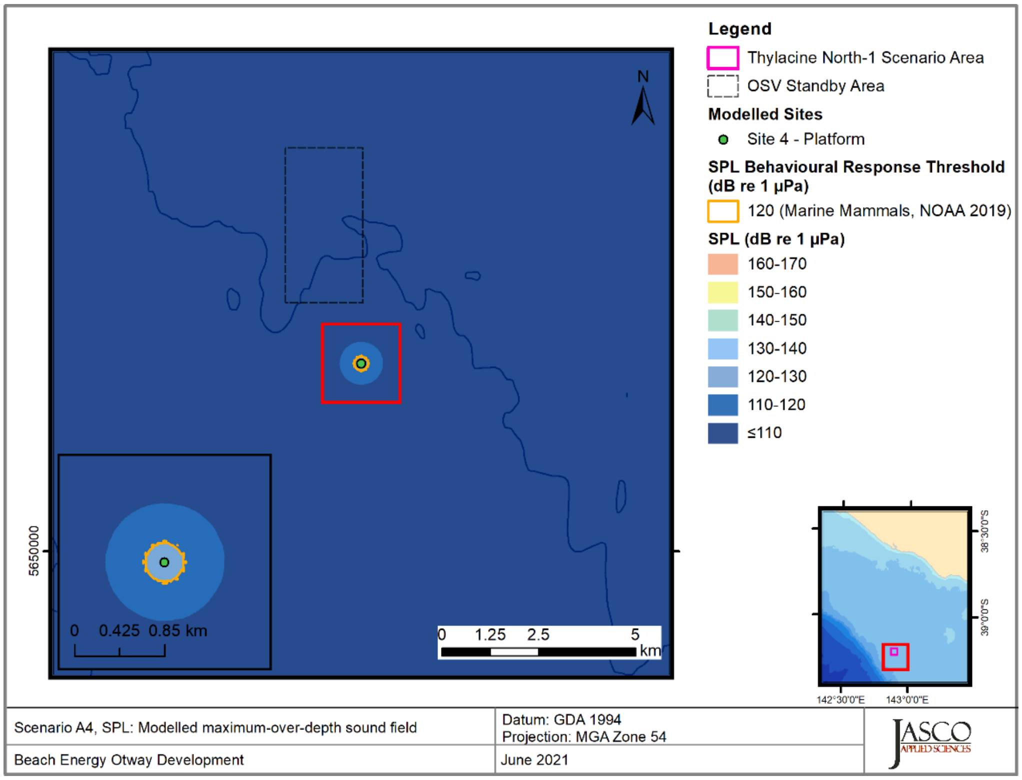

Figure 7. *Thylacine A, Platform Operations (Scenario A4) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

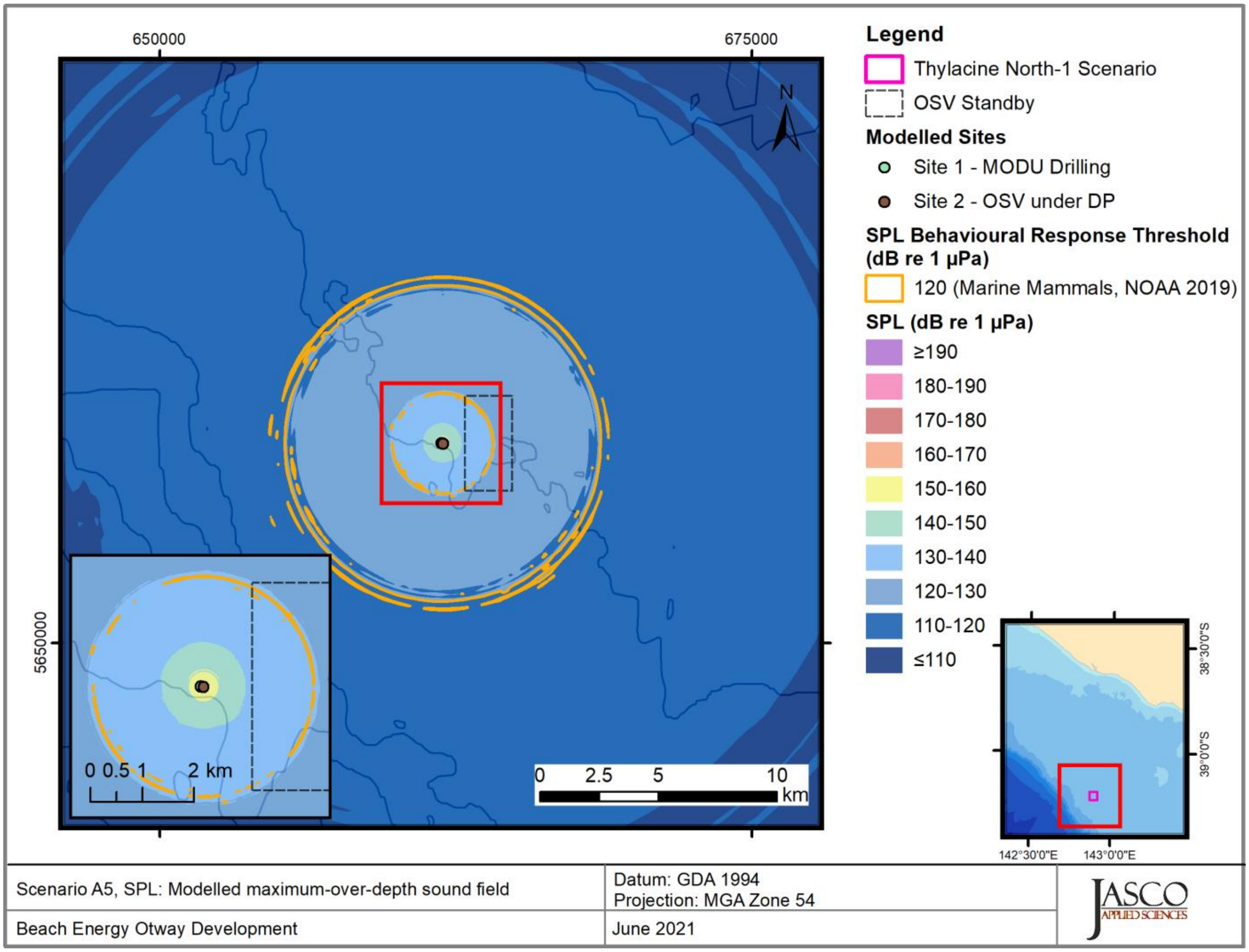

Figure 8. *Thylacine North-1, MODU Drilling and OSV Resupply (Scenario A5) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

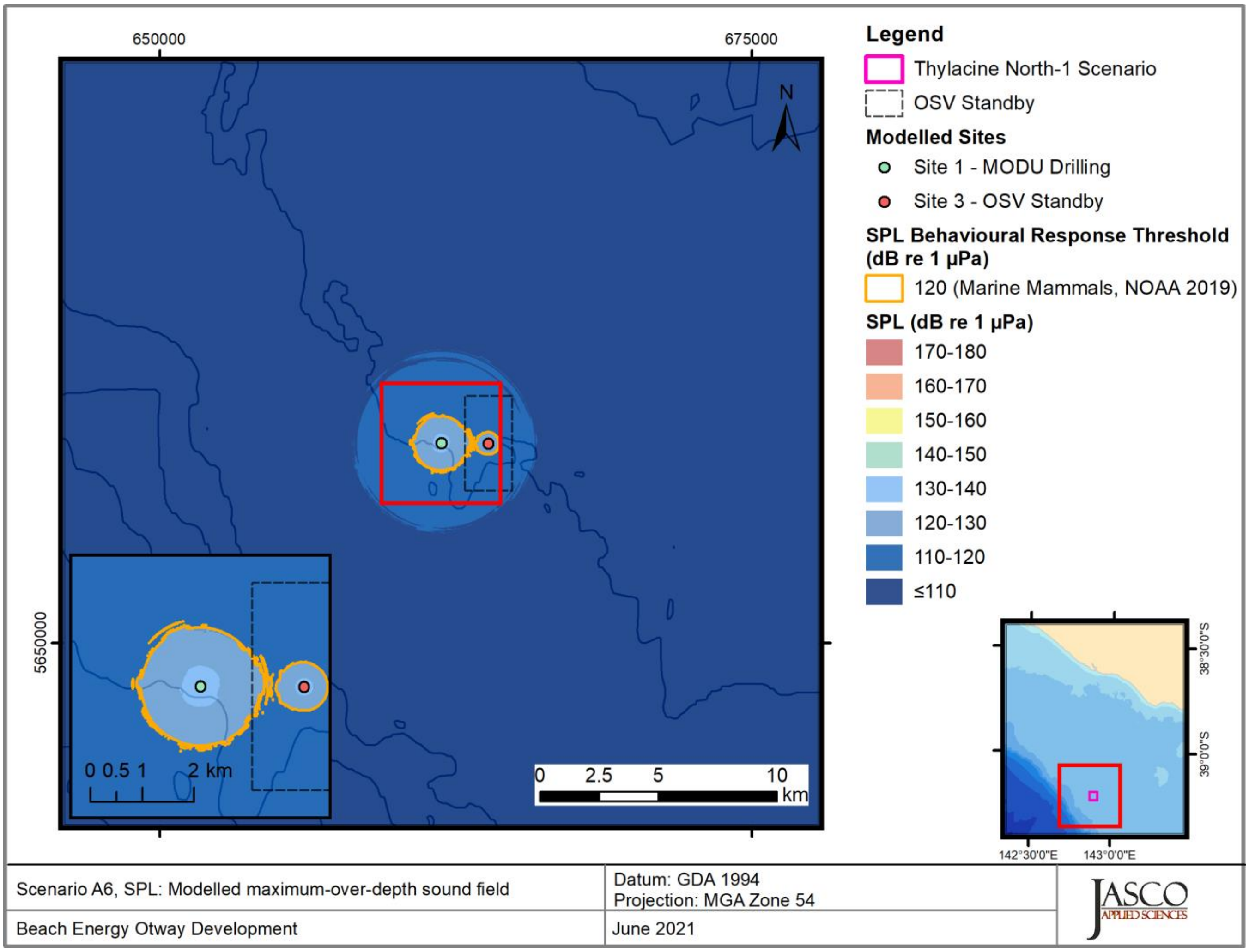

Figure 9. *Thylacine North-1, MODU Drilling and OSV Standby (Scenario A7) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

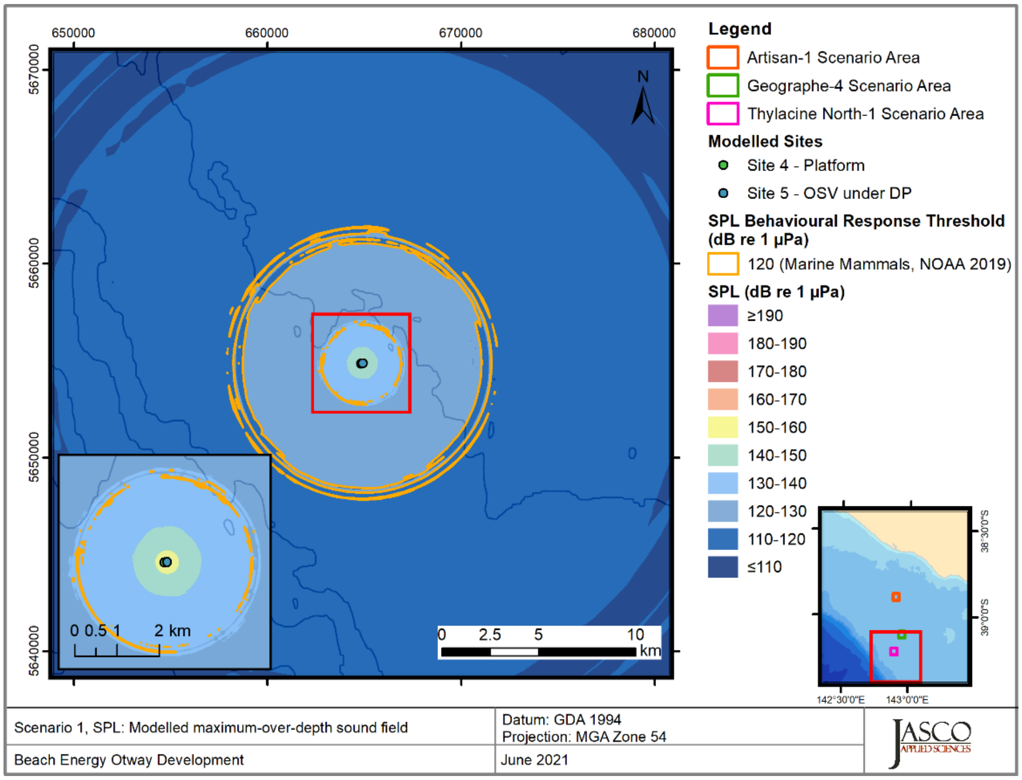

Figure 10. *Thylacine A Platform, Platform Resupply (Scenario1) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

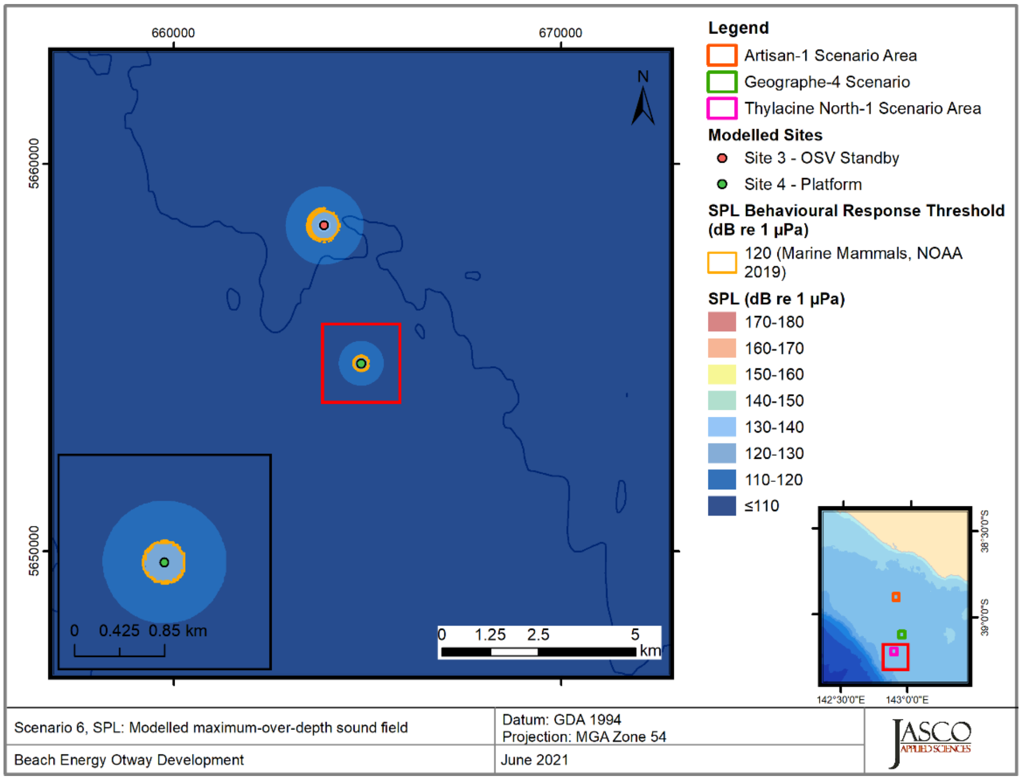

Figure 11. *Thylacine A Platform, OSV standby (Scenario 6) SPL :* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

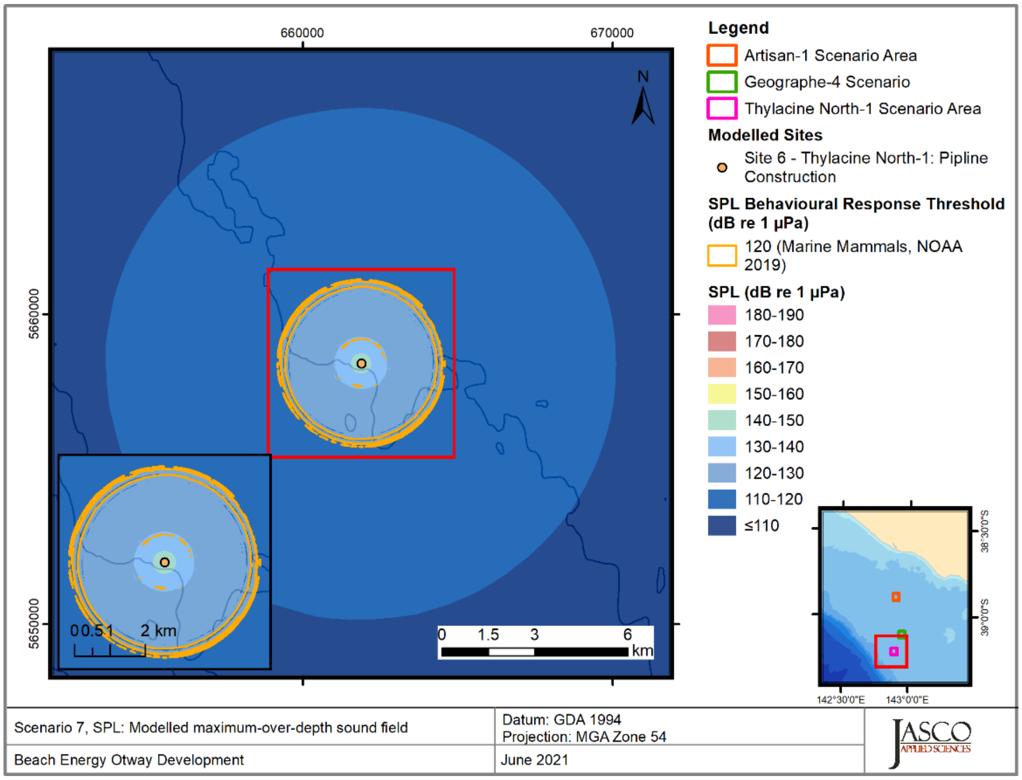

Figure 12. *Thylacine North-1, PLV stationary -June (Scenario 7) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

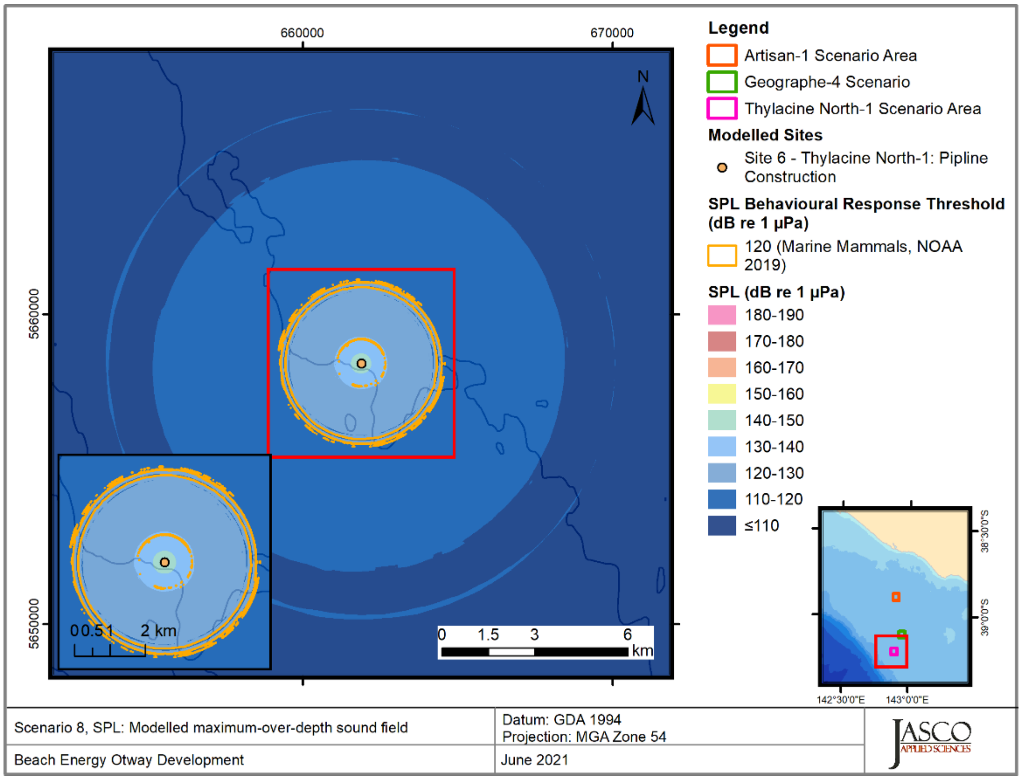

Figure 13. *Thylacine North-1, PLV stationary -November (Scenario 8) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

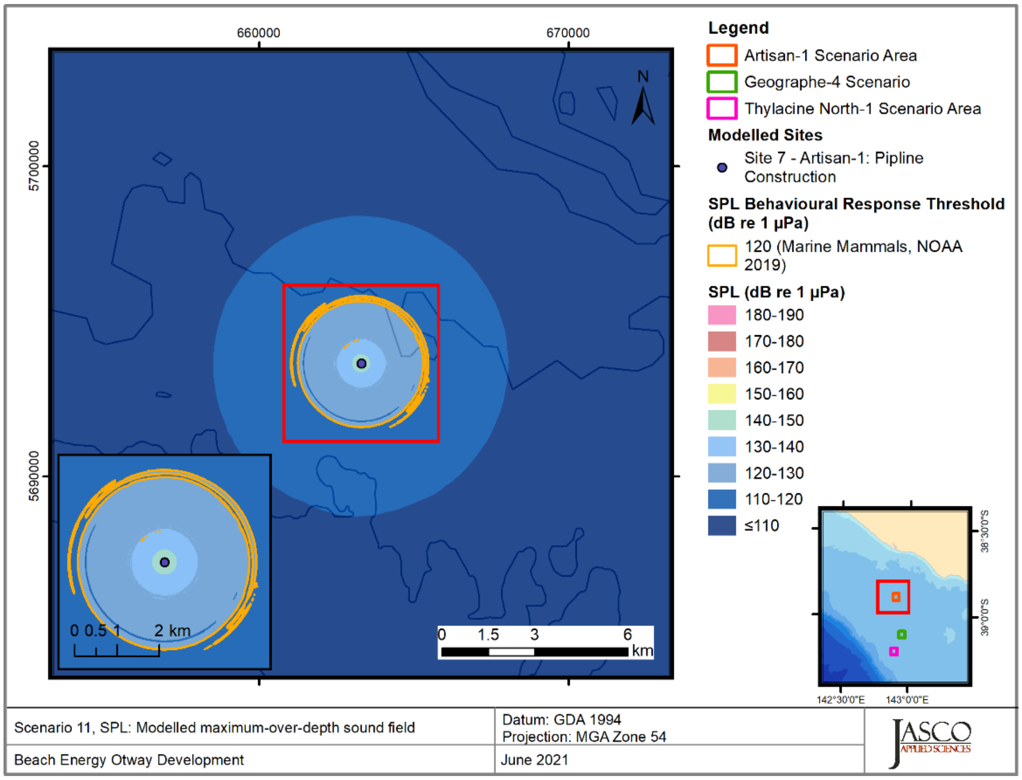

Figure 14. *Artisan-1, PLV stationary -June (Scenario 11) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

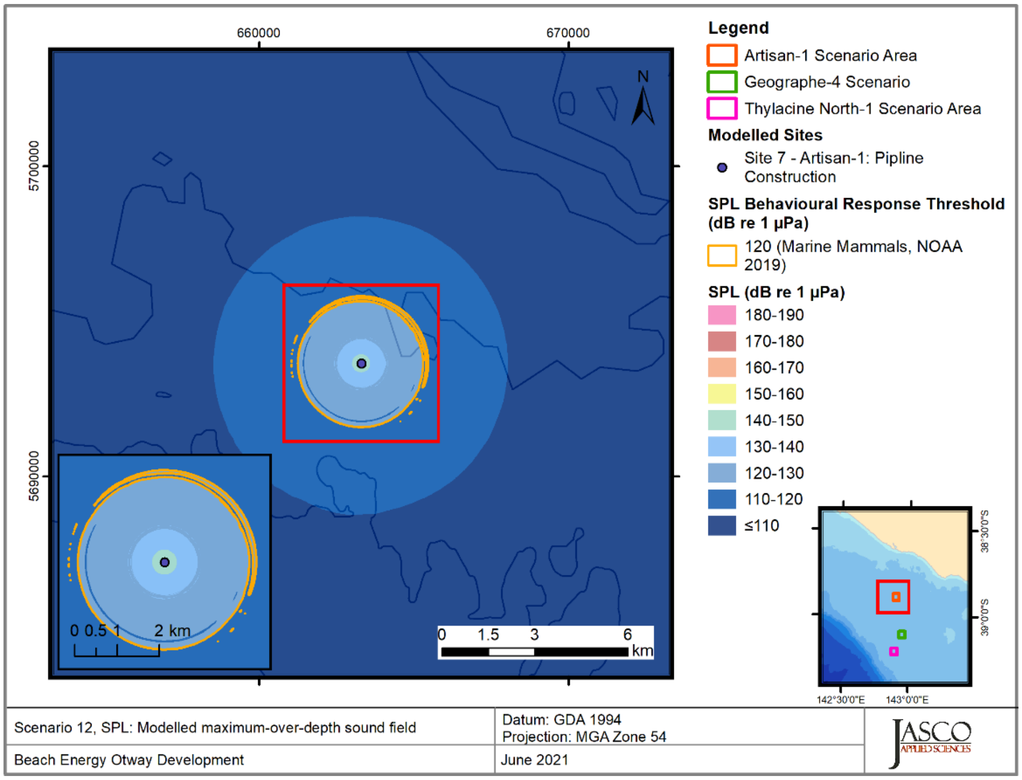

Figure 15. *Artisan-1, PLV stationary -November (Scenario 12) SPL:* S Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

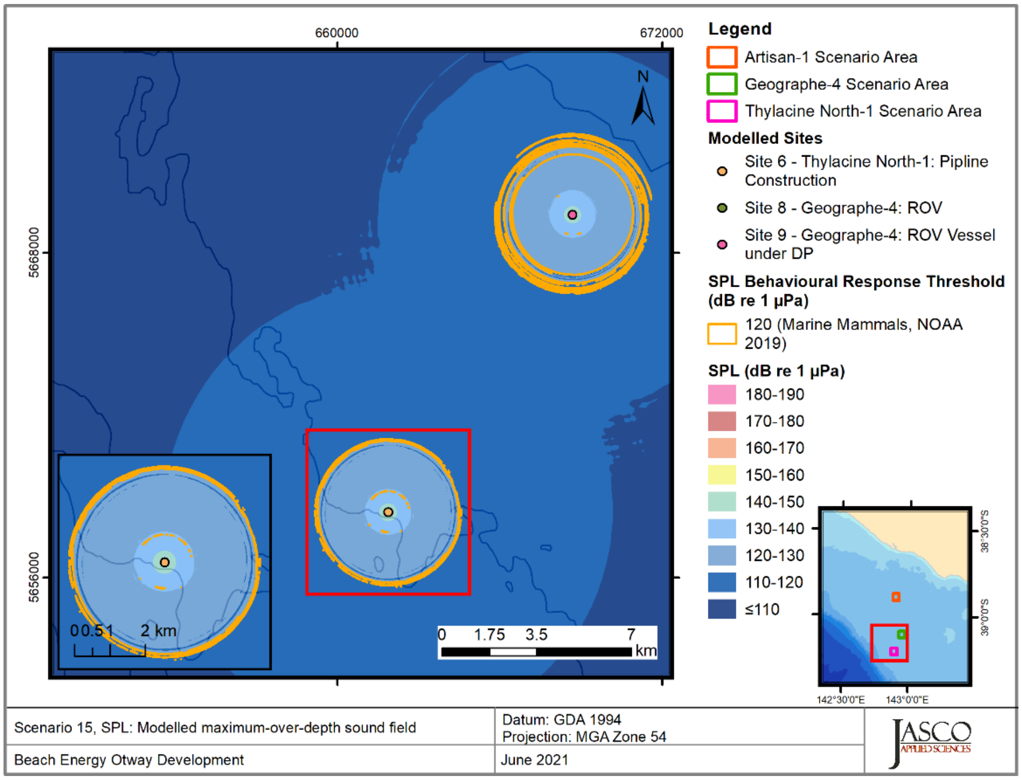

Figure 16. *Thylacine North-1, PLV stationary and ROV operations at Geographe-4 - June (Scenario 15) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

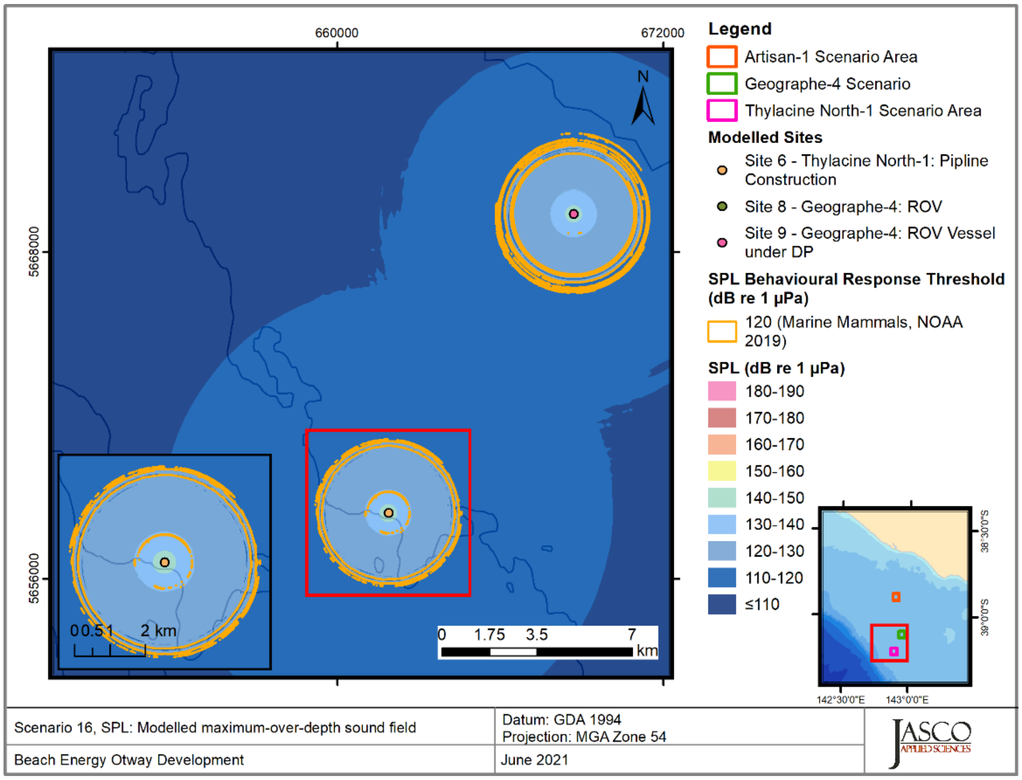

Figure 17. *Thylacine North-1, PLV stationary and ROV operations at Geographe-4 – November (Scenario 16) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

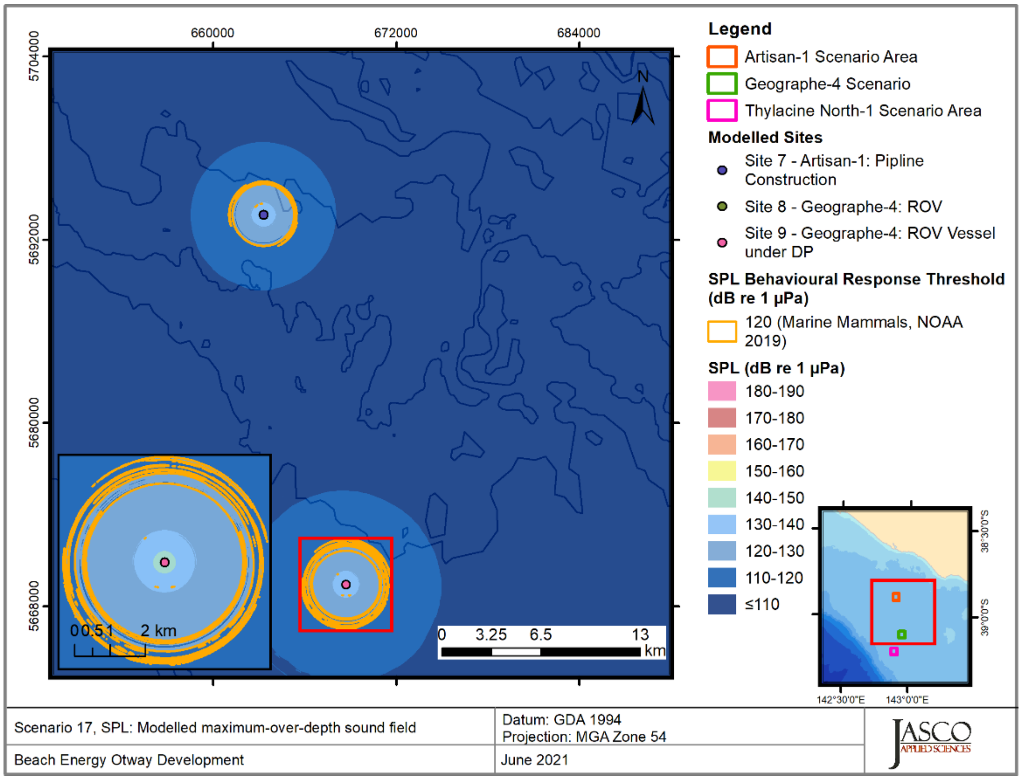

Figure 18. *Artisan-1, PLV stationary and ROV Operations at Geographe-4 – June (Scenario 17) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

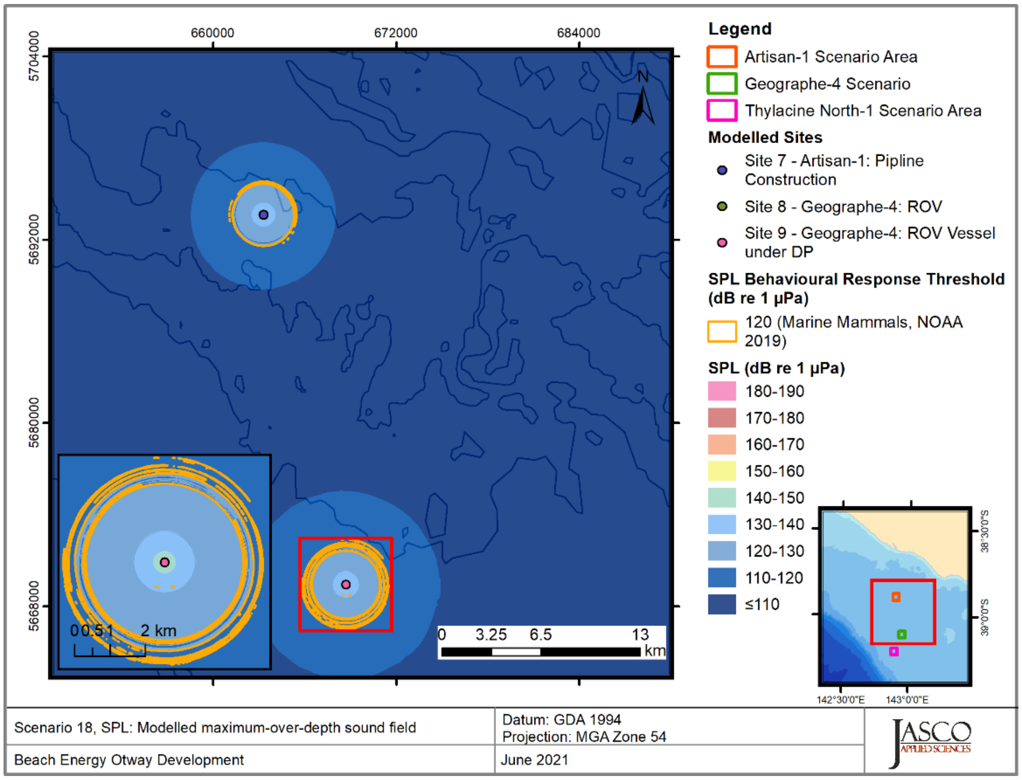

Figure 19. *Artisan-1, PLV stationary and ROV Operations at Geographe-4 – November (Scenario 18) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

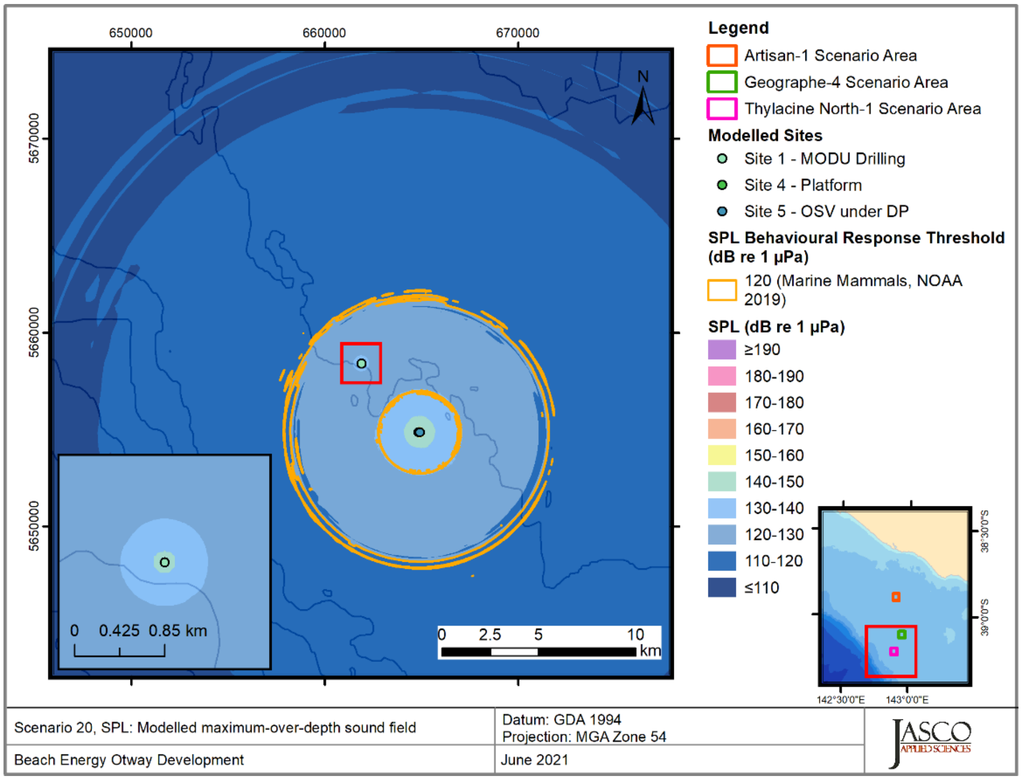

Figure 20. *Thylacine A Platform, Platform Resupply and MODU Drilling (Scenario 20) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

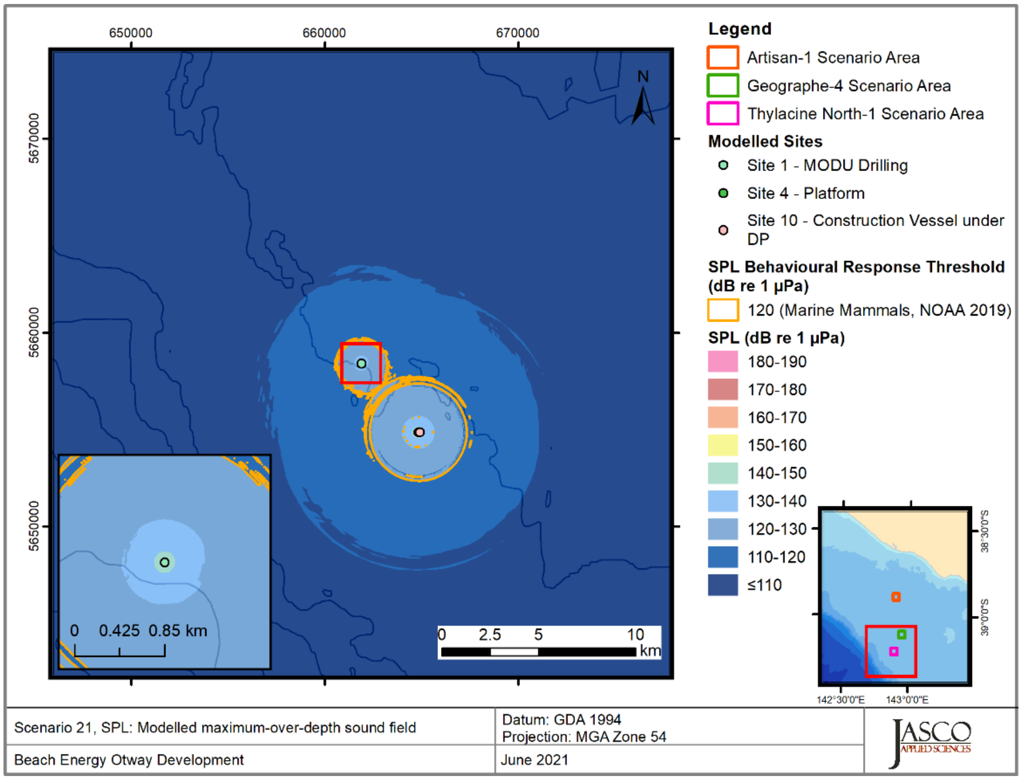

Figure 21. *Thylacine A Platform, Platform Resupply and skid installation (Scenario 20) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

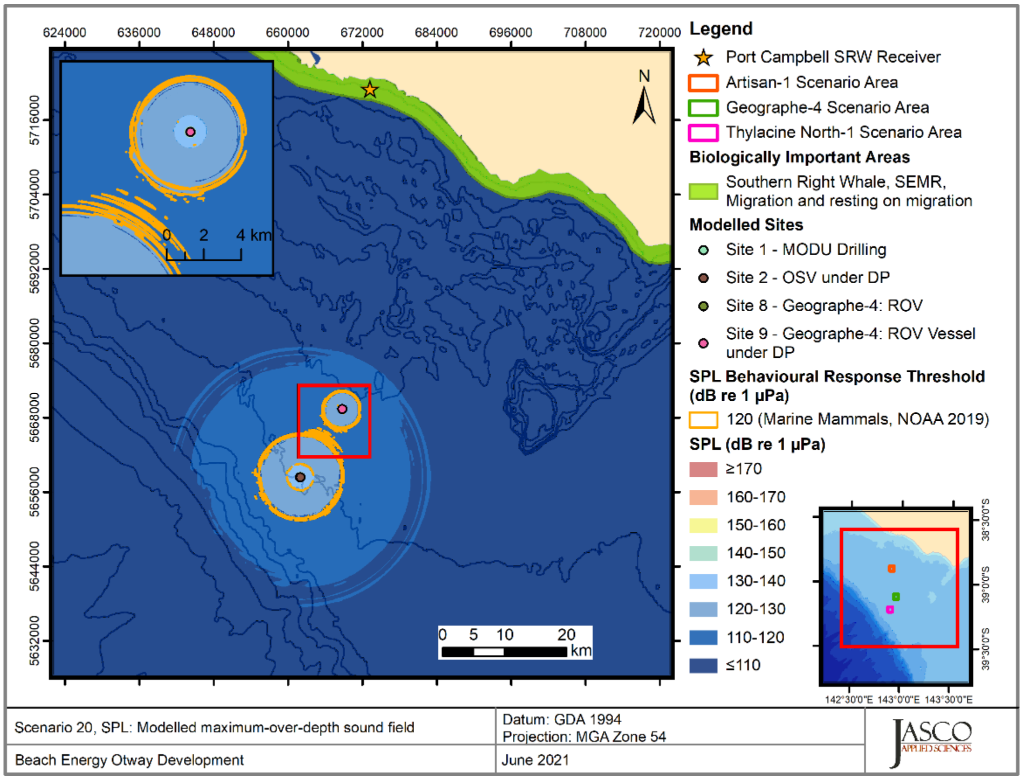

Figure 22. *Concurrent drilling operations at Thylacine North-1 and construction operations at Geographe-4 (Scenario 22) SPL:* Sound level contour map, showing unweighted maximum over-depth SPL results. Isopleth for marine mammal (120 dB re 1 µPa) behavioural criteria is shown as an orange contour line.

4.2.2. Accumulated SEL_{24h} Maps

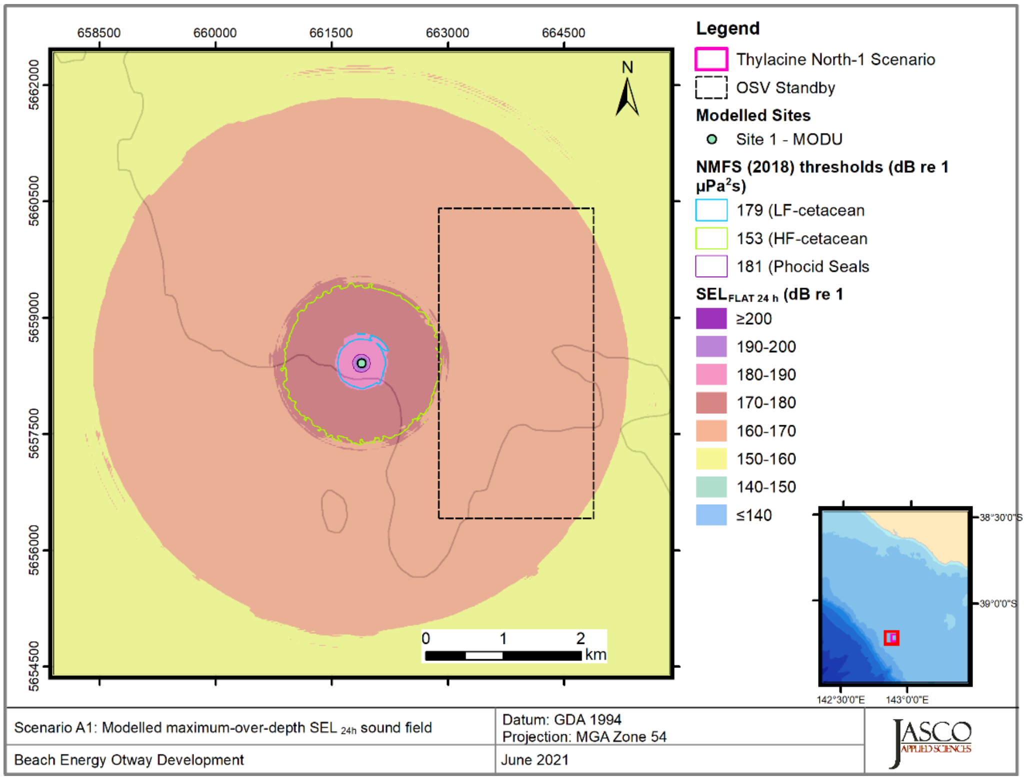

Figure 23. *Thylacine North-1, MODU Drilling (Scenario A1) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

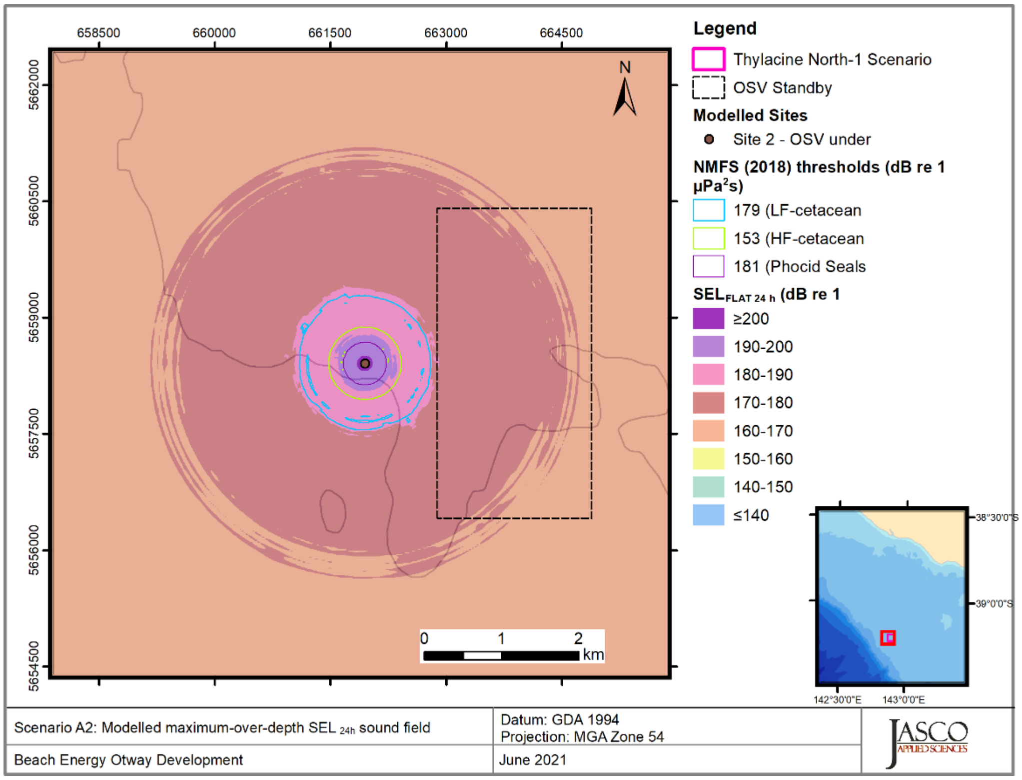

Figure 24. *Thylacine North-1, OSV on DP (4h) (Scenario A2) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

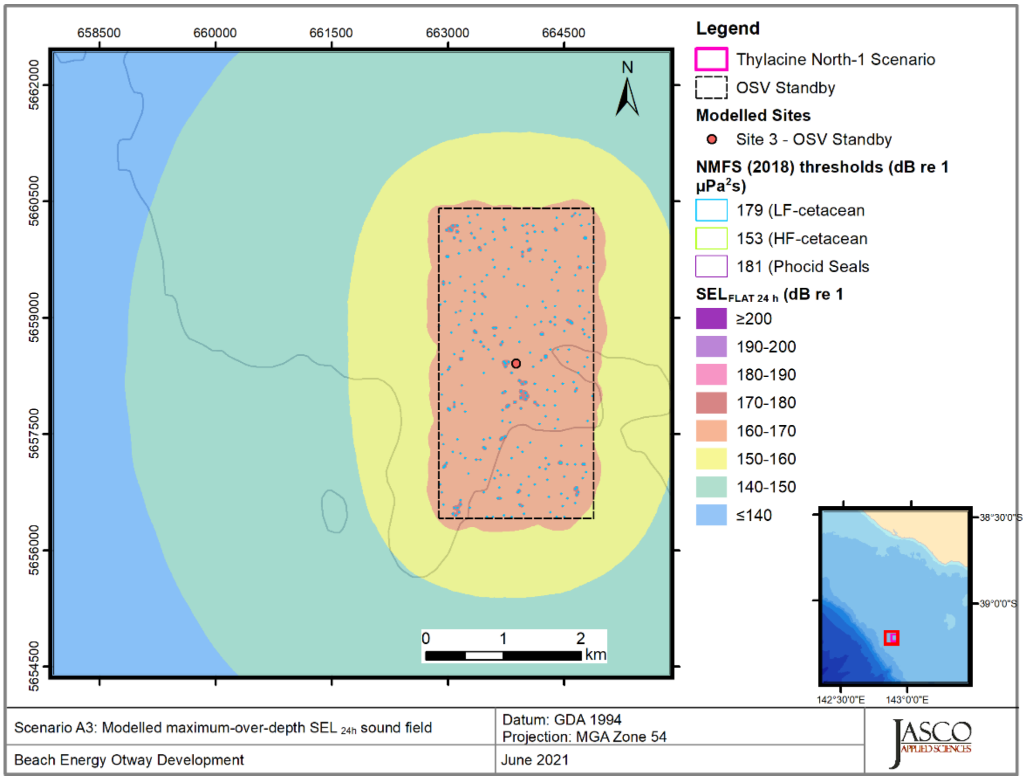

Figure 25. *Thylacine North-1, OSV Standby (Scenario A3) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

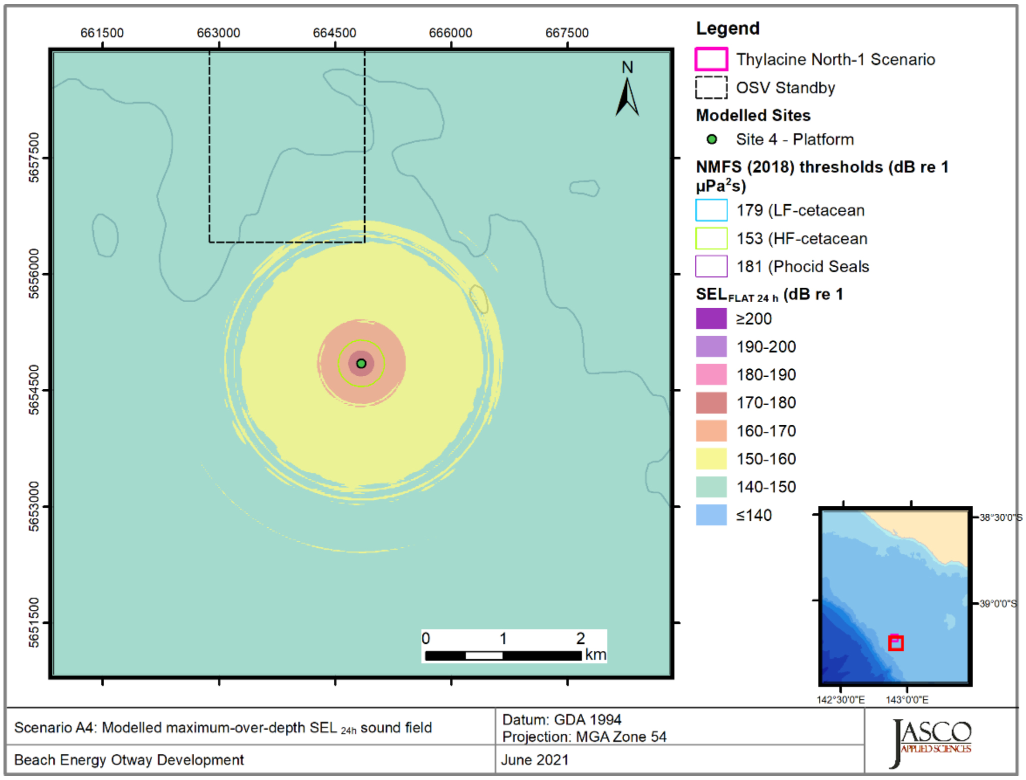

Figure 26. *Thylacine A, Platform Operations (Scenario A4) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

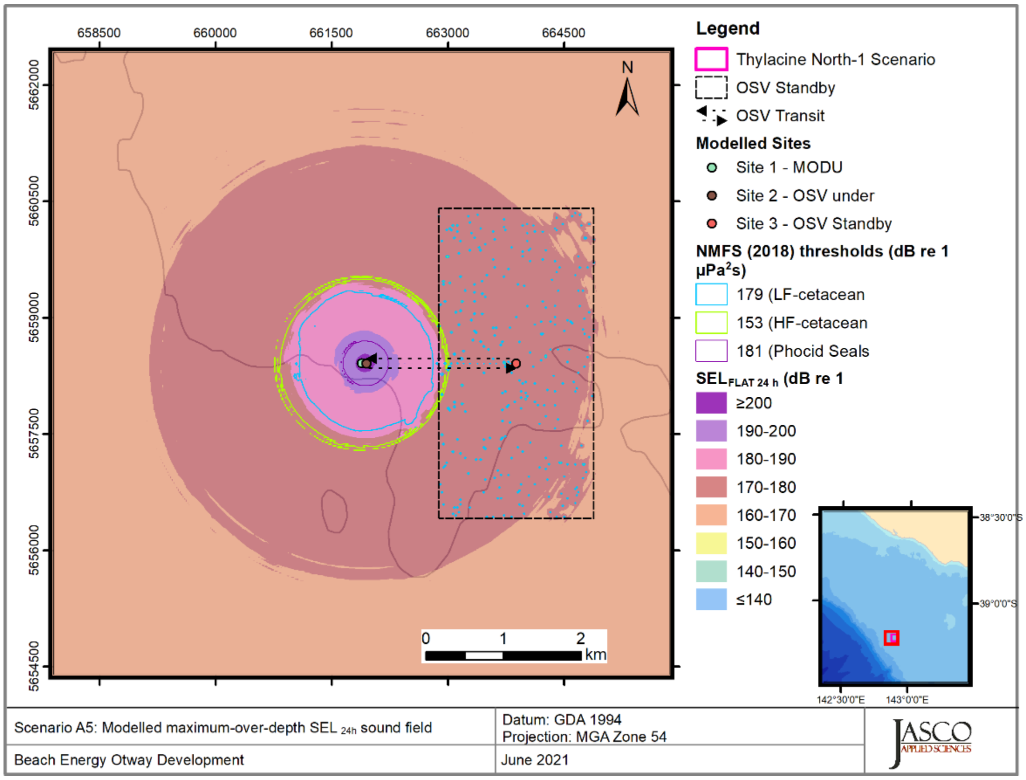

Figure 27. *Thylacine North-1, MODU 4h Resupply Operations (Scenario A5) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

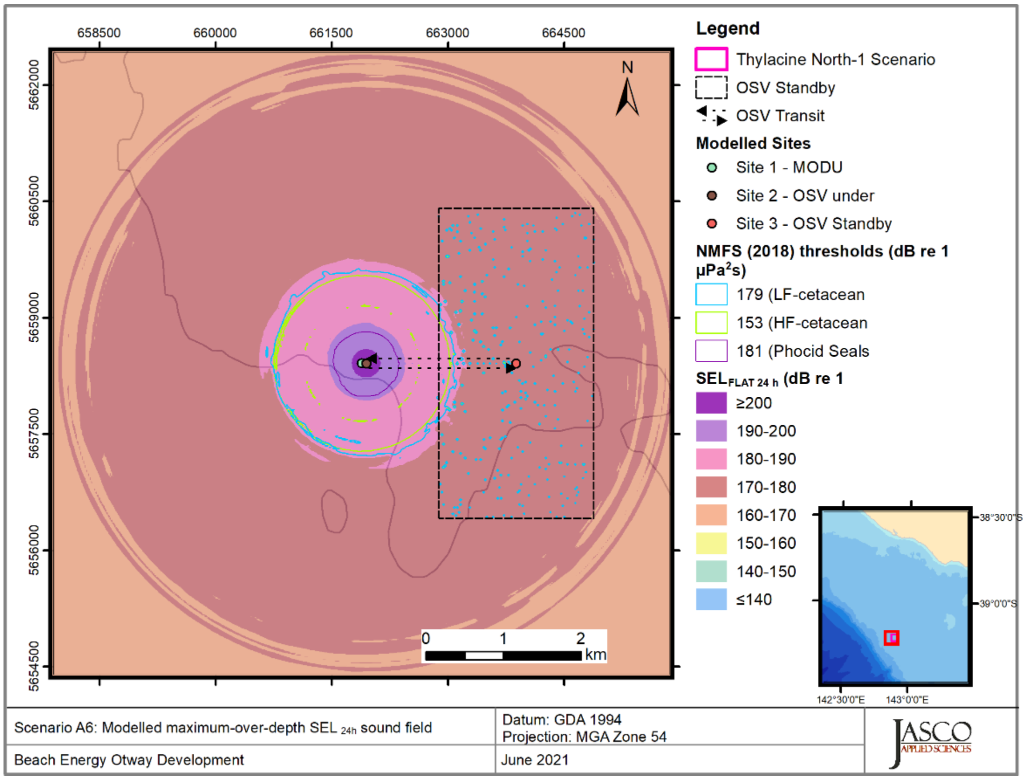

Figure 28. *Thylacine North-1, MODU 8h Resupply Operations (Scenario A6) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.*SEL24h:*

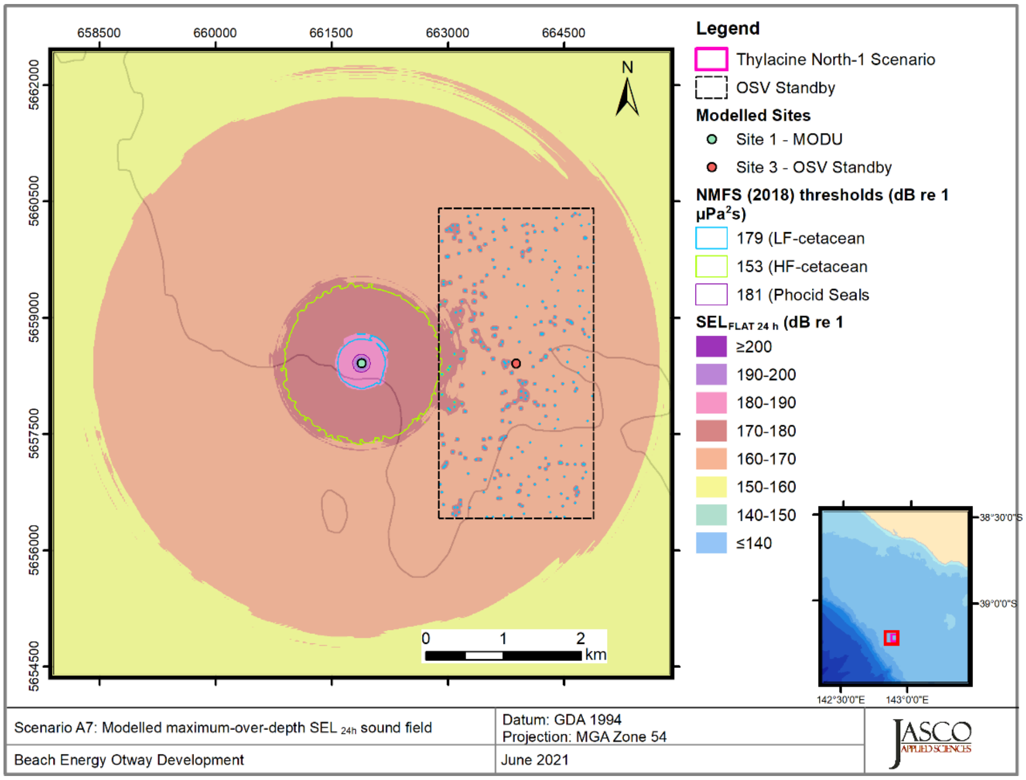

Figure 29. *Thylacine North-1, MODU Drilling and OSV standby (Scenario A7) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

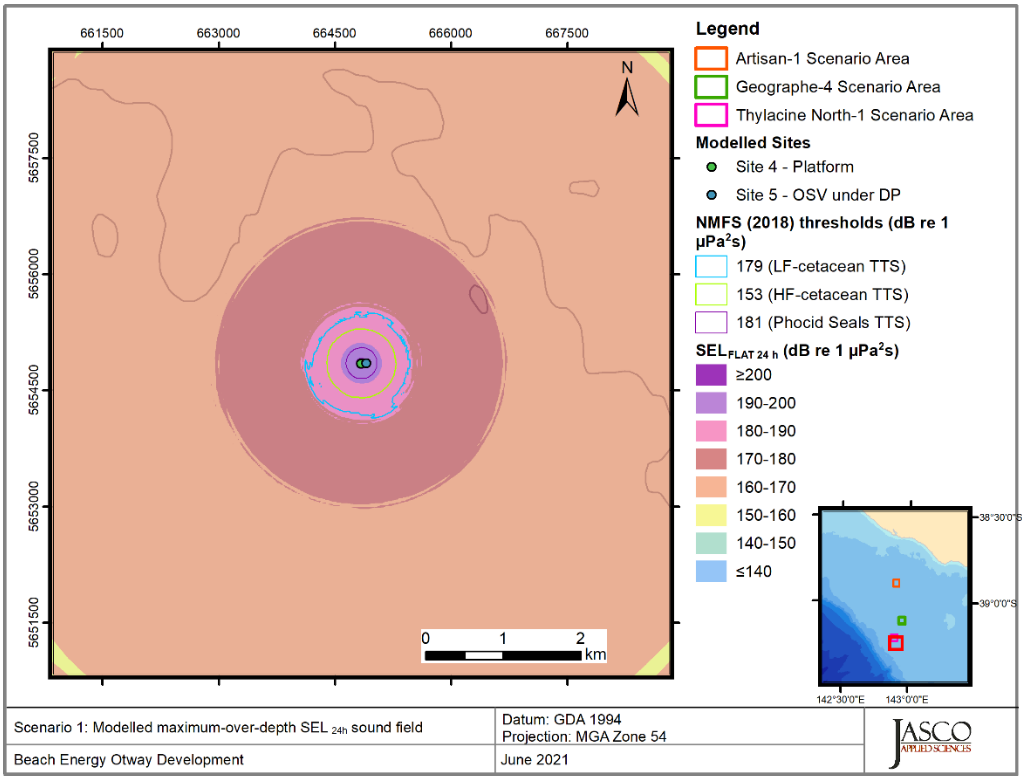

Figure 30. *Thylacine A Platform, 2 h Platform Resupply (Scenario 1) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

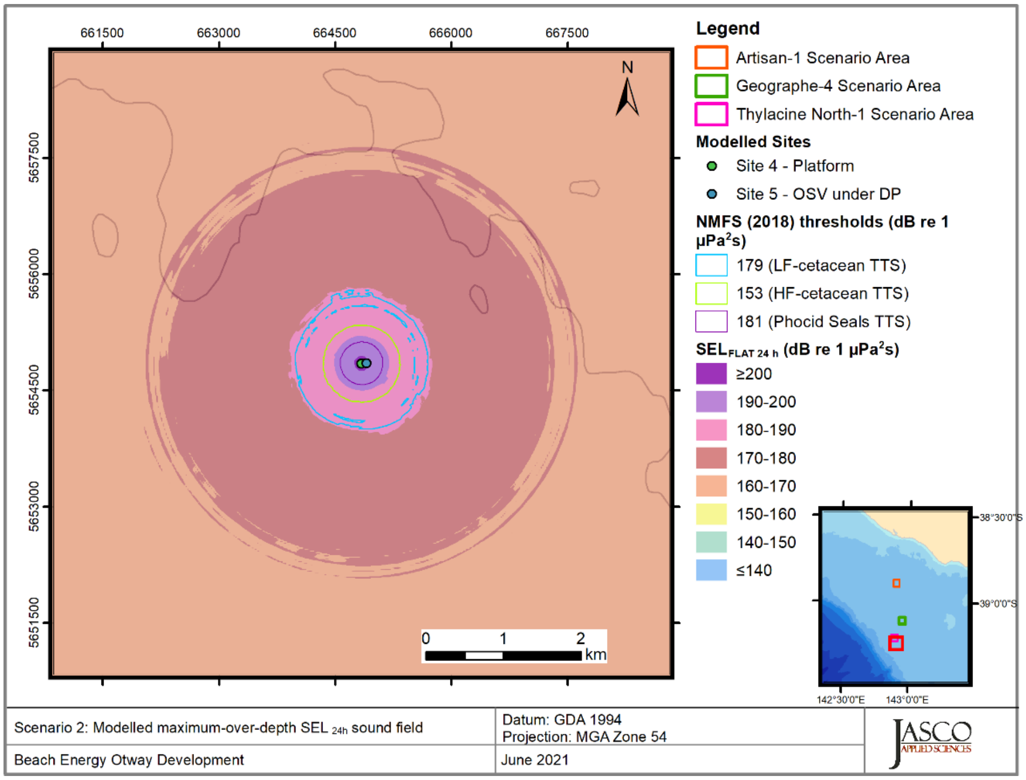

Figure 31. *Thylacine A Platform, 4 h Platform Resupply (Scenario 2) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

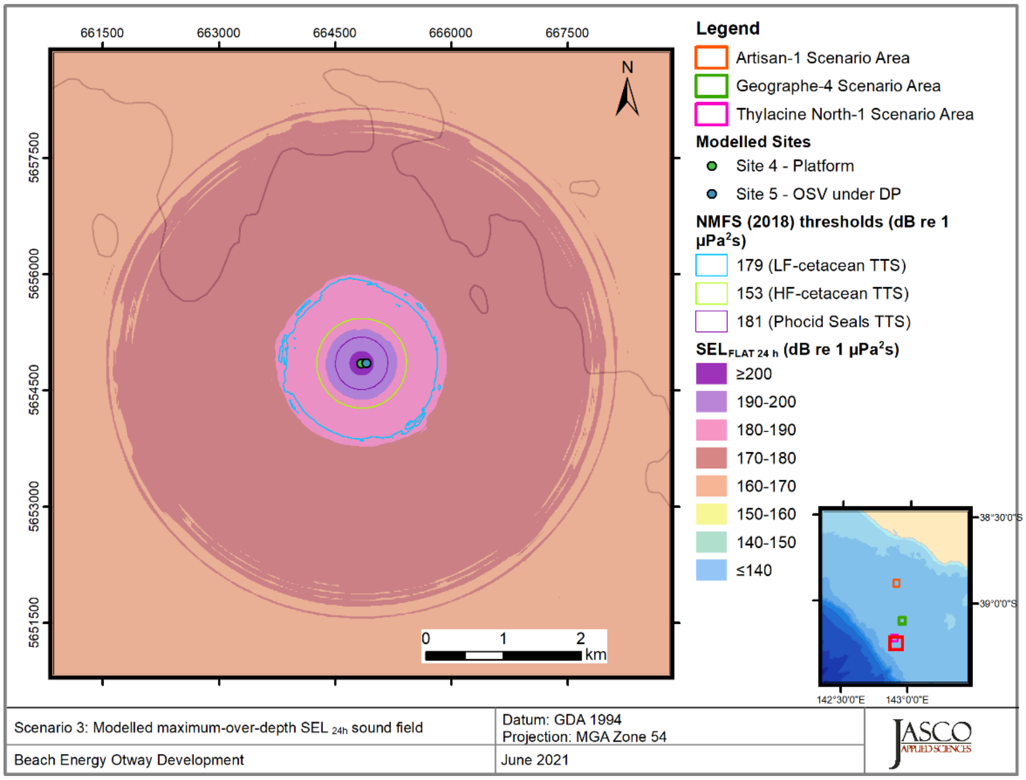

Figure 32. *Thylacine A Platform, 6 h Platform Resupply (Scenario 3) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

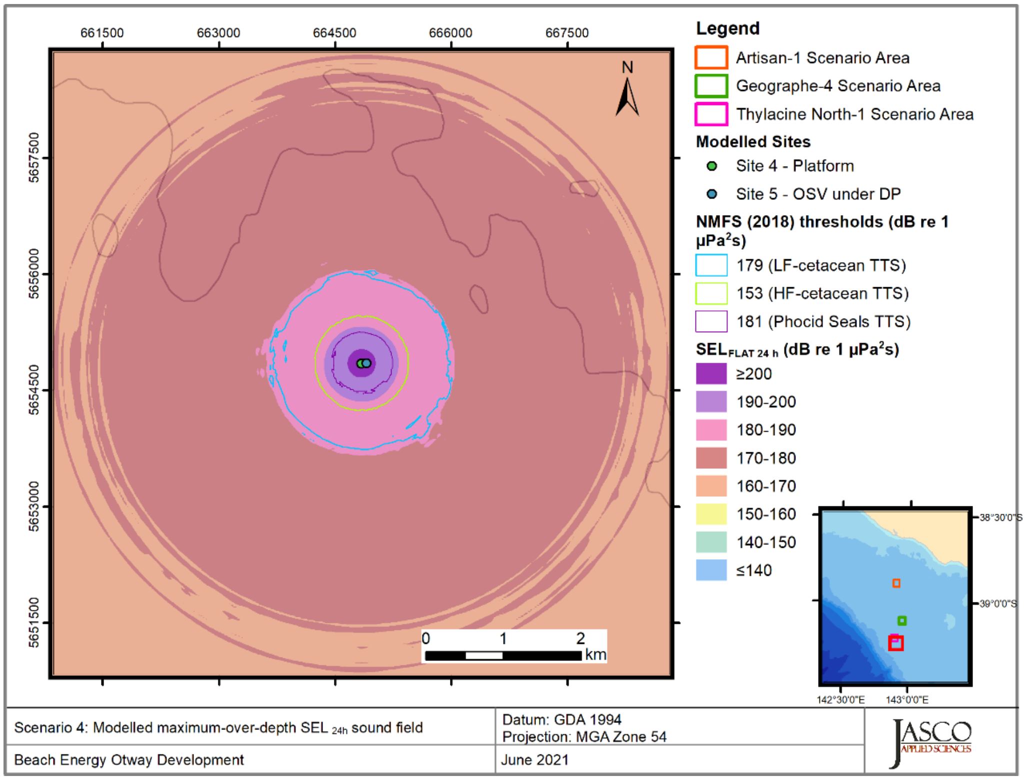

Figure 33. *Thylacine A Platform, 8 h Platform Resupply (Scenario 4) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

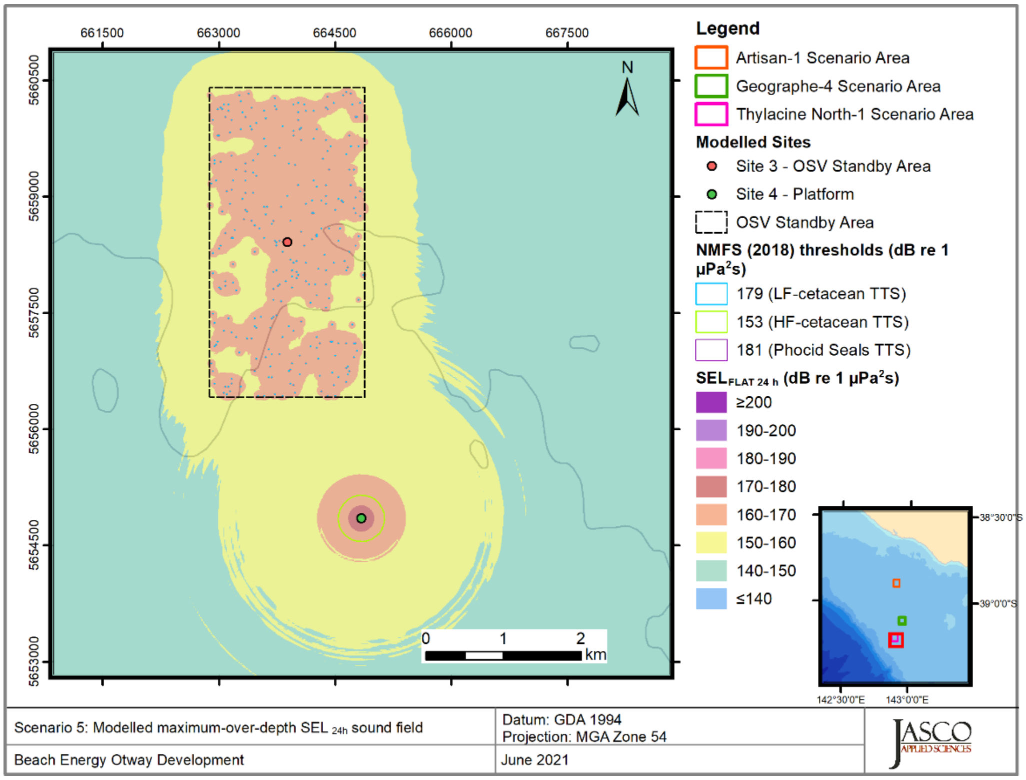

Figure 34. *Thylacine A Platform, 8h OSV standby (Scenario 5) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

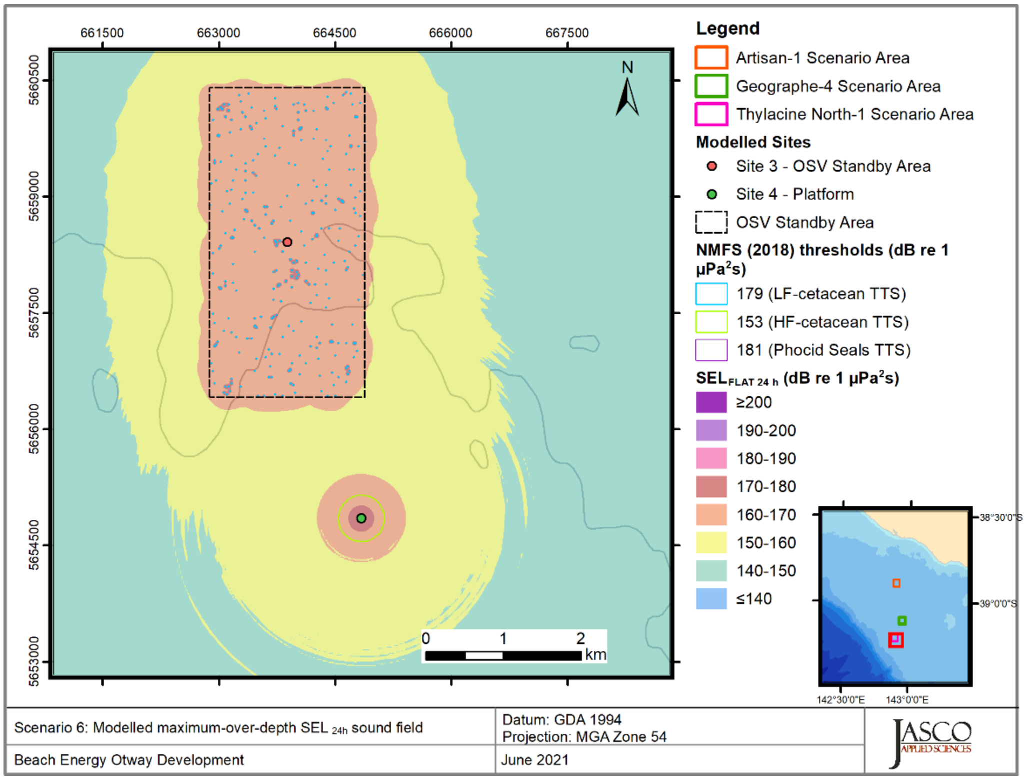

Figure 35. *Thylacine A Platform, 24h OSV standby (Scenario 6) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

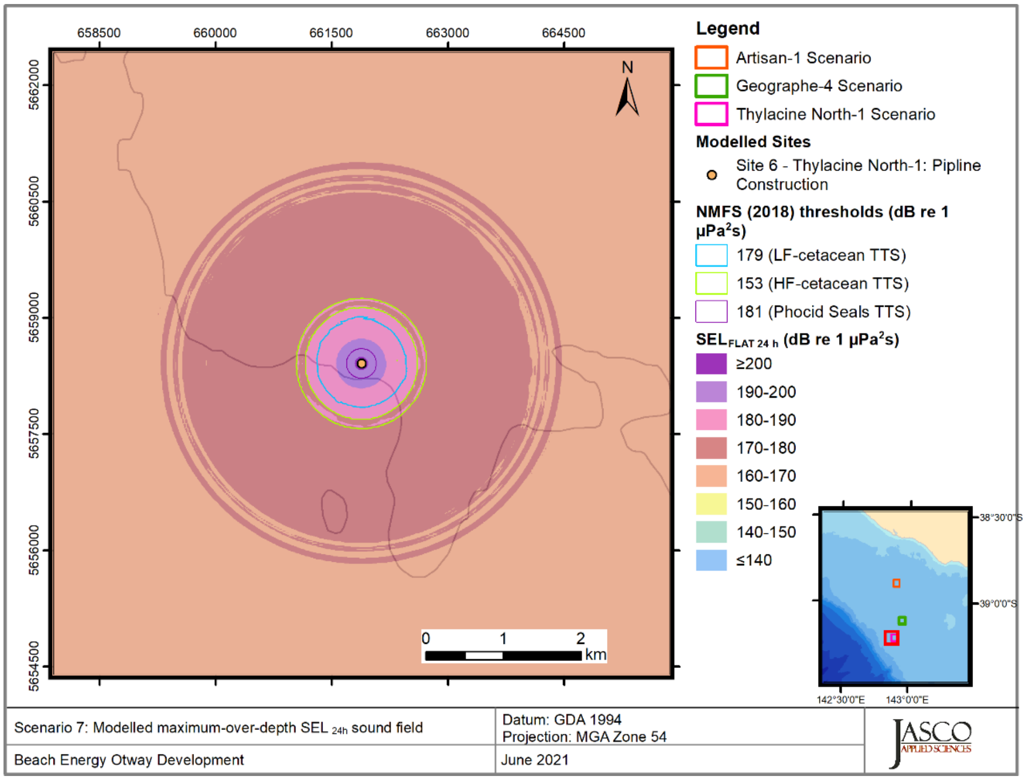

Figure 36. *Thylacine North-1, PLV stationary -June (Scenario 7) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL24h results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

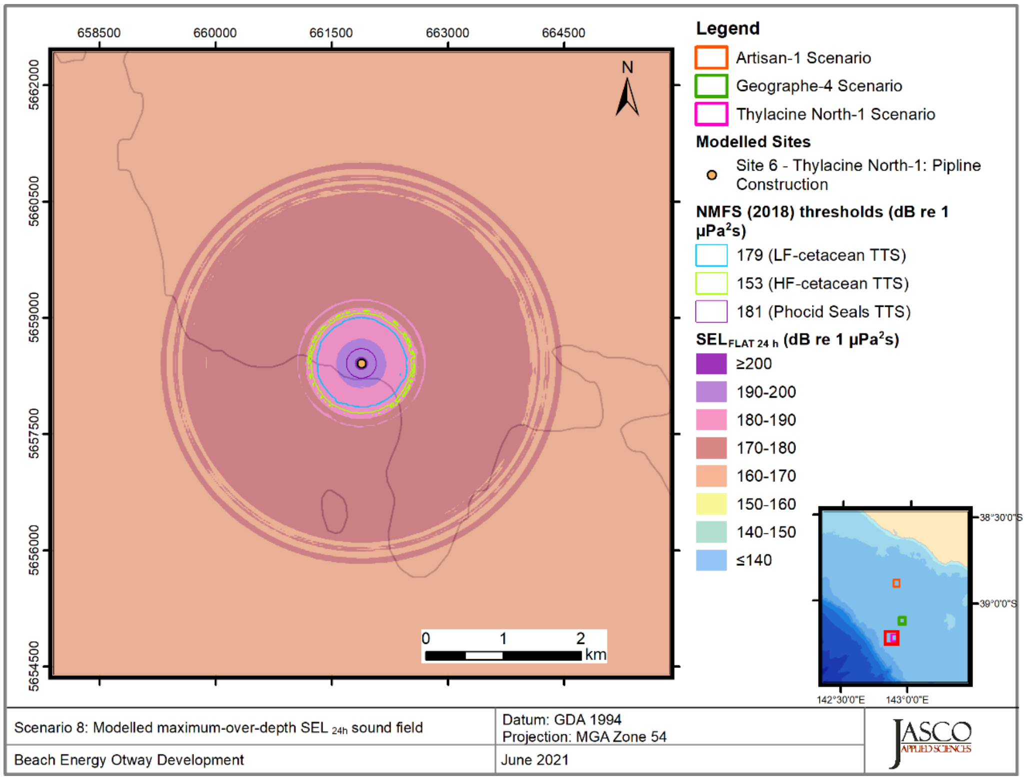

Figure 37. *Thylacine North-1, PLV stationary - November (Scenario 8) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

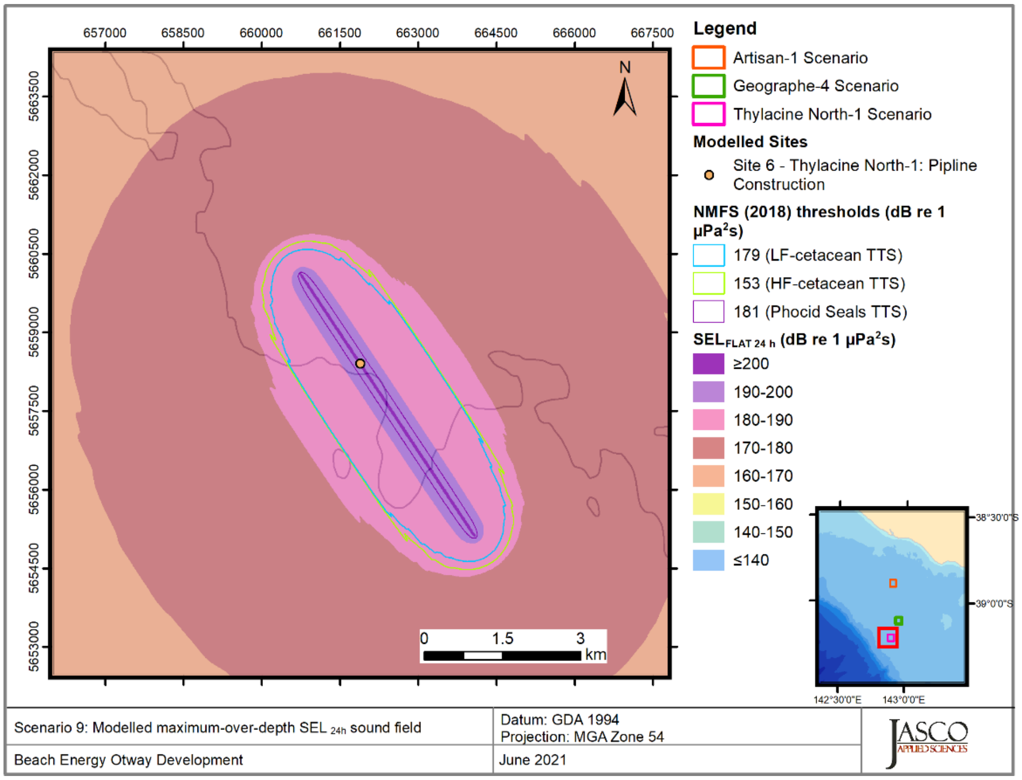

Figure 38. *Thylacine North-1, PLV pipe laying operations - June (Scenario 9) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

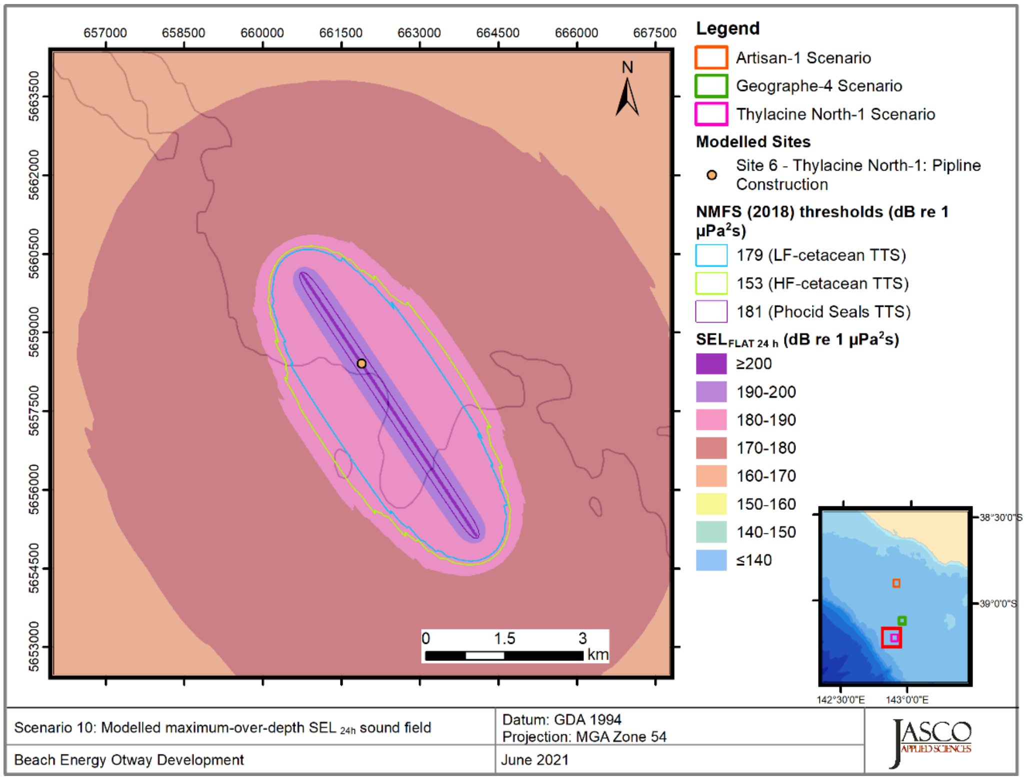

Figure 39. *Thylacine North-1, PLV pipe laying operations - November (Scenario 10) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL24h results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

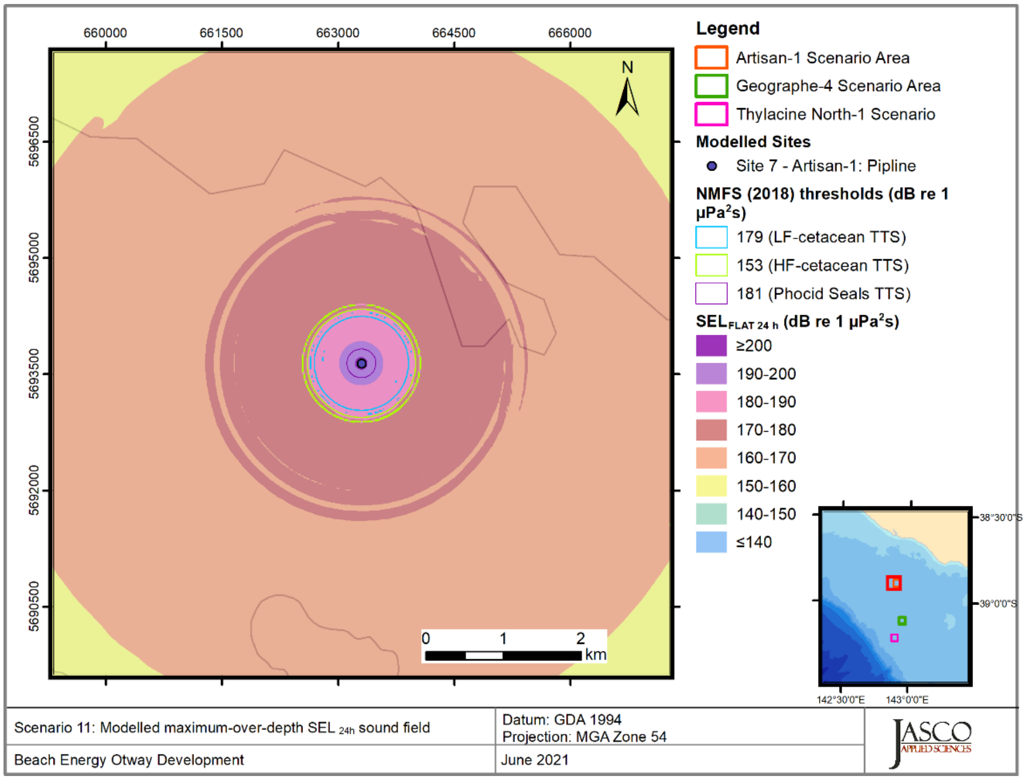

Figure 40. *Artisan-1, PLV stationary - June (Scenario 11) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

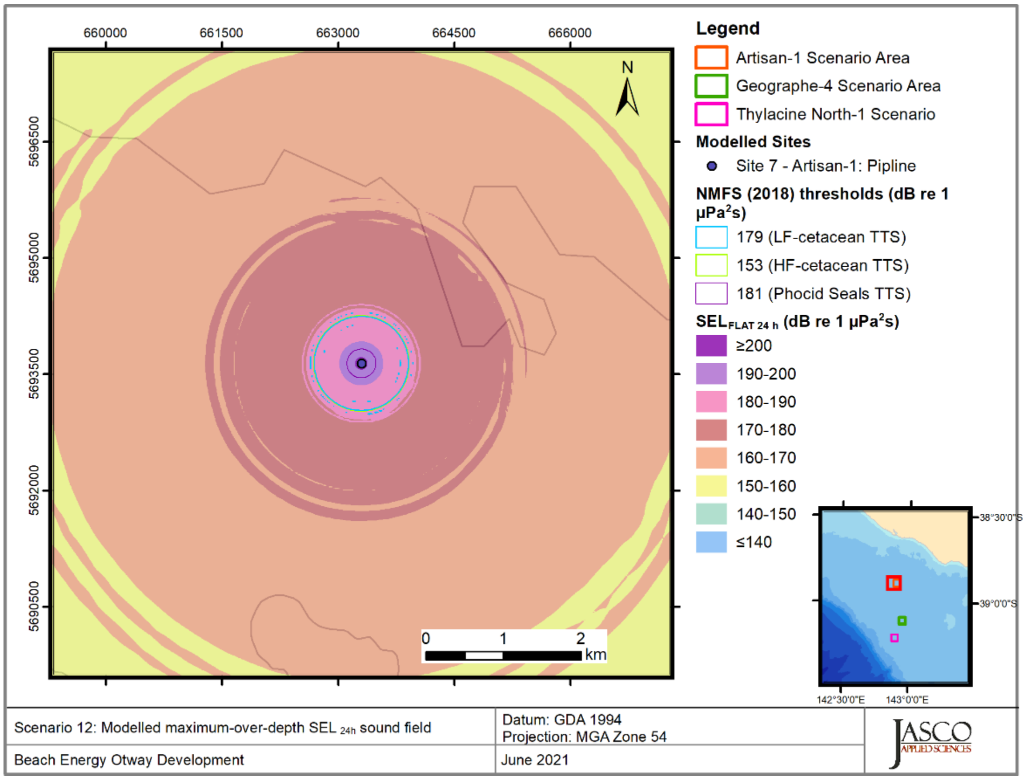

Figure 41. *Artisan-1, PLV stationary - November (Scenario 12) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

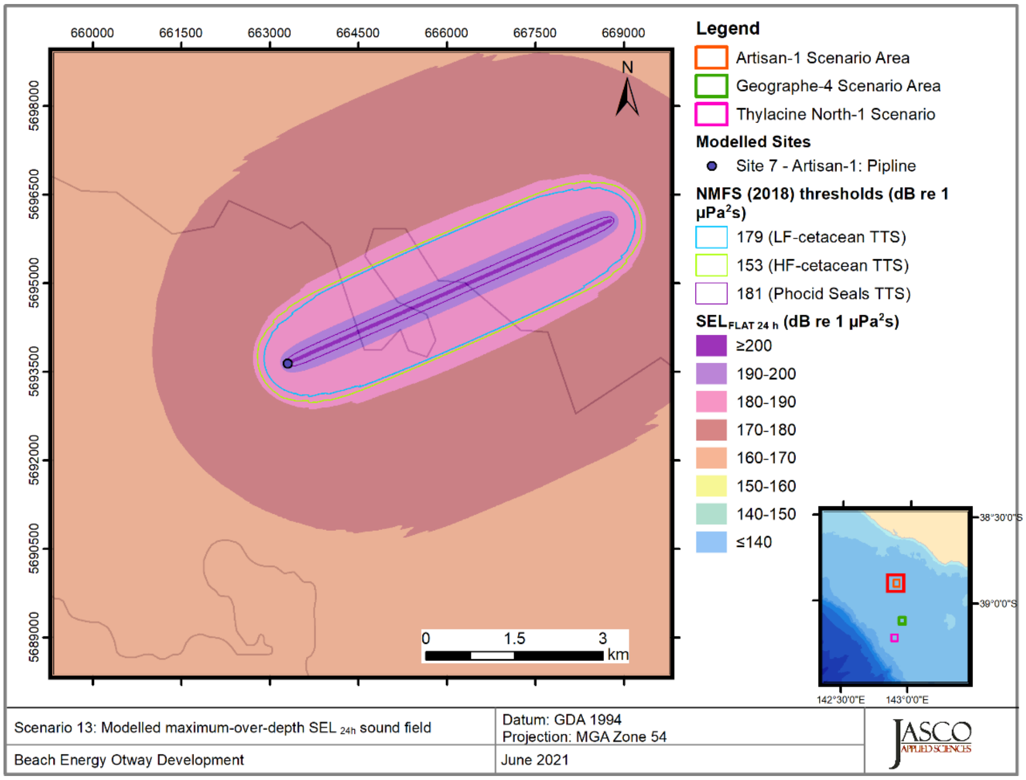

Figure 42. *Artisan-1, PLV pipe laying operations - June (Scenario 13) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

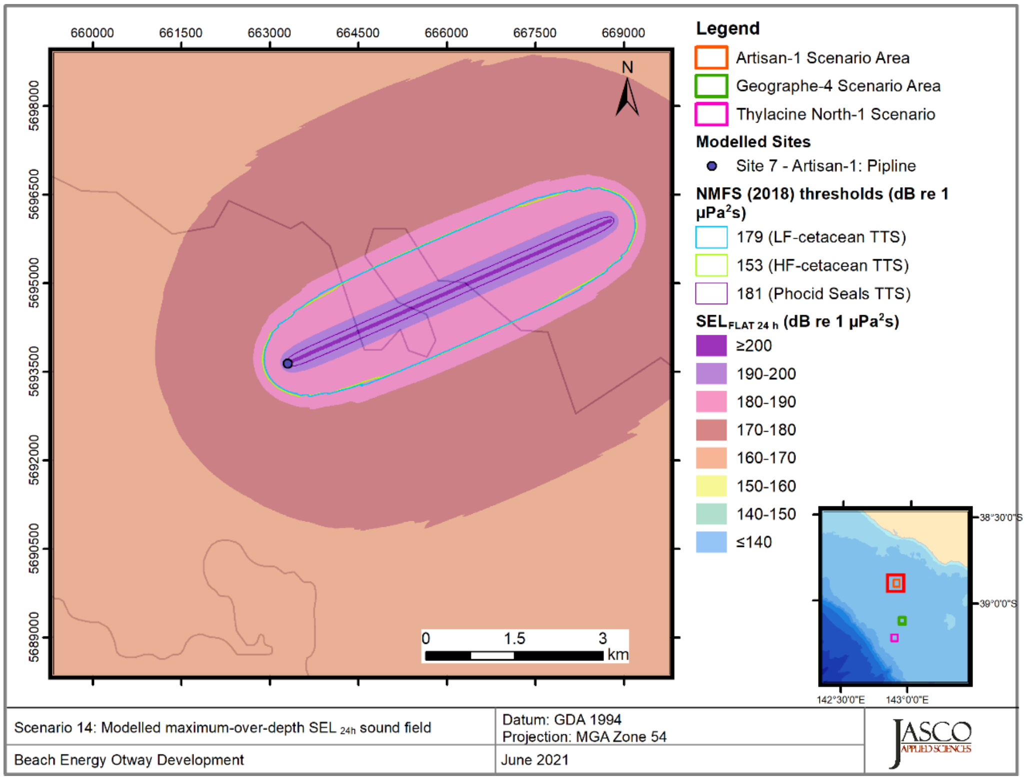

Figure 43. *Artisan-1, PLV pipe laying operations - November (Scenario 14) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

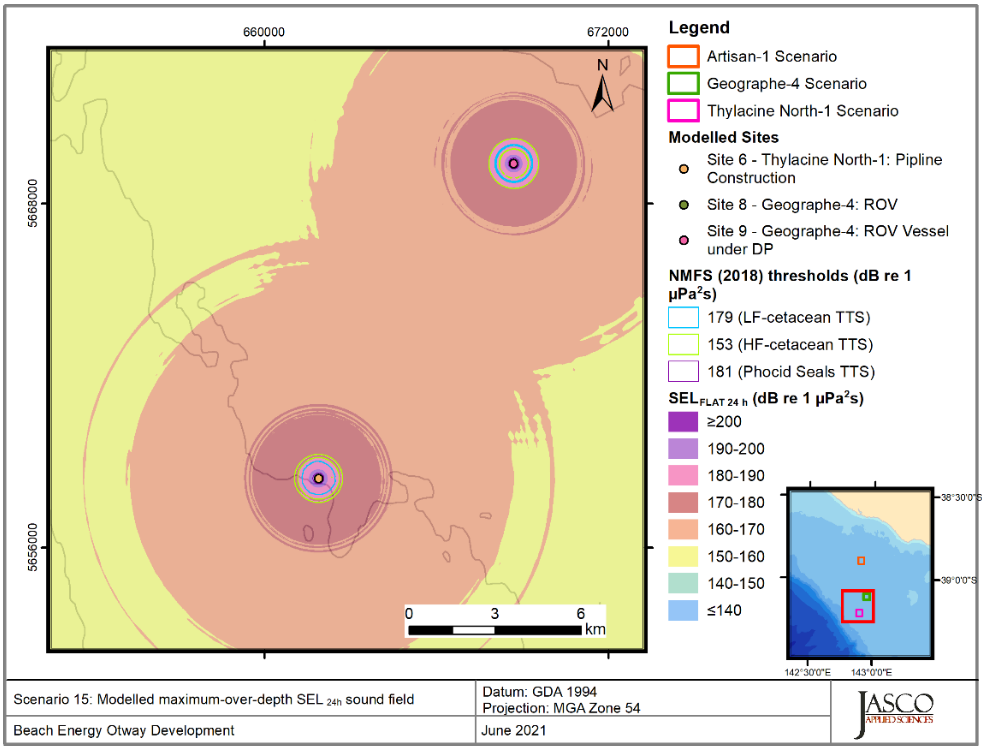

Figure 44. Thylacine North-1, PLV stationary and ROV Operations at Geographe-4 - June (Scenario 15) SEL$_{24h}$: Sound level contour map showing unweighted maximum-over-depth SEL24h results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

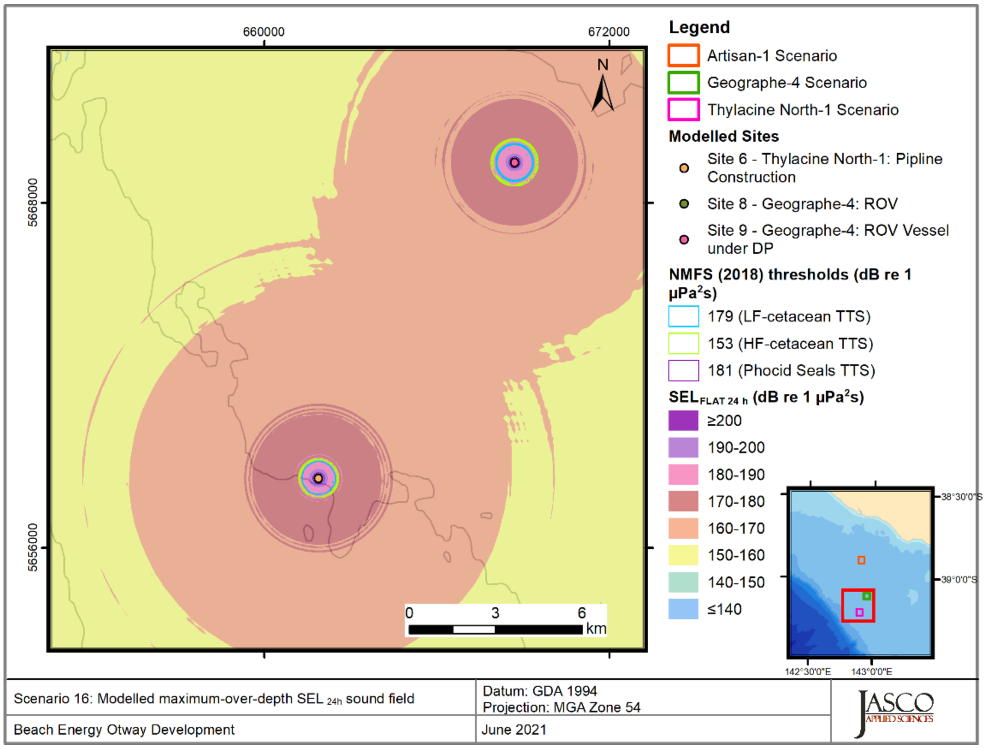

Figure 45. *Thylacine North-1, PLV stationary and ROV Operations at Geographe-4 - November (Scenario 16) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

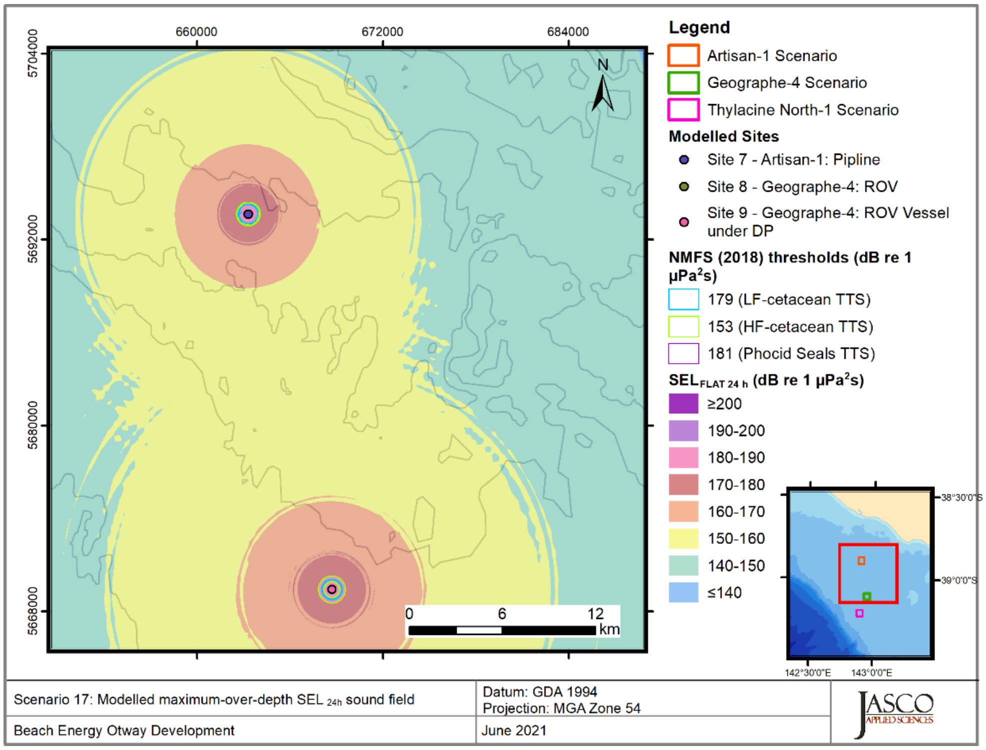

Figure 46. *Thylacine North-1, PLV stationary and ROV Operations at Geographe-4 - June (Scenario 17) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

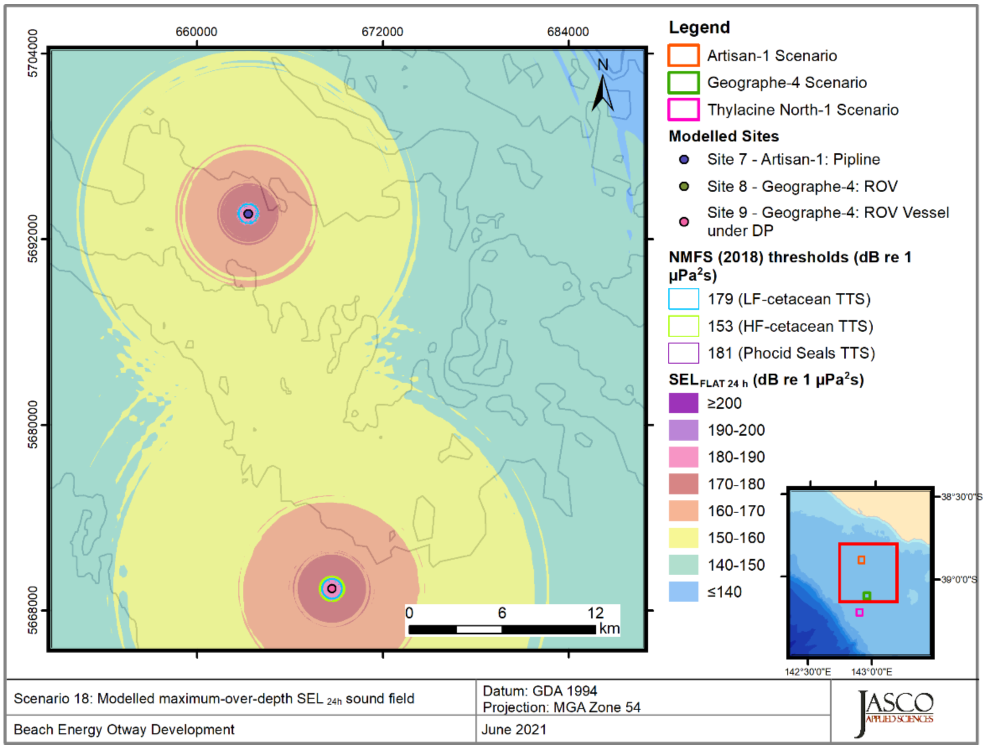

Figure 47. *Artisan-1, PLV stationary and ROV Operations at Geographe-4 - November (Scenario 18) SEL$_{24h}$*: Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

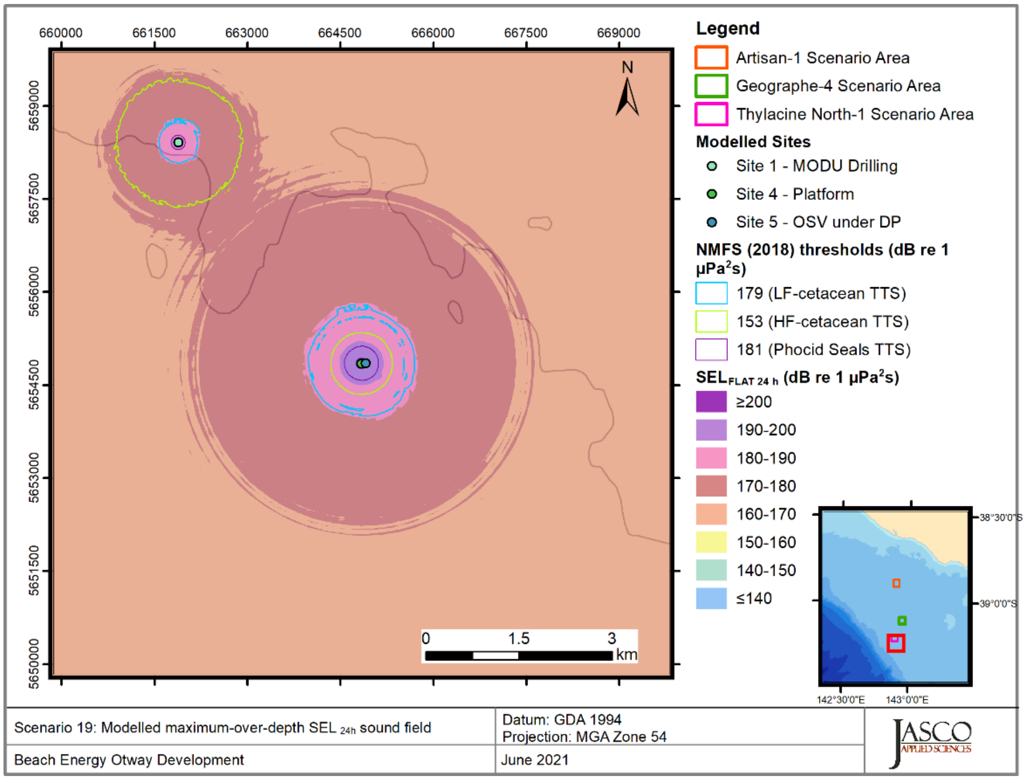

Figure 48. *Thylacine A Platform, 4h Platform Resupply and MODU Drilling (Scenario 19) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

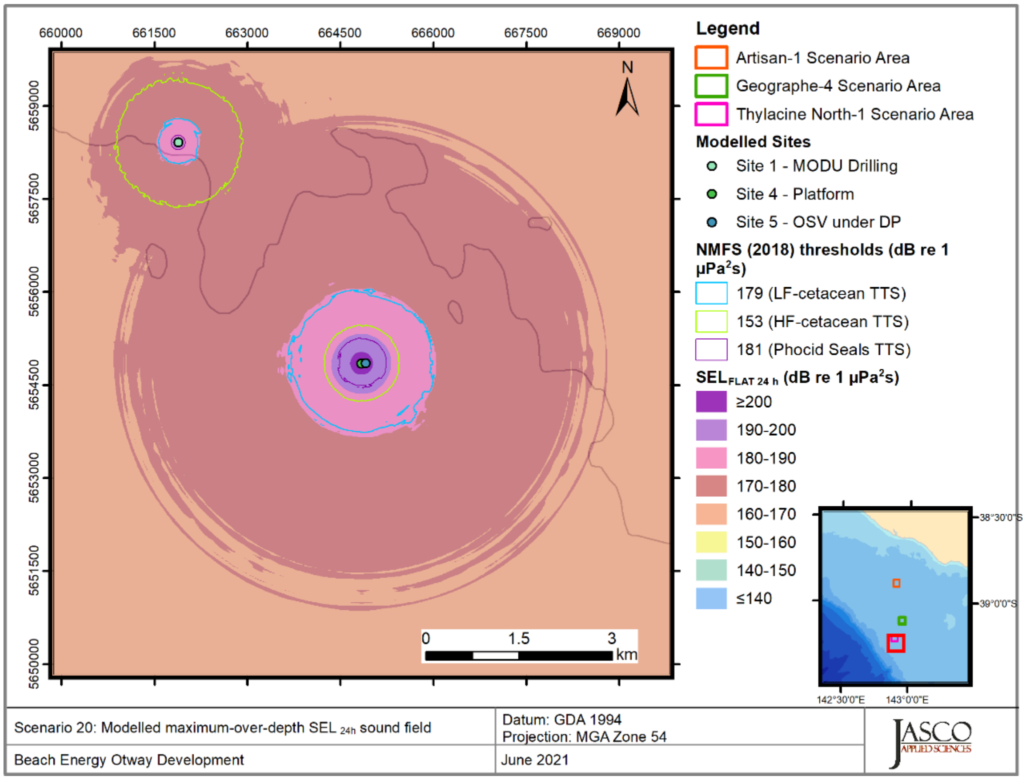

Figure 49. *Thylacine A Platform, 8h Platform Resupply and MODU Drilling (Scenario 20) SEL$_{24h}$:* Sound level contour map showing unweighted maximum-over-depth SEL$_{24h}$ results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

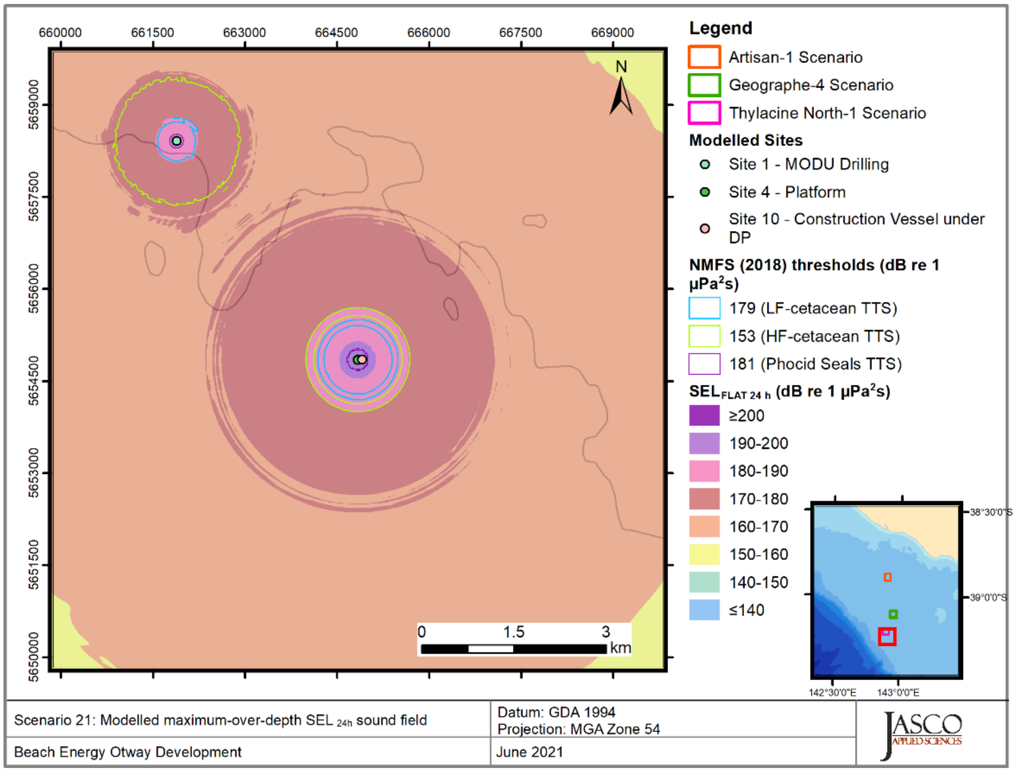

Figure 50. *Thylacine A Platform, Skid installation and MODU Drilling (Scenario 21) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

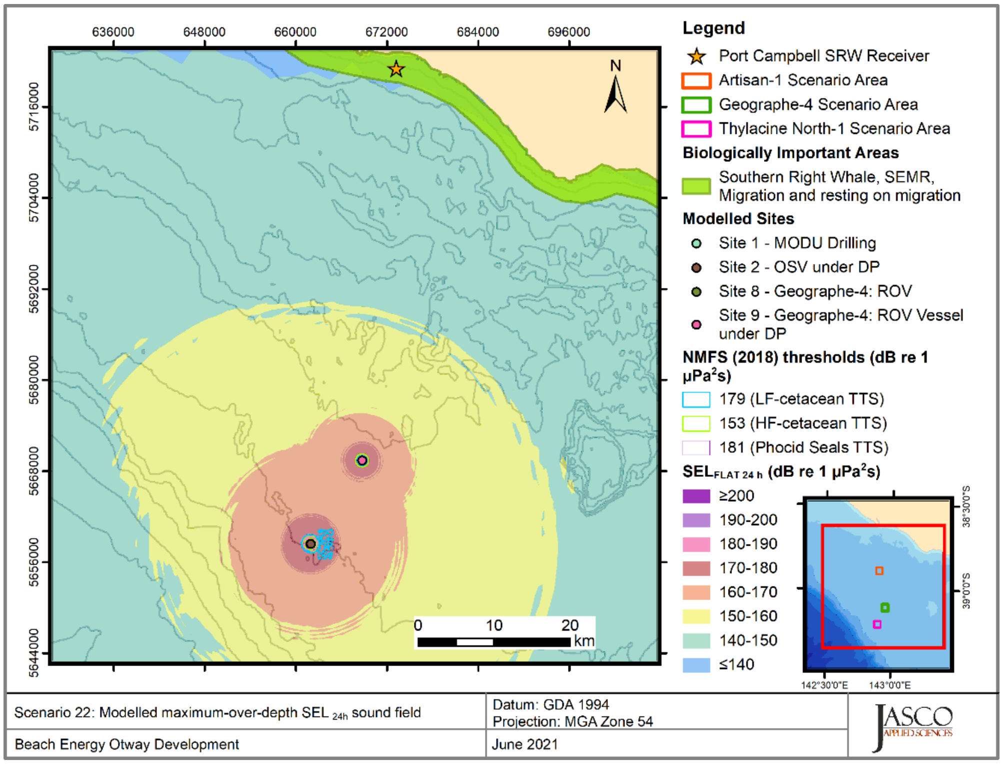

Figure 51 *Concurrent drilling operations at Thylacine North-1 and construction operations at Geographe-4 (Scenario 22) SEL_{24h}:* Sound level contour map showing unweighted maximum-over-depth SEL_{24h} results, along with isopleths for TTS thresholds. Thresholds for PTS and some thresholds for TTS were either not reached or were small enough such that they could not be displayed on a map.

5. Discussion

The approach applied here to model the propagation loss was based is suitable for other locations within the continental shelf portion of the Otway Basin because it is supported by measurements of very similar operational activities (McPherson et al. 2021). However, the accuracy of the modelling propagation loss within this environment depends significantly upon the frequency content of the radiating sound source together with thickness of the sand layer on the calcarenite seabed within Otway region. In general, for these types of sources (i.e., vessels and other sources with a significant amount of energy above a few hundred Hertz) the thinner the sand layer, the greater the propagation loss. Having accurate source and site-specific information reduces the amount of uncertainty results due to model inputs uncertainty particularly when seemingly small changes in parametrisation can have reasonable significant changes in predicted results.

The distances to the effect thresholds based on modelling conducted here and supported by the results of the measurement study McPherson et al. (2021) are generally smaller when compared to those originally presented in Koessler et al. (2020). The understanding of the environment gained through the measurement study allowed for the geological environment to be represented in a site-specific fashion, and a more appropriate configuration of numerical models to represent the environmental propagation loss particularly with the layered calcarenite seabed. The application of the revised modelling approach to represent other Beach Energy activities on the continental shelf of the Otway Basin would be appropriate.

The effect of different seasonality on predicted distances to the effect thresholds was minor but present. Considering the modelled Otway Offshore Project Construction scenarios, each scenario was modelled with a sound speed profiles for the ‘worst case over the year’ and for a period pygmy blue whales are present in the region, between November and January. These sound speed profiles were respectively selected as June and November. The effect thresholds applied to pygmy blue was the low-frequency cetacean SEL_{24h} thresholds based on NMFS (2018). The sound speed profile of November generally produced small distances to the low-frequency cetacean PTS and TTS threshold for the same operational activities modelled with a June SSP, see Tables 11–13. The seasonal differences were at most a few hundred metres. The receiver SPL level at the Port Campbell receiver locations presented in Table 8 are therefore expected to be lower in in November.

The SEL_{24h} is a cumulative metric that reflects the dosimetric impact of noise levels within 24 hours based on the assumption that an animal is consistently exposed to such noise levels at a fixed position. The corresponding SEL_{24h} radii represent an unlikely worst-case scenario. More realistically, marine mammals (as well as fish and turtles) are unlikely to stay in the same location for 24 hours. Therefore, a reported radius for SEL_{24h} criteria does not mean that marine fauna travelling within this radius of the source will be injured, but rather that an animal could be exposed to the sound level associated with impairment (either PTS or TTS) if it remained in that location for 24 hours.

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Appendix A. Acoustic Metrics

A.1. Pressure Related Acoustic Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 µPa. Because the perceived loudness of sound, especially impulsive noise such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate noise and its effects on marine life. We provide specific definitions of relevant metrics used in the accompanying report. Where possible we follow the ANSI and ISO standard definitions and symbols for sound metrics, but these standards are not always consistent.

The sound pressure level (SPL; L_p; dB re 1 µPa) is the rms pressure level in a stated frequency band over a specified time window (*T*, s) containing the acoustic event of interest. It is important to note that SPL always refers to a rms pressure level and therefore not instantaneous pressure:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T p^2(t)dt \Big/ p_0^2\right) \tag{A-1}$$

The SPL represents a nominal effective continuous sound over the duration of an acoustic event, such as the emission of one acoustic pulse, a marine mammal vocalization, the passage of a vessel, or over a fixed duration. Because the window length, *T*, is the divisor, events with similar sound exposure level (SEL) but more spread out in time have a lower SPL.

The sound exposure level (SEL; L_E; $L_{E,p}$; dB re 1 µPa^2·s) is a measure related to the acoustic energy contained in one or more acoustic events (*N*). The SEL for a single event is computed from the time-integral of the squared pressure over the full event duration (*T*):

$$L_E = 10\log_{10}\left(\int_T p^2(t)dt \Big/ T_0 p_0^2\right) \tag{A-2}$$

where T_0 is a reference time interval of 1 s. The SEL continues to increase with time when non-zero pressure signals are present. It therefore can be construed as a dose-type measurement, so the integration time used must be carefully considered in terms of relevance for impact to the exposed recipients.

SEL can be calculated over periods with multiple acoustic events or over a fixed duration. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, SEL can be computed by summing (in linear units) SEL of the *N* individual events:

$$L_{E,N} = 10\log_{10}\left(\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}}\right). \tag{A-3}$$

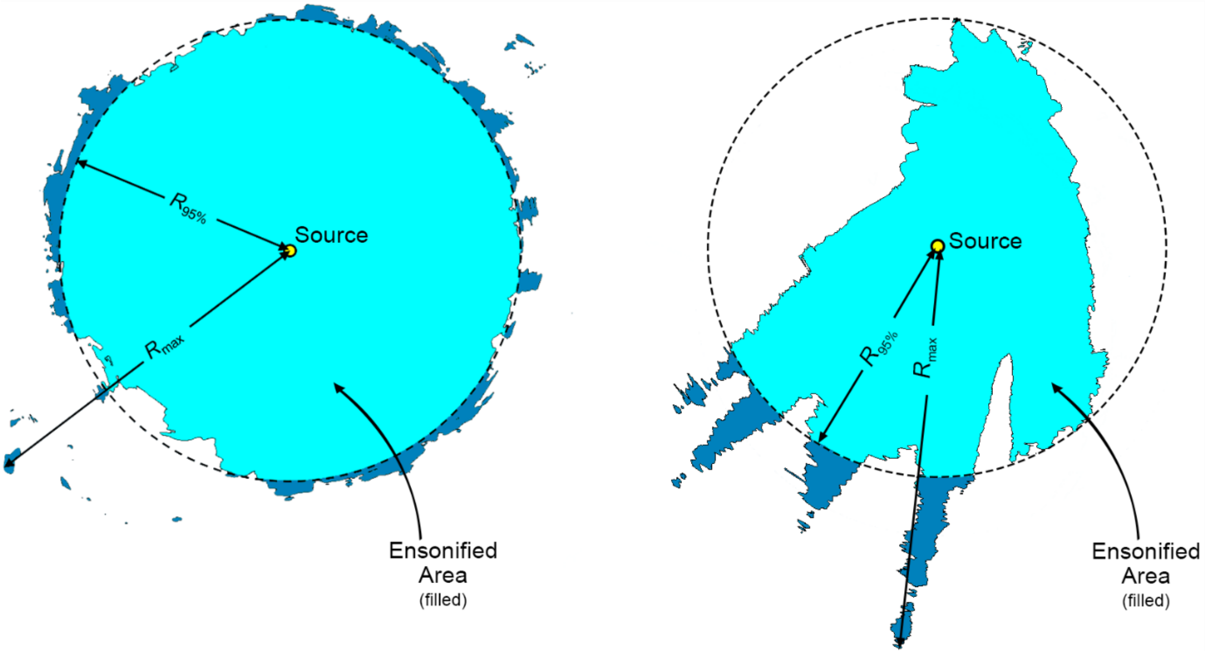
Appendix B. Methods and Parameters

This section describes the specifications of the seismic source that was used at all sites and the environmental parameters used in the propagation models.

B.1. Estimating Range to Thresholds Levels

Sound level contours were calculated based on the underwater sound fields predicted by the propagation models, sampled by taking the maximum value over all modelled depths above the sea floor for each location in the modelled region. The predicted distances to specific levels were computed from these contours. Two distances relative to the source are reported for each sound level: 1) $R_{\max}$, the maximum range to the given sound level over all azimuths, and 2) $R_{95\%}$, the range to the given sound level after the 5% farthest points were excluded (see examples in Figure B-1).

The $R_{95\%}$ is used because sound field footprints are often irregular in shape. In some cases, a sound level contour might have small protrusions or anomalous isolated fringes. This is demonstrated in the image in Figure B-1(a). In cases such as this, where relatively few points are excluded in any given direction, $R_{\max}$ can misrepresent the area of the region exposed to such effects, and $R_{95\%}$ is considered more representative. In strongly asymmetric cases such as shown in Figure B-1(b), on the other hand, $R_{95\%}$ neglects to account for significant protrusions in the footprint. In such cases $R_{\max}$ might better represent the region of effect in specific directions. Cases such as this are usually associated with bathymetric features affecting propagation. The difference between $R_{\max}$ and $R_{95\%}$ depends on the source directivity and the non-uniformity of the acoustic environment.



(a) (b)

Figure B-1. Sample areas ensonified to an arbitrary sound level with $R_{\max}$ and $R_{95\%}$ ranges shown for two different scenarios. (a) Largely symmetric sound level contour with small protrusions. (b) Strongly asymmetric sound level contour with long protrusions. Light blue indicates the ensonified areas bounded by $R_{95\%}$; darker blue indicates the areas outside this boundary which determine $R_{\max}$.

B.2. Environmental Parameters

B.2.1. Bathymetry

Water depths throughout the modelled areas were extracted from the Australian Bathymetry and Topography Grid, a 9 arc-second grid rendered for Australian waters (Whiteway 2009). Bathymetry data were re-gridded onto a Map Grid of Australia (MGA) coordinate projection (Zone 54) with a regular grid spacing of 100 × 100 m.

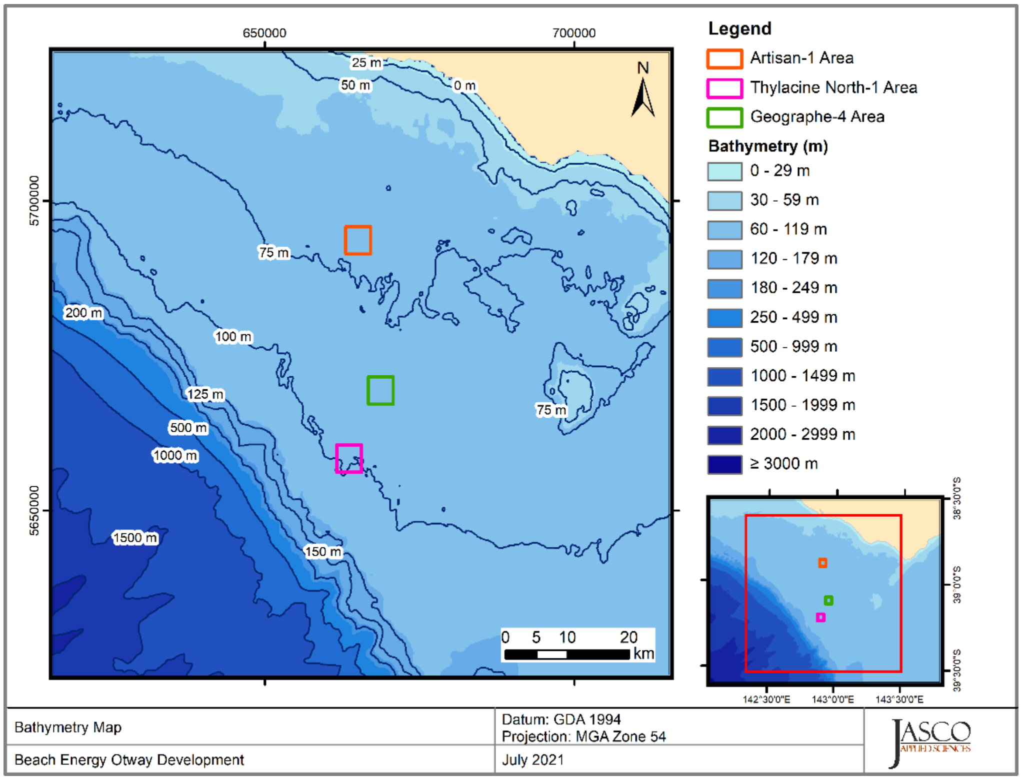


Figure B-2. Bathymetry in the modelled area.

B.2.2. Sound speed profile

The sound speed profile in the area was derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office's *Generalized Digital Environmental Model V 3.0* (GDEM; Teague et al. 1990, Carnes 2009). GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the U.S. Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to Coppens (1981).

Mean monthly sound speed profiles were derived from the GDEM profiles at distances less than 7 km around the modelled site. The June sound speed profile is expected to be most favourable to longer-range sound propagation across the entire year. As such, June was selected for sound propagation modelling to ensure precautionary estimates of distances to received sound level thresholds. For the pygmy blue whale period between November and January November is expected to be most favourable to longer-range propagation in that period. Figure B-3 shows the resulting profiles, which were used as input to the sound propagation modelling.

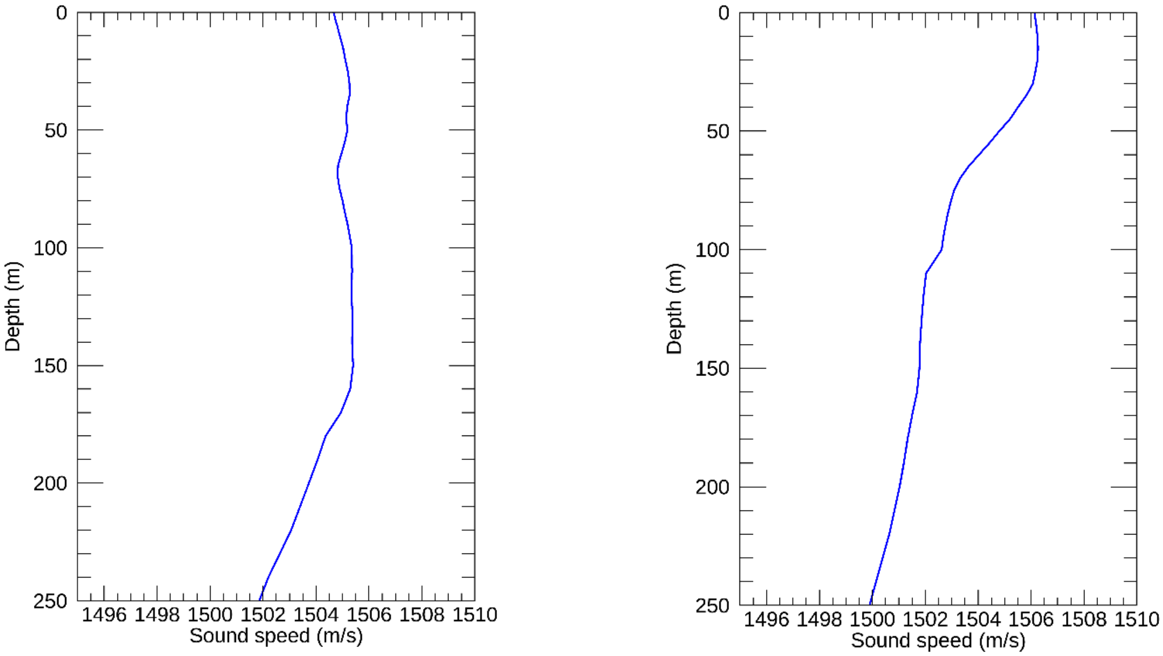


Figure B-3. The modelling sound speed profile corresponding to June (left) and November (right) Profiles are calculated from temperature and salinity profiles from *Generalized Digital Environmental Model* V 3.0 (GDEM; Teague et al. 1990, Carnes 2009).

B.2.3. Geoacoustics

The propagation model used in this study consider a single geoacoustic profile for each development area. These profiles determine how sound is reflected from the seabed, as well as how it is transmitted, reflected and absorbed into the sediment layers. As in previous acoustic studies in the area, the modelling area was divided into two seabed types (Wood and McPherson 2018). Both areas are located on the continental shelf, however the seabed in the Thylacine North-1 and were modelled as being characterised by well-cemented carbonate caprock (calcarenite), overlying semi-cemented carbonate rock (calcarenite). This contrast in seabed environment is consistent with larger scale geological data and interpretations of the Australian continental shelf environment (James and Bone 2010). Table B-1 present the geoacoustic profile used at the modelled sites in each respective development area.

Table B-1. *Thylacine North-1*: Geoacoustic profile. Each parameter varies linearly within the stated range.

Depth below seafloor (m)	Predicted lithology	Density (g/cm³)	Compressional wave		Shear wave	
			Speed (m/s)	Attenuation (dB/λ)	Speed (m/s)	Attenuation (dB/λ)
0–0.5	Well-cemented carbonate caprock	2.7	2600	0.50	1200	0.5
0.5–20	Increasingly cemented calcarenite	2.2	2000	0.30	900	0.27
20-40		2.3	2120	0.34	960	0.32
40-60		2.4	2240	0.38	1020	0.41
60-80		2.5	2360	0.42	1080	0.45
80–100		2.6	2480	0.46	1140	0.5
>100	Well-cemented calcarenite	2.7	2600	0.5	1200	0.5

Appendix D Fair Ocean Access Information Sheet

Fair Ocean Access

Minimising fishing impacts from offshore operations

Information Sheet | May 2021

Introduction

Licenced commercial fishers and petroleum title holders have lawful rights and obligations to carry out their activities safely and without interference. Beach is committed to *Fair Ocean Access* by minimising impacts from its offshore activities to commercial fishers.

Beach's *Fair Ocean Access Procedure* sets out commitments by Beach to genuine consultation with fishers to understand and minimise safety, environmental and economic impacts.

Where impacts cannot be minimised by Beach, and a fisher has acted to avoid risks and impacts to a Beach project, Beach's *Fair Ocean Access Procedure* includes a simple and fair process for a fisher to claim compensation for an economic loss, and a rapid approval and payment process.

Safety

Safety is Beach's first priority and operating safely will sometimes require restricted access for relatively small offshore areas over short periods. Beach will consult with fishers to seek to minimise potential disturbance to areas that are regular fishing grounds and where the fisher has no alternative fishing options.

Environmental Protection

Beach's projects are subject to stringent assessment and mitigation of potential environmental impacts. Beach must prepare Environment Plans for its offshore projects. These identify all environmental and socio-economic impacts and set out mitigation measures to reduce impacts, so they are "as low as reasonably practicable" and acceptable by regulators. Mitigation measures may include compensation where impacts on the commercial fishing industry cannot be minimised and where these impacts cause an economic loss.

Assessment of impacts includes identifying State and Commonwealth commercial fisheries that are actively fished in Beach's project areas and any biological or economic impacts to those fisheries. Consultation with commercial fishers is an important part of Beach's environmental assessment process.

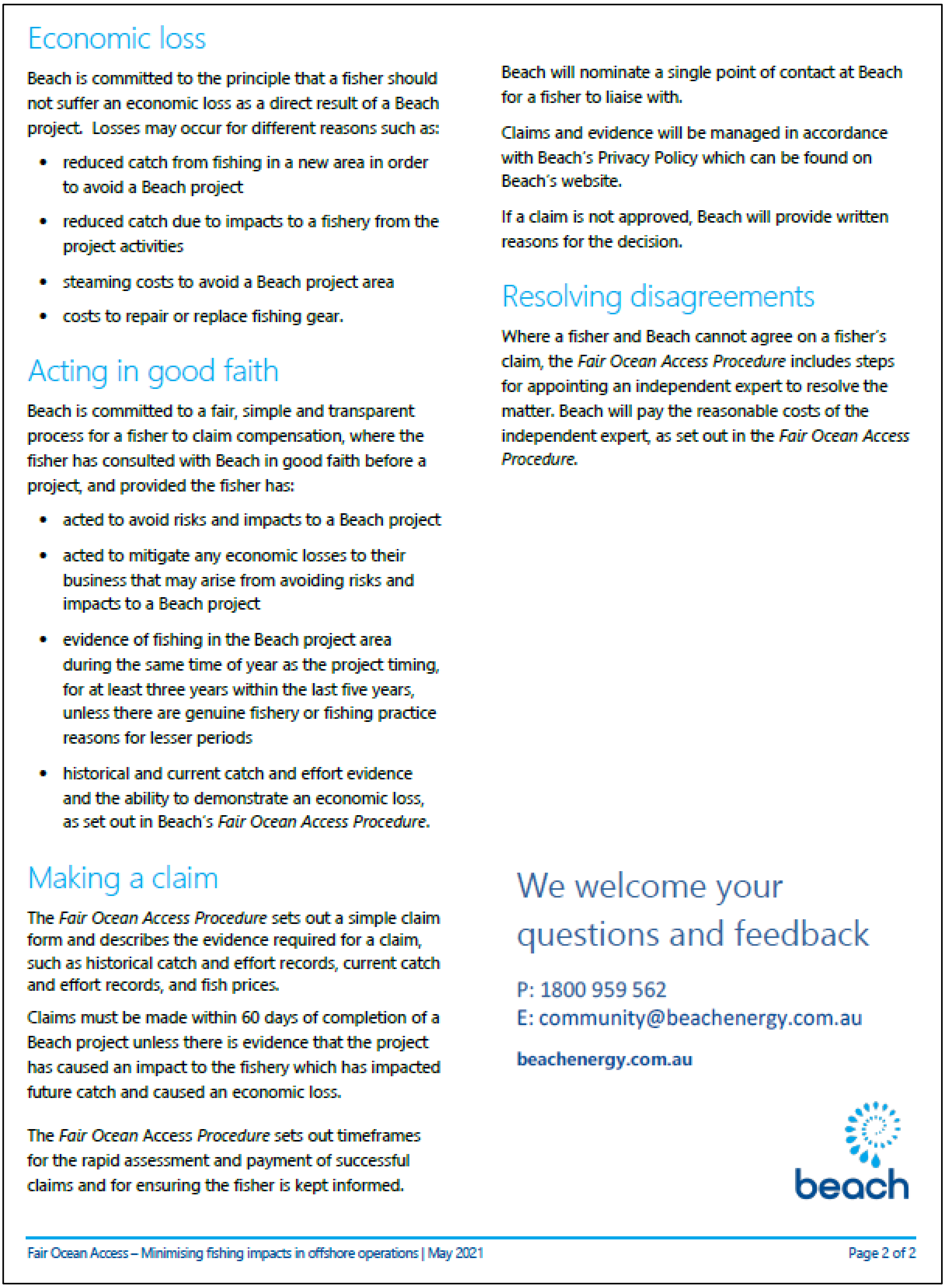
Genuine consultation

Beach will consult with openness, transparency and mutual respect with fishers who may be directly impacted by Beach's projects. Beach will use its best endeavours to consult with all potentially impacted fishers during preparation of its Environment Plan for a project, and before projects commence.

Respecting the representative role of fishing associations, Beach will seek engagement with potentially impacted fishers via the relevant association. Beach will also engage directly with a fisher if they are not a member of an association, or where they request direct engagement with Beach.

Where a fishing association or fisher believes they will be impacted by a Beach project, Beach will share its fishing impact assessments, validate that with fishers, and discuss their specific circumstances with the objective of minimising potential impacts.

If project avoidance and impact minimisation is not possible, Beach will provide a copy of its full *Fair Ocean Access Procedure* and discuss mitigation options set out in the procedure, as appropriate to the individual fisher or association.



Economic loss

Beach is committed to the principle that a fisher should not suffer an economic loss as a direct result of a Beach project. Losses may occur for different reasons such as:

- reduced catch from fishing in a new area in order to avoid a Beach project
- reduced catch due to impacts to a fishery from the project activities
- steaming costs to avoid a Beach project area
- costs to repair or replace fishing gear.

Acting in good faith

Beach is committed to a fair, simple and transparent process for a fisher to claim compensation, where the fisher has consulted with Beach in good faith before a project, and provided the fisher has:

- acted to avoid risks and impacts to a Beach project
- acted to mitigate any economic losses to their business that may arise from avoiding risks and impacts to a Beach project
- evidence of fishing in the Beach project area during the same time of year as the project timing, for at least three years within the last five years, unless there are genuine fishery or fishing practice reasons for lesser periods
- historical and current catch and effort evidence and the ability to demonstrate an economic loss, as set out in Beach's *Fair Ocean Access Procedure*.

Making a claim

The *Fair Ocean Access Procedure* sets out a simple claim form and describes the evidence required for a claim, such as historical catch and effort records, current catch and effort records, and fish prices.

Claims must be made within 60 days of completion of a Beach project unless there is evidence that the project has caused an impact to the fishery which has impacted future catch and caused an economic loss.

The *Fair Ocean Access Procedure* sets out timeframes for the rapid assessment and payment of successful claims and for ensuring the fisher is kept informed.

Beach will nominate a single point of contact at Beach for a fisher to liaise with.

Claims and evidence will be managed in accordance with Beach's Privacy Policy which can be found on Beach's website.

If a claim is not approved, Beach will provide written reasons for the decision.

Resolving disagreements

Where a fisher and Beach cannot agree on a fisher's claim, the *Fair Ocean Access Procedure* includes steps for appointing an independent expert to resolve the matter. Beach will pay the reasonable costs of the independent expert, as set out in the *Fair Ocean Access Procedure*.

We welcome your questions and feedback

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beachenergy.com.au

Fair Ocean Access – Minimising fishing impacts in offshore operations | May 2021

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Appendix E Oil Spill Modelling Reports

E. 1. Condensate Spill Modelling

OTWAY OFFSHORE OPERATIONS

Oil Spill Modelling

MAQ1246J
Otway Offshore Operations
Rev2
29 March 2023

www.rpsgroup.com/mst

Document status

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review date
Rev A	Draft issued for internal review	Jeremie Bernard	Dr. Ryan Dunn		16 February 2023
Rev 0	Draft issued for client review		Jeremie Bernard	Dr. Sasha Zigic	16 February 2023
Rev 1	Issued to client		Nathan Benfer	Dr. Sasha Zigic	16 March 2023
Rev 2	Issued to client		Nathan Benfer	Dr. Sasha Zigic	29 March 2023

Approval for issue

Dr. Sasha Zigic	S. Zigic	29 March 2023

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TABLES

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TERMS AND ABBREVIATIONS

AMP	Australian Marine Park
AMSA	Australian Maritime Safety Authority
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute gravity. A measure of how heavy or light a petroleum liquid is compared to water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
BIA	Biologically Important Areas
Bonn Agreement	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
BP	Boiling point. The temperature at which the vapor pressure of the liquid is equal to the pressure exerted on it by the surrounding atmosphere
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions.
Deterministic (single) oil spill modelling	Oil spill modelling involving a computer simulation of a single hypothetical oil spill event subject to a single sequence of wind, current and other sea conditions over time. Single oil spill modelling, also referred to as “deterministic modelling” provides a simulation of one possible outcome of a given spill scenario, subject to the metocean conditions that are imposed. Single oil spill modelling is commonly used to consider the fate and effects of ‘worst-case’ oil spill scenarios that are carefully selected in consideration of the nature and scale of the offshore petroleum activity and the local environment (NOPSEMA, 2017). Because the outcomes of a single oil spill simulation can only represent the outcome of that scenario under one sequence of metocean conditions, worst-case conditions are often identified from stochastic modelling. It is impossible to calculate the likelihood of any outcome from a single oil spill simulation. Single oil spill modelling is generally used for response planning, preparedness planning and for supporting oil spill response operations in the event of an actual spill
Dynamic viscosity	The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.
Floating oil exposure	Contact by floating oil on the sea surface at concentrations equal to or exceeding defined threshold concentrations. The consequence will vary depending on the threshold and the receptors
HYCOM	Hybrid Coordinate Ocean Model. A data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction.
IMCRA	Integrated marine and coastal regionalisation areas
KEF	Key Ecological Feature
LGA	Local Government Areas
MAHs	Monoaromatic Hydrocarbons
MNP	Marine National Park
MP	Marine Park
MS	Marine Sanctuary
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority

NP	National Park
NR	Nature Reserve
PAH	Polynuclear Aromatic Hydrocarbons
Pour Point	The pour point of a liquid is the temperature below which the liquid loses its flow characteristics
Ramsar site	A site listed under the Ramsar Convention on wetlands which is an international intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.
RSB	Reefs, Shoals and Banks
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations. Shoreline contact is judged for floating oil arriving within a 2 km buffer zone from any shoreline as a conservative measure
SIMAP	Spill Impact Model Application Package. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for surface or subsea releases
Stochastic (multiple) oil spill modelling	Stochastic oil spill modelling is created by overlaying and statistically analysing the outcomes of many single oil-spill simulations of a defined spill scenario, where each simulation was subject to a different sequence of metocean conditions, selected objectively (typically by random selection) from a long sequence of historic conditions for the study area. Analysis of this larger set of simulations provides a more accurate indication of the environment that maybe affected (EMBA) and indicates which locations are more likely to be affected (as well as other statistics). Stochastic oil spill modelling avoids biases that affect single oil spill modelling (due to the reliance on only one possible sequence of conditions). However, when interpreting stochastic modelling, which is based on a wide range of potential conditions that might happen to occur, it is essential to understand that calculations will encompass a much larger area than could be affected in any single spill event, where a more limited set of conditions will occur. Consequently, it is misleading to imply that the region derived from stochastic modelling indicate the outcomes expected from a single spill event (NOPSEMA, 2017) Stochastic modelling is generally used for risk assessment and preparedness planning by indicating locations that could be exposed and may require response or subsequent impact assessment
Sub-LGA	Sub-Local Government Areas
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations.

EXECUTIVE SUMMARY

Background

Beach Energy (Operations) Limited (Beach) plans to tie-in production from four new wells (TN-1, TN-2, TW-1 and TW-2) in the Thylacine field (T/L2) to the existing Otway Gas Pipeline (OGP). TW-1 was selected for this assessment as it has the largest production rate of the Otway Gas Development wells. TW-1 is located approximately 80 km south of Port Campbell in a water depth of approximately 100 m.

In order to support the update to the Otway Offshore Operations EP, Beach commissioned a detailed oil spill modelling study assessing the following hypothetical scenario:

- A 212.6 m^3/day subsea release of Thylacine condensate over 86 days from a loss of well containment.

The modelling assessment was undertaken on a seasonal basis as follows:

- Summer (November through to March); and
- Winter (April to October)

The purpose of the modelling is to provide an understanding of a conservative 'outer envelope' of the potential area that may be affected in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent that the released hydrocarbon may influence.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Methodology

The modelling study was carried out in several stages. Firstly, a 10-year wind and current dataset (2010–2019) was generated and the currents included the combined influence of three-dimensional large-scale ocean currents and tidal currents. Secondly, the currents, winds and detailed hydrocarbon characteristics were used as inputs in the three-dimensional oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilled oil.

As spills can occur during any set of wind and current conditions, modelling was conducted using a stochastic (random or non-deterministic) approach, which involved running 100 randomly selected single trajectory simulations per season, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions.

The SIMAP system, the methods and analysis presented herein, use modelling algorithms which have been anonymously peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-13 "*Standard Practice for Development and Use of Oil Spill Models*".

Oil Properties

Thylacine condensate has an API of 44.3 and a density of 804.6 kg/m^3 (at 15ºC) with a viscosity value (0.87.0 cP) classifying it as a Group I (not-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications.

The condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi- to low-volatile components. In favourable evaporation conditions, 64.0% of the oil mass should evaporate within the first 12 hours (BP < 180°C), a further 19.0% is expected to evaporate within the first

24 hours (180°C < BP < 265°C) and a further 16.0% should evaporate over several days (265°C < BP < 380°C). Approximately 1.0% of the condensate is shown to be persistent.

Results

Scenario: 212.6 m³/day loss of containment at TW-1

- No floating oil exposure above the high (> 50 g/m^2) threshold was predicted by the modelling.
- The maximum distance from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 44.5 km (southeast) during summer conditions and 0.4 km (south) during winter conditions, respectively.
- Floating oil exposure* above the low threshold was predicted at the West Tasmania Canyons KEF (2%) during summer only and the Pygmy Blue Whale – Foraging BIA (40% in summer and 25% in winter).
- No shoreline accumulation was predicted for the moderate (100 g/m^2) or high (1,000 g/m^2) threshold.
- The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 41% during summer conditions and 75% during winter conditions. The minimum time before oil accumulation at, or above, the low threshold was 13.00 days during summer conditions, and 6.54 days during winter conditions.
- The maximum volume ashore for a single spill trajectory during the summer and winter conditions was 11.6 m^3 and 16.6 m^3, respectively, whilst the maximum length of shoreline accumulation at the low threshold was 18.9 km and 28.9 km, respectively.
- The highest concentration of dissolved hydrocarbon* was predicted for the Central Bass Strait IMCRA (summer – 389.5 ppb, winter – 310 ppb) whilst the highest probability of low dissolved hydrocarbon exposure was recorded for Apollo AMP (summer – 93%, winter – 100%) and Pygmy Blue Whale – Known Foraging Area BIA (summer – 81%, winter – 85%). The maximum residence time of dissolved hydrocarbon exposure at the low threshold was predicted for Pygmy Blue Whale – Known Foraging Area BIA (summer – 3.29 days, winter – 1.17 days)
- The highest concentration of entrained hydrocarbon* was predicted for Apollo AMP (summer – 63.3 ppb, winter – 64.2 ppb) whilst the highest probability of low entrained hydrocarbon exposure was recorded for Apollo AMP (summer – 95%, winter – 100%), Zeehan AMP (summer – 92%, winter – 68%), Pygmy Blue Whale – Known Foraging Area BIA (summer – 91%, winter – 96%) and Central Bass Strait IMCRA (summer – 88%, winter – 98%).

* Outside of the receptors that the TW-1 well resides within

1 INTRODUCTION

1.1 Background

Beach Energy (Operations) Limited (Beach) plans to tie-in production from four new wells (TN-1, TN-2, TW-1 and TW-2) in the Thylacine field (T/L2) to the existing Otway Gas Pipeline (OGP). TW-1 was selected for this assessment as it has the largest production rate of the Otway Gas Development wells. TW-1 is located approximately 80 km south of Port Campbell in a water depth of approximately 100 m. The location of the well is shown in Table 1-1 and illustrated in Figure 1-1.

In order to support the update to the Otway Offshore Operations EP, Beach commissioned a detailed oil spill modelling study assessing the following hypothetical scenario:

- A 212.6 m^3/day subsea release of Thylacine condensate over 86 days from a loss of well containment.

The modelling assessment was undertaken on a seasonal basis as follows:

- Summer (November through to March); and
- Winter (April to October)

The purpose of the modelling is to provide an understanding of a conservative ‘outer envelope’ of the potential area that may be affected in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent that the released hydrocarbon may influence.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Note that the oil spill model, the method and analysis presented herein uses modelling algorithms which have been anonymously peer reviewed and published in international journals. Furthermore, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 “*Standard Practice for Development and Use of Oil Spill Models*”.

Table 1-1 Location of TW-1 well.

Well	Latitude	Longitude
TW-1	39° 13.338' S	142° 50.318' E

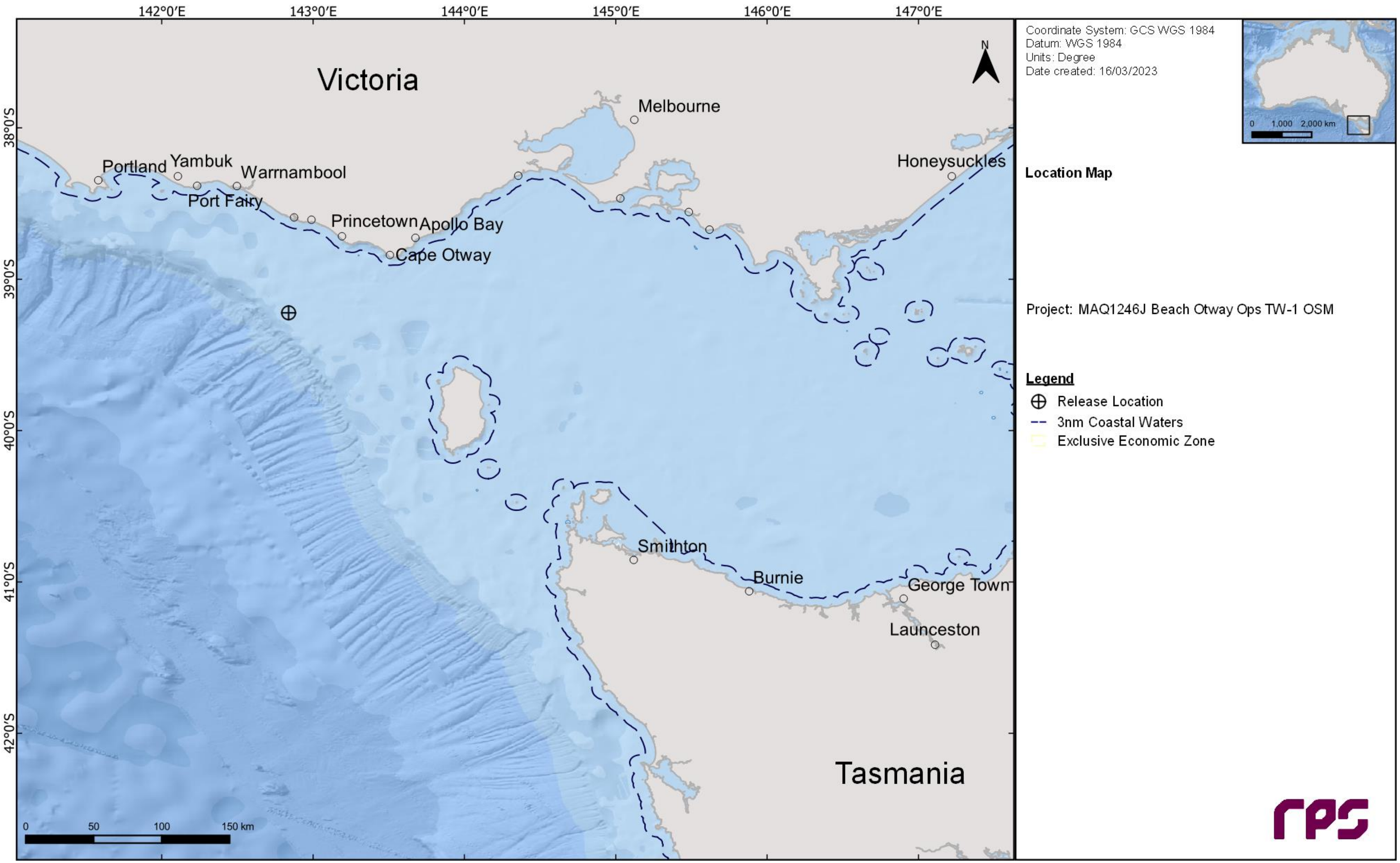


Figure 1-1 Map of the TW-1 well location.

1.2 What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic locations for deploying equipment and materials can be made, and the locations at most risk can be identified. The two types of oil spill modelling often used are stochastic (Section 1.2.1) and deterministic (Section 1.2.2) modelling.

1.2.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2).

Stochastic modelling is a common means of assessing the potential risks from oil spills related to new projects and facilities. Stochastic modelling typically utilises hydrodynamic data for the location in combination with historic wind data. Typically, 100 iterations of the model will be run utilising the data that is most relevant to the season or timing of the project.

The outcomes are often presented as a probability of exposure and is primarily used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

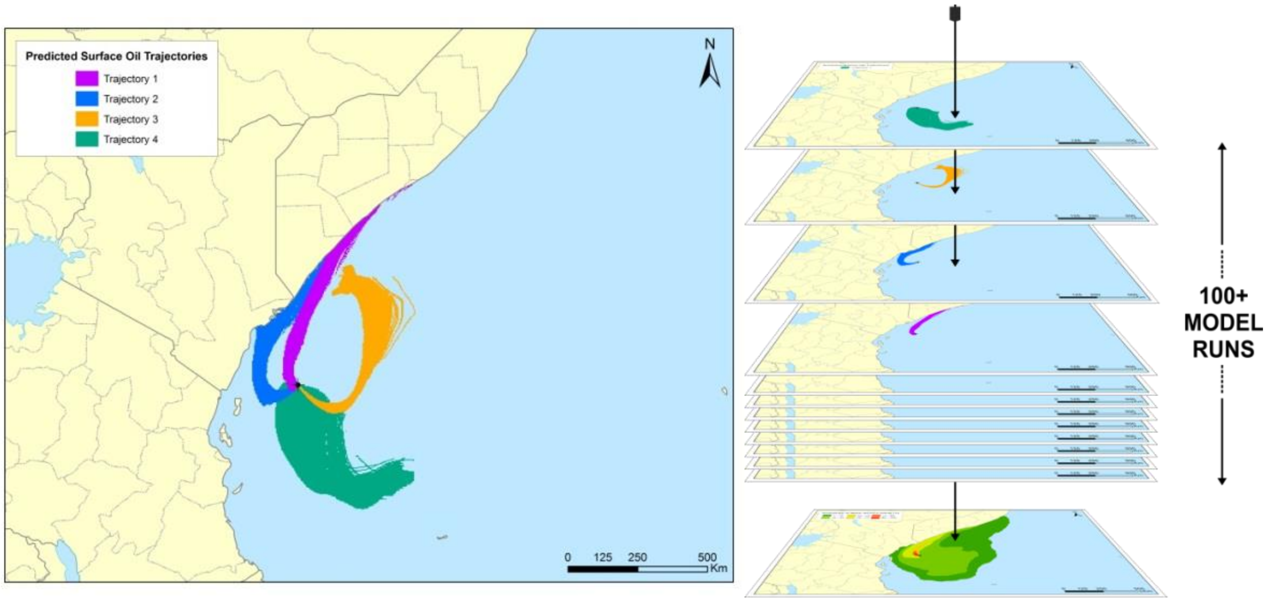


Figure 1-2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.2.2 Deterministic Modelling (Single Spill Simulation)

Deterministic modelling is the predictive modelling of a single incident subject to a single sample of wind and weather conditions over time (NOPSEMA, 2018; Figure 1-3).

Deterministic modelling is often paired with stochastic modelling to place the large stochastic footprint into perspective. This deterministic analysis is generally a single run selected from the stochastic analysis and serves as the basis for developing the plans and equipment needs for a realistic spill response. Deterministic spills can be selected on several basis such as minimum time to shoreline, largest swept area, maximum volume ashore, longest length of shoreline contacted by oil or largest area of entrained or dissolved hydrocarbons.

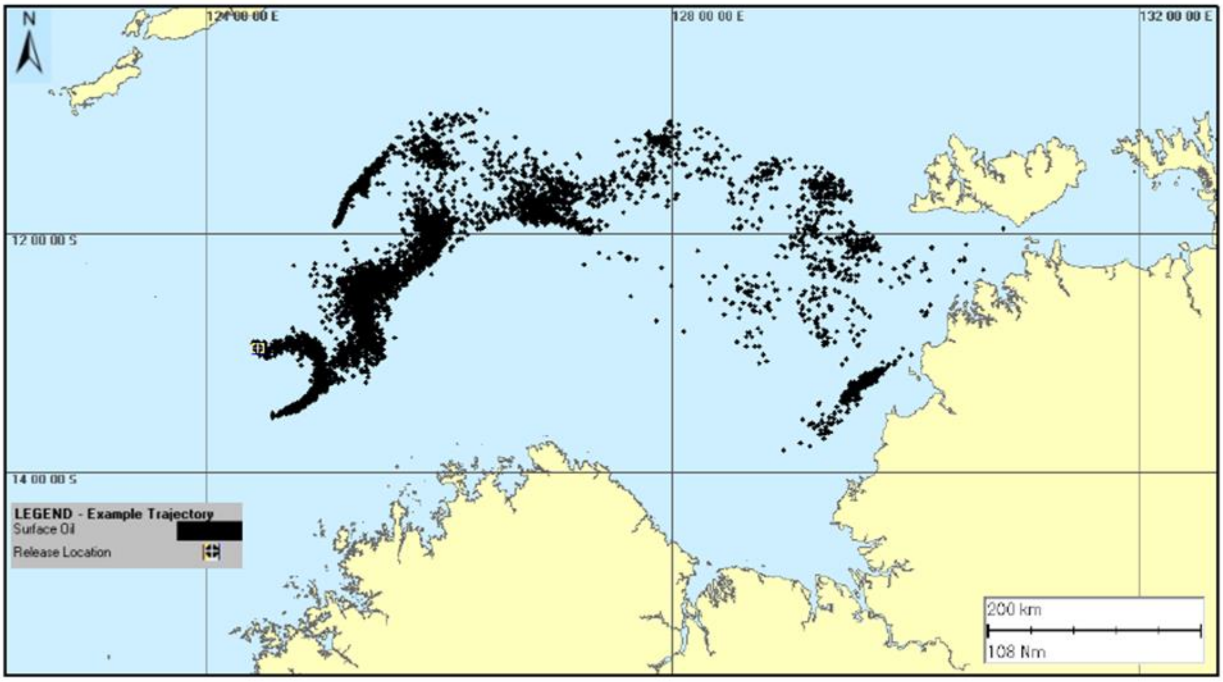


Figure 1-3 **Example of an individual spill trajectory predicted by SIMAP for a spill scenario. Note, this image represents surface oil as spillets and do not take any thresholds into consideration.**

2 SCOPE OF WORK

The scope of work included the following components:

- Generate 10-years of winds and three-dimensional currents from 2010 to 2019 (inclusive). The currents included the combined influence of tidal and ocean currents;
- Include the wind and current data and characteristics of Thylacine condensate as input into the three-dimensional oil spill model (SIMAP), to model the movement, spreading, weathering and shoreline contact by hydrocarbons over time;
- Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surrounding waters and shorelines. This involved running 100 randomly selected single trajectory simulations per season, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times. This ensured that each spill simulation was subject to a unique set of wind and current conditions;
- Results were assessed to determine the exposure to waters and contact to shorelines based upon the NOPSEMA thresholds; and
- The stochastic modelling results were reviewed, and the "worst case" deterministic runs were identified and presented based on the following criteria (if applicable):
    - largest instantaneous peak volume of oil ashore;
    - minimum time before shoreline contact above 10 g/m^2;
    - largest swept area of oil on the sea surface above 10 g/m^2;
    - largest entrained oil swept area above 100 ppb; and
    - largest dissolved oil swept area above 400 ppb.

3 REGIONAL CURRENTS

Bass Strait is a body of water separating Tasmania from the southern Australian mainland, specifically the state of Victoria. The strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Currents within the straight are primarily driven by tides, winds, incident continental shelf waves and density driven flows; high winds and strong tidal currents are frequent within the area (Jones, 1980).

The varied geography and bathymetry of the region, in addition to the forcing of the south-eastern Indian Ocean and local meteorology lead to complex shelf and slope circulation patterns (Middleton & Bye, 2007). Figure 3-1 displays seasonal current trends within the Bass Strait. During winter there is a strong eastward water flow due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery & Kämpf, 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward, as the coastal current develops due to south-easterly winds.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining deep ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with surface tidal currents developed by RPS. The following sections provide a summary of the hybrid regional dataset.

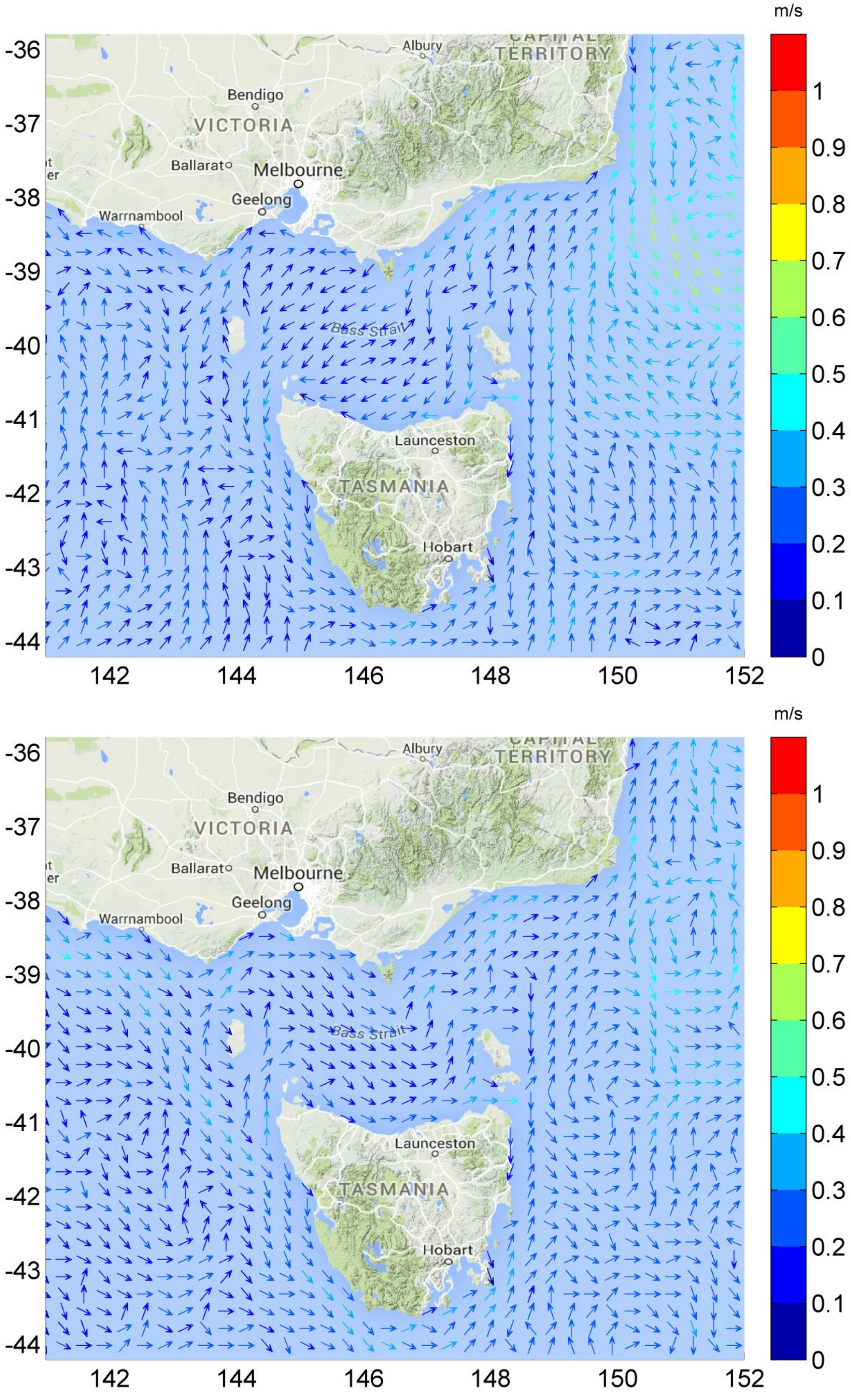


Figure 3-1 HYCOM averaged seasonal surface drift currents during summer (upper image) and winter (lower image).

3.1 Tidal currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for more than 30 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain is sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids are progressively allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over regions with more complex bathymetry. Figure 3-2 shows the tidal model grid covering the study domain.

A combination of datasets was used and merged to describe the shape of the seabed within the grid domain (Figure 3-3). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

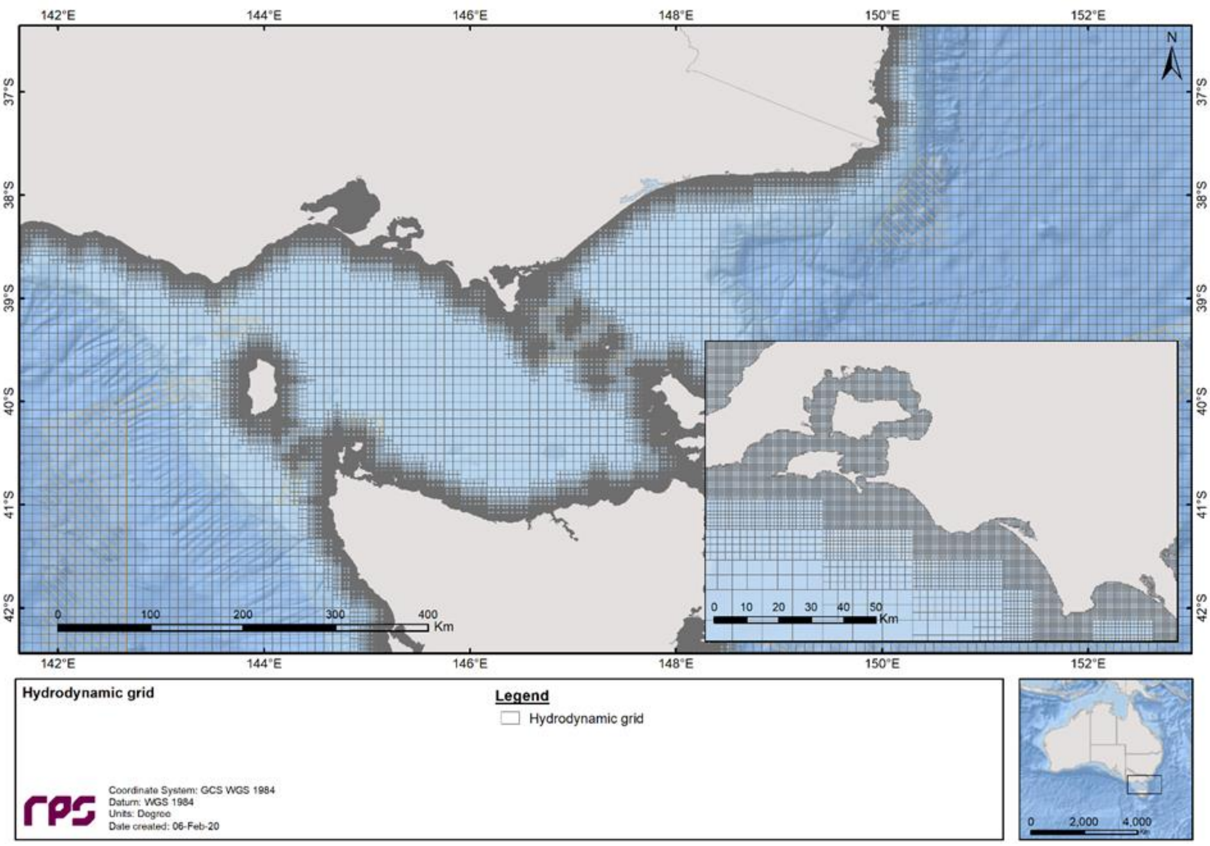


Figure 3-2 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

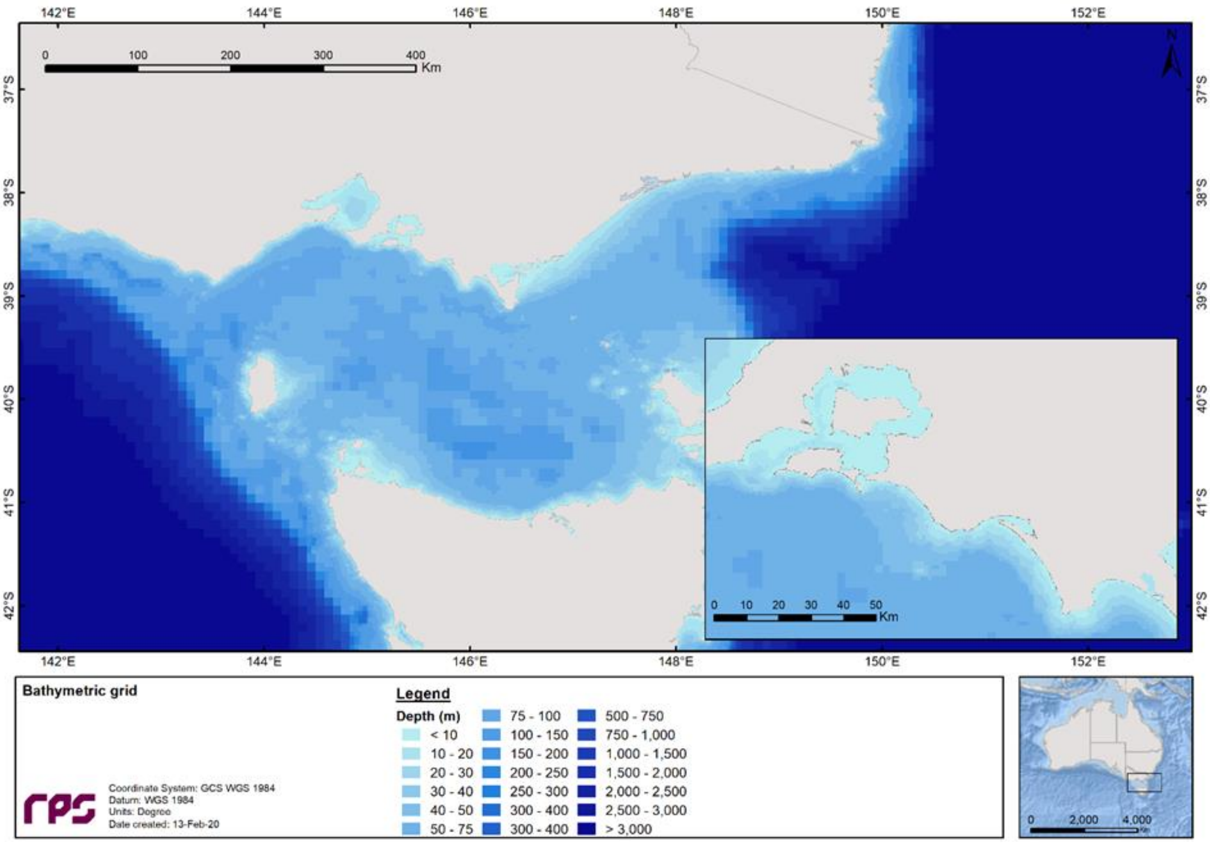


Figure 3-3 Bathymetry defined throughout the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 8.0) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, time series surface heights were calculated along the open boundaries for the simulation period.

The Topex/Poseidon satellite data has a resolution of 0.25 degrees globally, with higher resolution in coastal regions, and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The data capturing satellites, equipped with two altimeters capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for the period 1992–2005. In total these satellites carried out 62,000 orbits of the planet. The Topex/Poseidon tidal data has been widely used amongst the oceanographic community, being refereced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen 2010). The Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at a location situated within the study area (Figure 3-4).

To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott & Matsuura, 2005) were used.

The MAE (Eq.1) is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood. The MAE is determined by:

$$MAE = N^{-1} \sum_{i=1}^{N} |P_i - O_i| \qquad \text{Eq.1}$$

Where: N = Number of observations

P_i = Model predicted surface elevation

O_i = Observed surface elevation

The Index of Agreement (IOA; Eq. 2) in contrast, gives a non-dimensional measure of model accuracy or performance. A perfect agreement between the model predicted and observed surface elevations exists if the index gives an agreement value of 1, and complete disagreement between model and observed surface elevations will produce an index measure of 0 (Wilmott, 1981). Willmott et al. (1985) also suggests that values larger than 0.5 may represent good model performance. The IOA is determined by:

$$IOA = 1 - \frac{\sum |X_{model} - X_{obs}|^2}{\sum (|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2} \qquad \text{Eq.2}$$

Where: X_{model} = Model predicted surface elevation

X_{obs} = Observed surface elevation

Clearly, a greater IOA and lower MAE represent a better model performance.

Figure 3-5 and Figure 3-6 illustrate a comparison of the predicted and observed surface elevations in February 2017. As shown on the graph, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

Table 3-1 shows the IOA and MAE values for the selected tide station locations indicating that the model is performing well.

Table 3-1 Statistical comparison between the observed and HYDROMAP predicted surface elevations.

Tide Station	IOA	MAE (m)
Gabo Island	0.98	0.08
Port MacDonnell	0.98	0.05
Port Welshpool	0.92	0.30
Portland	0.97	0.07
Stack Island	0.96	0.22

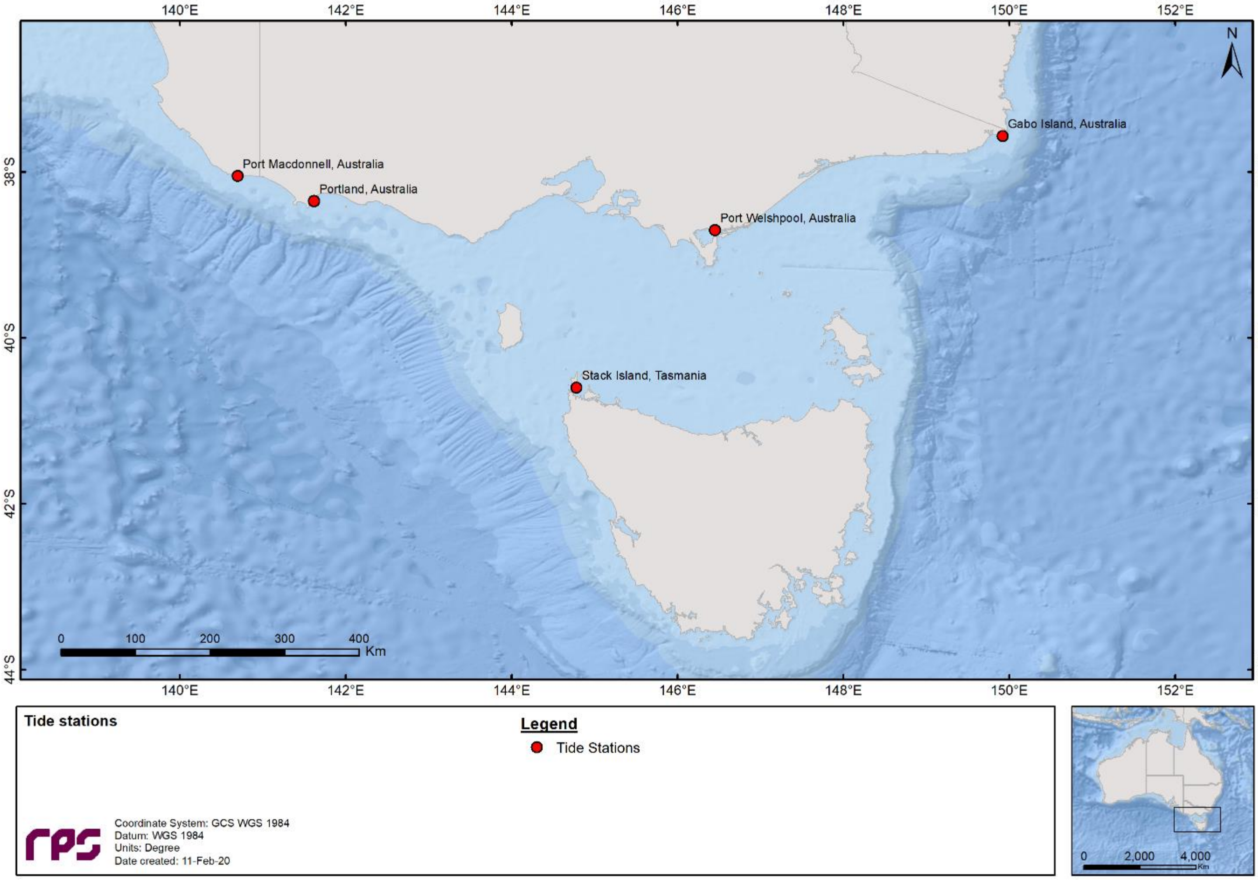


Figure 3-4 Location of the tide stations used in the surface elevation validation.

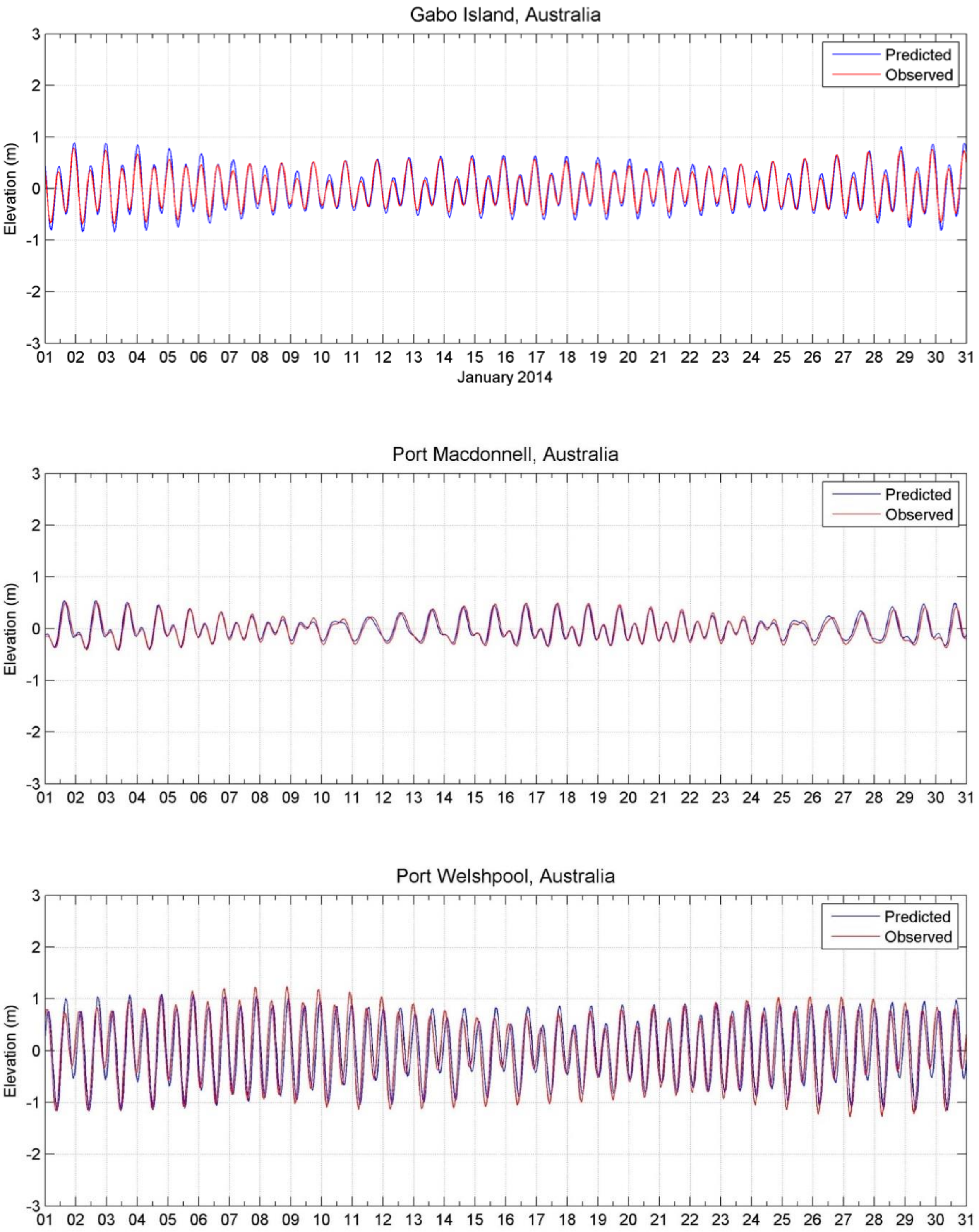


Figure 3-5 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Gabo Island (upper image), Port MacDonnell (middle image) and Port Welshpool (lower image).

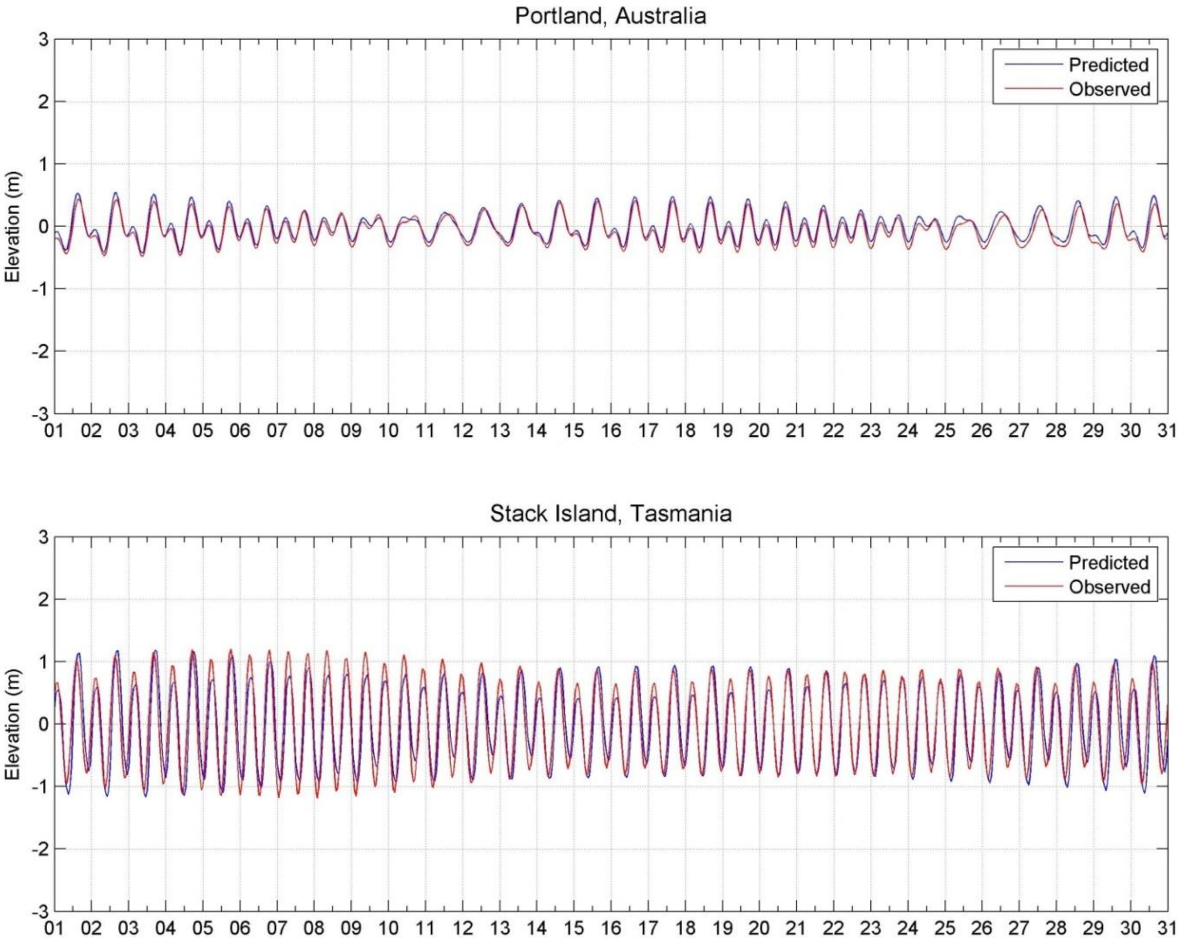


Figure 3-6 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Portland (upper image) and Stack Island (lower image).

3.2 Ocean Currents

Data describing the flow of ocean currents for the years 2010 to 2019 (inclusive) was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of every 3 hours. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain-following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas.

3.3 Surface Currents

Table 3-2 presents the average and maximum net surface current speeds nearby the release location by combining the ocean and tidal currents. Current speeds varied throughout the year with maximum current speeds ranging between approximately 0.81 m/s (October) and 1.15 m/s (August). The dominant surface current directions throughout the year were identified as (towards) east-southeast and west-northwest.

Figure 3-7 and Figure 3-8 show the monthly and total surface current rose distributions nearby the release location.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

Table 3-2 Predicted monthly average and maximum surface current speeds nearby the release location. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (towards)
January	0.20	0.90	East-northeast and West-southwest
February	0.21	1.00	East-northeast and West-southwest
March	0.22	1.14	East-northeast and West-southwest
April	0.22	0.90	East
May	0.27	1.03	East
June	0.25	0.99	East
July	0.29	0.94	East
August	0.26	1.15	East
September	0.23	0.98	East
October	0.22	0.81	East
November	0.21	0.83	East
December	0.22	0.82	East-northeast and West-southwest
Minimum	**0.20**	**0.81**	
Maximum	**0.29**	**1.15**	

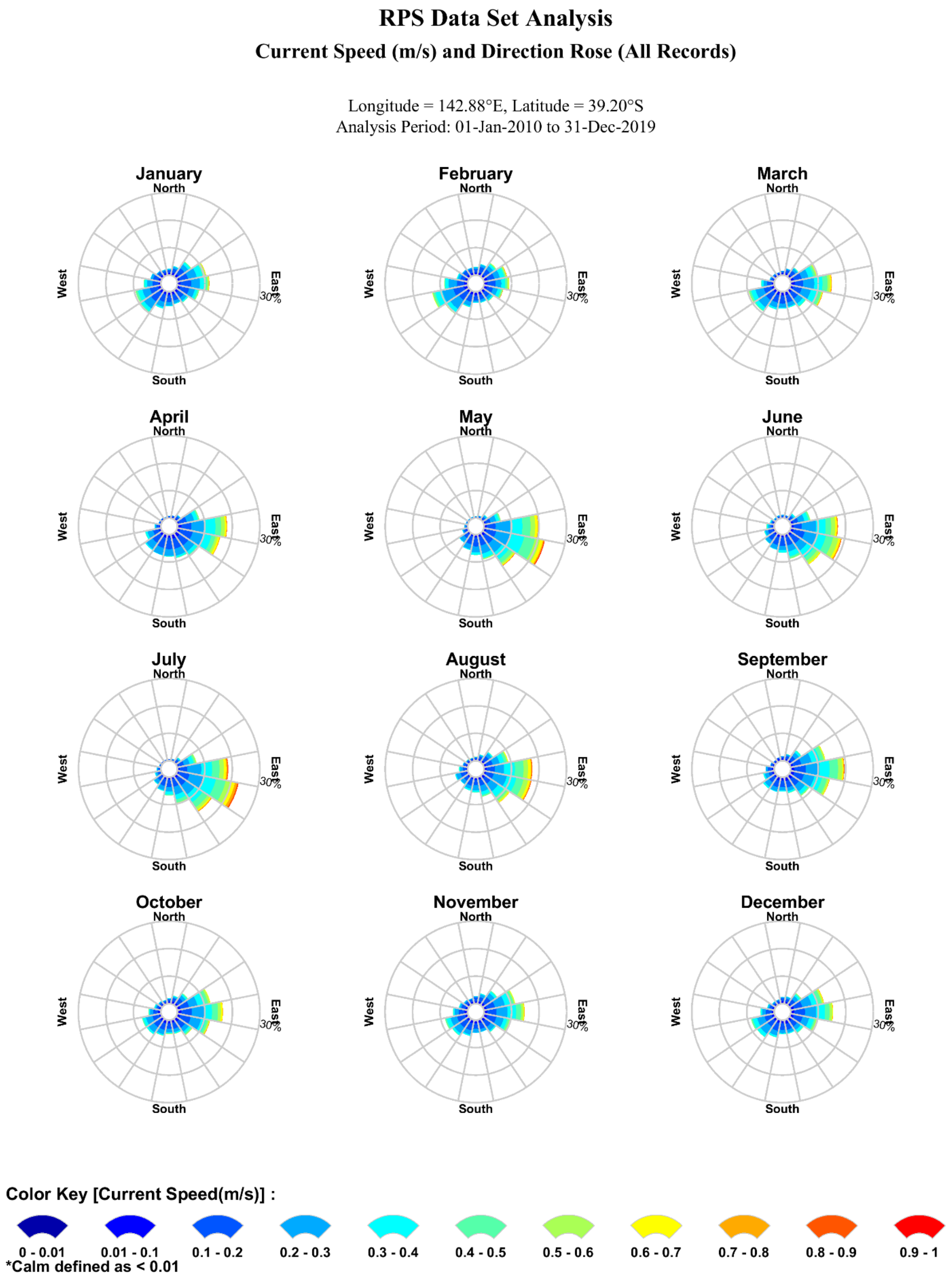


Figure 3-7 Monthly surface current rose plots nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

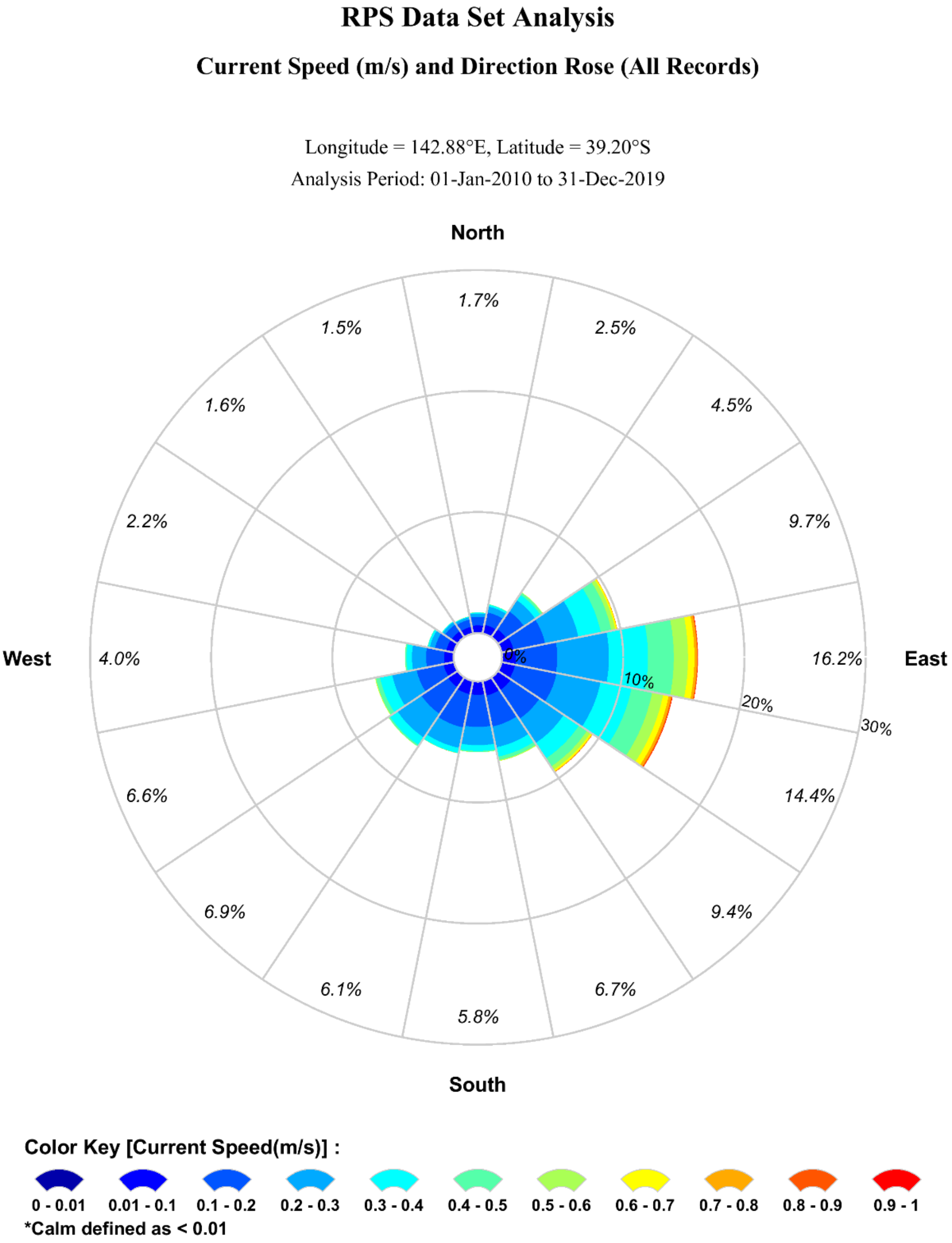


Figure 3-8 Total surface current rose plot nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

4 WIND DATA

High resolution wind data for the years 2010 to 2019 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis dataset (CFSR; see Saha et al., 2010). The CFSR wind model is a fully coupled, data-assimilative hindcast model representing the interaction between the earth's oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 4-1 shows the spatial resolution of the wind field used as input into the oil spill model.

Table 4-1 presents the monthly average and maximum winds derived from a CFSR wind node nearby the release location. The wind data demonstrated average monthly wind speeds ranging from 14.2 knots (January) to 20.1 knots (July) with maximums ranging between 58.9 knots (February) and 65.8 knots (December). The dominant wind direction throughout the year was from the west, whilst maximum wind speeds were typically associated with westerly winds during all months of the year.

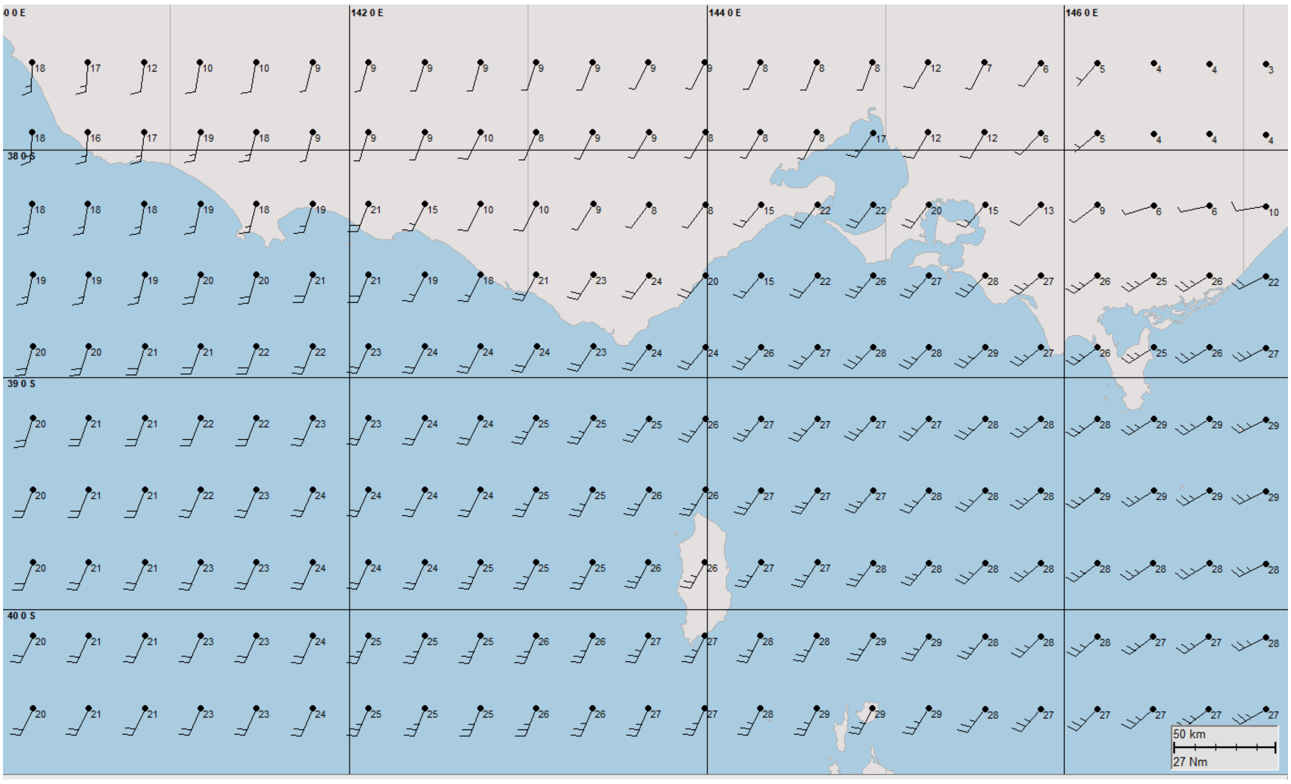


Figure 4-1 Spatial resolution of the CFSR modelled wind data used as input into the oil spill model.

Figure 4-2 and Figure 4-3 show the monthly and total wind rose distributions derived from the CFSR data for the selected node nearby the release location.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 5 knots are predominantly used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

Table 4-1 **Predicted average and maximum winds representative for the selected node nearby the release location. Data derived from CFSR hindcast model from 2010–2019 (inclusive).**

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (from)
January	14.2	62.8	East-southeast and West-southwest
February	14.8	58.9	Southeast
March	14.8	64.7	East and West
April	14.6	61.2	West
May	17.3	62.2	West
June	17.5	60.5	West to North
July	20.1	60.5	West to North
August	19.5	65.1	West to North
September	17.4	60.8	West
October	16.4	61.8	West
November	15.3	60.8	West
December	14.9	65.8	West and East-southeast
Minimum	**14.2**	**58.9**	
Maximum	**20.1**	**65.8**	

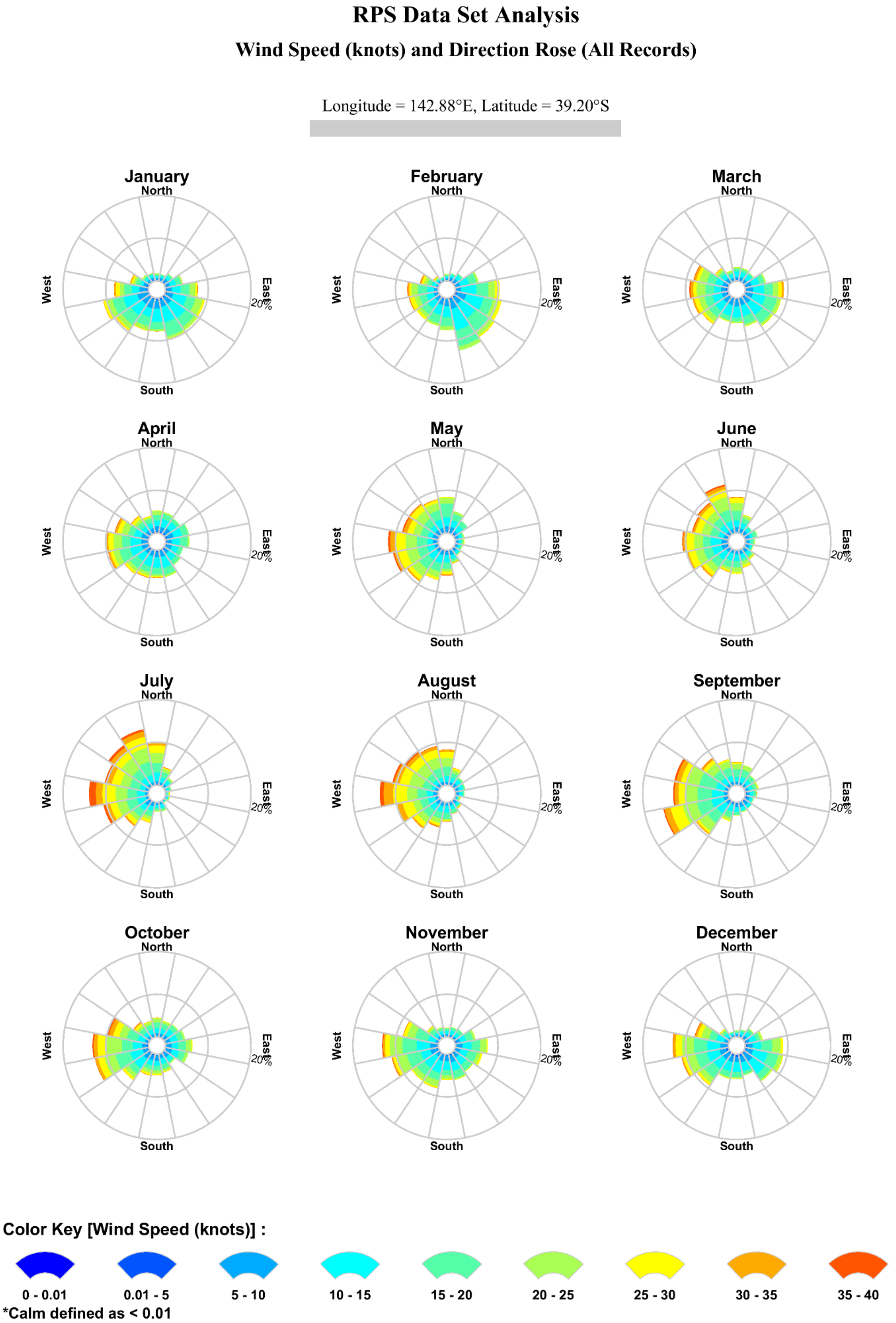


Figure 4-2 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.

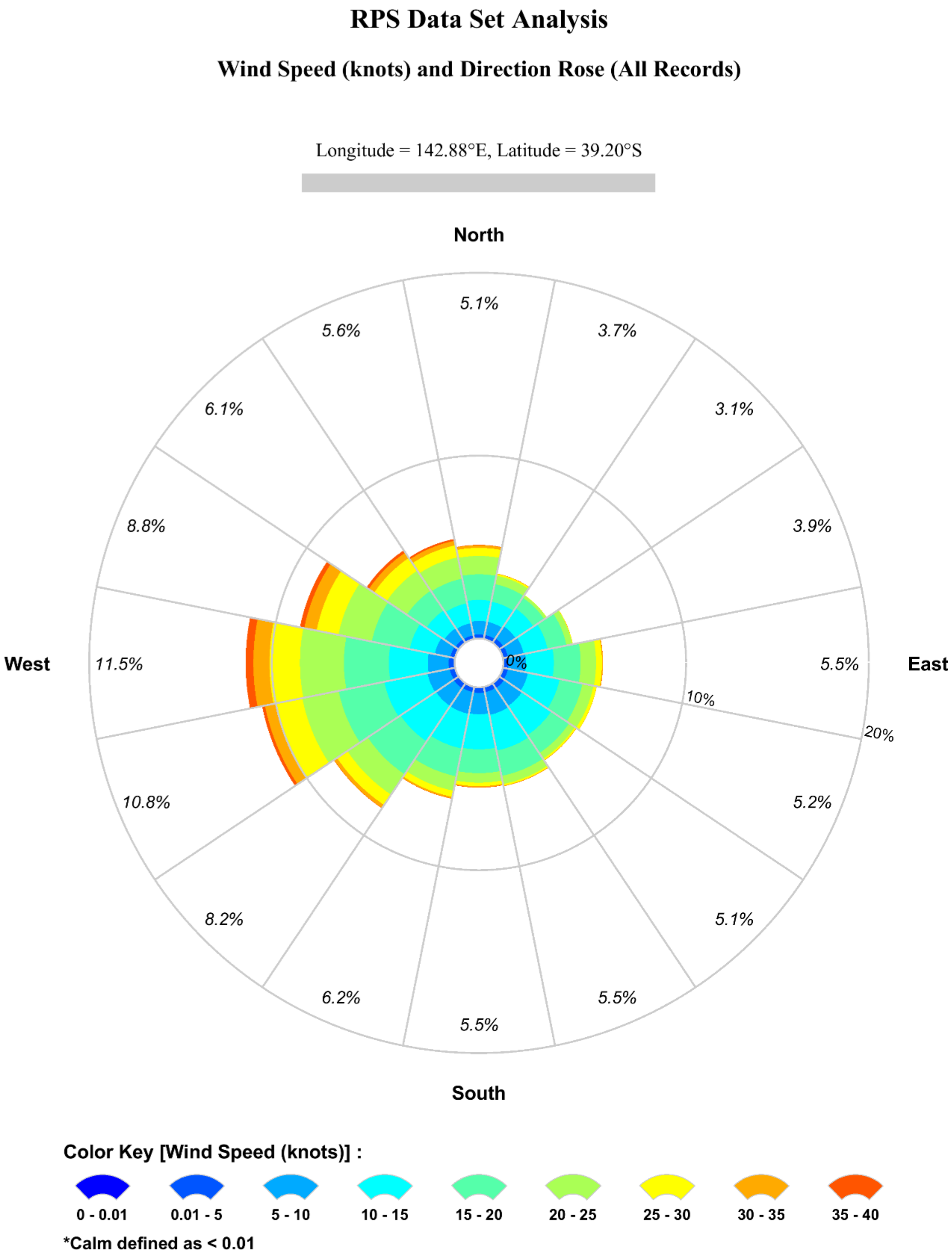


Figure 4-3 Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.

5 WATER TEMPERATURE AND SALINITY

The monthly sea temperature and salinity profiles of the water column within the study was obtained from the World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (see Levitus et al., 2013). These parameters were used as factors to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and sub-surface layers.

Figure 5-1 illustrates the vertical profile of sea temperature and salinity nearby the release location.

Table 5-1 presents the sea temperature and salinity of the surface layer nearby the selected location. The monthly average sea surface temperatures ranged between 13.2°C (September) and 17.8°C (March). The monthly average salinity values remain relatively consistent ranging between 35.1 psu (February) and 35.6 psu (July).

Table 5-1 Monthly average sea surface temperature and salinity in the study area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (ºC)	17.7	17.2	17.8	16.3	16.0	16.0	14.8	13.5	13.2	14.3	14.3	15.9
Salinity (psu)	35.3	35.1	35.4	35.3	35.3	35.4	35.6	35.3	35.3	35.4	35.4	35.4

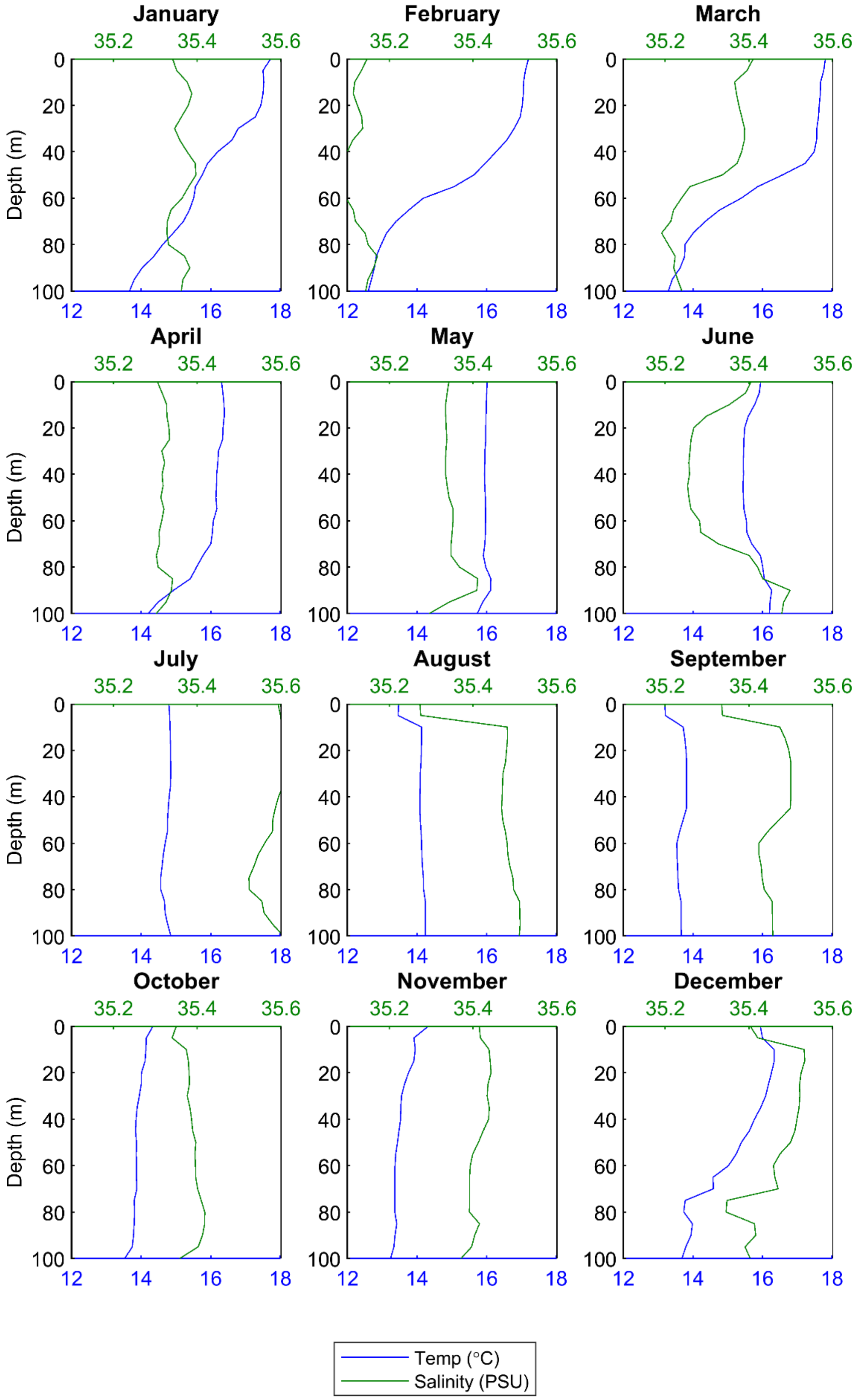


Figure 5-1 Temperature and salinity profiles nearby the selected location within the study area.

6 SUBSEA PLUME MODEL – OILMAP DEEP

In the event of a subsea release, the gas and condensate will initially behave like a jet, which dissipates in the water column over a short distance (<10 m). The escaping condensate shear into small droplets due to turbulence generated by passing through the exit hole and subsequent turbulence generated in the plume jet. The size-distribution of the droplets will vary with the exit velocity and viscosity of the condensate. Following this phase, the density and buoyancy difference of the gas and condensate mixture relative to the surrounding waters, forces the plume upward. As the plume rises, the volume of gas will increase due to reduction of water pressure, with gas bubbles dividing into an increasing number of bubbles due to the shearing effect exerted by the water column.

In shallow water (<200 m) the rising plume will tend to reach the sea surface before deflecting away from the centre of the plume (Spaulding et al., 2000). Figure 6-1 conceptually illustrates the various stages of a subsea release of oil and gas.

The OILMAP Deep model (Spaulding et al. 2015) was used to simulate the near-field behaviour of the gas-condensate subsea release in two phases – the initial jet phase and the buoyant plume phase. The initial jet phase is predominately driven by the exit velocity. During this phase, the condensate droplet-size-distributions are calculated for a range of classes or bins. Next, the plume model predicts the rise dynamics of the condensate and gas plume to calculate at which point gas lift will be lost (i.e. the trapping height).

Outputs which include the plume trapping height, plume diameter and droplet size distribution are used as input to the SIMAP model to simulate the rise and dispersion of the condensate droplets from this point onwards.

More details on the OILMAP-DEEP model, can be found in Spaulding et al. (2015). The model has been validated against observations from Deepwater Horizon as well as small and large-scale laboratory studies on subsurface oil releases (Brandvik et al 2013, 2014; Belore 2014; Spaulding et al. 2015; Li et al. 2017).

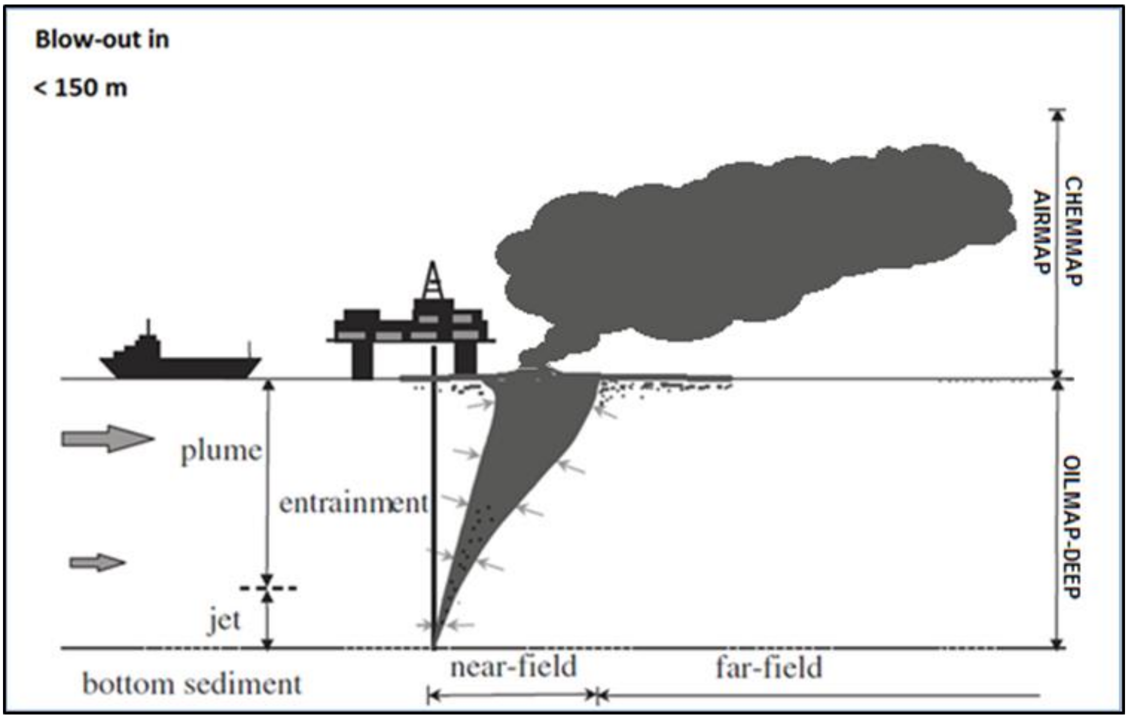


Figure 6-1 Schematic of the various stages of the plume in the water column (Source: ASA, 2011).

Table 6-1 presents the input parameters and key results for the subsea plume modelling. Note a depleting release rate was assessed.

The subsea modelling showed that in the event of a loss of containment, the amalgamated gas and condensate would propel rapidly upward from the seabed and rupture the sea surface. Droplet sizes would range from 527 µm to 2,278 µm. There were 10 oil droplet-size classes defined, which were evenly distributed (10%), to simulate the rise and dispersion of the condensate droplets more accurately.

Table 6-1 Input data and key results for the subsea plume modelling.

Input Variable	Value
Scenario	Loss of Containment
Water depth (m)	105
Tubing diameter (inch)	12.42
Condensate discharge rate (m^3/day)[stb/day]	212.6 [1,337]
Gas rate (MMscf/day)	139
Formation water flow rate (stb/day)	0
Key Results	
Plume execution depth (m BMSL)	0 (Breach the sea surface)
Droplet sizes (µm)	527 to 2,278

7 OIL SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using the Spill Impact Model Application Program (SIMAP). SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al., 1994; French et al., 1999; French-McCay, 2003, 2004; French-McCay et al., 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand.

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point (BP) ranges.

SIMAP is a three-dimensional model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French-McCay et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

7.1 Stochastic Modelling

For the stochastic modelling presented herein, **200 oil spills** (100 per season) were modelled for the scenario using the same spill information (release location, spill volume, duration and oil type) but with varied start dates. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations per season were analysed to determine the following statistics for every grid cell:

- Exposure load (concentrations);
- Minimum time before exposure;
- Maximum duration of exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may accumulate on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines;
- Exposure (instantaneous) to dissolved hydrocarbons in the water column; and
- Exposure (instantaneous) to entrained hydrocarbons in the water column.

7.1 Floating, Shoreline and In-Water Thresholds

The thresholds and their relationship to exposure for the sea surface, shoreline and water column (entrained and dissolved hydrocarbons) are presented in Sections 7.1.1 to 7.1.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of influence are also provided. It is important to note that the thresholds herein are based on NOPSEMA (2019).

7.1.1 Floating Oil Exposure Thresholds

The modelling results can be presented to any levels; therefore, thresholds have been specified (based on scientific literature) to record floating oil exposure to the sea-surface at meaningful levels only, described in the following paragraphs.

The low threshold to assess the potential for floating oil exposure, was 1 g/m^2, which equates approximately to an average thickness of 1 µm, referred to as visible oil. Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009; AMSA, 2014) (see Table 7-1). Figure 7-1 shows photographs highlighting the difference in appearance between a silvery sheen, rainbow sheen and metallic sheen. This threshold is considered below levels which would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure. Table 7-1 provides a description of the appearance in relation to exposure zone thresholds used to classify the zones of floating oil exposure.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) according to French et al. (1996) and French-McCay (2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance of oil at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009).

Scholten et al. (1996) and Koops et al. (2004) indicated that at oil concentrations on the sea surface of 25 g/m^2 (or greater), would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening. The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009). For this study the high exposure threshold was set to 50 g/m^2 and above based on NOPSEMA (2019). This threshold can also be used to inform response planning.

Table 7-2 defines the thresholds used to classify the zones of floating oil exposure reported herein.

Table 7-1 The Bonn Agreement Oil Appearance Code.

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	≥ 200	≥ 200,000

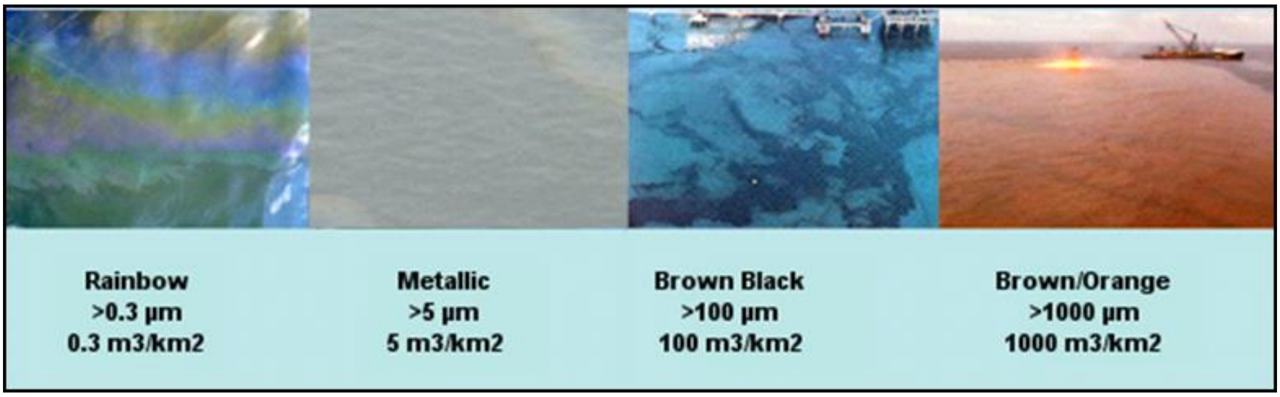


Figure 7-1 Photographs showing the difference between oil colour and thickness on the sea surface (source: adapted from Oil Spill Solutions, 2015).

Table 7-2 Floating oil exposure thresholds used in this report (in alignment with NOPSEMA, 2019).

Threshold level	Floating oil (g/m^2)	Description
Low	1	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring
Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals
High	50	Approximates surface oil slick and informs response planning

7.1.2 Shoreline Accumulation Thresholds

There are many different types of shorelines, ranging from cliffs, rocky beaches, sandy beaches, mud flats and mangroves, and each of these influences the volume of oil that can remain stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. A sandy beach shoreline was assumed as the default shoreline type for the modelling herein, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types). Hence the results contained herein would be indicative of a worst-case scenario, where the highest volume of oil may be stranded on the shoreline (when compared to other shoreline types, such as exposed rocky shores).

In previous risk assessment studies, French-McCay et al. (2005a; 2005b) used a threshold of 10 g/m^2 to assess the potential for shoreline accumulation. This is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m^2 shoreline accumulation threshold has been selected to define the zone of potential “low shoreline accumulation”.

French et al. (1996) and French-McCay (2009) define a shoreline oil accumulation threshold of 100 g/m^2, or above, would potentially harm shorebirds and wildlife (furbearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011; 2012; NOAA, 2013). Additionally, a shoreline concentration of 100 g/m^2, or above, is the minimum limit that the oil can be effectively cleaned according to the AMSA (2015) guideline. This threshold equates to approximately ½ a cup of oil per square meter of shoreline accumulation. The appearance is described as a thin oil coat. Therefore, 100 g/m^2 has been selected to define the zone of potential “moderate shoreline accumulation”.

Observations by Lin & Mendelssohn (1996) demonstrated that loadings of more than 1,000 g/m^2 of hydrocarbon during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing hydrocarbon impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). Hence, 1,000 g/m^2 has been selected to define the zone of potential "high shoreline accumulation". It equates to approximately 1 litre of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a hydrocarbon cover.

It is worth noting that the shoreline accumulation thresholds derived from extensive literature review (outlined in Table 7-3) agree with the commonly used threshold values for oil spill modelling specified in NOPSEMA (2019).

Table 7-3 Thresholds used to assess shoreline accumulation.

Threshold level	Shoreline loading (g/m^2)	Description
Low (socioeconomic/sublethal)	10	Predicts potential for some socio-economic impact
Moderate	100	Loading predicts area likely to require clean-up effort
High	> 1,000	Loading predicts area likely to require intensive clean-up effort

7.1.3 In-water Exposure Thresholds

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

7.1.3.1 Dissolved Hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed "bioavailable".

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan & Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; Mackay et al., 1992; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath and Di Toro, 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2-3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb total PAH concentration after 96 hrs exposure, with an average of 50 ppb. Hence, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of 10, 50 or 400 ppb over a 1-hour timestep (see Table 7-4) was applied to indicate increasing potential for sub-lethal to lethal toxic effects (or low to high), based on NOPSEMA (2019).

7.1.3.2 Entrained Hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. As such, insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, hence are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2005).

The 10 ppb threshold represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more.

This exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.

Thresholds of 10 ppb and 100 ppb were applied over a 1-hour time exposure (Table 7-4), to cover the range of thresholds outlined in ANZECC & ARMCANZ (2000) water quality guidelines, the incremental change for greater potential effect and is per NOPSEMA (2019).

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

Table 7-4 Dissolved and entrained hydrocarbon exposure values assessed over a 1-hour time step, as per NOPSEMA (2019).

Threshold level	Dissolved hydrocarbon concentration (ppb)	Entrained hydrocarbon concentrations (ppb)
Low	10	10
Moderate	50	-
High	400	100

8 OIL PROPERTIES

8.1 Oil Characteristics

Table 8-1 and Table 8-2 present the physical properties and boiling point ranges of Thylacine condensate.

Thylacine condensate has an API of 44.3 and a density of 804.6 kg/m^3 (at 15ºC) with a viscosity value (0.87.0 cP) classifying it as a Group I (not-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications.

The condensate is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi- to low-volatile components. In favourable evaporation conditions, about 64.0% of the oil mass should evaporate within the first 12 hours (BP < 180°C), a further 19.0% should evaporate within the first 24 hours (180°C < BP < 265°C) and a further 16.0% should evaporate over several days (265°C < BP < 380°C). Approximately 1.0% of the oil is shown to be persistent.

Table 8-1 Physical properties for Thylacine condensate.

Characteristic	Thylacine Condensate
Density (kg/m^3)	804.6 (at 15°C)
API	44.3
Dynamic viscosity (cP)	0.87 (at 20°C)
Pour point (°C)	-50
Hydrocarbon property category	Group I
Hydrocarbon property classification	Not - Persistent

Table 8-2 Boiling point ranges for Thylacine condensate.

Oil Type	Component	Volatile (%)	Semi-volatile (%)	Low-volatility (%)	Residual (%)
	Boiling point (°C)	<180 C_4 to C_{10}	180-265 C_{11} to C_{15}	265-380 C_{16} to C_{20}	>380 $>C_{20}$
Thylacine condensate	% of total	64.0	19.0	16.0	1.0

The BP are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate.

Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C_4 to C_{10} compounds (or <180°C BP).
- Up to 24 hours for the C_{11} to C_{15} compounds (180–265°C BP).
- Several days for the C_{16} to C_{20} compounds (265–380°C BP).
- Not applicable for the residual compounds (BP >380°C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

The actual fate of oil will depend greatly on the amount that reaches the surface.

8.2 Weathering Characteristics

8.2.1 Overview

A series of model weather tests were conducted to illustrate the potential behaviour of Thylacine condensate when exposed to idealised and representative environmental conditions:

- A 50 m^3 surface release over 1-hour under calm wind conditions (constant 5 knots or 2.6 m/s), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

- A 50 m^3 surface release over 1-hour under variable wind conditions (1-12 knots or 1.9-23 m/s, drawn from representative data files), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

Note, a surface release is used in the weathering test to solely focus on the weathering and fates of the hydrocarbons when exposed to atmospheric conditions.

The first case is indicative conditions that would not generate entrainment, while the second case may represent conditions that could cause a minor degree of entrainment. Both scenarios provide examples of potential behaviour during a spill once the oil reaches the surface.

8.2.2 Thylacine Condensate Mass Balance Forecasts

The mass balance for the condensate under the constant 5 knot wind case (Figure 8-1) shows that 82.5% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation shall cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 8-2), where the winds are of greater strength on average, entrainment of the condensate into the water column is predicted to increase. Approximately 24 hours after the spill, 22.1% of the oil mass is forecast to have entrained and a further 69.4% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<0.1%).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of 1.9% per day with or ~10.9% after 7 days, compared to <0.1% per day and a total of 0.8% after 7 days for the constant-wind case. Given the proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

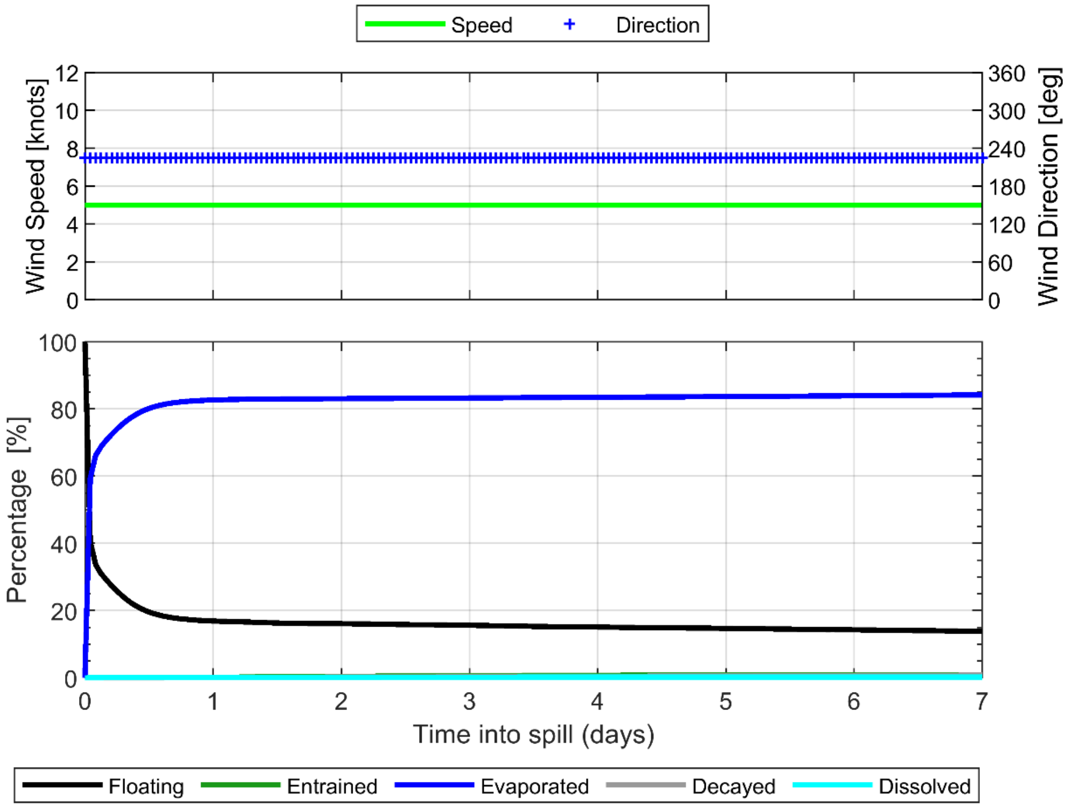


Figure 8-1 **Proportional mass balance plot representing the weathering of Thylacine condensate spilled onto the water surface over 1 hour and subject to a constant 5 knots (2.6 m/s) wind speed at 15°C water temperature and 20°C air temperature.**

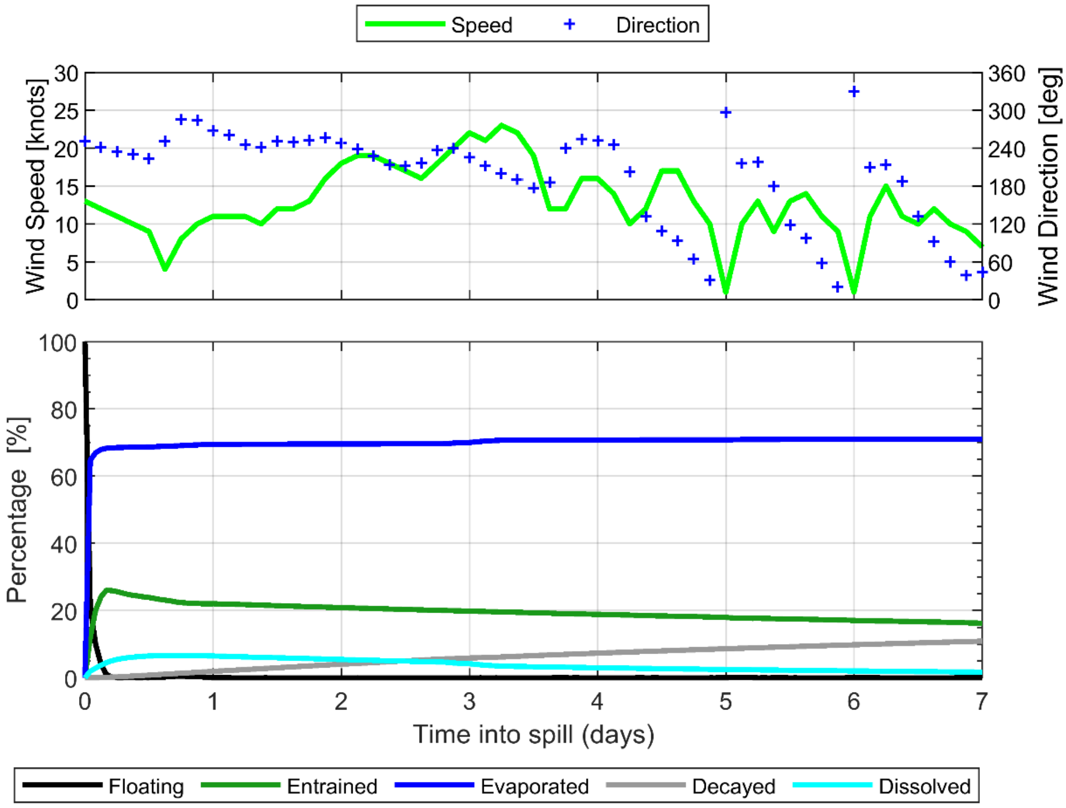


Figure 8-2 **Proportional mass balance plot representing the weathering of Thylacine condensate spilled onto the water over 1 hour and subject to variable wind speeds (1-12 knots or 1.9-23 m/s) at 15°C water temperature and 20°C air temperature.**

9 MODEL SETTINGS

Table 9-1 provides a summary of the oil spill model settings.

Table 9-1 Summary of the oil spill model settings and thresholds used in this assessment.

Parameter	Scenario
Description	Loss of containment
Number of randomly selected spill start times	200 (100 per season)
Model period	Summer (November through to March) Winter (April to October)
Oil type	Thylacine condensate
Spill volume (m^3) [bbl]	18,283 [114,982]
Release type	Subsea
Release duration	86 days
Simulation length	100 days
Surface oil concentration thresholds (g/m^2) ^	1 (low); 10 (moderate); 50 (high)
Shoreline oil accumulation thresholds (g/m^2) ^	10 (low); 100 (moderate); 1,000 (high)
Dissolved hydrocarbon concentrations (ppb) ^	10 (low); 50 (moderate); 400 (high)
Entrained hydrocarbon concentrations (ppb) ^	10 (low); 100 (high)

^Thresholds based on NOPSEMA (2019)

10 PRESENTATION AND INTERPRETATION OF MODEL RESULTS

The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of the predicted sea-surface and water column (subsurface) exposure and shoreline accumulation (if predicted).

10.1 Annual Analysis

10.1.1 Statistics

The statistics are based on the following principles:

- The ***greatest distance travelled by a spill trajectory*** – is determined by a) recording the maximum and b) second greatest distance travelled (or 99th percentile) by a single trajectory, within a scenario, from the release location to the identified exposure thresholds.

- The ***probability of oil exposure to a receptor*** – is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.

- The ***minimum time before oil exposure to a receptor*** – is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.

- The ***maximum residence time for oil exposure within a receptor*** – is determined by recording the longest continuous length of time a grid cell is exposed to either floating, entrained or dissolved hydrocarbon above each threshold, within a receptor.

- The ***probability of oil accumulation at a receptor*** – is determined by recording the number of spill trajectories to reach a specified shoreline accumulation threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.

- The ***maximum potential oil loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario.

- The ***dissolved and entrained hydrocarbon exposure*** – is determined by recording the maximum instantaneous concentrations at each grid cell.

- ***Maximum total volume*** ashore (found in shoreline statistics table)- Is the total volume of oil stranded on the shorelines throughout the duration of the simulation.

- ***Maximum instantaneous peak volume ashore*** (found in the deterministic analysis section and derived from the histogram) - Is the peak volume of oil accumulated on shorelines at a single point in time. This peak value does not include oil that came ashore earlier in the simulation and was subsequently lost through evaporation or other weathering processes.

10.2 Deterministic Trajectories

The stochastic modelling results were assessed for the scenario, and the deterministic runs were identified and are presented in the result section based on the following criteria.

a. largest instantaneous peak volume of oil ashore;

b. minimum time before shoreline contact above 10 g/m^2;

c. largest swept area of oil on the sea surface above 10 g/m^2;

d. largest entrained oil swept area above 100 ppb; and

e. largest dissolved oil swept area above 400 ppb.

10.2.1 Receptors Assessed

A range of environmental receptors and shorelines were assessed for floating oil exposure, shoreline accumulation and water column exposure as part of the study (see Figure 10-1 to Figure 10-11). Receptor categories (see Table 10-1) include sections of shorelines which are defined by local government areas (LGAs), sub-LGAs and offshore islands. All other sensitive receptors other than submerged reefs, shoals and banks (RSB) were sourced from Australian Government Department of Climate Change, Energy, the Environment and Water (http://www.environment.gov.au/).

Risks of exposure were separately calculated for each sensitive receptor area and have been tabulated.

Table 10-2 summarises the receptors that the release location resides within.

Table 10-1 Summary of receptors used to assess floating oil, shoreline and in-water exposure to hydrocarbons.

Receptor Category	Acronym	Hydrocarbon Exposure Assessment			Figure reference
		Water Column	Floating oil	Shoreline	
Australian Marine Park	AMP	✓	✓	×	Figure 10-1
Integrated Marine and Coastal Regionalisation Areas	IMCRA	✓	✓	×	Figure 10-2
Marine National Park	MNP	✓	✓	×	Figure 10-3
Marine Park	MP	✓	✓	×	Figure 10-4
Nature Reserve	NR	✓	✓	×	Figure 10-5
Ramsar	Ramsar	✓	✓	✓	Figure 10-6
Reefs, Shoals and Banks	RSB	✓	✓	×	Figure 10-7
Key Ecological Feature	KEF	✓	✓	×	Figure 10-8
State Waters	State Waters	✓	✓	×	
Local Government Areas	LGA	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Shore)	Figure 10-9 to Figure 10-11

Table 10-2 Summary of the receptors that the release location resides within.

Acronym	Receptor
BIA	Antipodean Albatross – Foraging
	Black-browed Albatross – Foraging
	Buller’s Albatross – Foraging
	Campbell Albatross – Foraging
	Common Diving-petrel – Foraging
	Indian Yellow-nosed Albatross – Foraging
	Pygmy Blue Whale – Distribution
	Pygmy Blue Whale - Foraging (annual high use area)
	Short-tailed Shearwater – Foraging
	Shy Albatross – Foraging
	Southern Right Whale - Known Core Range
	Wandering Albatross – Foraging
	Wedge-tailed Shearwater – Foraging
	White Shark – Distribution
IMCRA	Otway

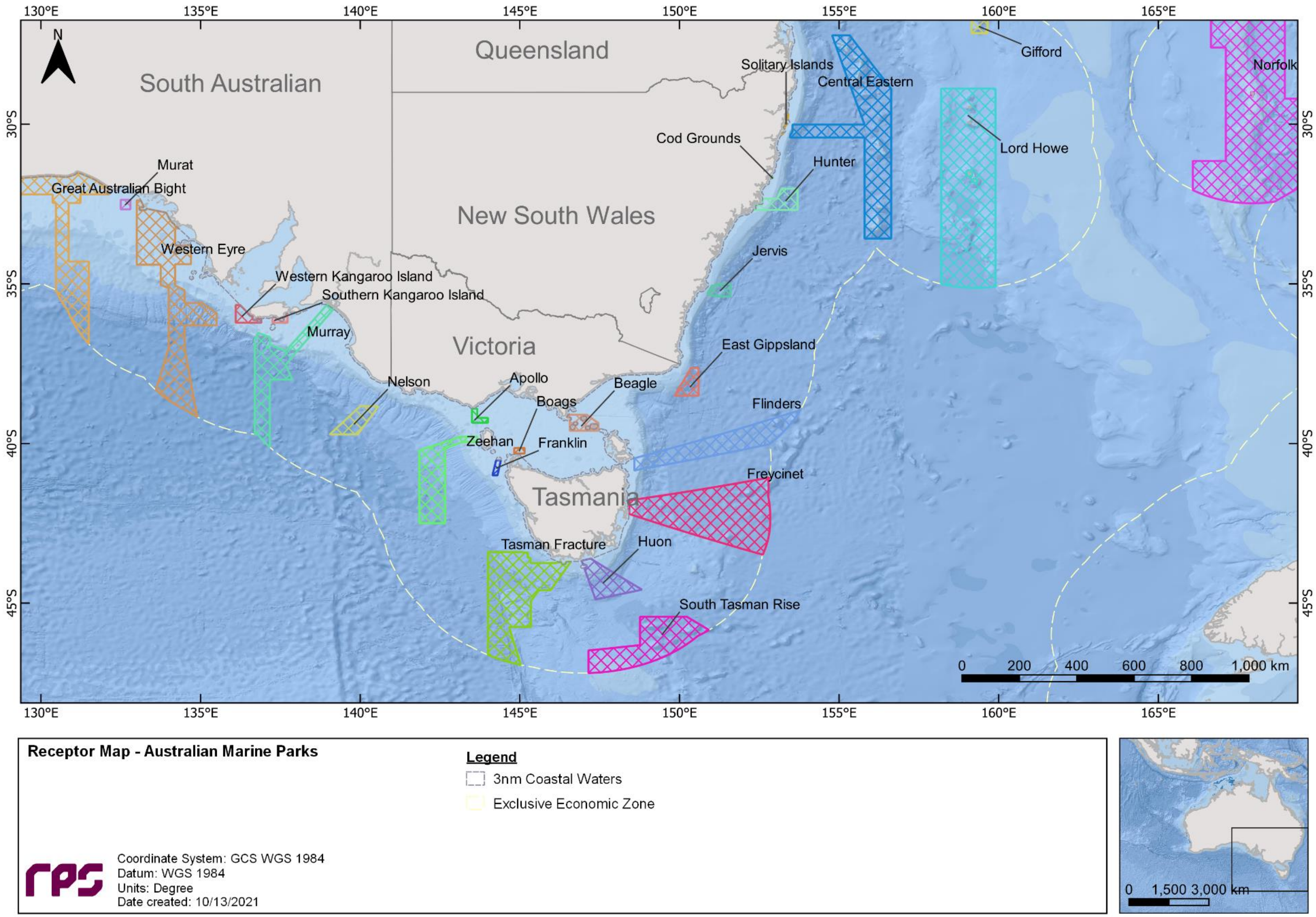


Figure 10-1 Receptor map for Australian Marine Parks (AMP).

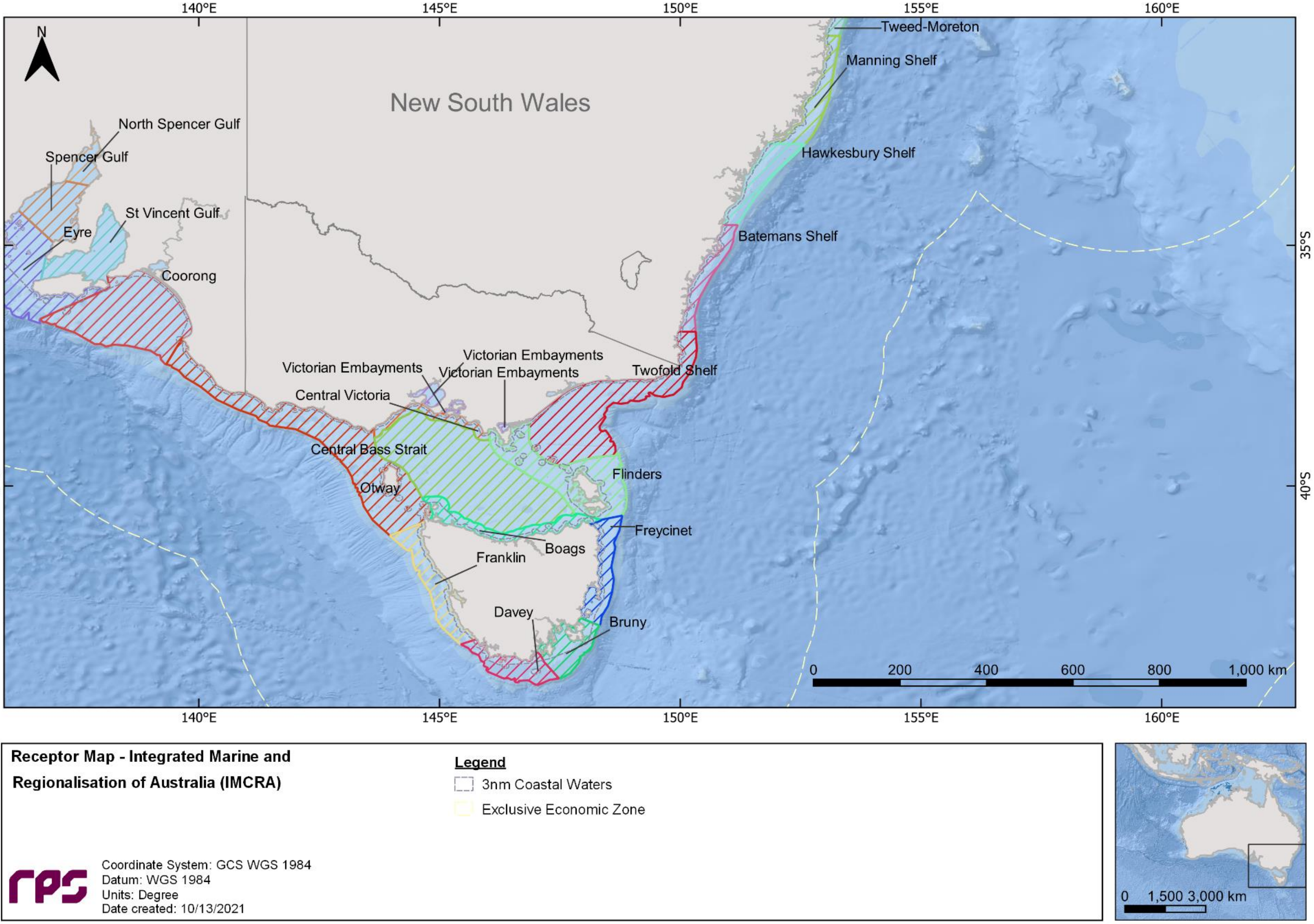


Figure 10-2 Receptor map for integrated marine and coastal regionalisation (IMCRA) areas.

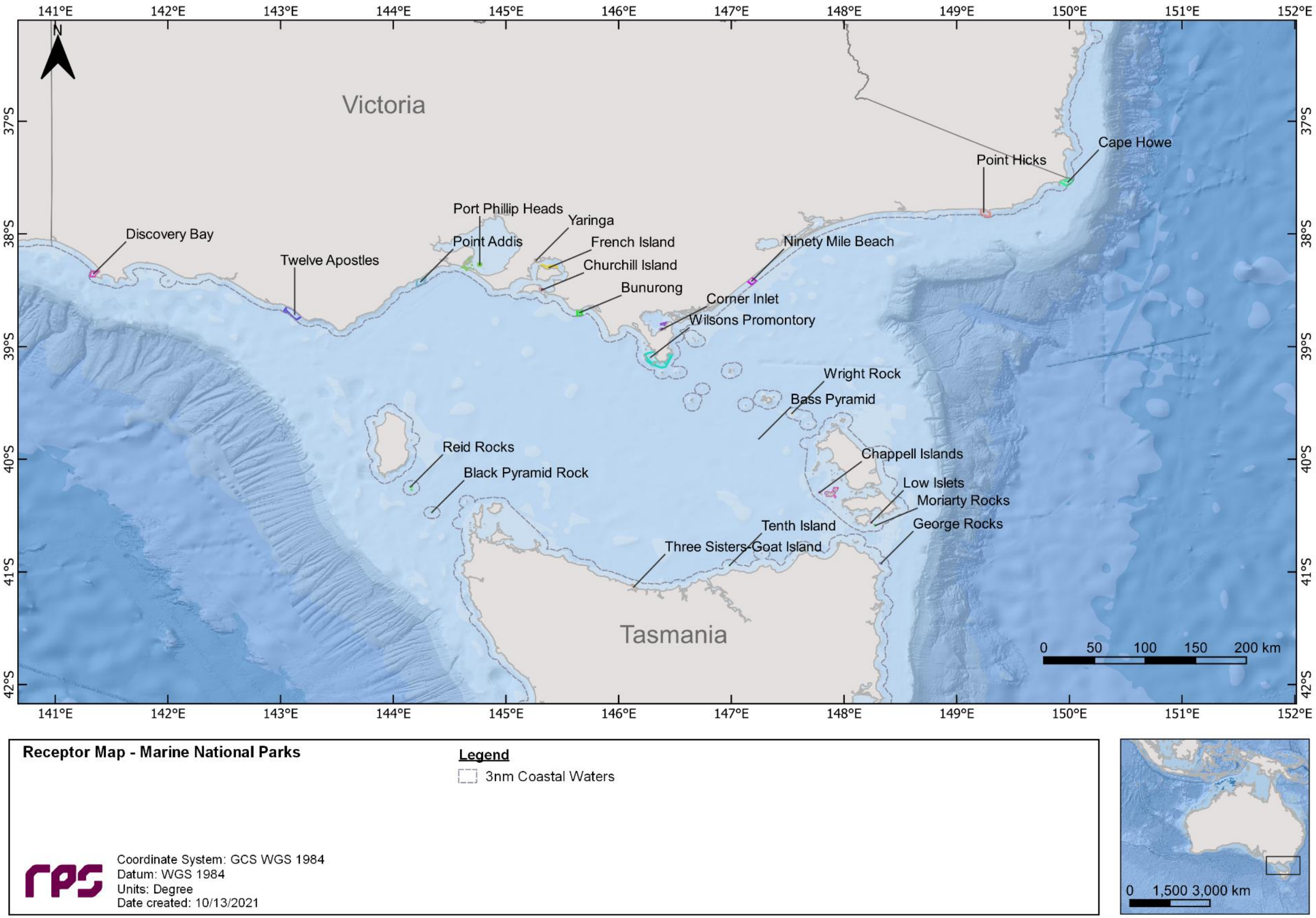


Figure 10-3 Receptor map for Marine National Parks (MNP).

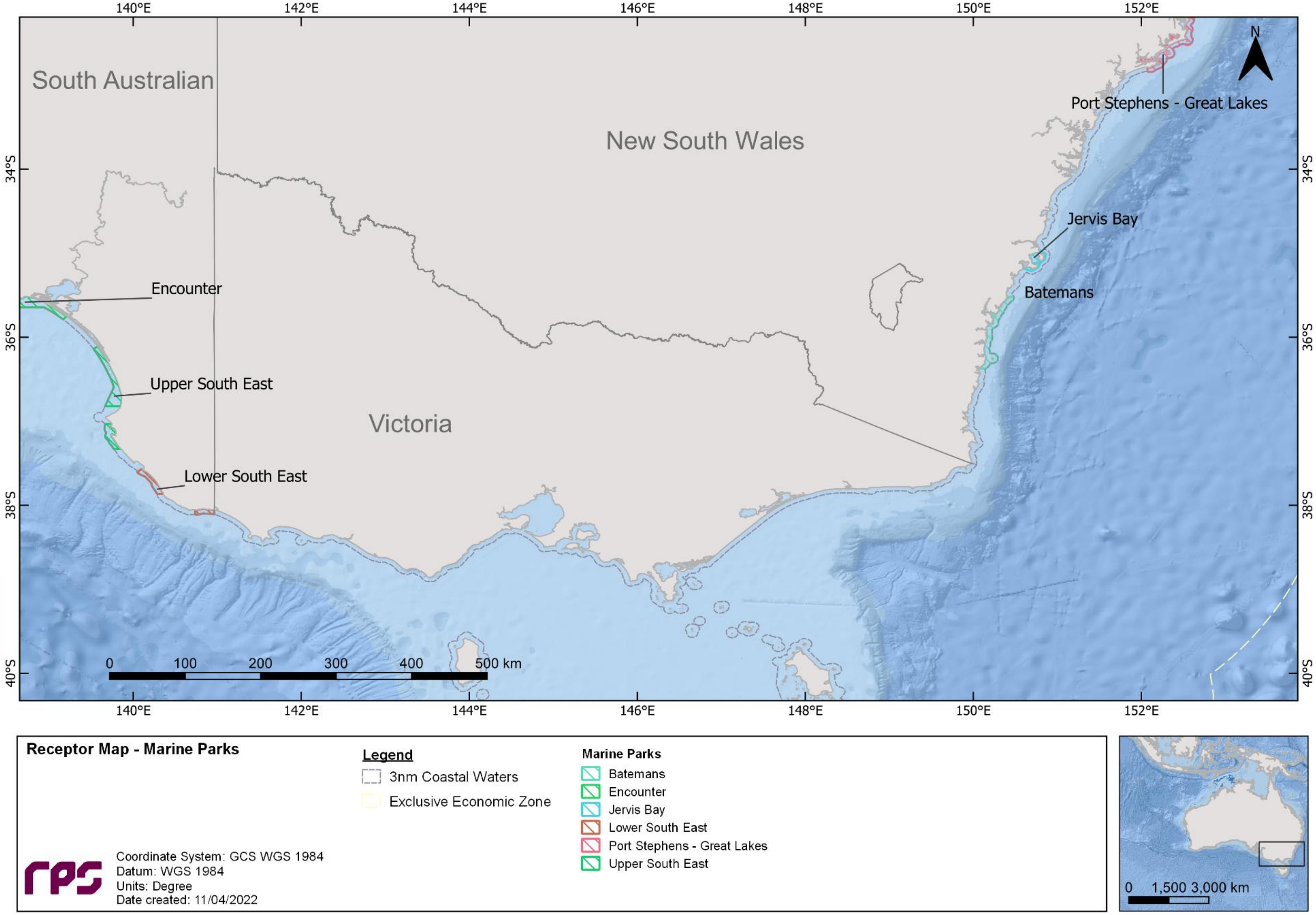


Figure 10-4 **Receptor map for Marine Parks (MP).**

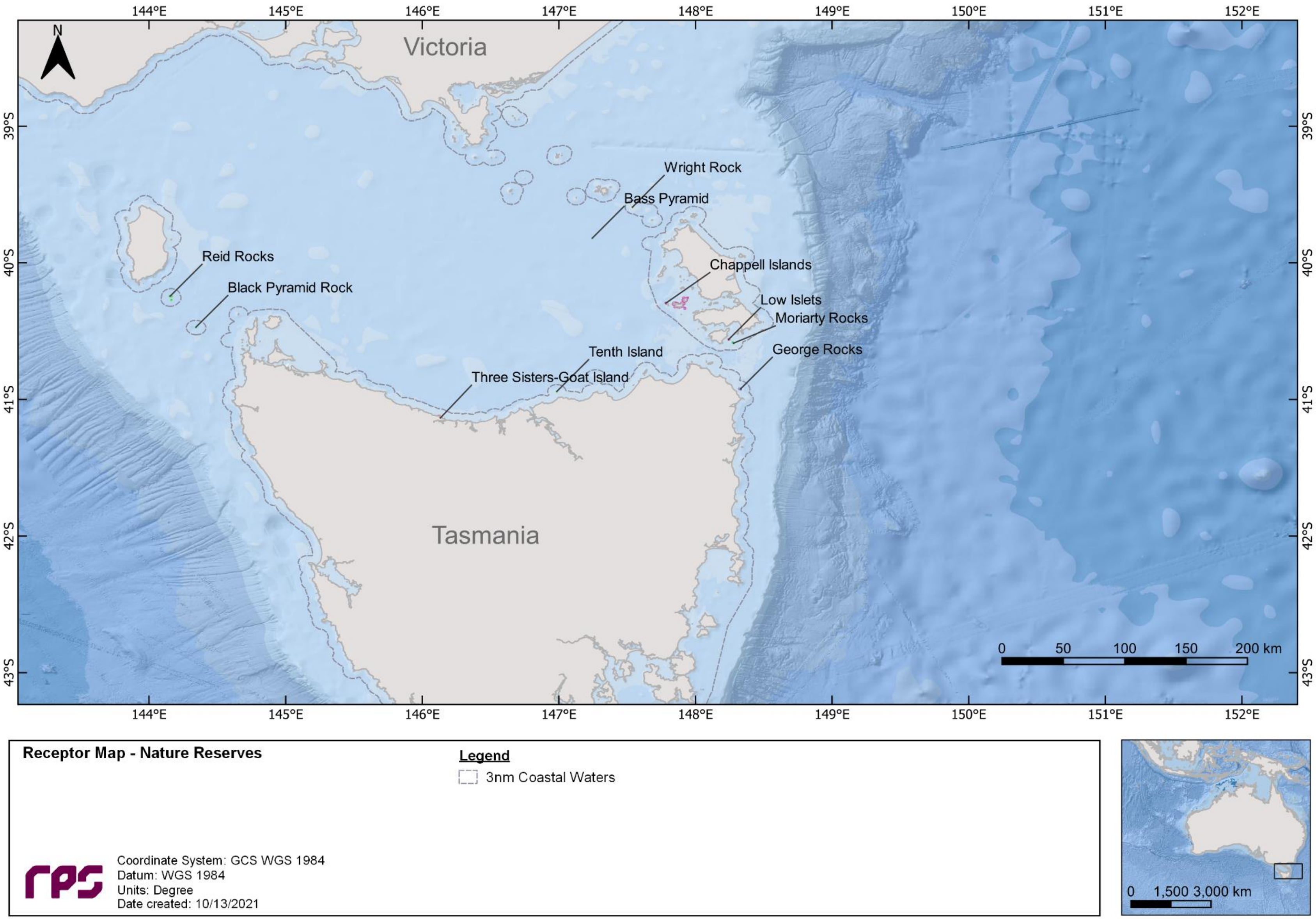


Figure 10-5 Receptor map for Nature Reserves (NR).

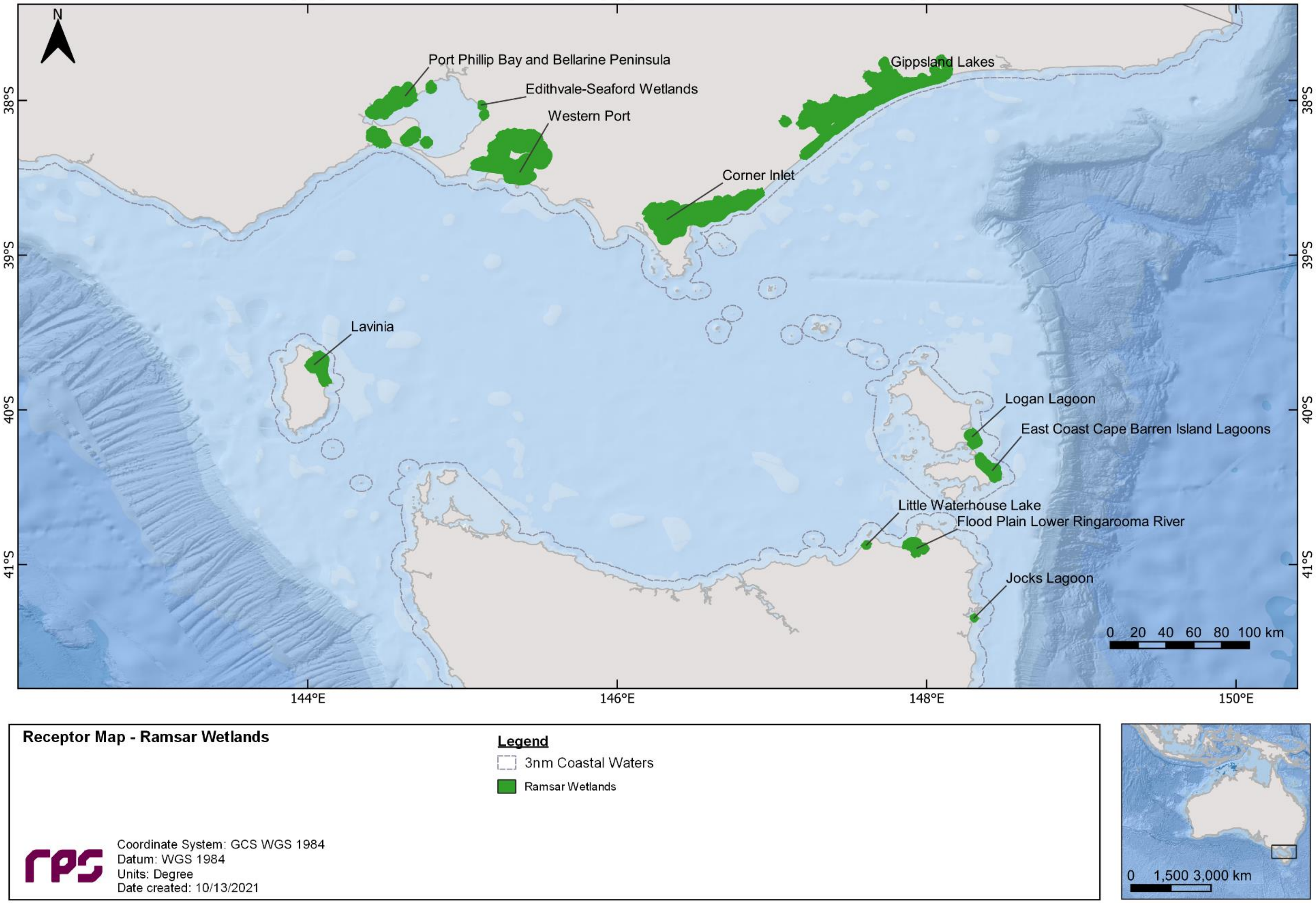


Figure 10-6 Receptor map for Ramsar Sites (Ramsar).

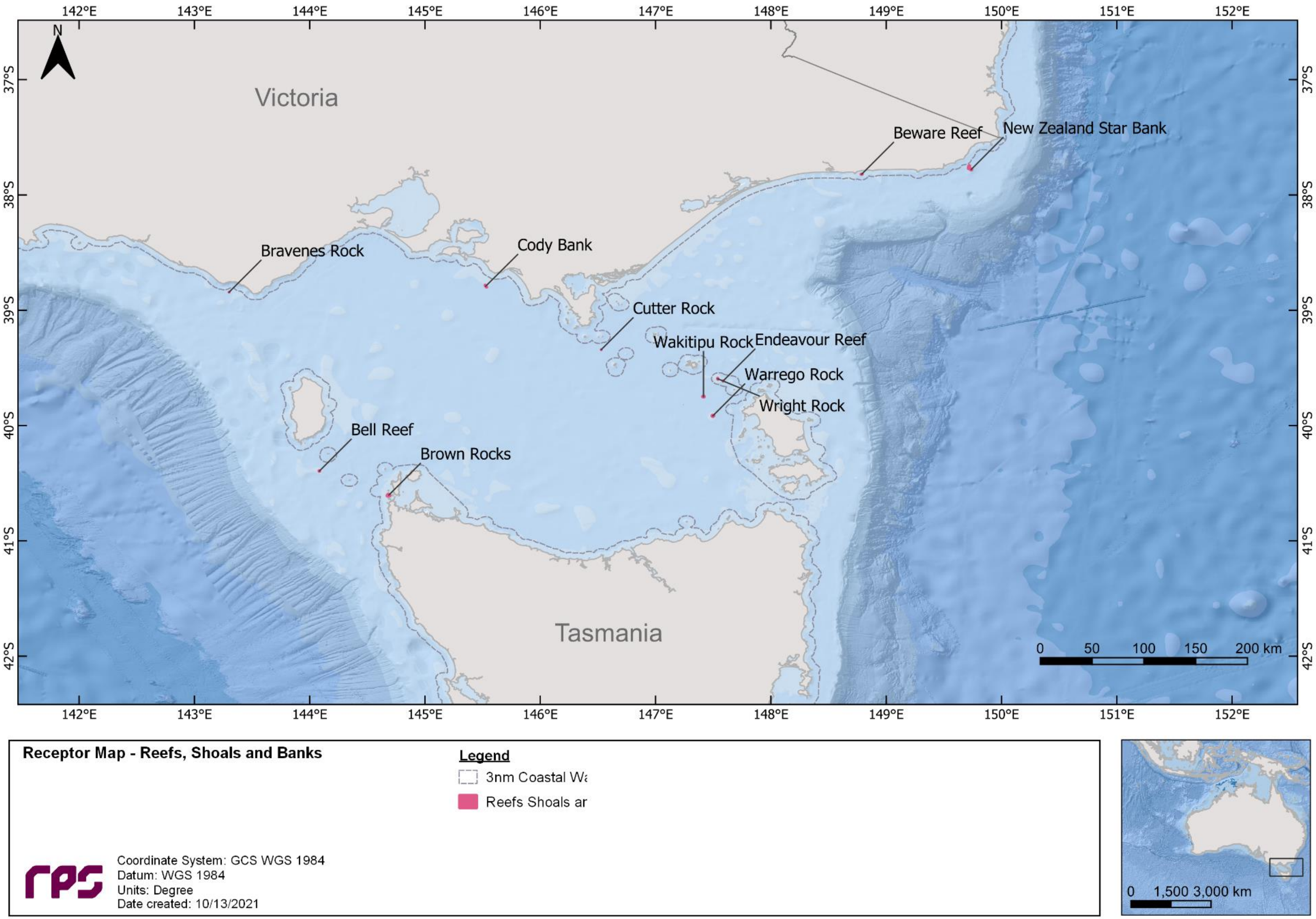


Figure 10-7 **Receptor map for Reefs, Shoals and Banks (RSB).**

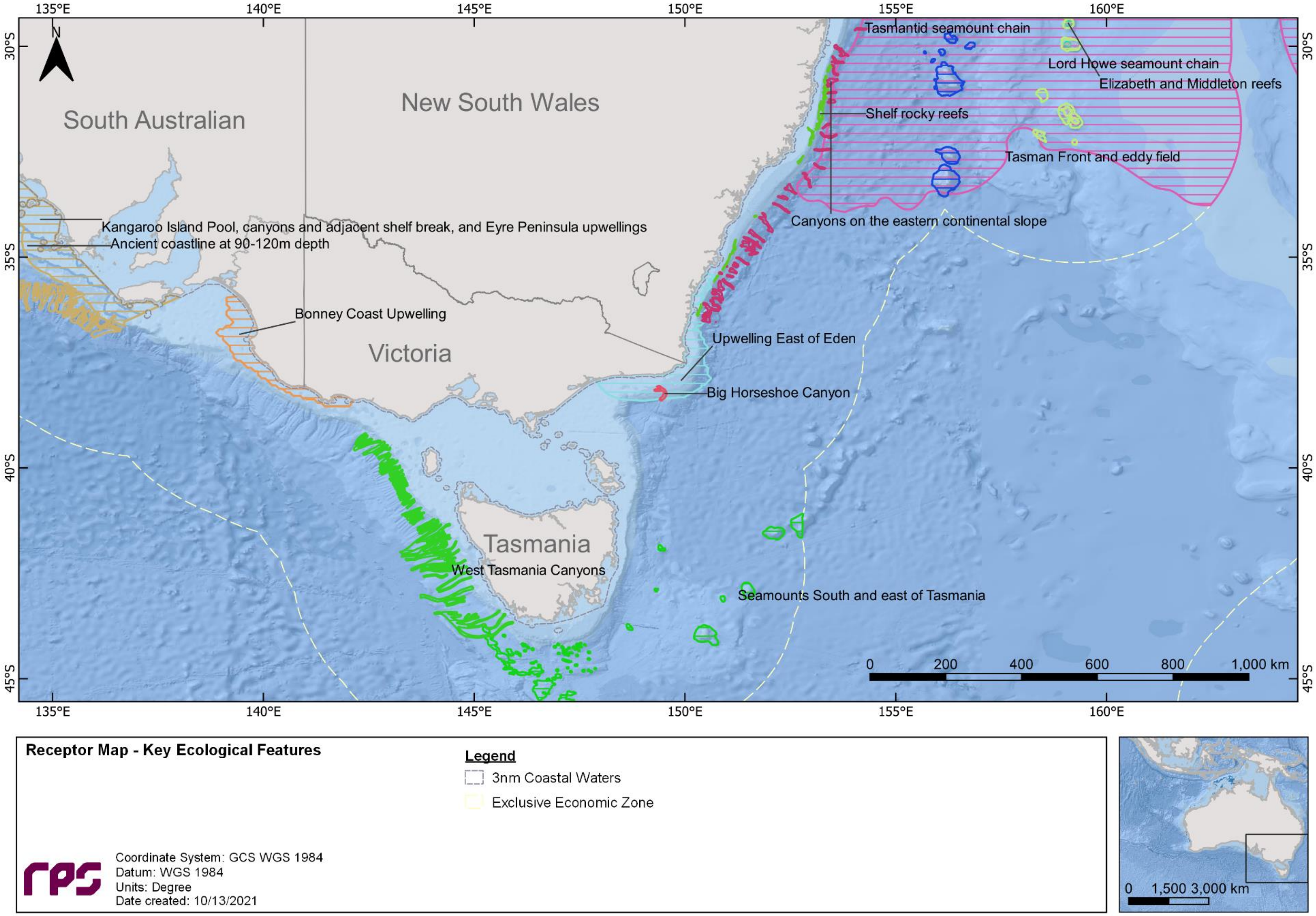


Figure 10-8 Receptor map for Key Ecological Features (KEF).

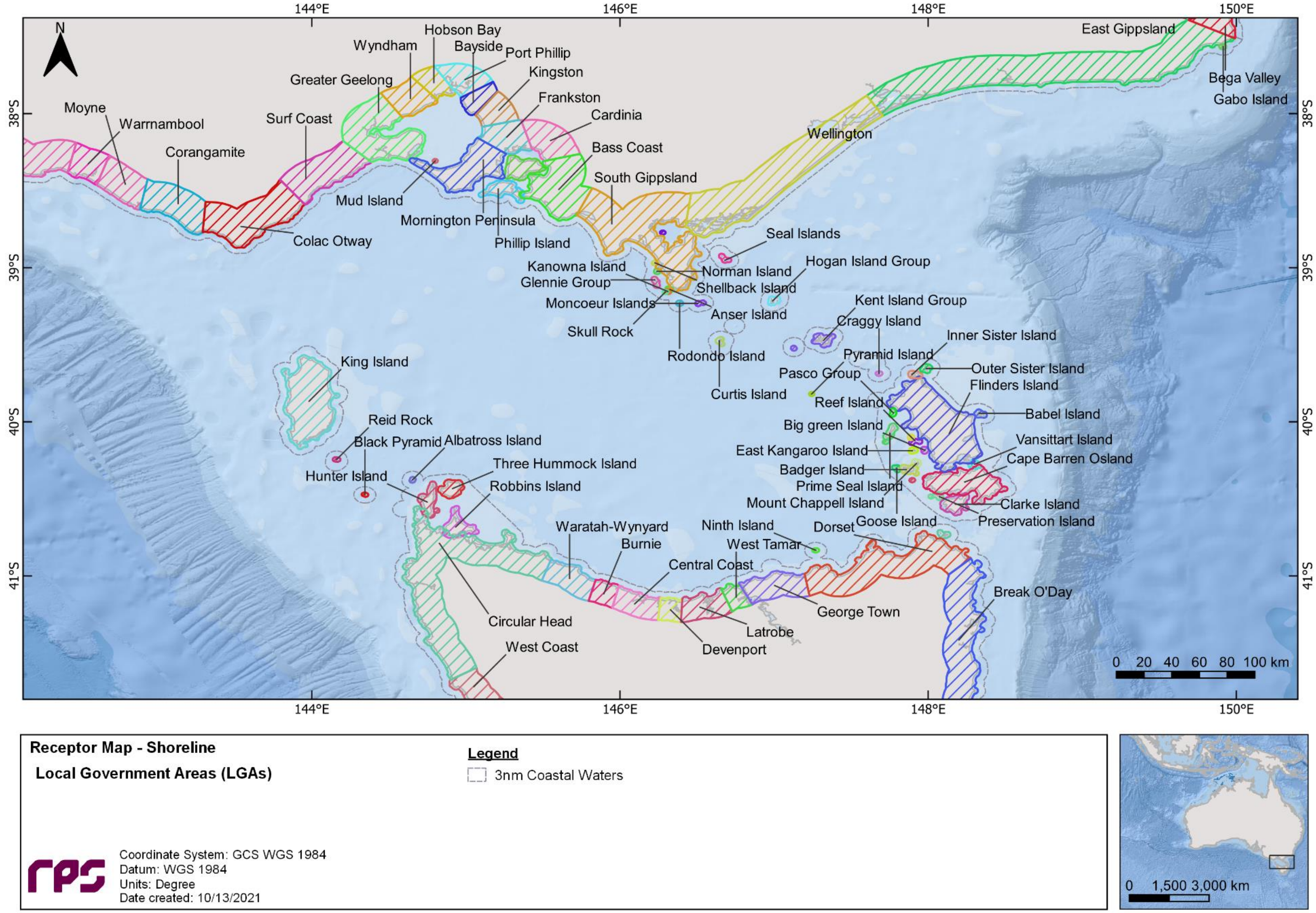


Figure 10-9 Receptor map for shorelines (1 of 3).

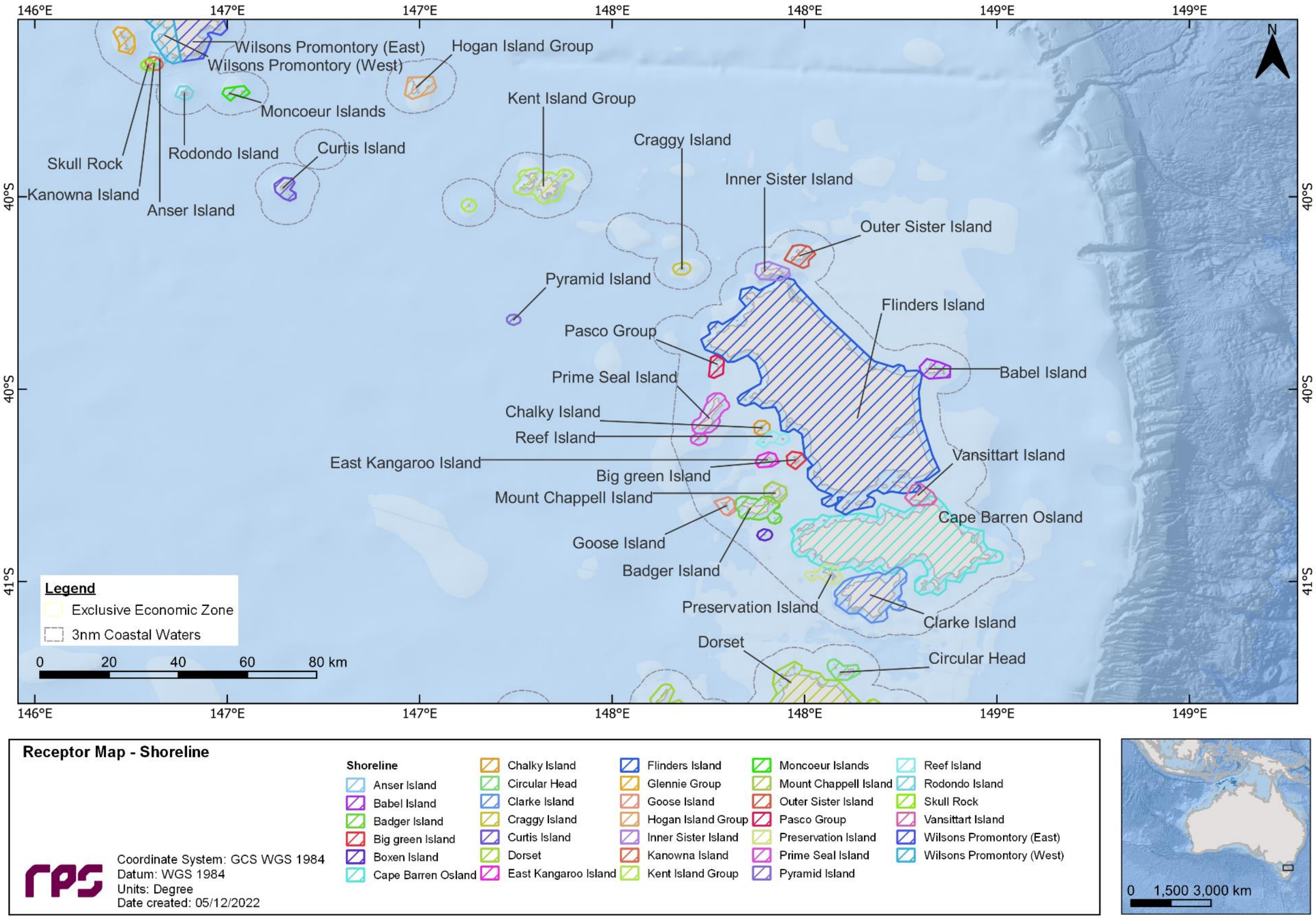


Figure 10-10 Receptor map for shorelines (2 of 3).

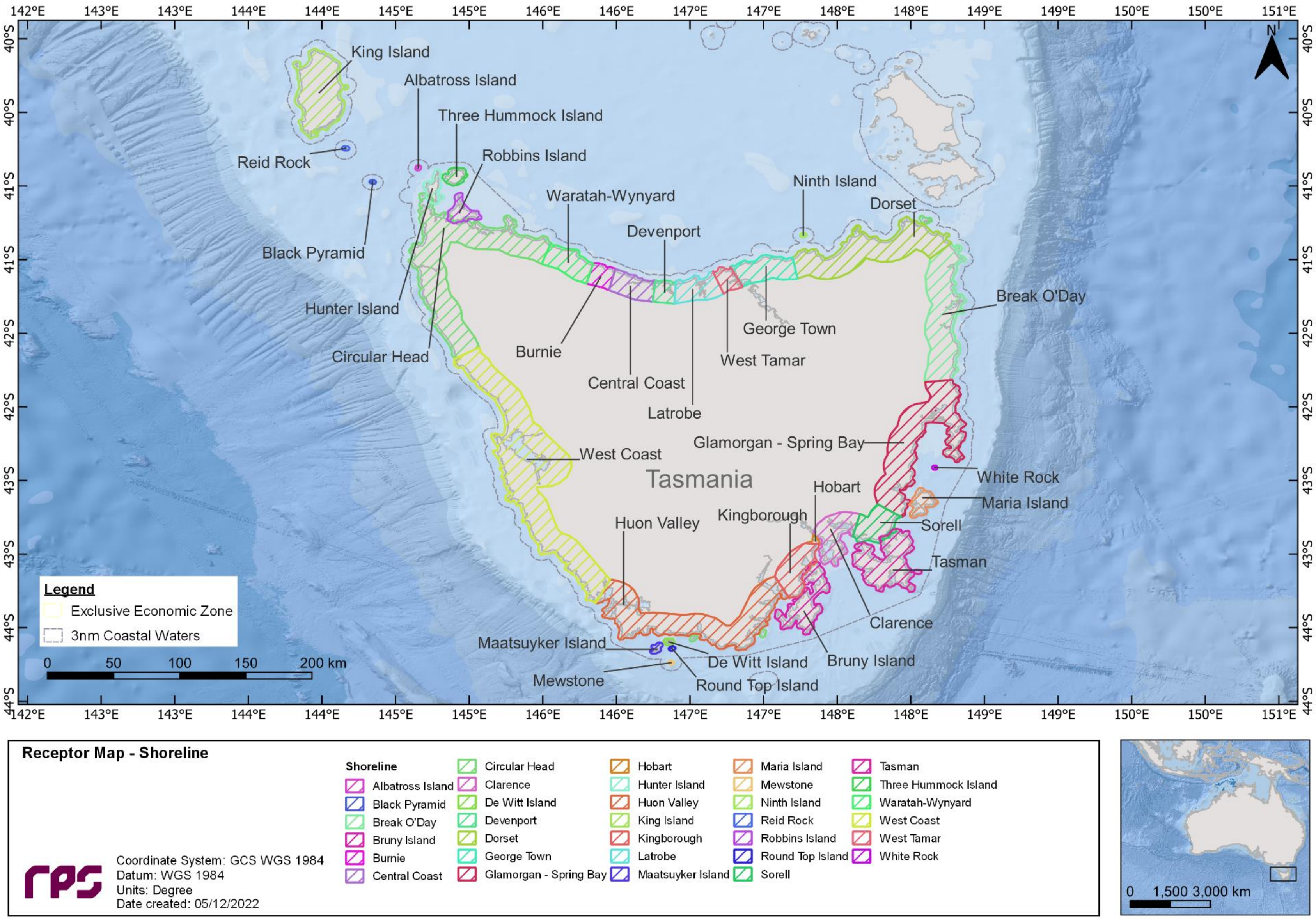


Figure 10-11 Receptor map for shorelines (3 of 3).

11 RESULTS – 212.6 M³/DAY LOSS OF WELL CONTROL AT TW-1

This scenario examined a 212.6 m³/day subsea release of Thylacine condensate over 86 days to represent a loss of containment at TW-1. A total of 200 spill simulations were run (i.e., 100 spills per season) and tracked for 100 days. The results for all 100 simulations per season were combined and are presented on a seasonal basis (i.e., summer and winter).

Sections 11.1 and 11.2 present the annual stochastic analysis and deterministic analysis results, respectively.

11.1 Stochastic Analysis

11.1.1 Area of Exposure

Figure 11-1 presents the combined area of potential exposure for surface, shoreline, entrained and dissolved, by overlaying the results from all 200 simulations (i.e., 100 per season) during summer and winter conditions.

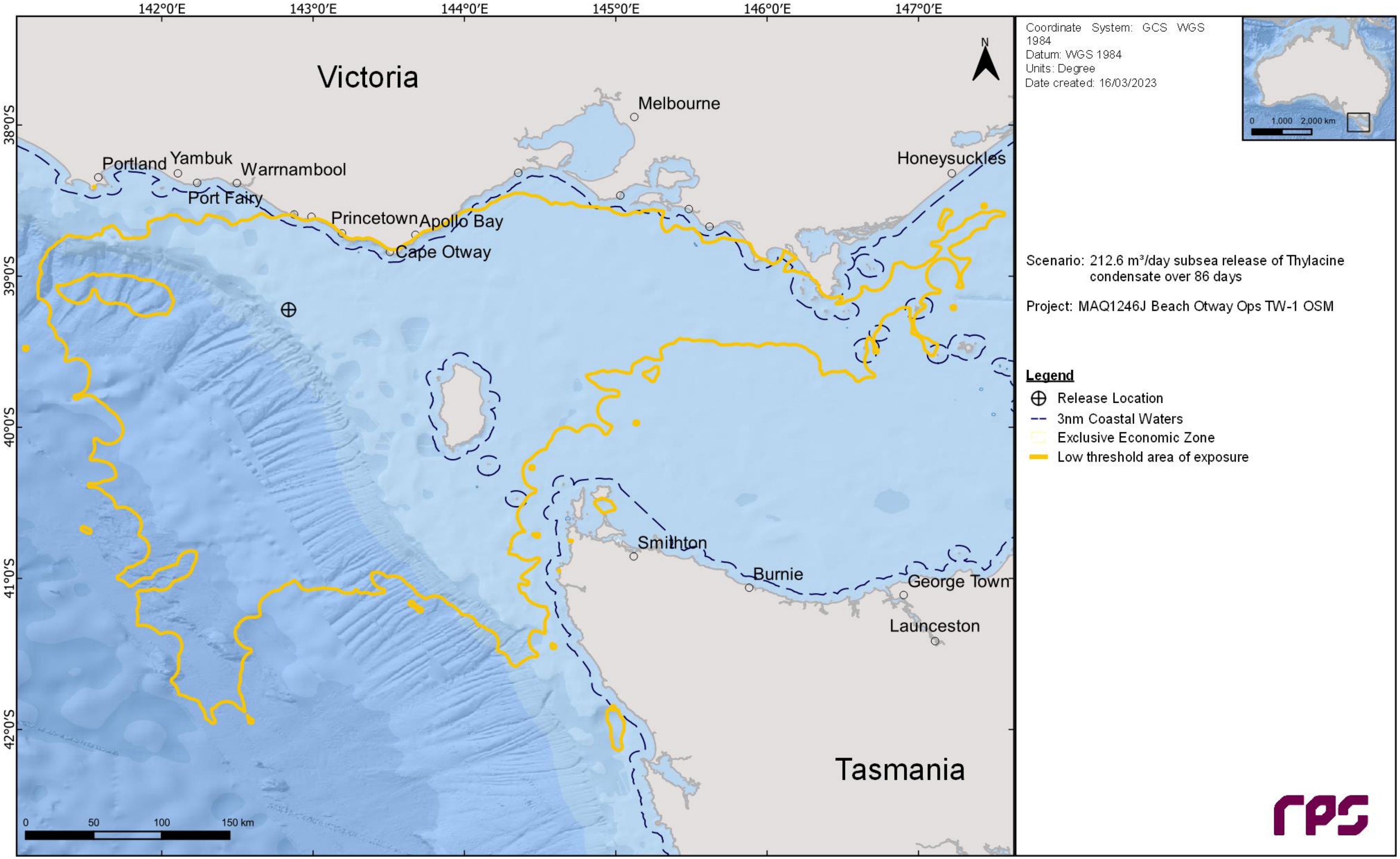


Figure 11-1 Predicted area of exposure for low thresholds produced by overlaying the results from all 200 simulations, resulting from a 212.6 m³/day subsea release of Thylacine condensate over 86 days during summer and winter conditions.

11.1.2 Floating Oil Exposure

Table 11-1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance from the release location to the low (1–10 g/m^2) and moderate (10–50 g/m^2) exposure zones was 44.5 km (southeast) during summer conditions and 0.4 km (south) during winter conditions, respectively. Note, no floating oil exposure above the high (> 50 g/m^2) threshold was predicted by the modelling.

Table 11-2 summarises the potential floating oil exposure to individual receptors during the summer and winter conditions. Outside of the receptors that the TW-1 well resides within (refer to Table 10-2), floating oil exposure above the low threshold was predicted at the West Tasmania Canyons KEF (2%) during summer only and the Pygmy Blue Whale – Foraging BIA (40% in summer and 25% in winter).

Table 11-3 presents the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor during summer and winter.

Figure 11-2 and Figure 11-3 present the zones of potential floating oil exposure for all thresholds under summer and winter conditions, respectively.

Figure 11-4 and Figure 11-5 present the maximum residence time of floating oil exposure for the NOPSEMA thresholds during summer and winter, respectively.

Table 11-1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Season	Distance and direction travelled	Zones of potential floating oil exposure		
		Low	Moderate	High
Summer	Maximum distance (km) from release location	44.5	-	-
	Maximum distance (km) from release location (99th percentile)	40.2	-	-
	Direction	SE	-	-
Winter	Maximum distance (km) from release location	20.6	0.4	-
	Maximum distance (km) from release location (99th percentile)	18.1	0.4	-
	Direction	South-southeast	South	-

Table 11-2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)						Winter (April to October)					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Black-browed Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Buller's Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Campbell Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Common Diving-petrel – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Indian Yellow-nosed Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Pygmy Blue Whale – Distribution*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Pygmy Blue Whale - Foraging	40	-	-	2.13	-	-	25	-	-	2.21	-	-
	Pygmy Blue Whale - Foraging (annual high use area) *	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Short-tailed Shearwater – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Shy Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Southern Right Whale - Known Core Range*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Wandering Albatross – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	Wedge-tailed Shearwater – Foraging*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
	White Shark – Distribution*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
IMCRA	Otway*	100	-	-	0.04	-	-	100	3	-	0.04	25.42	-
KEF	West Tasmania Canyons	2	-	-	28.92	-	-	-	-	-	-	-	-

*The release location resides within the receptor boundaries.

Table 11-3 Summary of the maximum residence time of floating oil exposure for each individual grid cell within each individual receptor. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum residence time of floating oil exposure (days)			Maximum residence time of floating oil exposure (days)		
		Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Black-browed Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Buller's Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Campbell Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Common Diving-petrel – Foraging*	68.67	-	-	65.67	0.04	-
	Indian Yellow-nosed Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Pygmy Blue Whale – Distribution*	68.67	-	-	65.67	0.04	-
	Pygmy Blue Whale - Foraging	0.46	-	-	0.13	-	-
	Pygmy Blue Whale - Foraging (annual high use area) *	68.67	-	-	65.67	0.04	-
	Short-tailed Shearwater – Foraging*	68.67	-	-	65.67	0.04	-
	Shy Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Southern Right Whale - Known Core Range*	68.67	-	-	65.67	0.04	-
	Wandering Albatross – Foraging*	68.67	-	-	65.67	0.04	-
	Wedge-tailed Shearwater – Foraging*	68.67	-	-	65.67	0.04	-
	White Shark – Distribution*	68.67	-	-	65.67	0.04	-
IMCRA	Otway*	68.67	-	-	65.67	0.04	-
KEF	West Tasmania Canyons	0.04	-	-	-	-	-

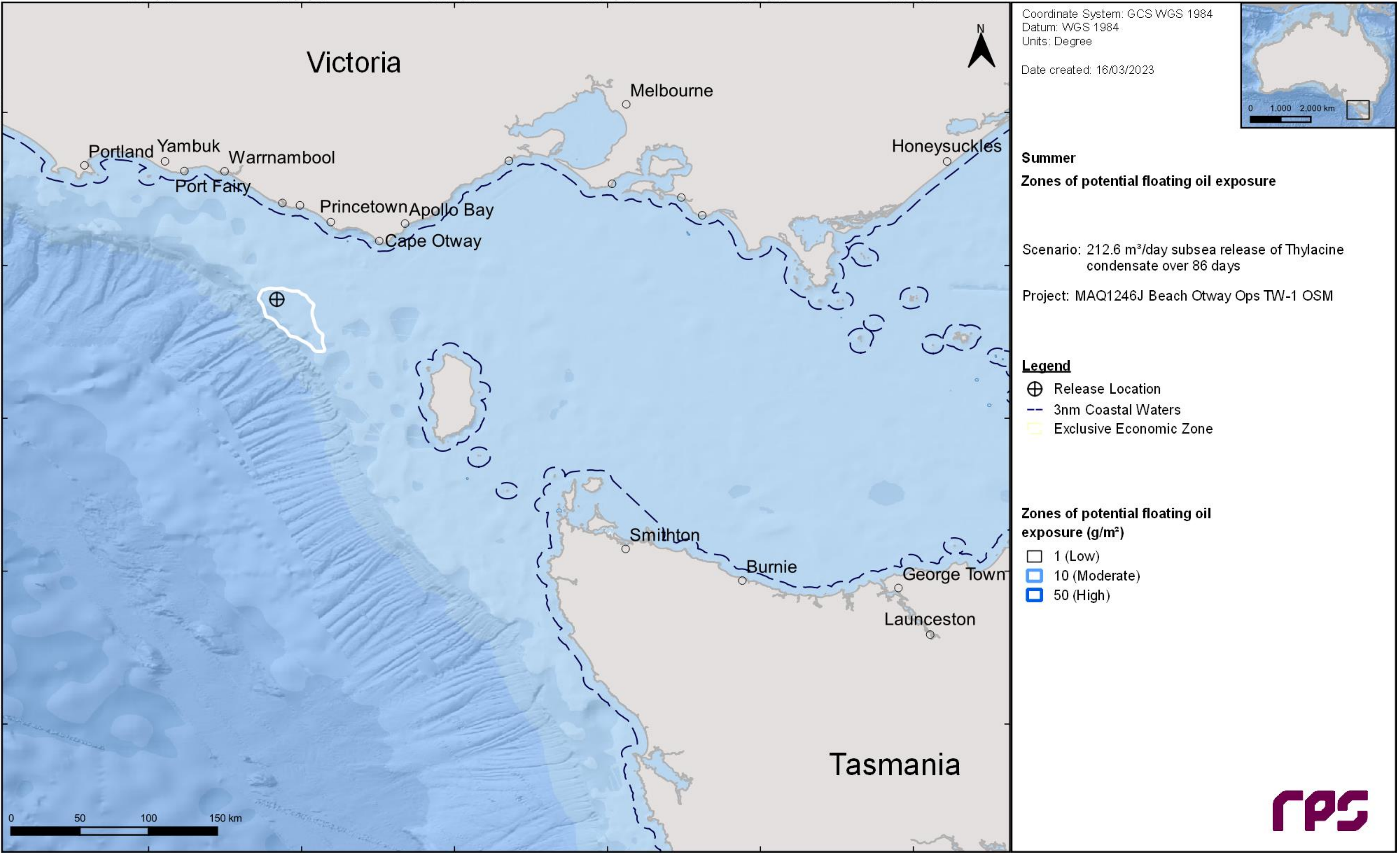


Figure 11-2 Zones of potential floating oil exposure in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

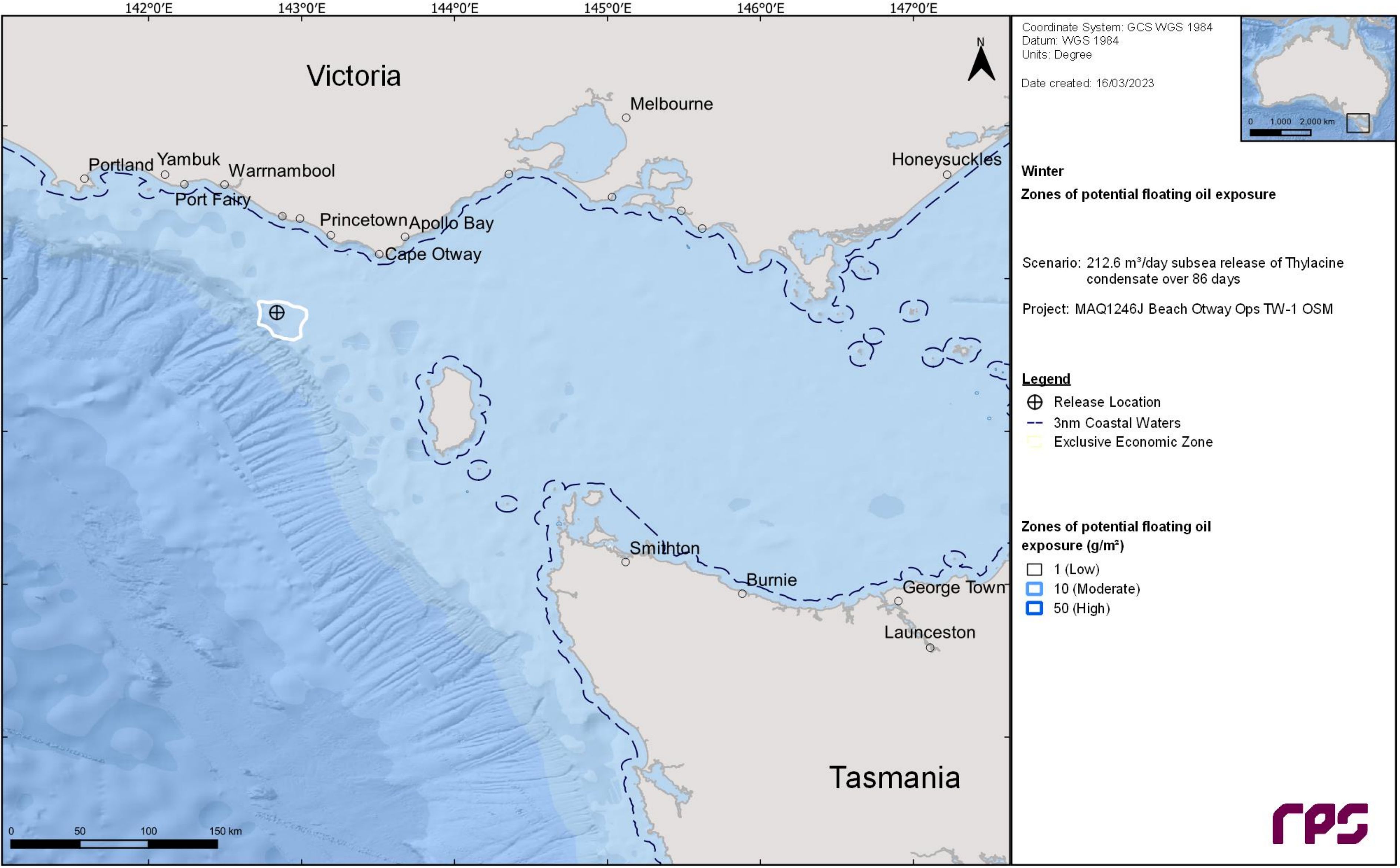


Figure 11-3 Zones of potential floating oil exposure in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

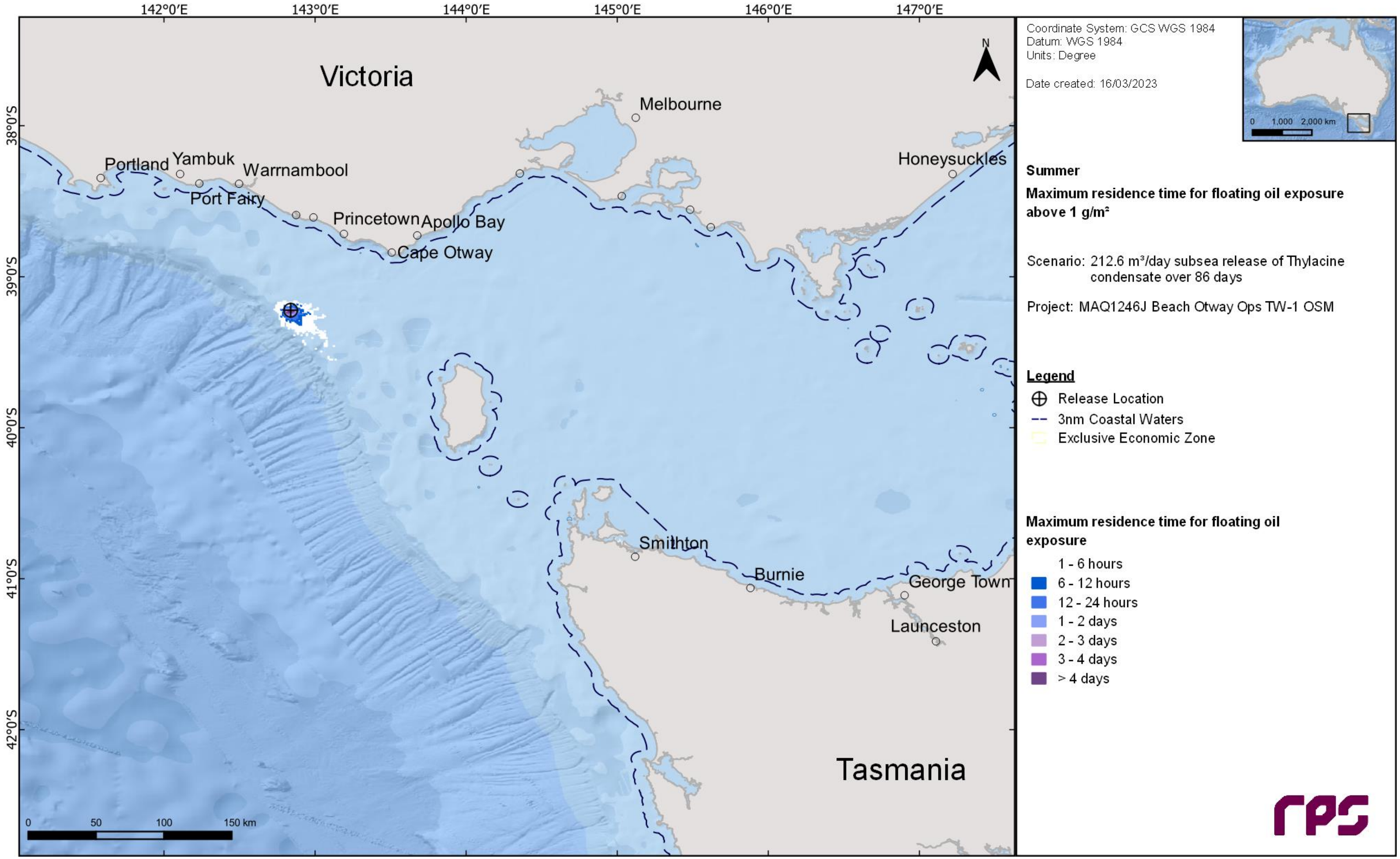


Figure 11-4 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

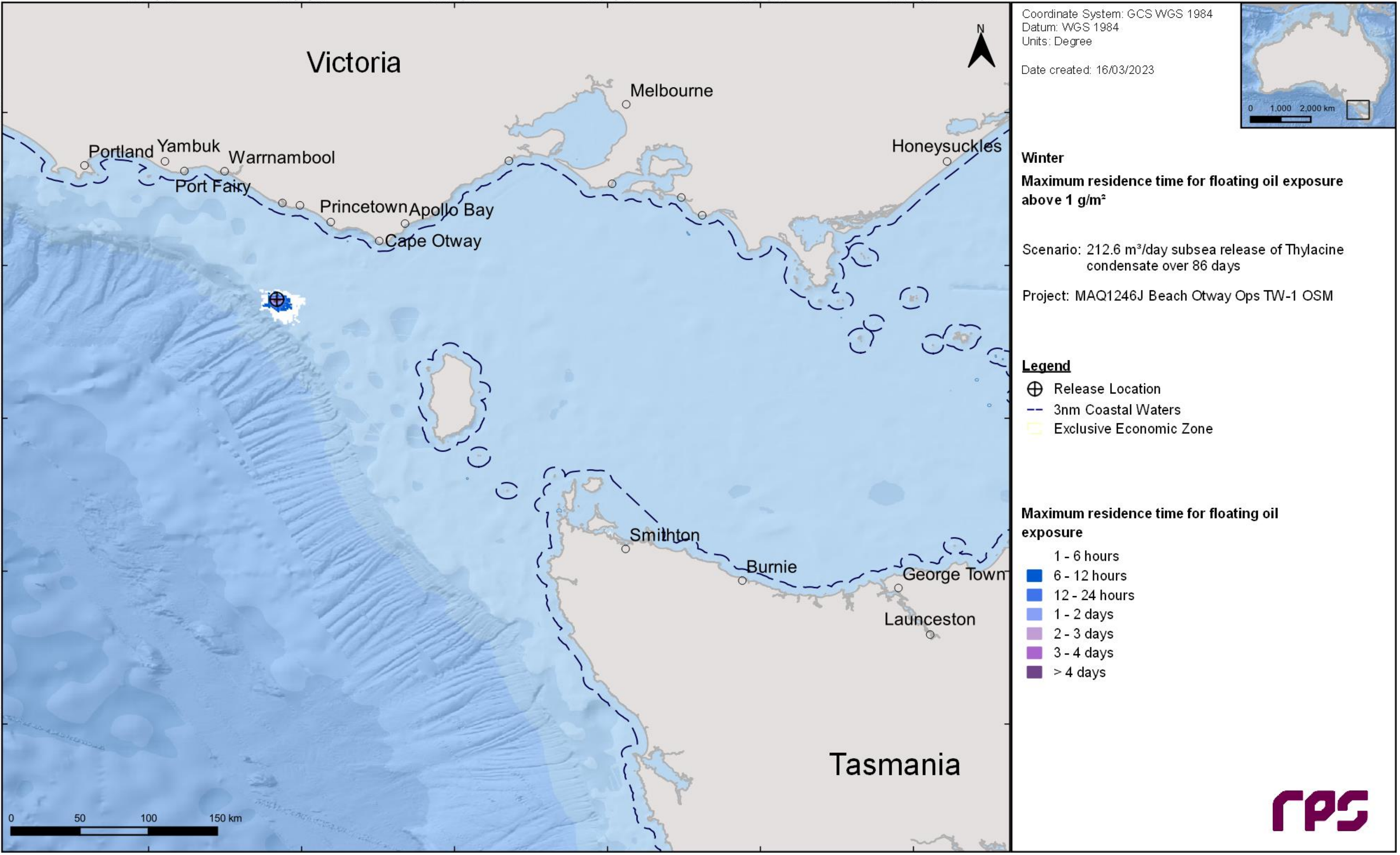


Figure 11-5 Maximum residence time of floating oil exposure above 1 g/m^2, in the event of 212.6 m^3/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.3 Shoreline Accumulation

Table 11-4 presents a summary of the predicted potential shoreline accumulation during the summer and winter conditions. The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 41% during summer conditions and 75% during winter conditions. The minimum time before oil accumulation at, or above, the low threshold was 13.00 days during summer conditions, and 6.54 days during winter conditions. The maximum volume ashore for a single spill trajectory during the summer and winter conditions was 11.6 m^3 and 16.6 m^3, respectively, whilst the maximum length of shoreline accumulation at the low threshold was 18.9 km and 28.9 km, respectively. No shoreline accumulation was predicted for the moderate (100 g/m^2) or high (1,000 g/m^2) threshold.

Table 11-5 summarises the shoreline accumulation on individual receptors during the summer and winter conditions. King Island recorded the highest probability of shoreline accumulation at the low threshold with 39% (summer) and 65% (winter) and the largest shoreline accumulation with 17.2 m^3 and 11.7 m^3, respectively.

The minimum time before shoreline accumulation above the low threshold was 13.00 days predicted for King Island during summer conditions and 6.54 days during the winter conditions predicted for Colac Otway West sub-LGA (which is part of Colac Otway West LGA).

The summer and winter conditions maximum potential shoreline loading above the low, moderate and high shoreline thresholds are presented in Figure 11-6 and Figure 11-7, respectively.

Table 11-4 Summary of oil accumulation across all shorelines. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	41	75
Absolute minimum time for visible oil to shore (days)	13.00	6.54
Maximum total volume of hydrocarbons ashore (m^3)	11.6	16.5
Average volume of hydrocarbons ashore (m^3)	3.2	5.8
Maximum length of the shoreline at **10 g/m^2** (km)	18.9	28.9
Average shoreline length (km) at **10 g/m^2** (km)	6.5	9.4
Maximum length of the shoreline at **100 g/m^2** (km)	-	-
Average shoreline length (km) at **100 g/m^2** (km)	-	-
Maximum length of the shoreline at **1,000 g/m^2** (km)	-	-
Average shoreline length (km) at **1,000 g/m^2** (km)	-	-

Table 11-5 Summary of oil accumulation on individual shoreline receptors. Results are based on a 212.6 m^3/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Shoreline Receptor		Summer																Winter															
		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)			Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA	Circular Head	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	33.00	-	-	< 1	20	0.4	2.3	1.7	-	-	3	-	-
	Colac Otway	9	-	-	23.38	-	-	< 1	47	0.4	3.3	3.4	-	-	7.1	-	-	15	-	-	6.54	-	-	1	39	0.6	3.2	2.9	-	-	8.1	-	-
	Corangamite	4	-	-	50.13	-	-	< 1	14	0.2	1.2	1.5	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Glenelg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	39.29	-	-	< 1	14	0.6	1.1	1	-	-	1	-	-
	Glennie Group	1	-	-	95.38	-	-	< 1	13	< 0.1	0.4	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	King Island	39	-	-	13.00	-	-	2	67	2	7.4	5.8	-	-	17.2	-	-	65	-	-	6.92	-	-	3	96	3.7	11.7	9.7	-	-	27.3	-	-
	Moyne	2	-	-	65.50	-	-	< 1	11	0.1	0.6	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Phillip Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	25.83	-	-	< 1	12	0.1	0.5	1	-	-	1	-	-
	South Gippsland	3	-	-	60.88	-	-	< 1	14	0.3	1.5	1.7	-	-	2	-	-	8	-	-	26.75	-	-	1	19	0.5	1.9	1.9	-	-	3	-	-
Sub-LGA	Apollo Bay	3	-	-	47.13	-	-	< 1	47	0.2	2.7	6.4	-	-	7.1	-	-	7	-	-	9	-	-	2	39	0.3	2.8	4.6	-	-	8.1	-	-
	Bay of Islands	2	-	-	65.50	-	-	< 1	11	< 0.1	0.6	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Cape Liptrap (NW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	41.21	-	-	1	19	0.1	0.5	1	-	-	1	-	-
	Cape Nelson	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	39.29	-	-	1	14	0.5	0.6	1	-	-	1	-	-
	Cape Otway West	6	-	-	23.38	-	-	1	24	0.2	1.4	1.9	-	-	4	-	-	8	-	-	6.54	-	-	2	22	0.3	0.7	1.4	-	-	2	-	-
	Moonlight Head	2	-	-	50.13	-	-	< 1	12	< 0.1	0.5	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Port Campbell	3	-	-	65.38	-	-	< 1	14	< 0.1	0.8	1.3	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Waratah Bay	3	-	-	69.46	-	-	< 1	12	< 0.1	0.3	1	-	-	1	-	-	4	-	-	26.75	-	-	1	16	< 0.1	0.4	1.3	-	-	2	-	-
	Wilsons Promontory (West)	2	-	-	60.88	-	-	< 1	14	0.2	0.8	1	-	-	1	-	-	6	-	-	27.83	-	-	1	15	0.2	1	1.2	-	-	2	-	-

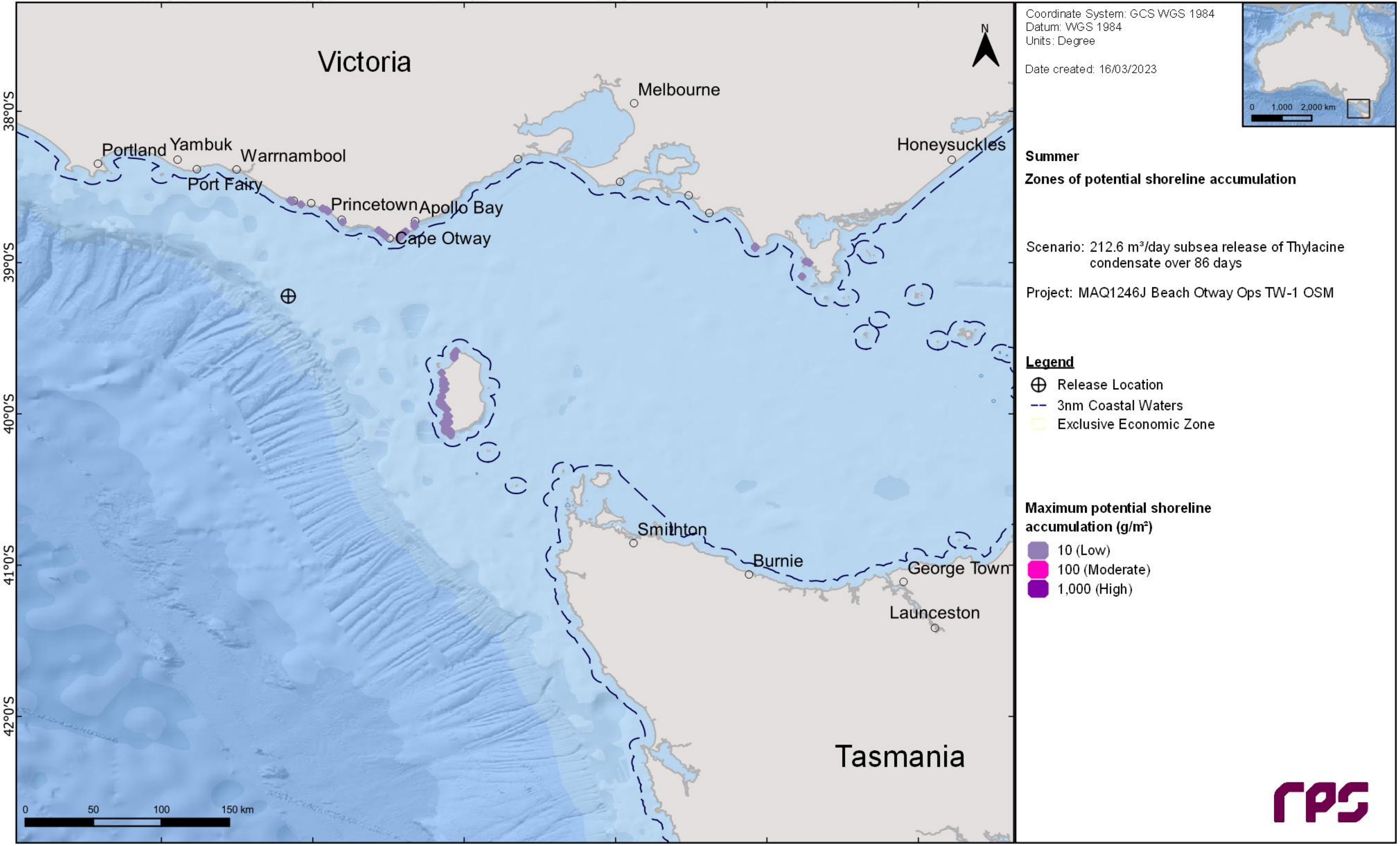


Figure 11-6 Maximum potential shoreline loading in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

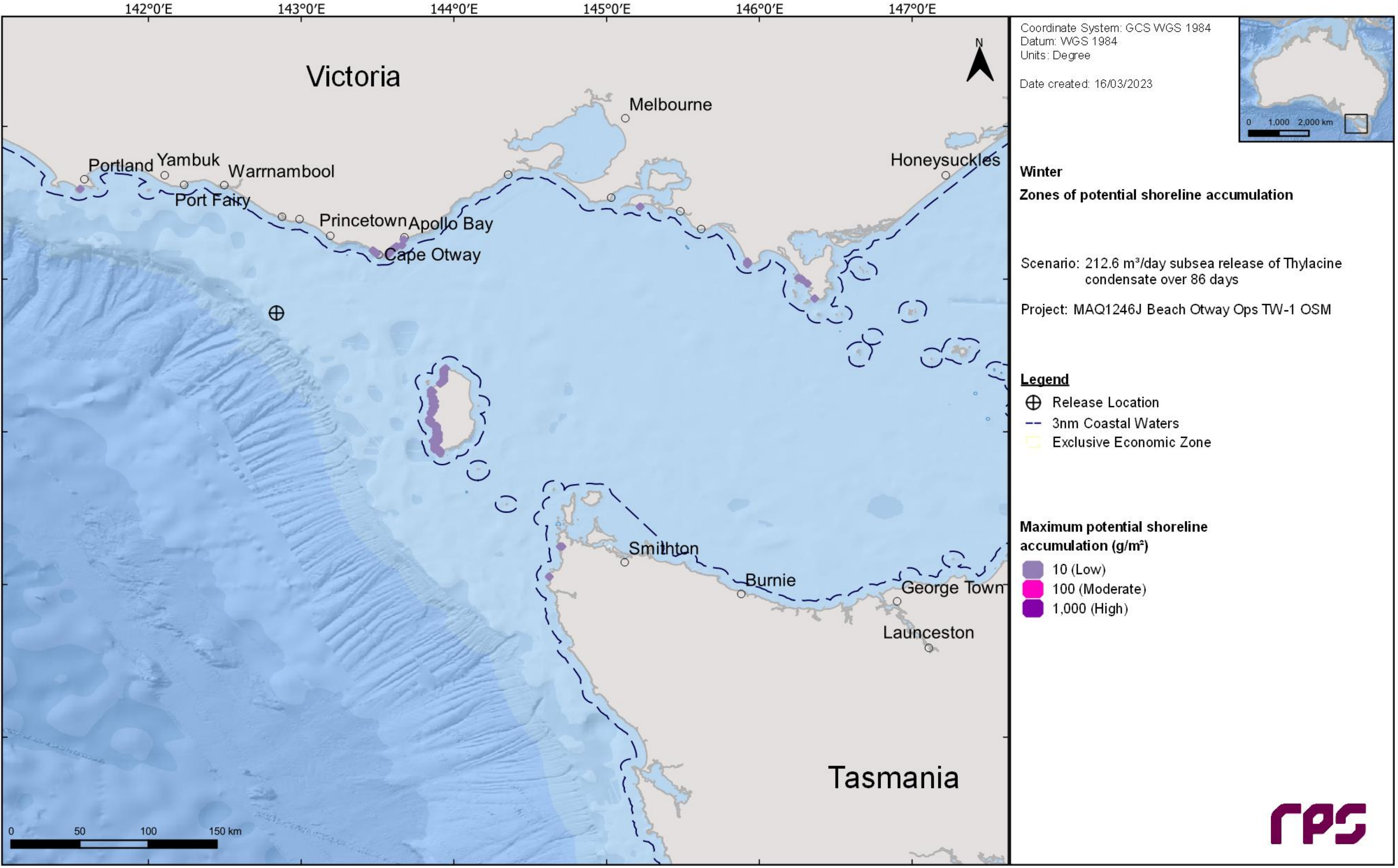


Figure 11-7 Maximum potential shoreline loading in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.4 In-water exposure

11.1.4.1 Dissolved Hydrocarbons

Table 11-6 summarises the probability of exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer during the summer and winter conditions.

Outside of the receptors that the TW-1 well resides within (refer to Table 10-2), the highest concentration of dissolved hydrocarbon was predicted for the Central Bass Strait IMCRA (summer – 389.5 ppb, winter – 310 ppb) whilst the highest probability of low dissolved hydrocarbon exposure was recorded for Apollo AMP (summer – 93%, winter – 100%) and Pygmy Blue Whale – Known Foraging Area BIA (summer – 81%, winter – 85%).

Table 11-7 presents the predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors, in the 0-10 m depth layer, for all seasonal conditions and all thresholds assessed. The maximum residence time of dissolved hydrocarbon exposure at the low threshold was predicted for Pygmy Blue Whale – Known Foraging Area BIA (summer – 3.29 days, winter – 1.17 days).

Figure 11-8 and Figure 11-9 presents the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions, respectively.

Figure 11-10 to Figure 11.15 presents the maximum residence time of dissolved hydrocarbon exposure for the NOPSEMA thresholds in summer and winter.

Table 11-6 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m dept. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)				Winter (April to October)			
		Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure			Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	360.2	93	21	-	310.1	100	35	-
	Beagle	21.1	4	-	-	14.4	1	-	-
	Franklin	27.1	1	-	-	16.6	1	-	-
	Zeehan	151.9	79	9	-	149.3	74	9	-
BIA	Antipodean Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Australasian Gannet - Foraging	69.1	5	1	-	37.4	3	-	-
	Black-browed Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Black-faced Cormorant - Foraging	128.1	43	3	-	136.4	53	5	-
	Buller’s Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Campbell Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Common Diving-petrel – Foraging*	686.4	100	100	7	664.6	100	100	8
	Indian Yellow-nosed Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Little Penguin - Foraging	79.3	39	2	-	136.4	52	4	-
	Pygmy Blue Whale – Distribution*	686.4	100	100	7	664.6	100	100	8
	Pygmy Blue Whale - Foraging	482.6	100	100	1	664.6	100	100	1
	Pygmy Blue Whale - Foraging (annual high use area) *	686.4	100	100	7	664.6	100	100	8
	Pygmy Blue Whale - Known Foraging Area	209.5	81	9	-	310.1	85	12	-
	Short-tailed Shearwater - Foraging	625.8	100	100	7	664.6	100	100	8
	Shy Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Soft-plumaged Petrel - Foraging	10.6	1	-	-	8.3	-	-	-
	Southern Right Whale - Aggregation	26.4	2	-	-	26.2	3	-	-
	Southern Right Whale - Connecting habitat	57.4	17	1	-	57.8	28	1	-
	Southern Right Whale - Known Core Range*	686.4	100	100	7	664.6	100	100	8
	Wandering Albatross – Foraging*	686.4	100	100	7	664.6	100	100	8
	Wedge-tailed Shearwater – Foraging*	686.4	100	100	7	664.6	100	100	8

Receptor		Summer (November through to March)				Winter (April to October)			
		Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure			Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure		
			Low	Moderate	High		Low	Moderate	High
	White Shark - Breeding	12	1	-	-	18.5	2	-	-
	White Shark – Distribution*	686.4	100	100	7	664.6	100	100	8
	White Shark - Foraging	69.1	8	1	-	68.3	15	1	-
	White-faced Storm-petrel - Foraging	183.4	43	4	-	202.5	66	7	-
IMCRA	Boags	7.3	-	-	-	12.4	1	-	-
	Central Bass Strait	389.5	68	11	-	310.1	93	14	-
	Central Victoria	162.7	42	7	-	111.5	56	6	-
	Flinders	55.1	4	1	-	57.5	2	1	-
	Franklin	22.5	2	-	-	25.7	3	-	-
	Otway*	686.4	100	100	7	664.6	100	100	8
	Twofold Shelf	19.2	1	-	-	21.7	1	-	-
	Victorian Embayments	3.2	-	-	-	18.5	2	-	-
KEF	West Tasmania Canyons	358	100	85	-	293.6	99	68	-
MNP	Twelve Apostles	4.1	-	-	-	10.7	1	-	-
	Wilsons Promontory	9.5	-	-	-	10.9	1	-	-
NPS4	Shallow Inlet Marine and Coastal Park	0.5	-	-	-	12.9	1	-	-
RSB	Bell Reef	11.1	1	-	-	11.8	1	-	-
	Bravenes Rock	11.4	1	-	-	23.3	3	-	-
	Cody Bank	9.6	-	-	-	26.8	1	-	-
Nearshore Waters (LGA)	Colac Otway	13.4	1	-	-	29.7	3	-	-
	Corangamite	10.3	1	-	-	11.3	1	-	-
	Curtis Island	8.3	-	-	-	10.8	1	-	-
	Glennie Group	11.1	1	-	-	7.4	-	-	-
	Hogan Island Group	10.5	1	-	-	13.9	1	-	-
	King Island	60.1	17	1	-	66.4	32	1	-
	Martins Island	1	-	-	-	10	1	-	-
	Moncoeur Islands	7.7	-	-	-	18.3	1	-	-
	Reid Rock	48.3	4	-	-	9.9	-	-	-

Receptor		Summer (November through to March)				Winter (April to October)			
		Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure			Maximum dissolved hydrocarbon exposure	Probability of dissolved hydrocarbon exposure		
			Low	Moderate	High		Low	Moderate	High
	Robbins Island	2.3	-	-	-	10.3	1	-	-
	Rodondo Island	9.1	-	-	-	10.5	1	-	-
	South Gippsland	11.6	1	-	-	18.5	2	-	-
	Three Hummock Island	3.6	-	-	-	12.4	1	-	-
	Wellington	1.5	-	-	-	10.9	1	-	-
State Waters	Tasmania State Waters	88.8	36	2	-	111.2	48	3	-
	Victoria State Waters	26.1	5	-	-	62.8	10	1	-
Nearshore Waters (Sub-LGA)	Apollo Bay	13.1	1	-	-	23.9	3	-	-
	Cape Liptrap	11.6	1	-	-	13.4	1	-	-
	Cape Otway West	11.5	1	-	-	29.7	2	-	-
	Cape Patton	13.4	1	-	-	19.7	1	-	-
	Moonlight Head	8.3	-	-	-	11.3	1	-	-
	Port Welshpool	1.3	-	-	-	18.5	2	-	-
	Snake Island	1.5	-	-	-	10.9	1	-	-
	Waratah Bay	9.7	-	-	-	12.9	1	-	-

*The release location resides within the receptor boundaries.

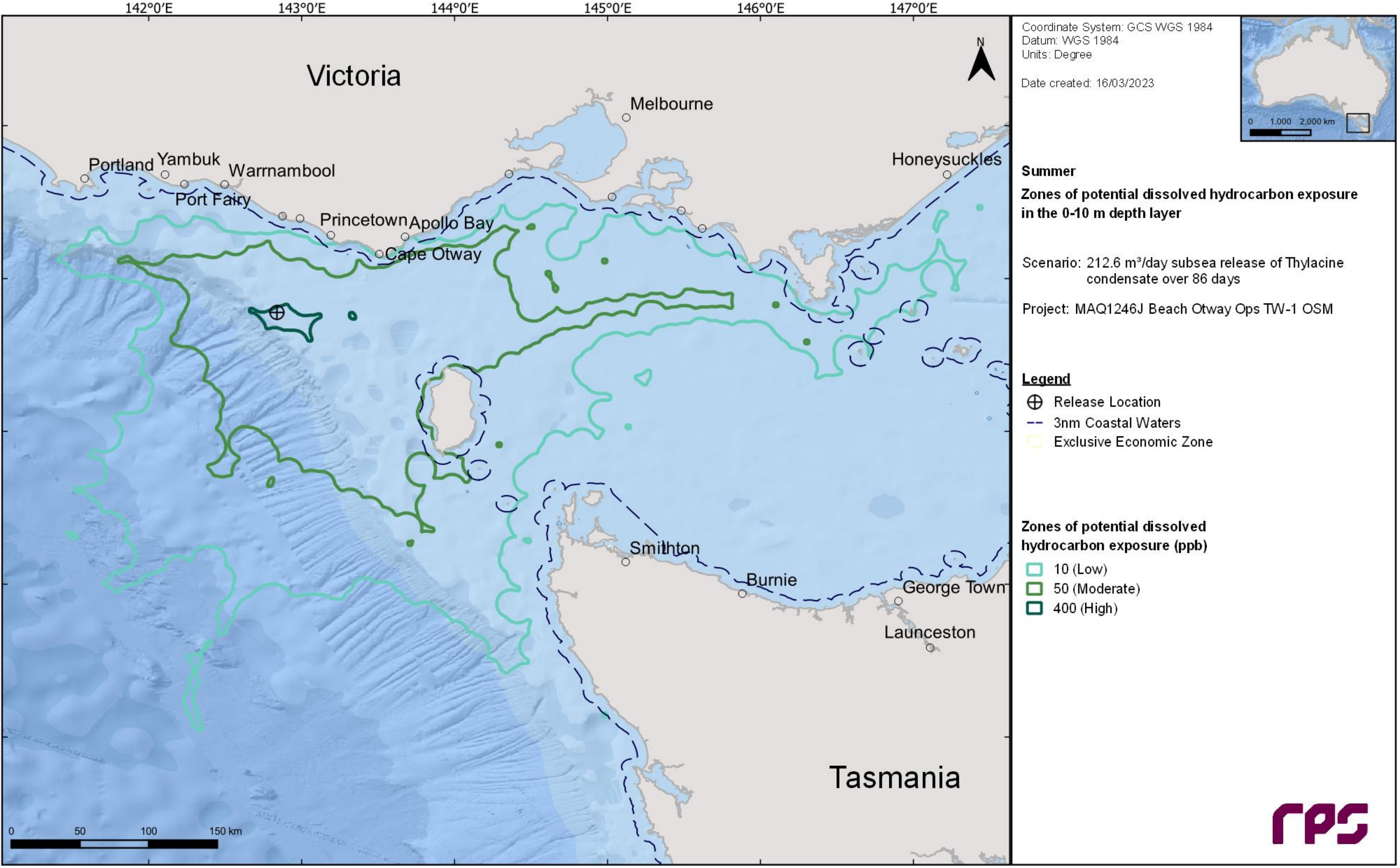
Table 11-7 Predicted minimum time to dissolved hydrocarbon exposure and maximum residence time for dissolved hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill trajectories per season.

Receptor		Summer (November through to March)						Winter (April to October)					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
AMP	Apollo	1.38	1.63	52.46	2.25	0.58	-	1.63	2.54	-	2.79	0.5	-
	Beagle	28.54	-	-	0.13	-	-	35.33	-	-	0.04	-	-
	Franklin	20.83	-	-	0.17	-	-	26.67	-	-	0.08	-	-
	Zeehan	2.63	4.17	-	1.17	0.17	-	2.54	5.54	-	1.17	0.17	-
BIA	Antipodean Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Australasian Gannet - Foraging	11.13	27.63	-	0.42	0.04	-	9.67	-	-	0.21	-	-
	Black-browed Albatross - Foraging	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Black-faced Cormorant - Foraging	3.67	33.00	-	0.92	0.08	-	3.33	3.83	-	1.17	0.17	-
	Buller's Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Campbell Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Common Diving-petrel – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Indian Yellow-nosed Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Little Penguin - Foraging	4.00	42.33	-	0.71	0.08	-	3.54	7.88	-	1.17	0.13	-
	Pygmy Blue Whale – Distribution*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Pygmy Blue Whale - Foraging	0.33	0.46	12.75	21	1.75	0.04	0.21	0.42	9.83	21.54	1.96	0.08
	Pygmy Blue Whale - Foraging (annual high use area) *	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Pygmy Blue Whale - Known Foraging Area	1.96	4	-	3.29	0.38	-	2.33	3.38	-	1.17	0.29	-
	Short-tailed Shearwater – Foraging*	0.04	0.04	2.42	79.21	50.71	0.08	0.04	0.04	3.50	76.13	44.25	0.08
	Shy Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Soft-plumaged Petrel - Foraging	29.92	-	-	0.04	-	-	24.21	-	-	-	-	-
	Southern Right Whale - Aggregation	44.58	-	-	0.17	-	-	5.79	-	-	0.21	-	-
	Southern Right Whale - Connecting habitat	8.08	26.29	-	3.29	0.04	-	4.13	7.96	-	1.17	0.04	-
	Southern Right Whale - Known Core Range*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Wandering Albatross – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Wedge-tailed Shearwater – Foraging*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08

Receptor		Summer (November through to March)						Winter (April to October)					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
	White Shark - Breeding	45.58	-	-	0.04	-	-	36.96	-	-	0.13	-	-
	White Shark – Distribution*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	White Shark - Foraging	10.54	26.71	-	0.46	0.04	-	8.25	30.13	-	0.42	0.04	-
	White-faced Storm-petrel - Foraging	6.17	8.38	-	3.29	0.25	-	3.29	4.92	-	0.83	0.25	-
IMCRA	Boags	-	-	-	-	-	-	50.33	-	-	0.04	-	-
	Central Bass Strait	1.92	6.54	-	1.21	0.63	-	1.96	3.38	-	1.5	0.29	-
	Central Victoria	3.58	8.38	-	1.25	0.21	-	3.71	8.42	-	0.67	0.13	-
	Flinders	27.79	77	-	0.25	0.04	-	15.17	30.13	-	0.33	0.04	-
	Franklin	17.88	-	-	0.08	-	-	16.33	-	-	0.21	-	-
	Otway*	0.04	0.04	2.42	79.21	50.71	0.17	0.04	0.04	3.50	76.13	44.25	0.08
	Twofold Shelf	45.08	-	-	0.08	-	-	42.88	-	-	0.04	-	-
	Victorian Embayments	-	-	-	-	-	-	39.5	-	-	0.13	-	-
MNP	Twelve Apostles	-	-	-	-	-	-	31.88	-	-	0.04	-	-
	Wilsons Promontory	-	-	-	-	-	-	35.67	-	-	0.04	-	-
NPS4	Shallow Inlet Marine and Coastal Park	-	-	-	-	-	-	49.46	-	-	0.04	-	-
RSB	Bell Reef	11.58	-	-	0.04	-	-	12.13	-	-	0.04	-	-
	Bravenes Rock	34.21	-	-	0.04	-	-	5.71	-	-	0.04	-	-
	Cody Bank	-	-	-	-	-	-	49.46	66.92	-	0.04	-	-
Nearshore Waters (LGA)	Colac Otway	34.83	-	-	0.08	-	-	5.79	-	-	0.29	-	-
	Corangamite	44.88	-	-	0.04	-	-	31	-	-	0.04	-	-
	Curtis Island	64.04	-	-	-	-	-	50.58	-	-	0.04	-	-
	Glennie Group	47	-	-	0.04	-	-	-	-	-	-	-	-
	Hogan Island Group	74.08	-	-	0.04	-	-	63.58	-	-	0.04	-	-
	King Island	8.38	26.29	-	3.29	0.04	-	7.75	14.54	-	1.17	0.04	-
	Martins Island	-	-	-	-	-	-	91.29	-	-	0.04	-	-
	Moncoeur Islands	64.38	-	-	-	-	-	15.17	-	-	0.04	-	-
	Reid Rock	19.71	-	-	0.25	-	-	79.71	-	-	-	-	-
	Robbins Island	-	-	-	-	-	-	66.88	-	-	0.04	-	-

Receptor		Summer (November through to March)						Winter (April to October)					
		Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)			Minimum time before dissolved hydrocarbon exposure (days)			Maximum residence time for dissolved hydrocarbon exposure (days)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
	Rodondo Island	-	-	-	-	-	-	38.79	-	-	0.04	-	-
	South Gippsland	91.63	-	-	0.08	-	-	37.04	-	-	0.17	-	-
	Three Hummock Island	-	-	-	-	-	-	67.75	-	-	0.04	-	-
	Wellington	-	-	-	-	-	-	53.5	-	-	0.04	-	-
State Waters	Tasmania State Waters	7.96	26.17	-	3.29	0.08	-	2.88	7.67	-	1.17	0.08	-
	Victoria State Waters	11.5	-	-	0.21	-	-	4.5	22.04	-	0.46	0.04	-
Nearshore Waters (Sub-LGA)	Apollo Bay	52.42	-	-	0.08	-	-	5.79	-	-	0.29	-	-
	Cape Liptrap	91.63	-	-	0.08	-	-	37.04	-	-	0.04	-	-
	Cape Otway West	34.83	-	-	0.04	-	-	10	-	-	0.17	-	-
	Cape Patton	76.08	-	-	0.04	-	-	35.38	-	-	0.17	-	-
	Moonlight Head	-	-	-	-	-	-	31	-	-	0.04	-	-
	Port Welshpool	-	-	-	-	-	-	39.5	-	-	0.13	-	-
	Snake Island	-	-	-	-	-	-	53.5	-	-	0.04	-	-
	Waratah Bay	-	-	-	-	-	-	38.83	-	-	0.17	-	-

*The release location resides within the receptor boundaries.



Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

Date created: 16/03/2023

Summer

Zones of potential dissolved hydrocarbon exposure in the 0-10 m depth layer

Scenario: 212.6 m³/day subsea release of Thylacine condensate over 86 days

Project: MAQ1246J Beach Otway Ops TW-1 OSM

Legend

⊕ Release Location
-- 3nm Coastal Waters
☐ Exclusive Economic Zone

Zones of potential dissolved hydrocarbon exposure (ppb)

☐ 10 (Low)
☐ 50 (Moderate)
☐ 400 (High)

Figure 11-8 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

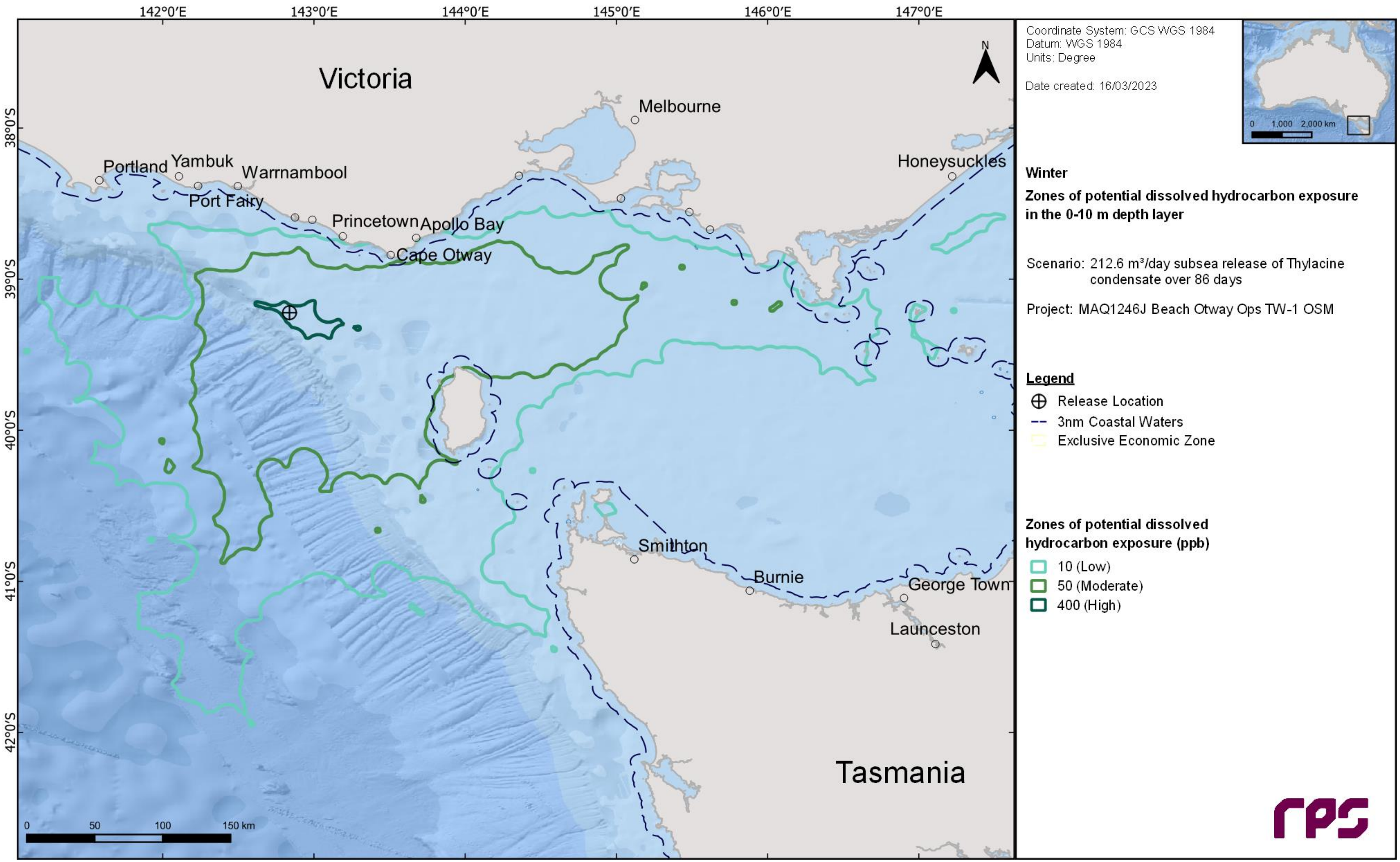


Figure 11-9 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

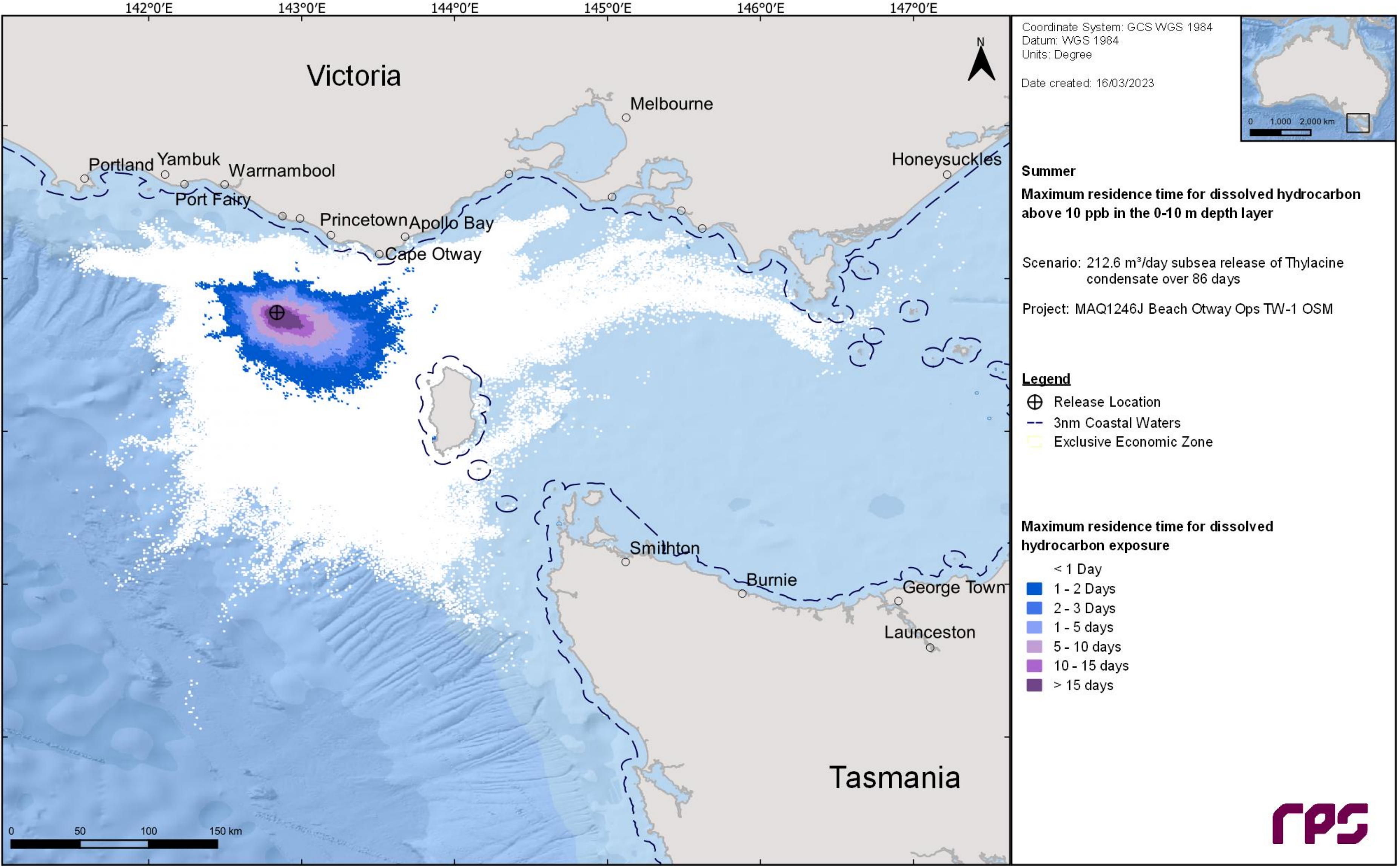


Figure 11-10 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

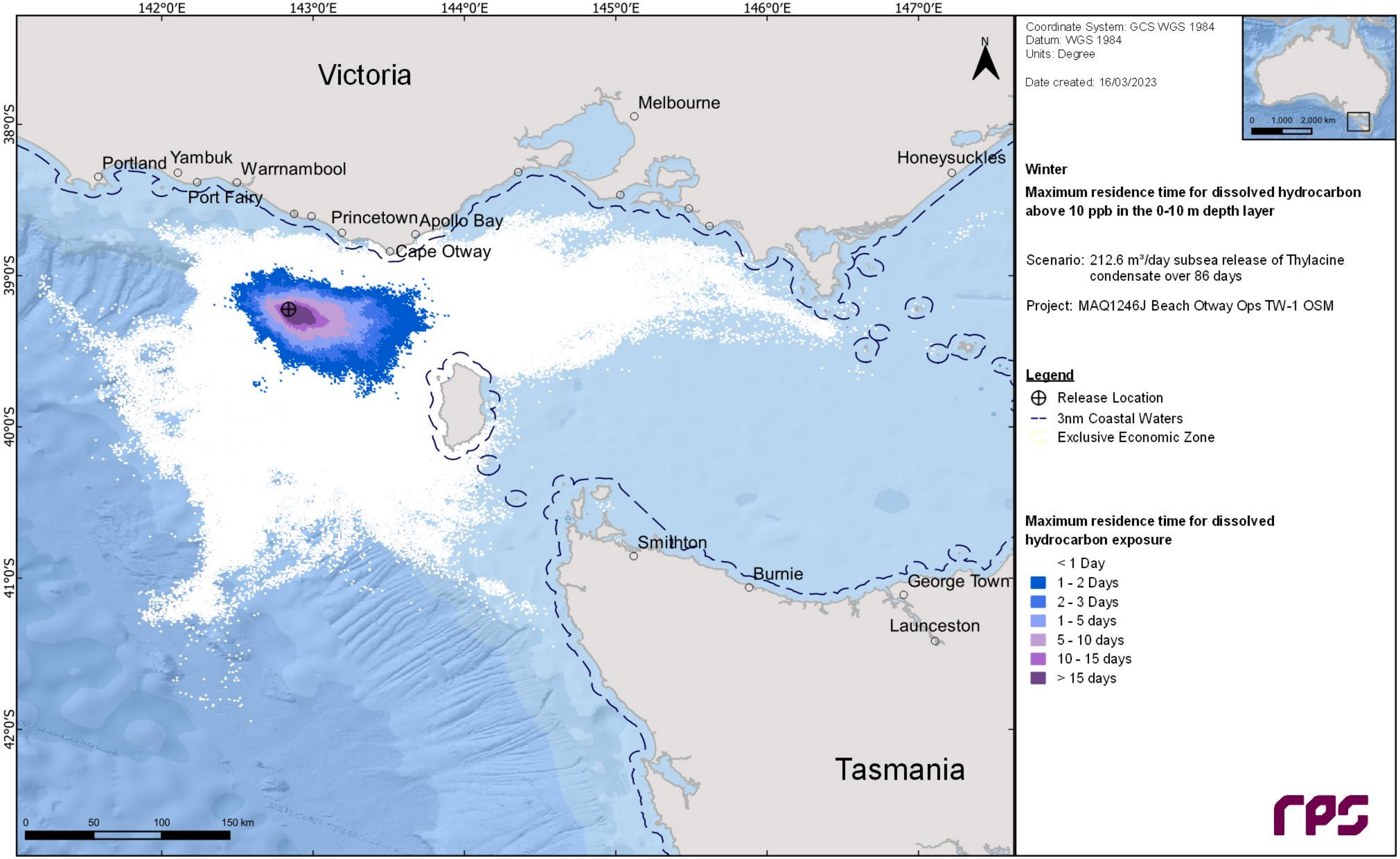


Figure 11.11 Maximum residence time for dissolved hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

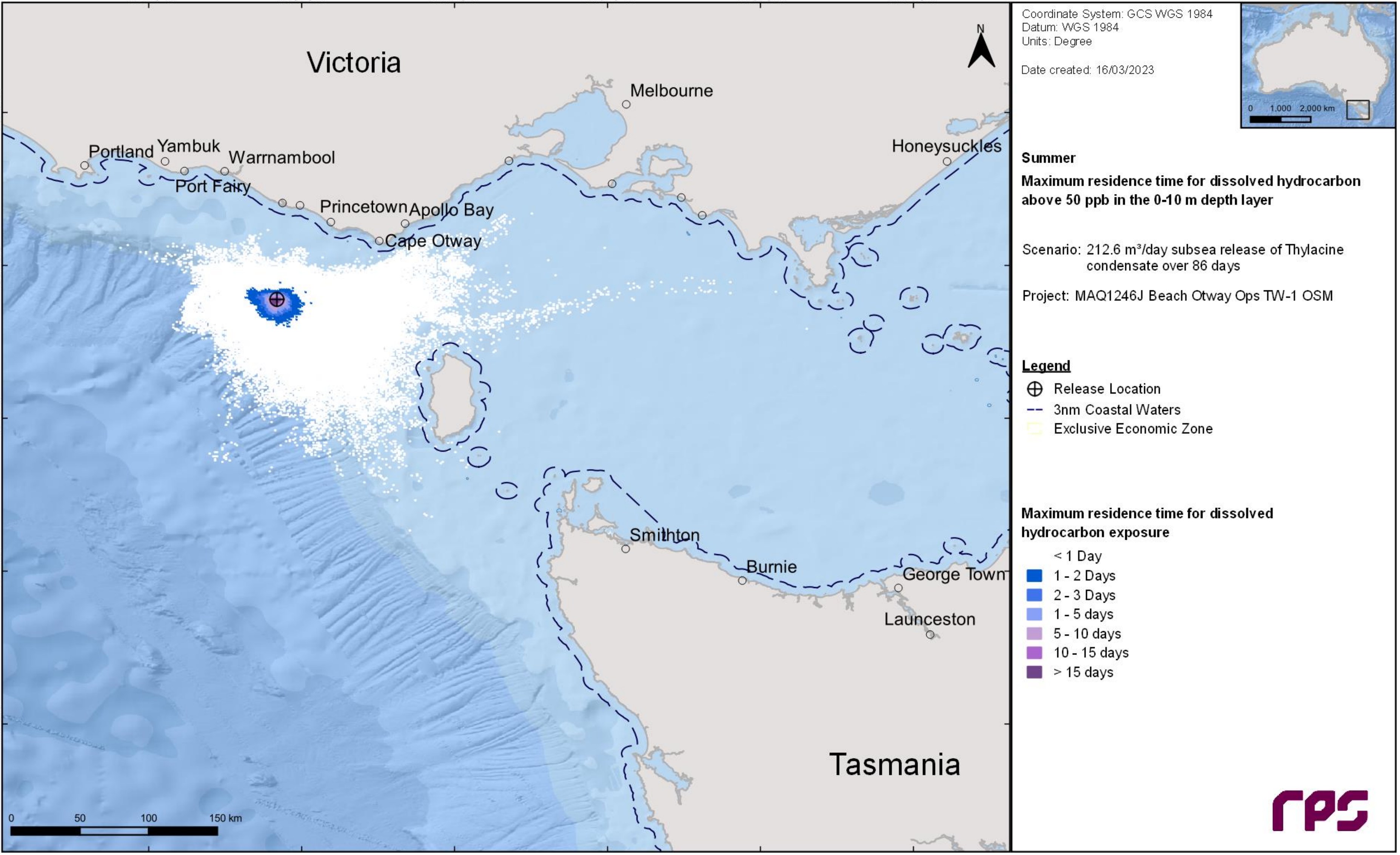


Figure 11.12 Maximum residence time for dissolved hydrocarbon exposure above 50 ppb, at 0-10 m below the sea surface in the event of a 212.6m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

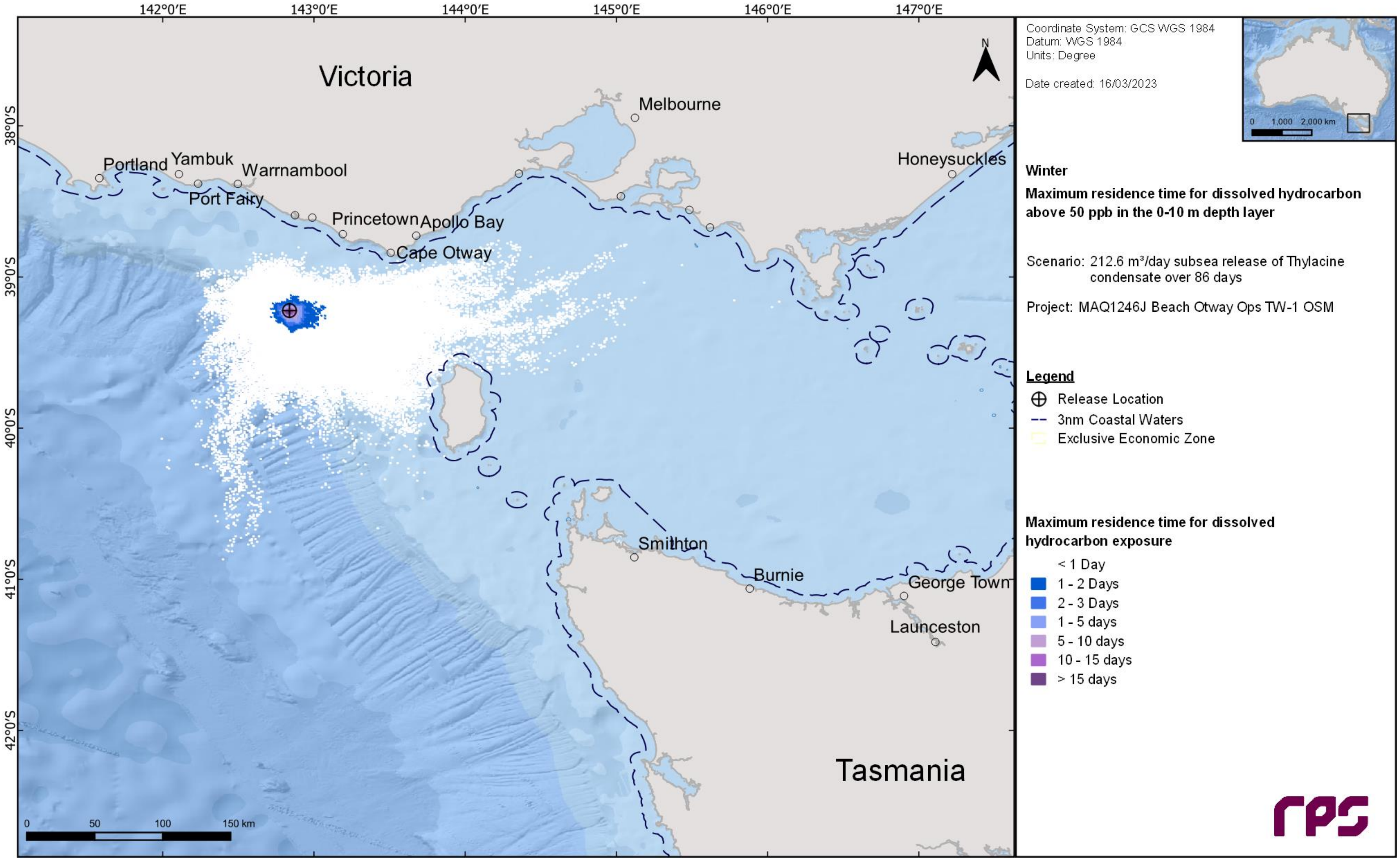
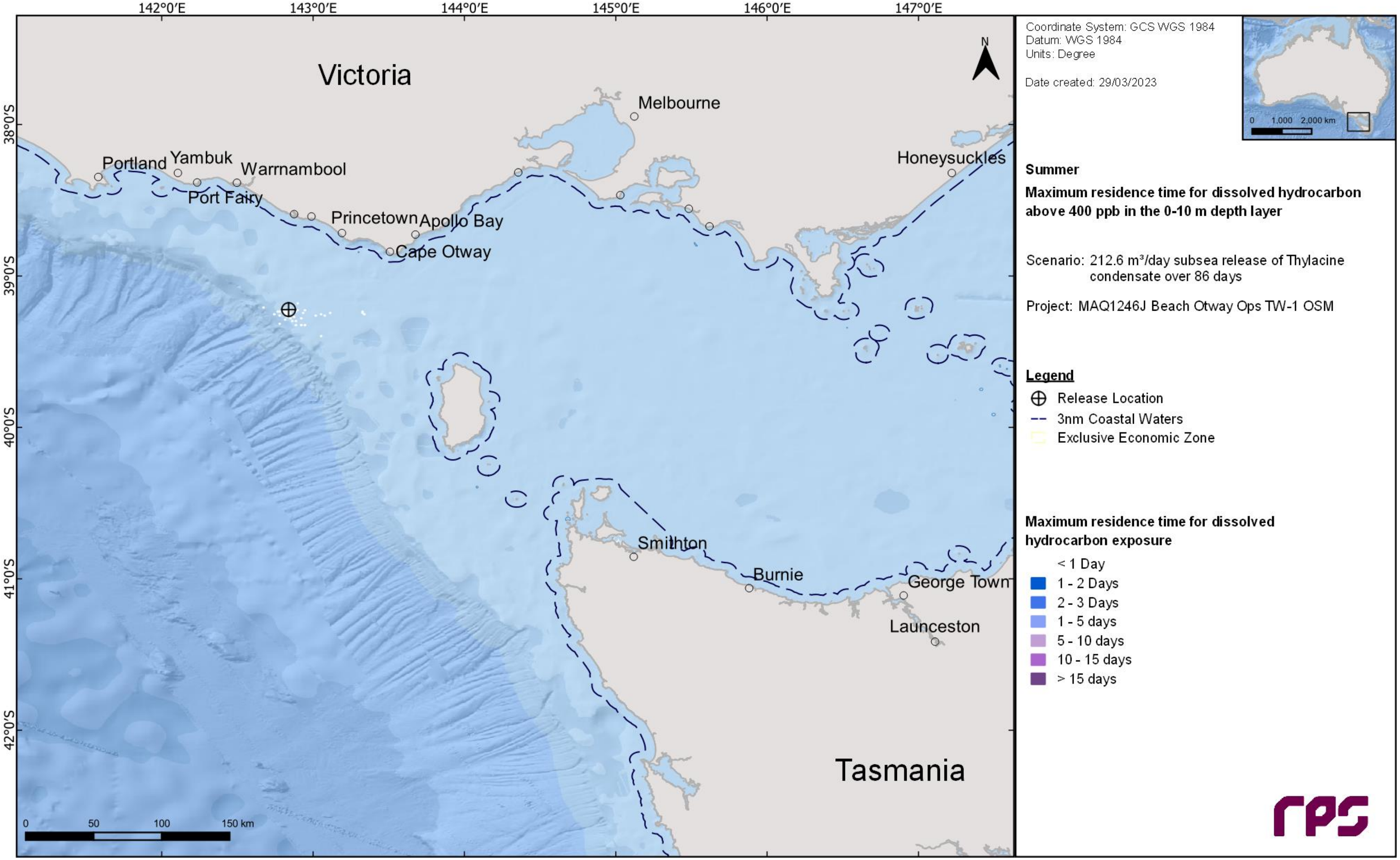


Figure 11.13 Maximum residence time for dissolved hydrocarbon exposure above 50 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.



Coordinate System: GCS WGS 1984
Datum: WGS 1984
Units: Degree

Date created: 29/03/2023

Summer

Maximum residence time for dissolved hydrocarbon above 400 ppb in the 0-10 m depth layer

Scenario: 212.6 m³/day subsea release of Thylacine condensate over 86 days

Project: MAQ1246J Beach Otway Ops TW-1 OSM

Legend

- ⊕ Release Location
- -- 3nm Coastal Waters
- ▢ Exclusive Economic Zone

Maximum residence time for dissolved hydrocarbon exposure

- < 1 Day
- ■ 1 - 2 Days
- ■ 2 - 3 Days
- ■ 1 - 5 days
- ■ 5 - 10 days
- ■ 10 - 15 days
- ■ > 15 days

Figure 11.14 Maximum residence time for dissolved hydrocarbon exposure above 400 ppb, at 0-10 m below the sea surface in the event of a 212.6m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

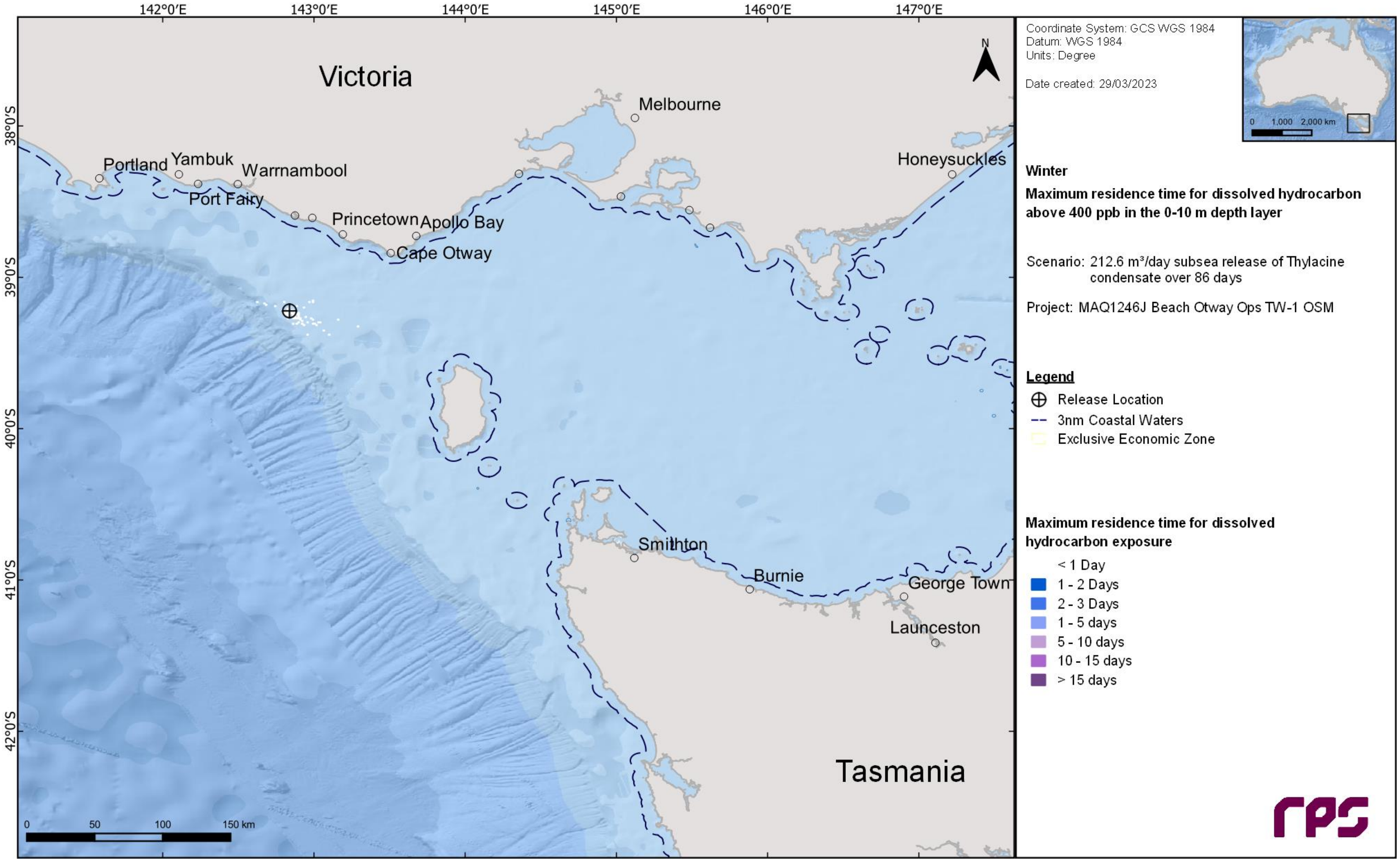


Figure 11.15 Maximum residence time for dissolved hydrocarbon exposure above 400 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.4.2 Entrained Hydrocarbons

Table 11-8 presents the probability of exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer for the summer and winter conditions.

Outside of the receptors that the TW-1 well resides within (refer to Table 10-2), the highest concentration of entrained hydrocarbon was predicted for Apollo AMP (summer – 63.3 ppb, winter – 64.2 ppb) whilst the highest probability of low entrained hydrocarbon exposure was recorded for Apollo AMP (summer – 95%, winter – 100%), Zeehan AMP (summer – 92%, winter – 68%), Pygmy Blue Whale – Known Foraging Area BIA (summer – 91%, winter – 96%) and Central Bass Strait IMCRA (summer – 88%, winter – 98%).

Table 11-9 presents the predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer, for all seasonal conditions and all thresholds assessed.

Figure 11-16 and Figure 11-17 presents the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions, respectively

Figure 11-18 to Figure 11-21 presents the maximum residence time of entrained hydrocarbon exposure for the NOPSEMA thresholds in summer and winter.

Table 11-8 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure	
			Low	High		Low	High
AMP	Apollo	63.3	95	-	64.2	100	-
	Franklin	8.3	-	-	13.4	6	-
	Zeehan	44.8	92	-	44.4	68	-
BIA	Antipodean Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Australasian Gannet - Foraging	19.5	8	-	19.2	6	-
	Black-browed Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Black-faced Cormorant - Foraging	29.8	63	-	49.9	66	-
	Buller’s Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Campbell Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Common Diving-petrel – Foraging*	927.6	100	100	1,000.90	100	100
	Indian Yellow-nosed Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Little Penguin - Foraging	27.8	57	-	36.4	63	-
	Pygmy Blue Whale – Distribution*	927.6	100	100	1,000.90	100	100
	Pygmy Blue Whale - Foraging	186.2	100	64	223.9	100	80
	Pygmy Blue Whale - Foraging (annual high use area) *	927.6	100	100	1,000.90	100	100
	Pygmy Blue Whale - Known Foraging Area	50.8	91	-	54.1	96	-
	Short-tailed Shearwater - Breeding	7.8	-	-	12.50	4	-
	Short-tailed Shearwater - Foraging	866.5	100	100	929	100	100
	Shy Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Soft-plumaged Petrel - Foraging	11.2	1	-	11.5	3	-
	Southern Right Whale - Aggregation	15.7	5	-	15.6	5	-
	Southern Right Whale - Connecting habitat	33.1	50	-	42.5	49	-
	Southern Right Whale - Known Core Range*	927.6	100	100	1,000.90	100	100
	Wandering Albatross – Foraging*	927.6	100	100	1,000.90	100	100
	Wedge-tailed Shearwater – Foraging*	927.6	100	100	1,000.90	100	100

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure	
			Low	High		Low	High
	White Shark – Distribution*	927.6	100	100	1,000.90	100	100
	White Shark - Foraging	33.1	41	-	32	41	-
	White-faced Storm-petrel - Foraging	43.4	61	-	34.6	77	-
IMCRA	Central Bass Strait	53.4	88	-	57.8	98	-
	Central Victoria	43.4	47	-	33.6	61	-
	Flinders	12.6	2	-	19.2	8	-
	Franklin	15.9	1	-	18	7	-
	Otway*	927.6	100	100	1,000.90	100	100
KEF	West Tasmania Canyons	126.7	100	7	117.9	100	3
MNP	Twelve Apostles	16.5	3	-	9.5	-	-
	Wilsons Promontory	10.1	1	-	19.2	7	-
NPS4	Wilsons Promontory Marine Park	10.3	1	-	10.4	1	-
RSB	Bell Reef	15.6	4	-	15.9	5	-
	Bravenes Rock	14	2	-	18.8	8	-
Nearshore Waters (LGA)	Anser Island	7.9	-	-	13.50	6	-
	Colac Otway	18.4	5	-	19.3	12	-
	Corangamite	15.4	2	-	10.6	1	-
	Glennie Group	9.7	-	-	18.6	6	-
	Kanowna Island	8	-	-	13.5	6	-
	King Island	33.1	50	-	41.4	49	-
	Moyne	10.2	1	-	8.5	-	-
	Norman Island	12.6	2	-	17.5	8	-
	Reid Rock	15.7	4	-	15.9	5	-
	Rodondo Island	11.7	1	-	11.3	2	-
	Skull Rock	8	-	-	13.5	5	-
	South Gippsland	10.6	2	-	15.2	6	-
State Waters	Tasmania State Waters	33.4	54	-	42.5	62	-
	Victoria State Waters	18.8	8	-	25.4	27	-

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure		Maximum entrained hydrocarbon exposure	Probability of entrained hydrocarbon exposure	
			Low	High		Low	High
Nearshore Waters (Sub-LGA)	Apollo Bay	13.2	2	-	16.1	7	-
	Bay of Islands	10.2	1	-	8.5	-	-
	Cape Liptrap	6.8	-	-	15.2	3	-
	Cape Otway West	18.4	5	-	19.3	12	-
	Cape Patton	8.1	-	-	17	3	-
	Moonlight Head	15.4	2	-	10.6	1	-
	Port Campbell	15.4	2	-	8.2	-	-
	Waratah Bay	5.6	-	-	14	3	-
	Wilsons Promontory	10.6	2	-	13.3	6	-

*The release location resides within the receptor boundaries.

Table 11-9 Predicted minimum time to entrained hydrocarbon exposure and maximum residence time for entrained hydrocarbon exposure to individual receptors in the 0-10 m depth layer. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill trajectories per season.

Receptor		Summer (November through to March)				Winter (April to October)			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
AMP	Apollo	1.33	-	9.63	-	1.21	-	12.67	-
	Franklin	-	-	-	-	26.46	-	0.46	-
	Zeehan	2.67	-	5.08	-	2.25	-	4.08	-
BIA	Antipodean Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Australasian Gannet - Foraging	16.54	-	2.88	-	11.54	-	3.42	-
	Black-browed Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Black-faced Cormorant - Foraging	9.54	-	9.54	-	2.79	-	25.38	-
	Buller’s Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Campbell Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Common Diving-petrel – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Indian Yellow-nosed Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Little Penguin - Foraging	10.21	-	8.33	-	3.04	-	21.75	-
	Pygmy Blue Whale – Distribution*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Pygmy Blue Whale - Foraging	0.33	0.58	31.38	0.46	0.17	0.63	35.83	0.83
	Pygmy Blue Whale – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Pygmy Blue Whale - Known Foraging Area	1.88	-	17.17	-	1.83	-	26.88	-
	Short-tailed Shearwater - Breeding	-	-	-	-	51.5	-	0.42	-
	Short-tailed Shearwater – Foraging*	0.04	0.04	74.5	42.63	0.04	0.04	76.67	43.5
	Shy Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Soft-plumaged Petrel - Foraging	98.29	-	0.08	-	46.54	-	0.13	-
	Southern Right Whale - Aggregation	39	-	0.58	-	5.63	-	0.17	-
	Southern Right Whale - Connecting habitat	10.54	-	17.17	-	3.71	-	26.88	-
	Southern Right Whale - Known Core Range*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	Wandering Albatross – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5

Receptor		Summer (November through to March)				Winter (April to October)			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Wedge-tailed Shearwater – Foraging*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	White Shark – Distribution*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
	White Shark - Foraging	10.42	-	13.13	-	7.71	-	16.13	-
	White-faced Storm-petrel - Foraging	6.25	-	17.17	-	2.88	-	26.88	-
IBRA	Gippsland Plain	77.38	-	0.04	-	24.38	-	3.21	-
	King Island	10.54	-	17.17	-	3.96	-	26.88	-
	Otway Plain	17.21	-	5.17	-	5.67	-	3.04	-
	Otway Ranges	34.17	-	0.92	-	7.38	-	2.88	-
	Strzelecki Ranges	-	-	-	-	26.25	-	2.25	-
	Warrnambool Plain	59.63	-	14.33	-	-	-	-	-
	Wilsons Promontory	76.08	-	0.21	-	22.21	-	3.63	-
IMCRA	Central Bass Strait	1.5	-	7.46	-	1.79	-	9.29	-
	Central Victoria	3.54	-	5.96	-	3.13	-	7.17	-
	Flinders	60.67	-	0.21	-	22.21	-	3.63	-
	Franklin	94.13	-	0.46	-	25.29	-	0.83	-
	Otway*	0.04	0.04	77.08	42.63	0.04	0.04	76.67	43.5
KEF	West Tasmania Canyons	0.71	3.63	18.63	0.17	0.79	62.67	16.67	0.08
MNP	Twelve Apostles	54	-	16.54	-	-	-	-	-
	Wilsons Promontory	92.88	-	0.08	-	38.42	-	3.63	-
NPS4	Wilsons Promontory Marine Park	77.38	-	0.04	-	66.58	-	0.08	-
RSB	Bell Reef	39.08	-	0.33	-	30.92	-	0.38	-
	Bravenes Rock	63.08	-	1.33	-	5.79	-	3.25	-
Nearshore Waters (LGA)	Anser Island	-	-	-	-	49.5	-	1.5	-
	Colac Otway	17.21	-	5.17	-	5.67	-	3.04	-
	Corangamite	59.63	-	14.33	-	62.67	-	0.04	-
	Glennie Group	-	-	-	-	48.33	-	3.63	-
	Kanowna Island	-	-	-	-	49.54	-	1.33	-
	King Island	10.54	-	17.17	-	3.96	-	26.88	-

Receptor		Summer (November through to March)				Winter (April to October)			
		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)		Minimum time before entrained hydrocarbon exposure (days)		Maximum residence time for entrained hydrocarbon exposure (days)	
		Low	High	Low	High	Low	High	Low	High
	Moyne	63.92	-	0.04	-	-	-	-	-
	Norman Island	77.21	-	0.21	-	39.29	-	2.67	-
	Reid Rock	18.79	-	0.13	-	12.04	-	0.13	-
	Rodondo Island	76.08	-	0.13	-	22.21	-	0.08	-
	Skull Rock	-	-	-	-	49.54	-	1.33	-
	South Gippsland	77.38	-	0.08	-	24.38	-	3.21	-
State Waters	Tasmania State Waters	10.13	-	17.17	-	3.25	-	26.88	-
	Victoria State Waters	10.58	-	16.54	-	4.88	-	4	-
Nearshore Waters (LGA)	Apollo Bay	46.79	-	0.17	-	7.38	-	1.83	-
	Bay of Islands	63.92	-	0.04	-	-	-	-	-
	Cape Liptrap	-	-	-	-	24.38	-	3.21	-
	Cape Otway West	17.21	-	5.17	-	5.67	-	3.04	-
	Cape Patton	-	-	-	-	73.33	-	2.88	-
	Moonlight Head	59.63	-	14.33	-	62.67	-	0.04	-
	Port Campbell	60.08	-	13	-	-	-	-	-
	Waratah Bay	-	-	-	-	26.25	-	2.25	-
	Wilsons Promontory	77.38	-	0.08	-	49.92	-	0.67	-

*The release location resides within the receptor boundaries.

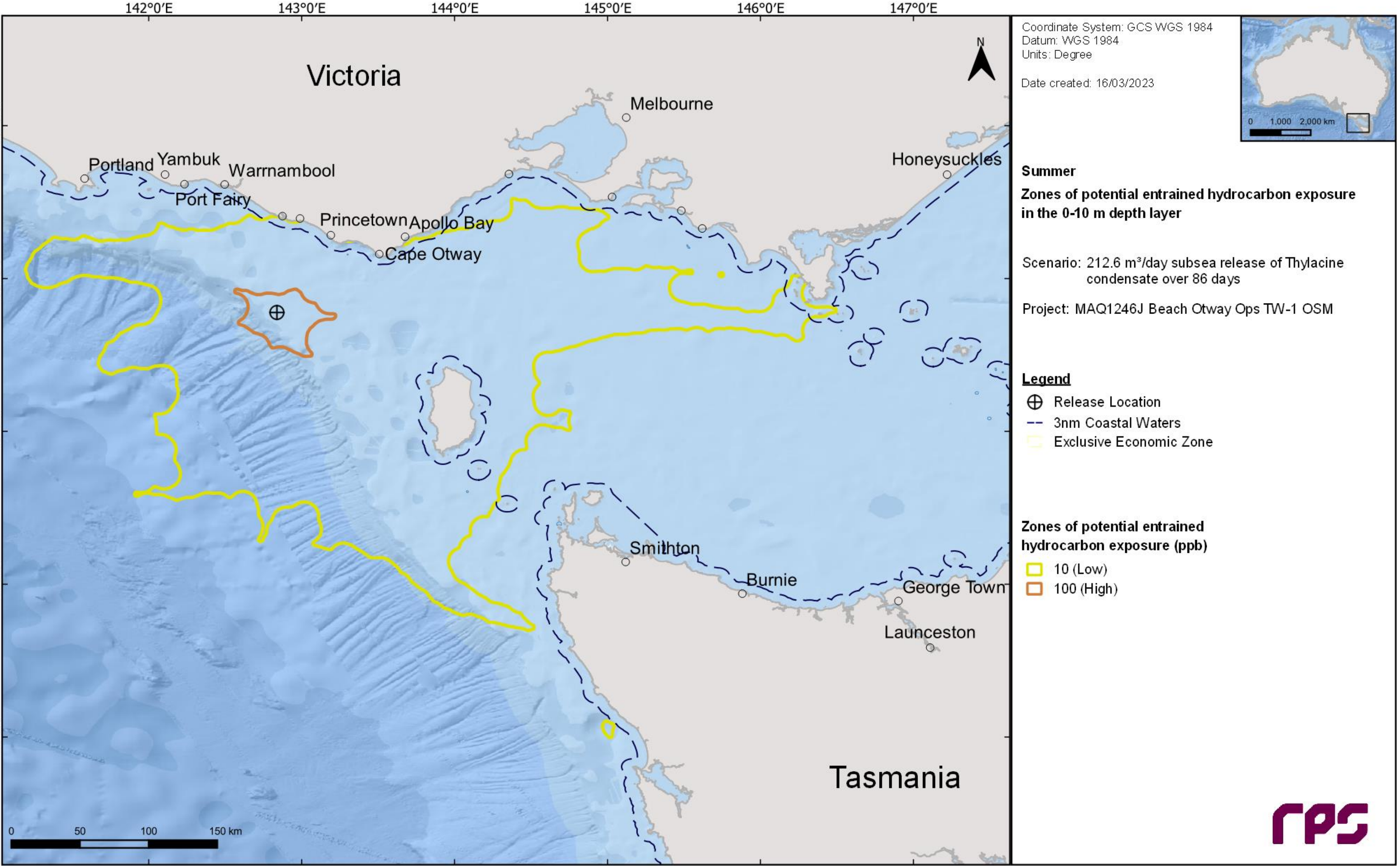


Figure 11-16 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

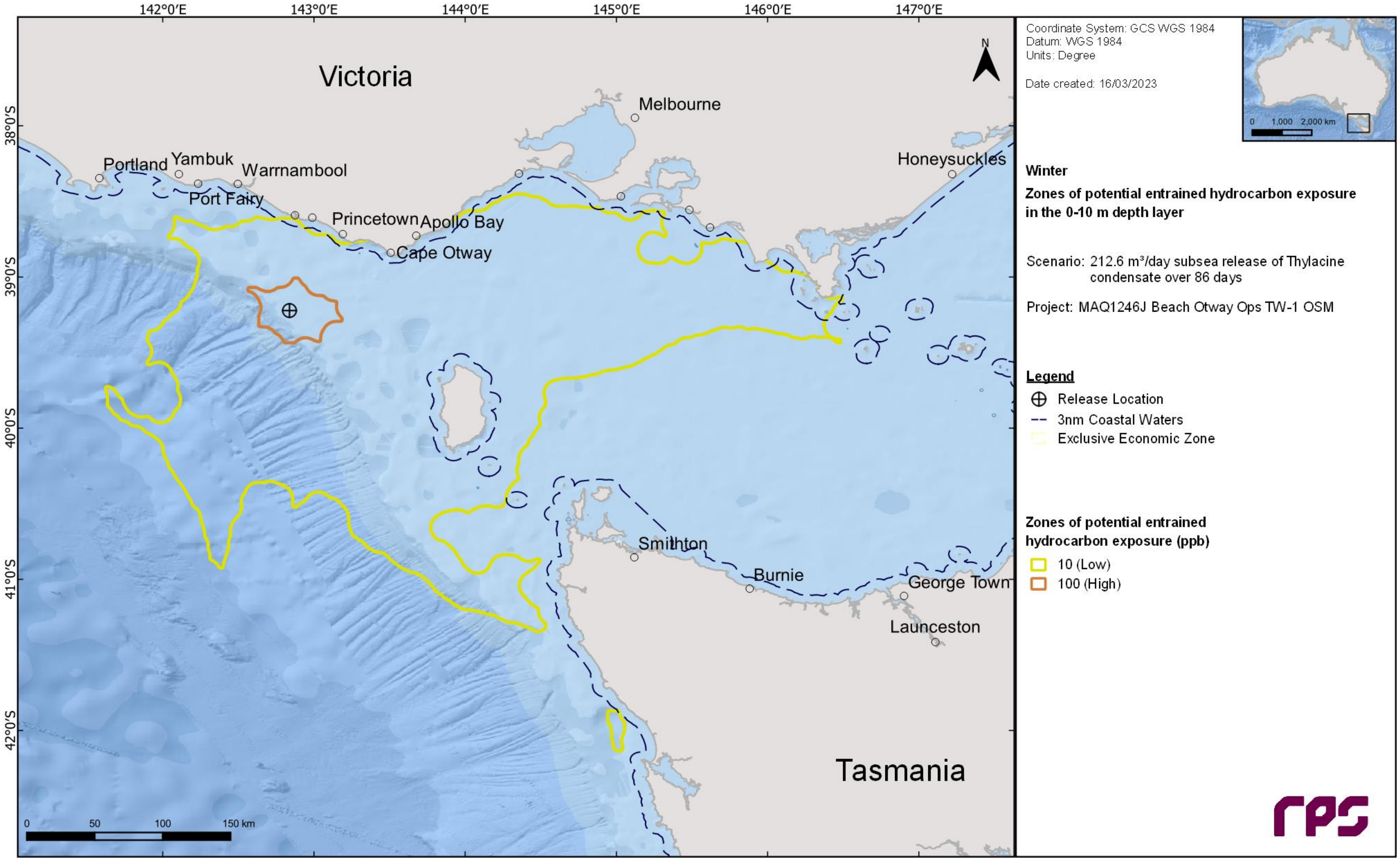


Figure 11-17 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

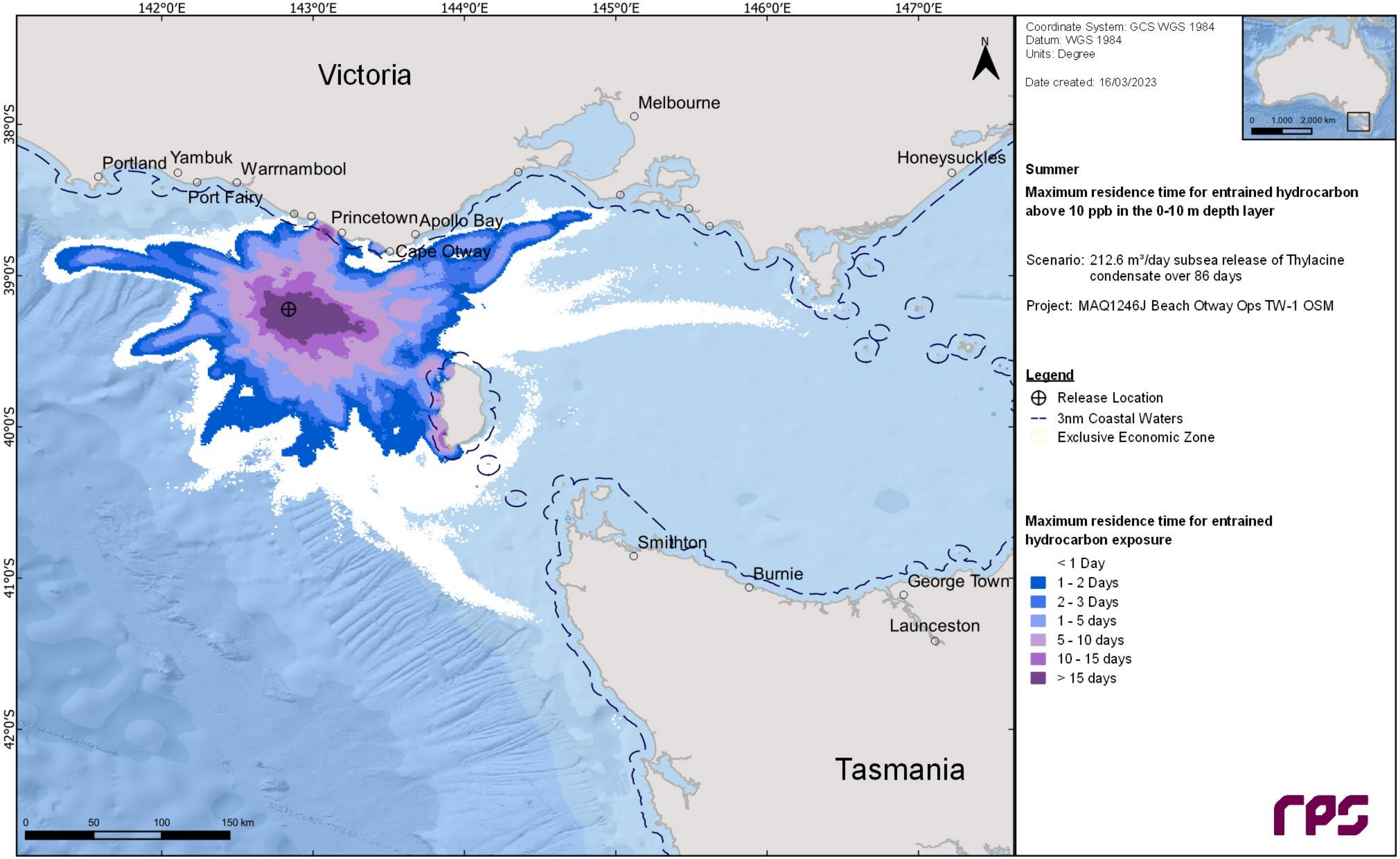


Figure 11-18 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

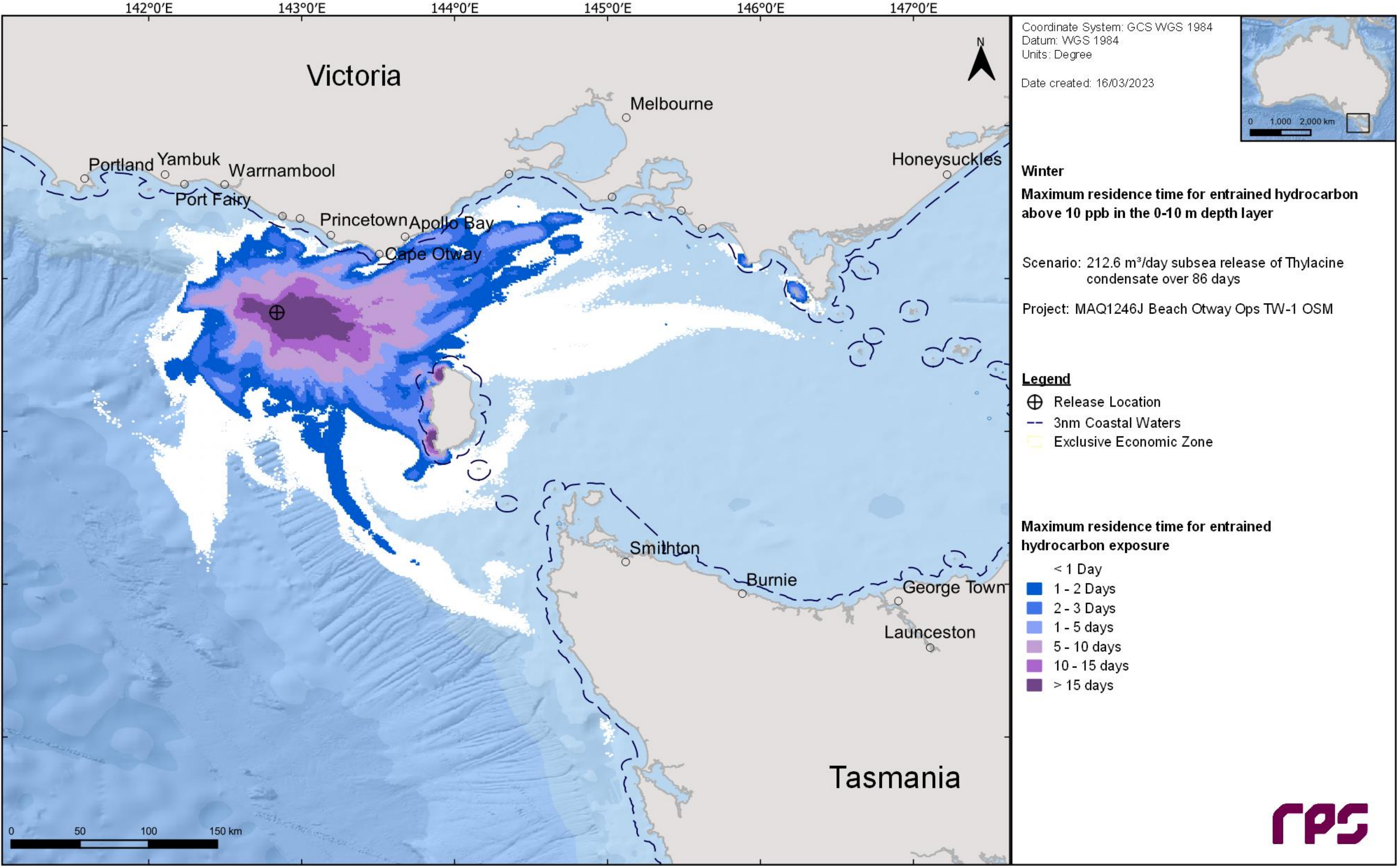


Figure 11-19 Maximum residence time for entrained hydrocarbon exposure above 10 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

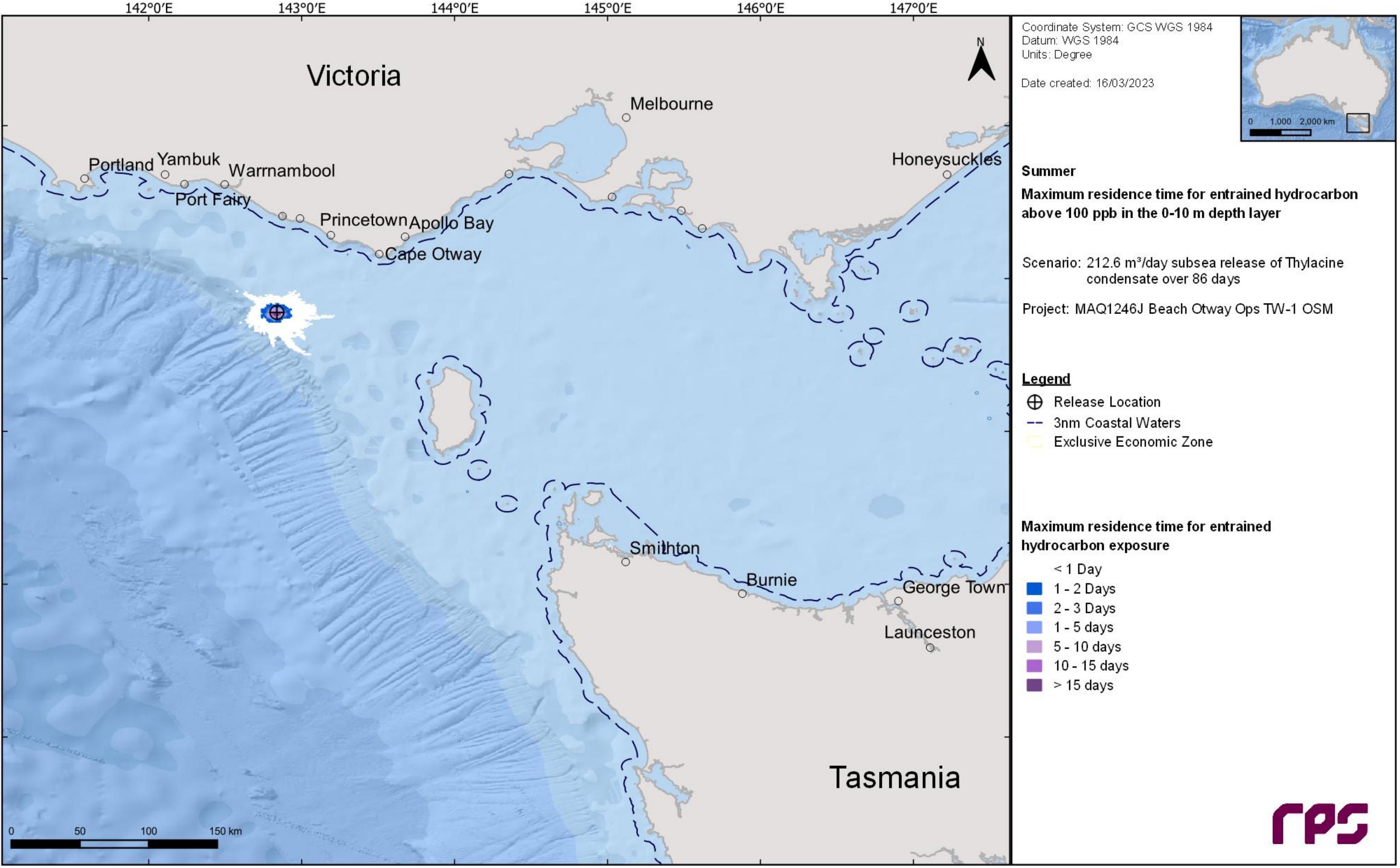


Figure 11-20 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during summer conditions.

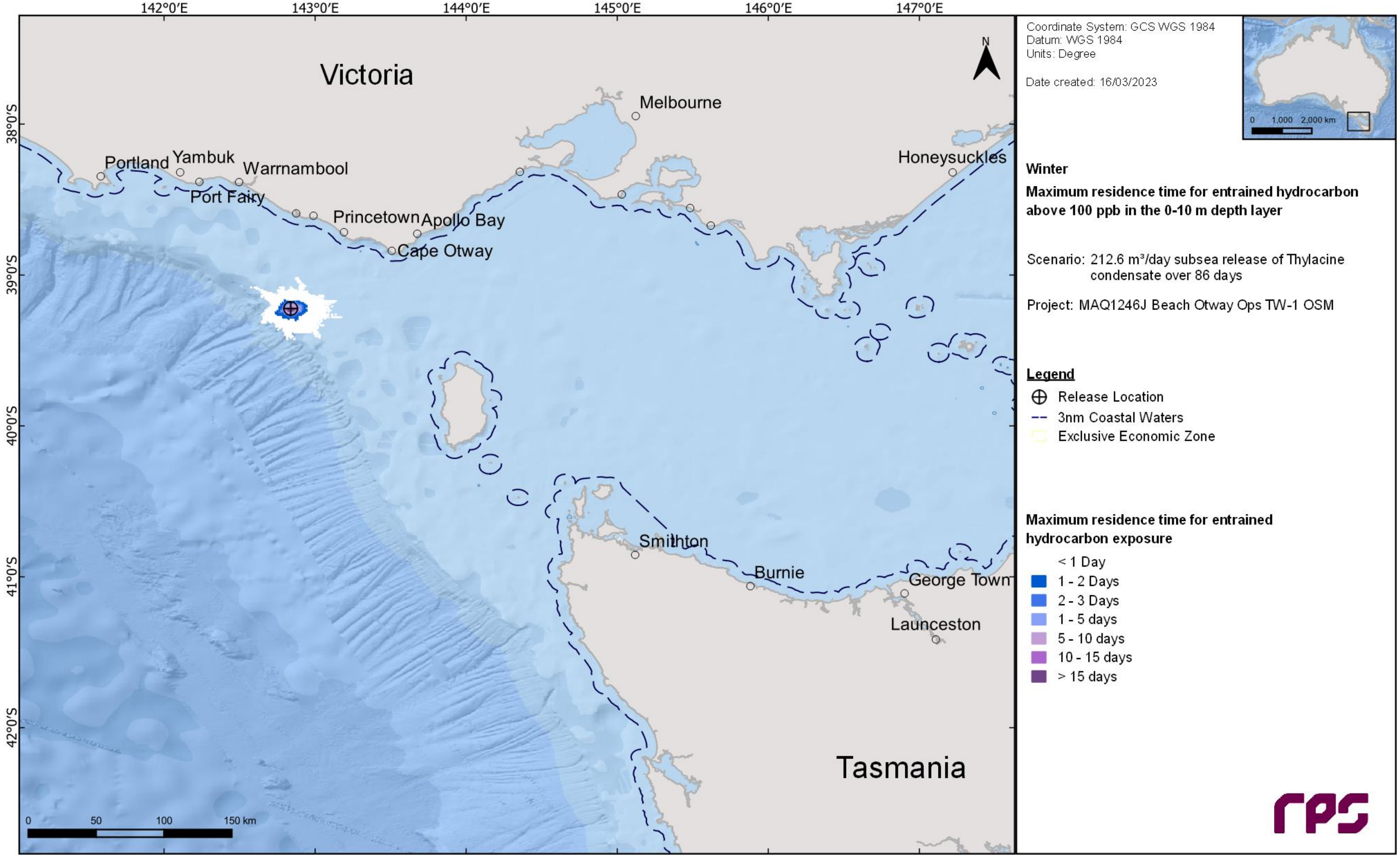


Figure 11-21 Maximum residence time for entrained hydrocarbon exposure above 100 ppb, at 0-10 m below the sea surface in the event of a 212.6 m³/day subsea release of Thylacine condensate over 86 days. The results were calculated from 100 spill simulations during winter conditions.

11.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below;

a. largest instantaneous peak volume of oil ashore; (Section 11.2.2)

b. minimum time before shoreline contact above 10 g/m^2; (Section 11.2.3)

c. largest swept area of oil on the sea surface above 10 g/m^2 (Section 11.2.1)

d. largest entrained oil swept area above 100 ppb; (Section 11.2.4)

e. largest dissolved oil swept area above 400 ppb. (11.2.5)

Table 11-10 presents a summary of shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 11-10 Summary of the worst-case deterministic analysis based on the scenario presented in the Stochastic Analysis Section.

Variable	Threshold	Deterministic Analysis Criteria				
		Largest swept area of floating oil above 10 g/m^2	Largest instantaneous peak volume of oil ashore	Minimum time before shoreline accumulation above 10 g/m^2	Largest area of entrained hydrocarbons above 100 ppb	Largest area of dissolved hydrocarbons above 400 ppb
Season		Winter	Winter	Winter	Winter	Summer
Run Number		28	69	64	70	27
Total area of floating Oil exposure (km^2)	**1 g/m^2**	136.6	62.2	135.6	157.0	175.0
	10 g/m^2	1.0	-	-	-	-
	50 g/m^2	-	-	-	-	-
Total length of shoreline accumulation (km)	**10 g/m^2**	NC	28.3	3.0	NC	NC
	100 g/m^2	NC	-	-	NC	NC
	1,000 g/m^2	NC	-	-	NC	NC
Minimum time before accumulation on any shoreline (days)	**10 g/m^2**	NC	42.8	**6.5**	NC	NC
	100 g/m^2	NC	-	-	NC	NC
	1,000 g/m^2	NC	-	-	NC	NC
Maximum instantaneous peak volume ashore (m^3)		NC	**11.7**	1.4	NC	NC
Total area of entrained hydrocarbon exposure (km^2)	**10 ppb**	15,604	14,130	12,818	13,431.0	14,668
	100 ppb	366	328	408	**450**	365
Total area of dissolved hydrocarbon exposure (km^2)	**10 ppb**	10,569	12,134	8,955	9,594	9,164
	50 ppb	2,526	2,137	2,514	2,471	2,357
	400 ppb	2	-	-	0.0	**12**
Start Date		18th July 2014	3rd May 2019	6th August 2019	19th October 2010	24th January 2014

NC = No contact at, or above the specified shoreline accumulation threshold.

11.2.1 Deterministic Case: Largest swept area of floating oil above 10 g/m^2

The deterministic trajectory that resulted in the largest swept area of floating oil above 10 g/m^2 was identified as run number 28 during winter season, which started on 18th July 2014. Figure 11-22 illustrates the floating oil exposure over the 100-day simulation.

Figure 11-23 displays the time series of the swept area of low (1 g/m^2), moderate (10 g/m^2) and high (50 g/m^2) floating oil over the 100-day simulation.

Figure 11-24 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11-11 summarises the mass balance at the peak and at end of the simulation.

Table 11-11 Summary of the mass balance for the trajectory that resulted in the largest swept area of floating oil above 10 g/m^2. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 100
Surface (m^3)	65.1	28.50	2.2
Entrained (m^3)	662.8	82.54	358.6
Dissolved (m^3)	101.2	55.54	5.3
Evaporation (m^3)	14,648.6	100.00	14,648.6
Decay (m^3)	3,302.9	100.00	3,302.9
Ashore (m^3)	0.0	0.0	0.0

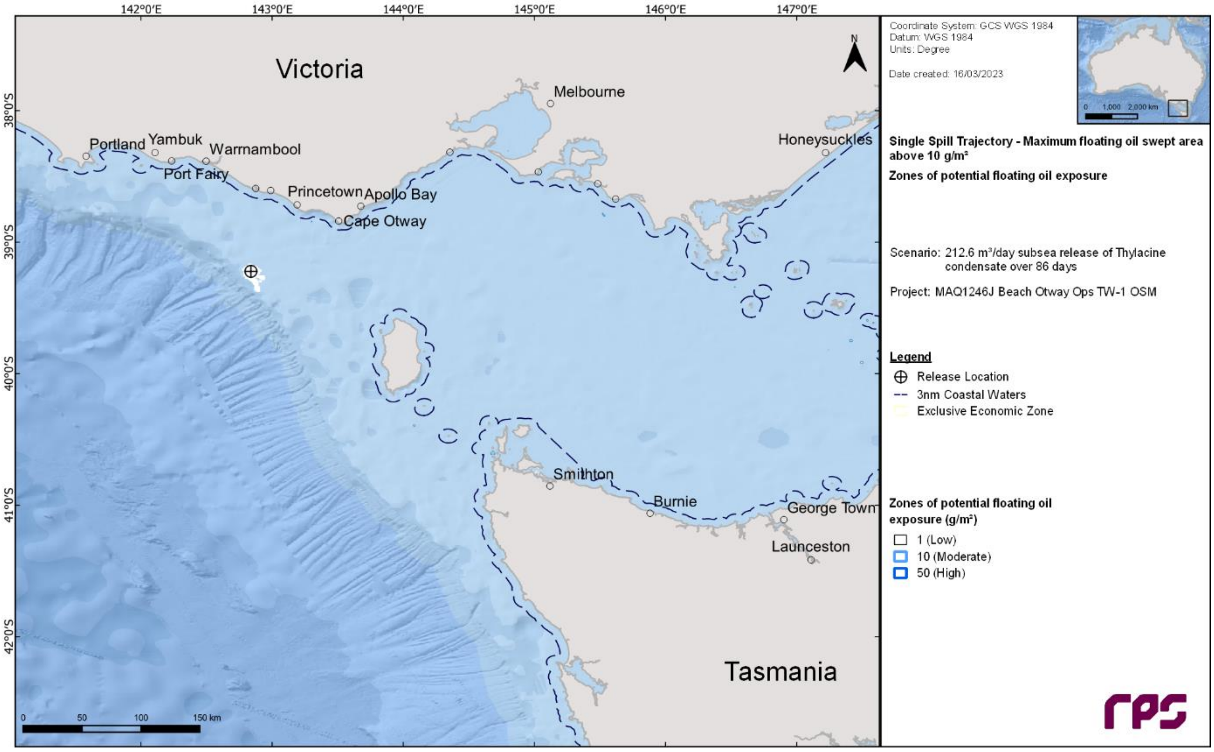


Figure 11-22 Zones of potential floating oil exposure for the trajectory with the largest swept area of floating oil above 10 g/m^2. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

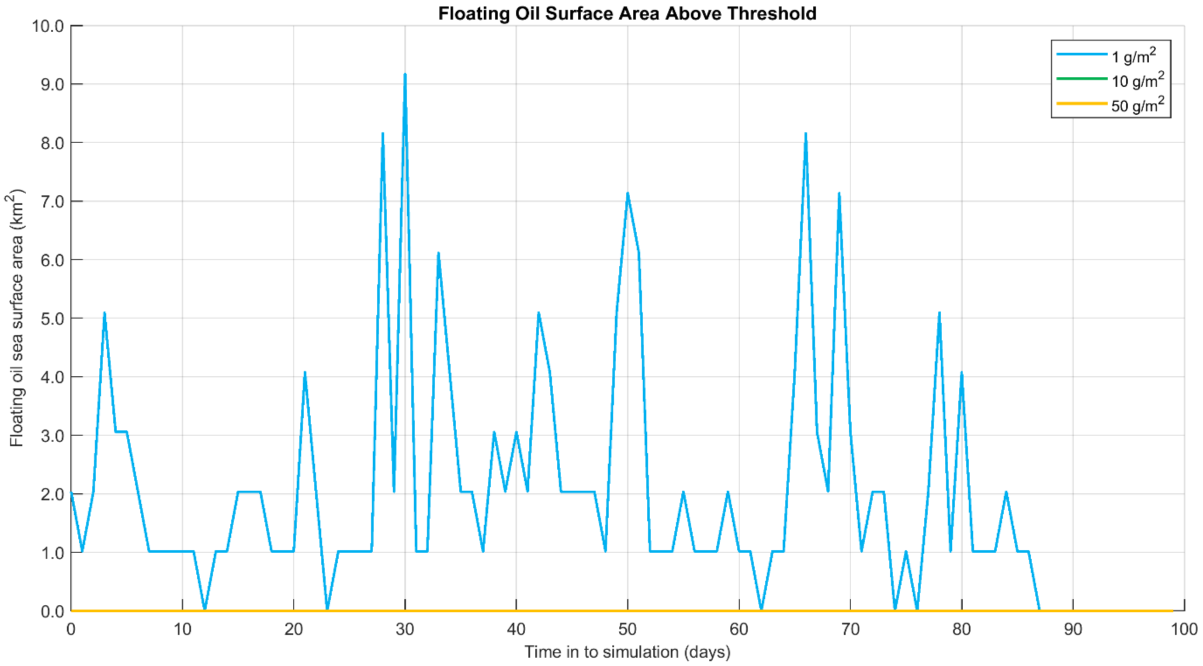


Figure 11-23 Time series of the area of floating oil for the trajectory with the largest swept area of floating oil above 10 g/m^2. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

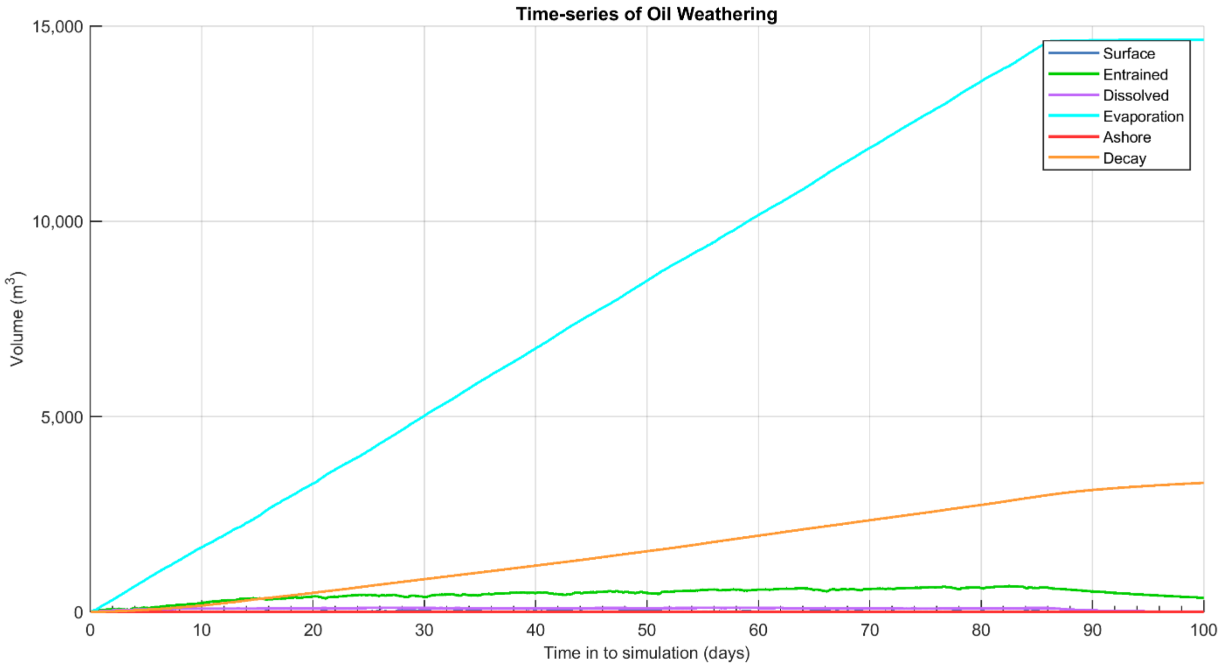


Figure 11-24 Predicted weathering and fates graph for the trajectory with the largest swept area of floating oil above 10 g/m^2. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

11.2.2 Deterministic Case: Largest instantaneous peak volume of oil ashore

The deterministic trajectory that resulted in the largest instantaneous peak volume of oil ashore was identified as run number 69 during winter conditions, which started on 3rd May 2019. Figure 11-25 illustrates the floating oil exposure and shoreline accumulation over the 100-day simulation.

Figure 11-26 displays the time series of the volume of oil accumulating on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 100-day simulation.

Figure 11-27 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11-12 summarises the mass balance at the end of the simulation.

Table 11-12 Summary of the mass balance for the trajectory that resulted in the largest instantaneous peak volume of oil ashore. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 100
Surface (m^3)	40.5	84.21	0.3
Entrained (m^3)	677.3	70.29	332.4
Dissolved (m^3)	97.4	65.04	4.4
Evaporation (m^3)	14,624.1	100.00	14,624.1
Decay (m^3)	3,333.0	100.00	3,333.0
Ashore (m^3)	11.7	88.96	3.9

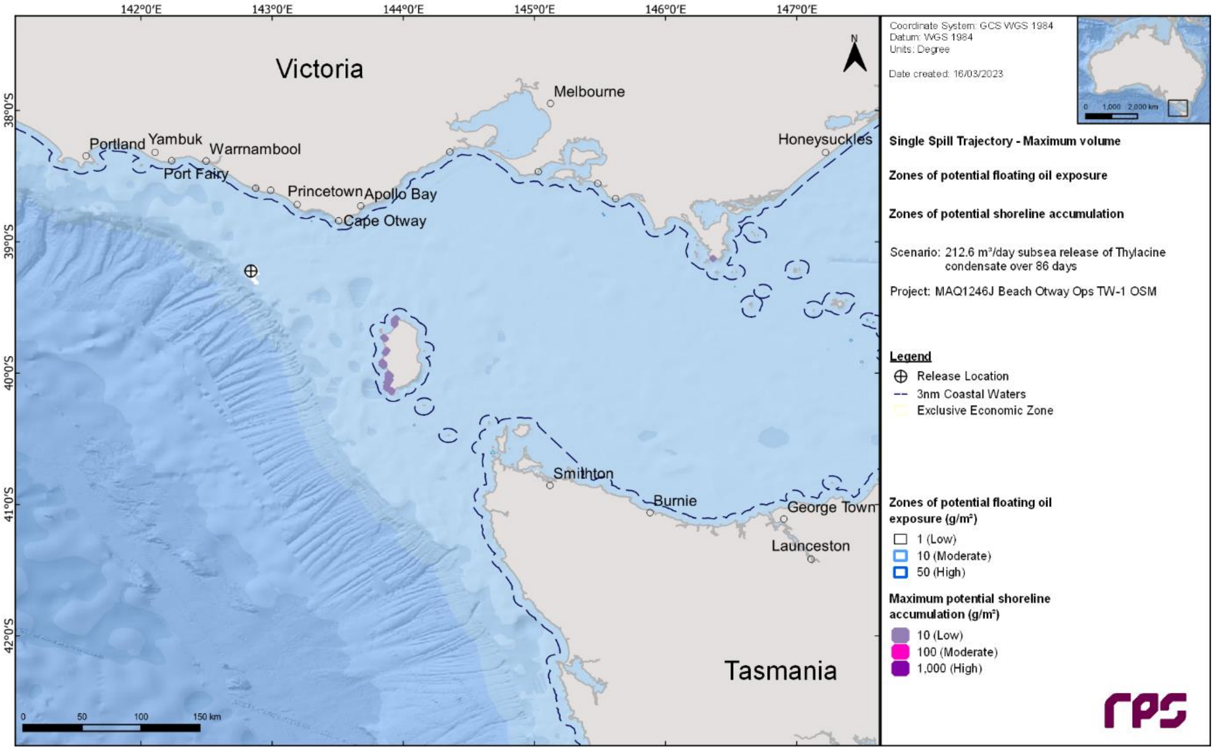


Figure 11-25 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest instantaneous peak volume of oil ashore. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

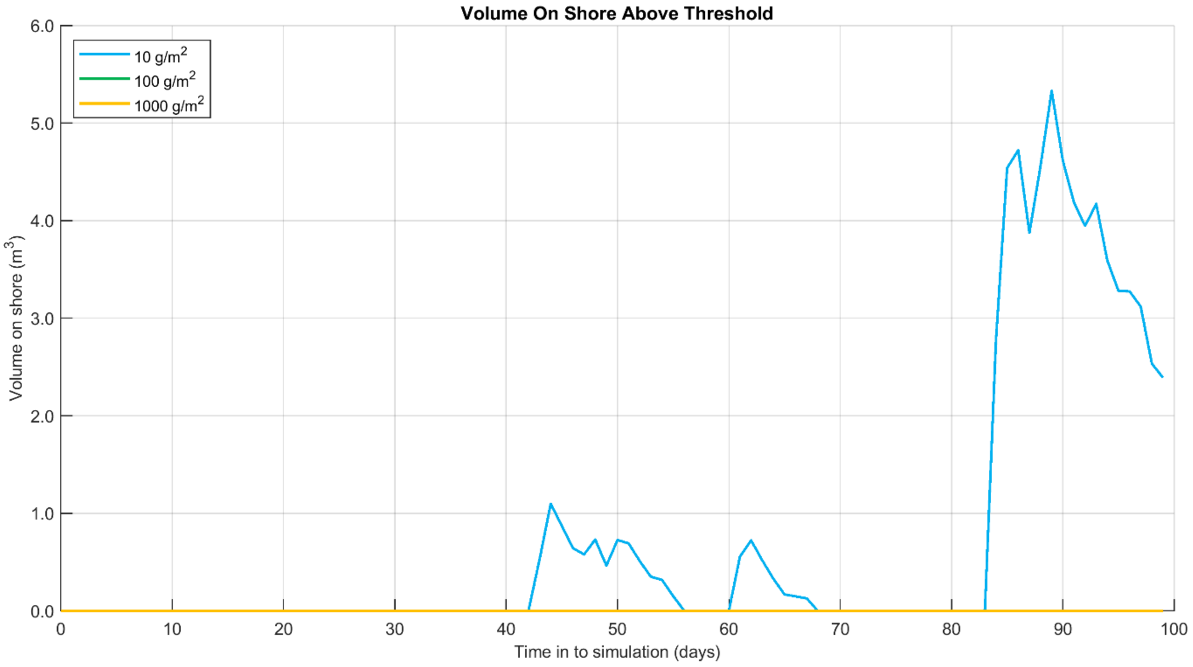


Figure 11-26 Time series of the volume of oil accumulating on shorelines at the low (10 g/m²), moderate (100 g/m²) and high (1,000 g/m²) thresholds for the trajectory with the largest instantaneous peak volume of oil ashore. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

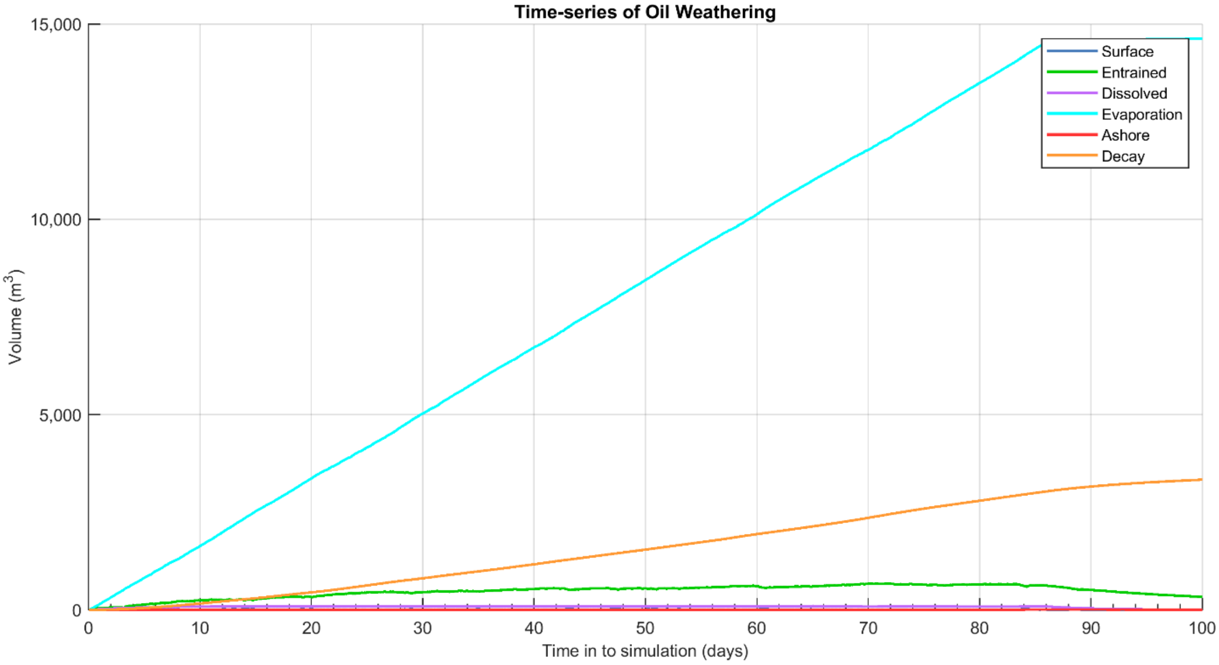


Figure 11-27 Predicted weathering and fates graph for the trajectory with the largest instantaneous peak volume of oil ashore. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

11.2.3 Deterministic Case: Minimum time before shoreline accumulation above 10 g/m^2

The deterministic trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m^2) was identified as run number 64 during winter conditions which started on the 6th August 2019. Figure 11-28 illustrates the floating oil exposure and shoreline accumulation over the 30 days.

Figure 11-29 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11-13 summarises the mass balance at the end of the 100-day simulation.

Table 11-13 Summary of the mass balance for the trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m^2). Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 100
Surface (m^3)	75.0	77.88	0.5
Entrained (m^3)	651.4	67.04	344.7
Dissolved (m^3)	100.8	37.33	4.0
Evaporation (m^3)	14,588.0	100.00	14,588.0
Decay (m^3)	3,383.0	100.00	3,383.0
Ashore (m^3)	1.4	97.04	0.7

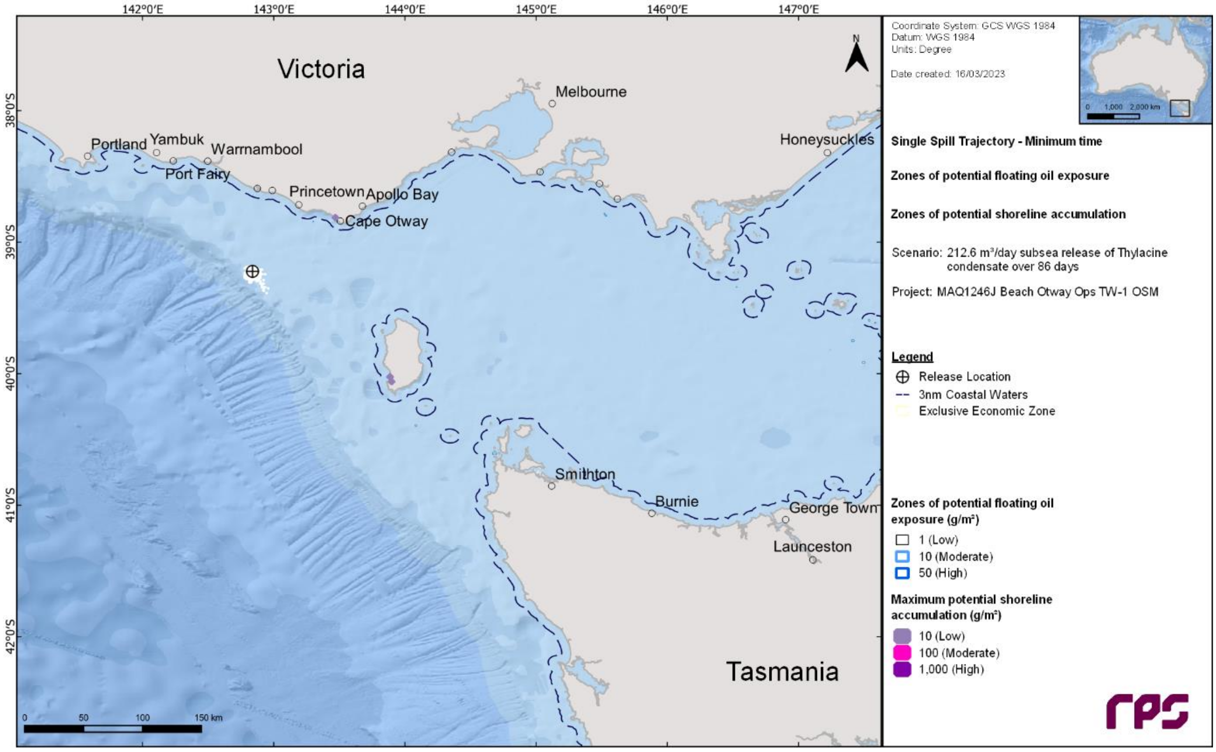


Figure 11-28 Zones of potential floating oil exposure and shoreline accumulation over the 100-day simulation, for the trajectory with the minimum time before shoreline accumulation above 10 g/m^2. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

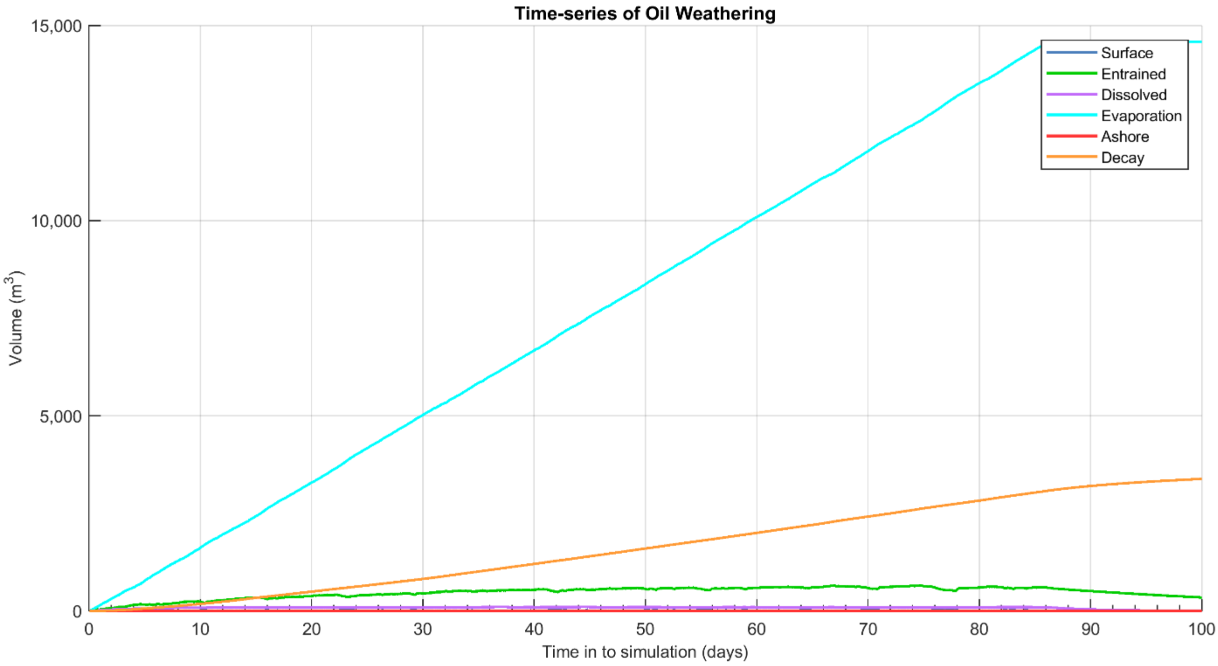


Figure 11-29 Predicted weathering and fates graph for the trajectory with the minimum time before shoreline accumulation above 10 g/m^2. Results are based on a 212.6 m^3/day subsea release of Thylacine condensate over 86 days.

11.2.4 Deterministic Case: Largest area of entrained hydrocarbons above 100 ppb

The deterministic trajectory that resulted in the largest area of entrained hydrocarbons above 100 ppb was identified as run number 70 during winter season, which started on 19th October 2010. Figure 11-30 illustrates the zones of potential entrained hydrocarbon exposure.

Figure 11-31 displays the time series of the area of entrained hydrocarbons at the low (10 ppb) and moderate (100 ppb) thresholds over the 100-day simulation.

Figure 11-32 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11-14 summarises the mass balance at the peak and at end of the simulation.

Table 11-14 Summary of the mass balance for the trajectory that resulted in the largest area of entrained hydrocarbons above 10 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 100
Surface (m^3)	60.6	5.63	0.5
Entrained (m^3)	629.3	86.00	355.5
Dissolved (m^3)	102.1	21.92	5.2
Evaporation (m^3)	14,652.6	100.00	14,652.6
Decay (m^3)	3,313.7	100.00	3,313.7
Ashore (m^3)	0.0	0.0	0.0

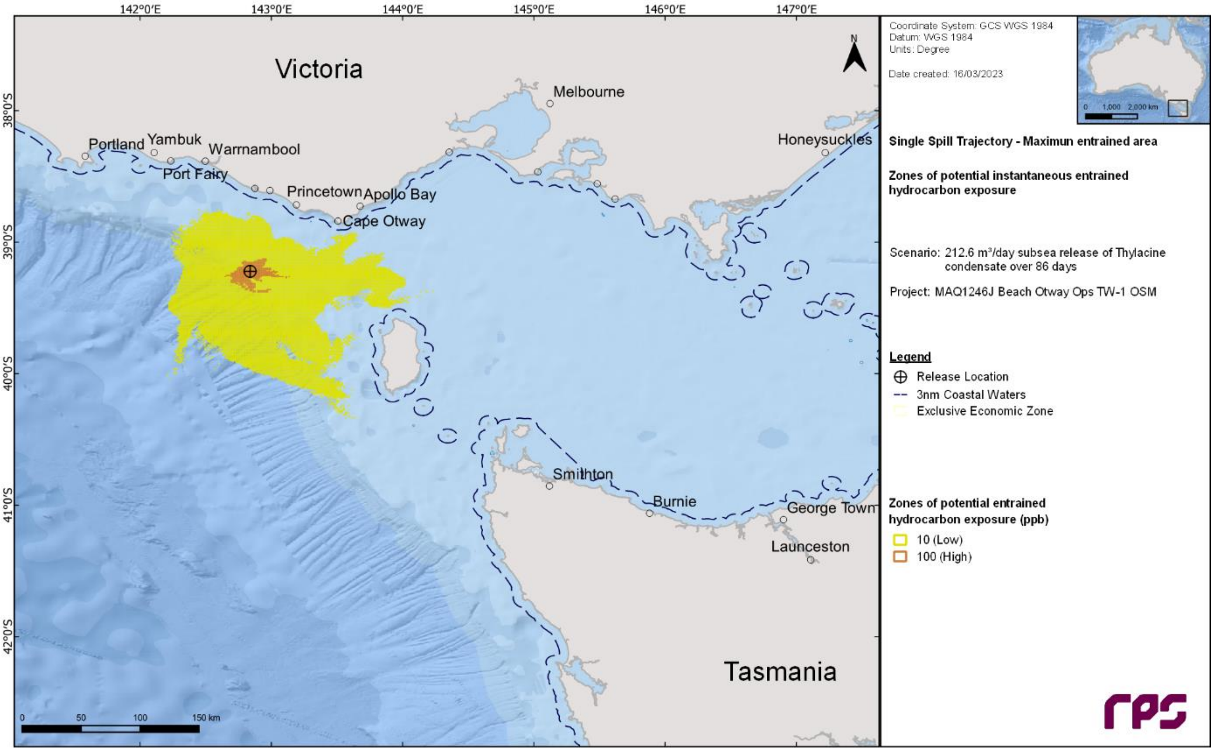


Figure 11-30 Zones of potential entrained hydrocarbon exposure, for the trajectory with the largest area of entrained hydrocarbons above 100 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

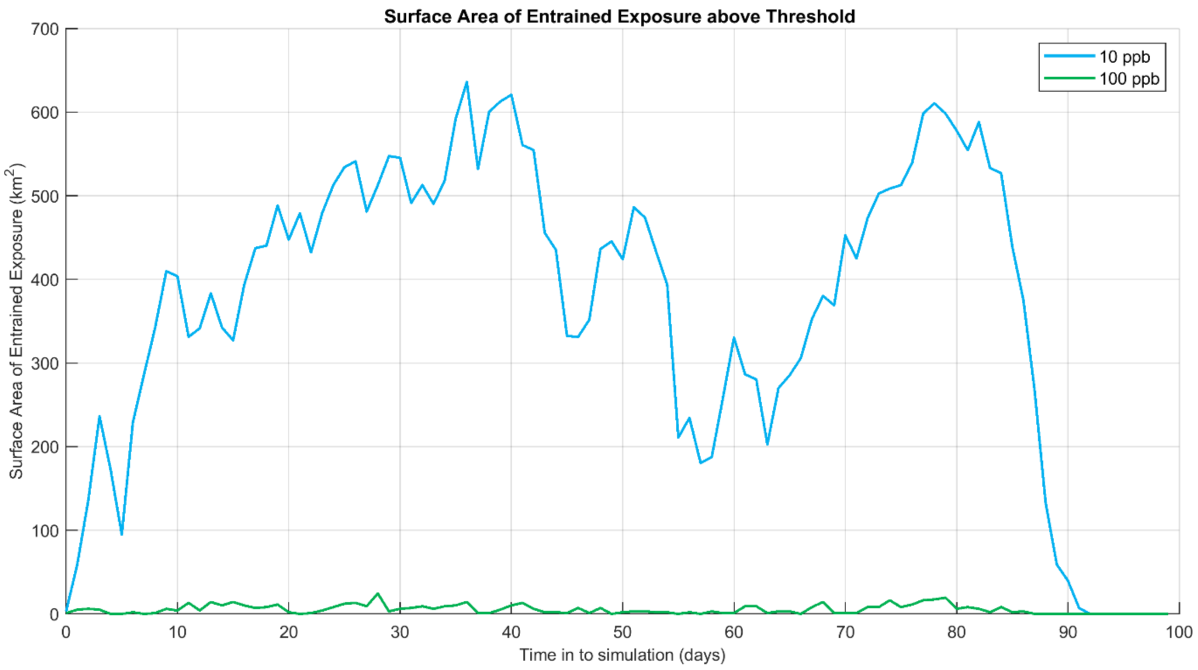


Figure 11-31 Time series of the predicted area of entrained hydrocarbon exposure for the trajectory with the largest area of entrained hydrocarbons above 100 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

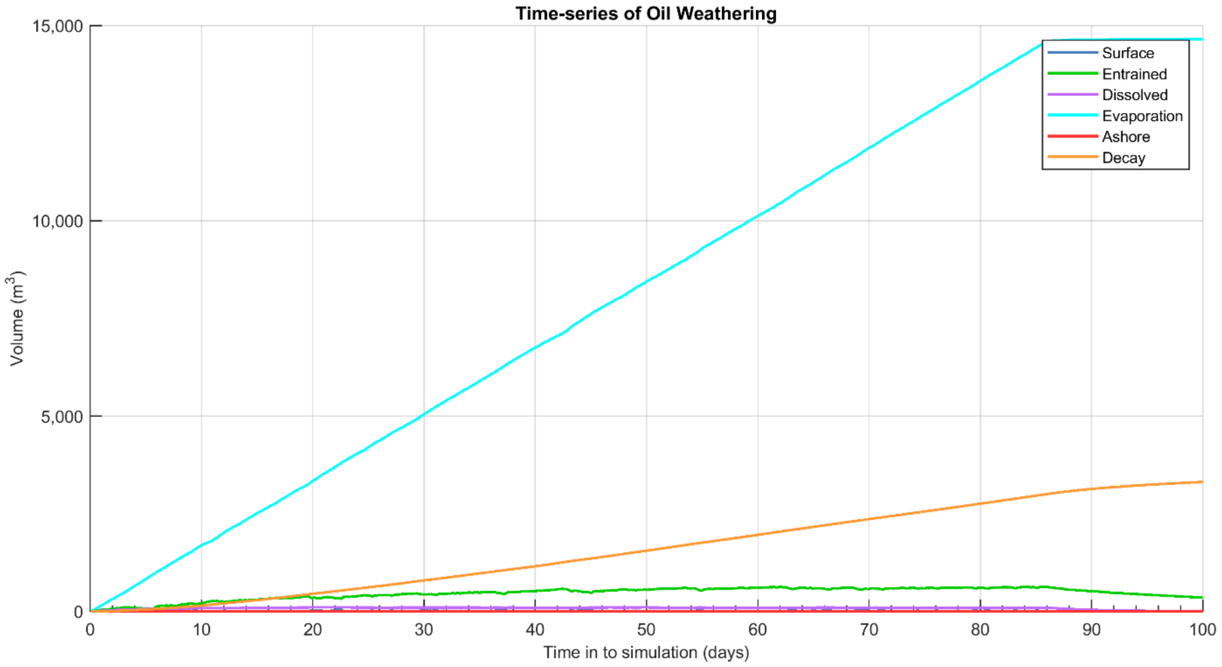


Figure 11-32 Predicted weathering and fates graph for the trajectory with the largest area of entrained hydrocarbon exposure above 100 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

11.2.5 Deterministic Case: Largest area of dissolved hydrocarbons above 400 ppb

The deterministic trajectory that resulted in the largest area of dissolved hydrocarbons above 400 ppb was identified as run number 27, during summer season, which started on 24th January 2014. Figure 11-33 illustrates the zones of potential dissolved hydrocarbon exposure.

Figure 11-34 displays the time series of the area of dissolved hydrocarbons at the low (10 ppb), moderate (50 ppb) and high (400 g/m^2) thresholds over the 100-day simulation.

Figure 11-35 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11-15 summarises the mass balance at the peak and at end of the simulation.

Table 11-15 Summary of the mass balance for the trajectory that resulted in the largest area of dissolved hydrocarbon exposure above 400 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 100
Surface (m^3)	81.9	64.17	0.0
Entrained (m^3)	603.3	85.33	335.3
Dissolved (m^3)	101.9	51.79	5.3
Evaporation (m^3)	14,773.6	100.00	14,773.6
Decay (m^3)	3,171.3	100.00	3,171.3
Ashore (m^3)	0.0	0.0	0.0

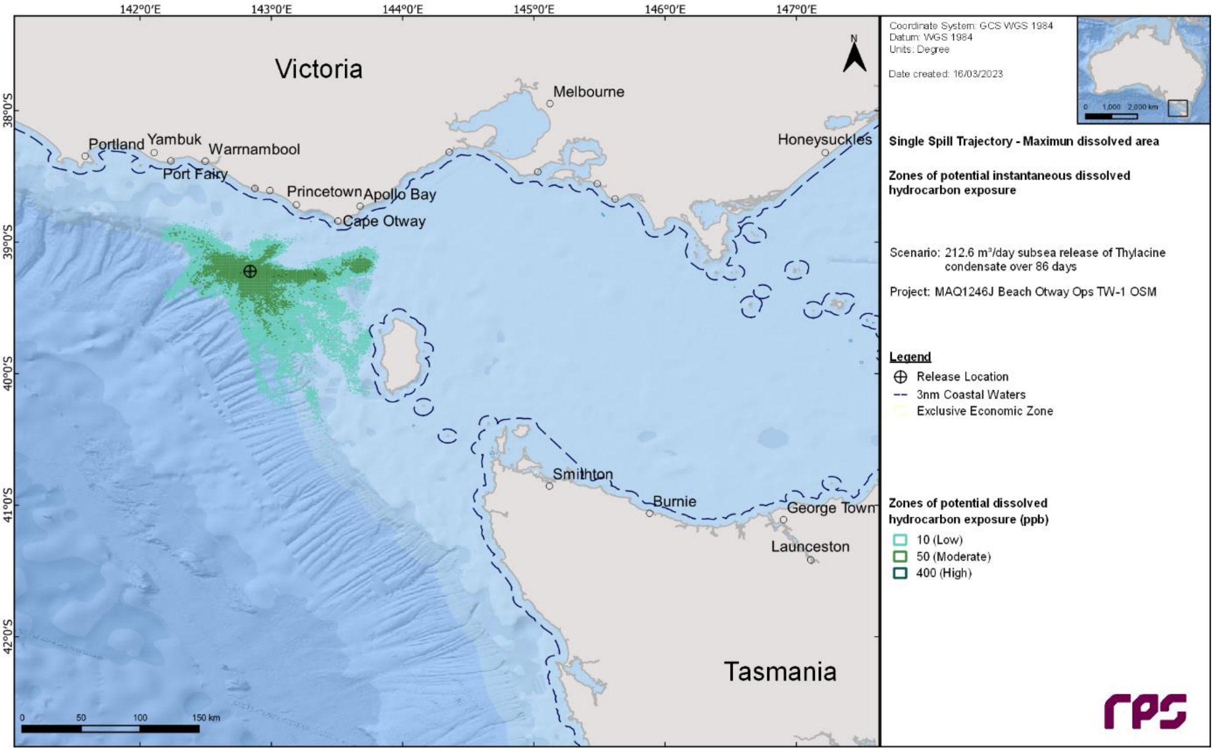


Figure 11-33 Zones of potential dissolved hydrocarbon exposure for the trajectory with the largest area of dissolved hydrocarbons above 400 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

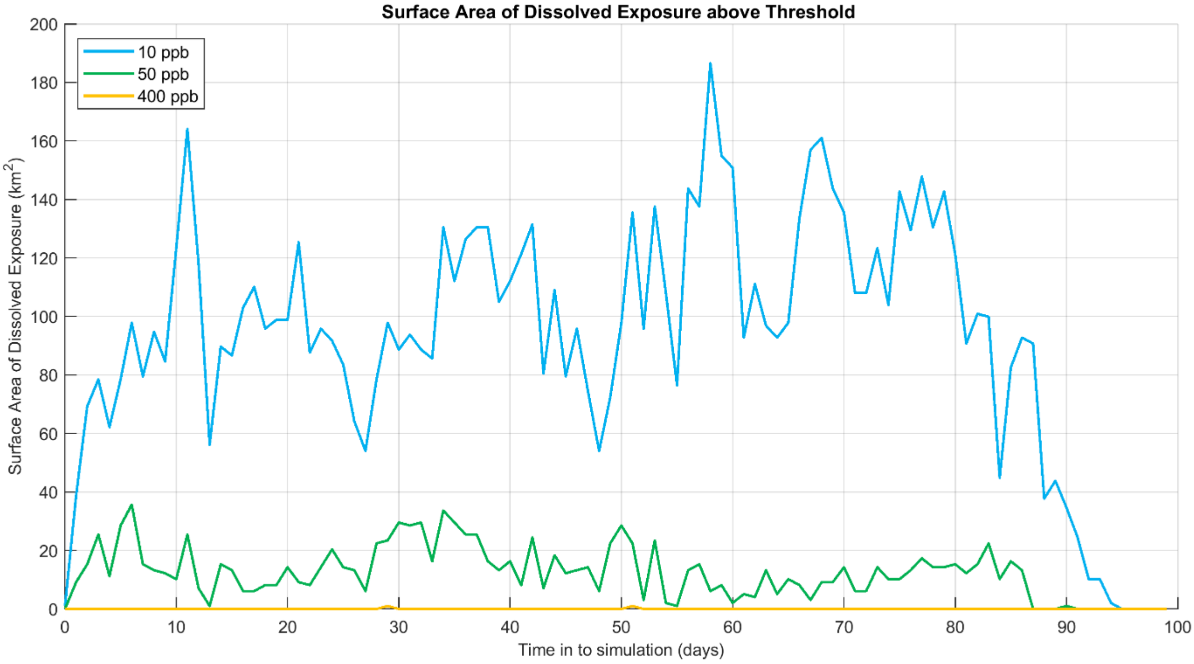


Figure 11-34 Time series of the area of dissolved hydrocarbon exposure for the trajectory with the largest area of dissolved hydrocarbons above 400 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

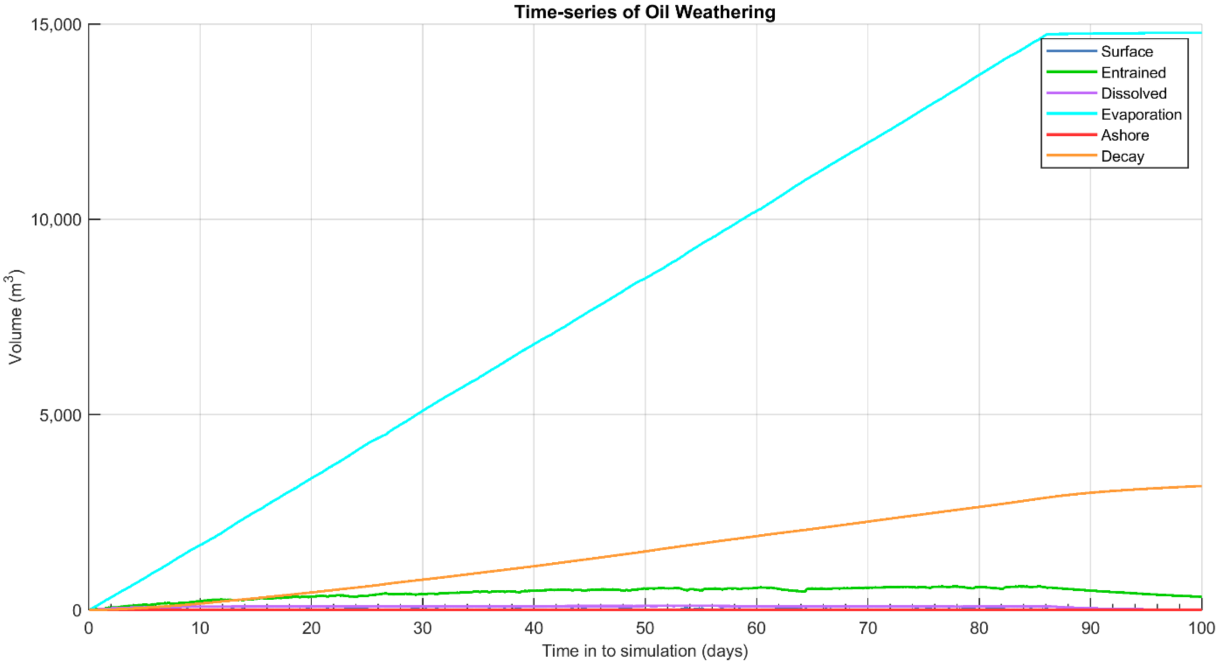


Figure 11-35 Predicted weathering and fates graph for the trajectory with the largest area of dissolved hydrocarbons above 400 ppb. Results are based on a 212.6 m³/day subsea release of Thylacine condensate over 86 days.

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E. 2. Diesel Spill Modelling

THYLACINE INSTALLATION AND COMMISSIONING – PHASE 5

Oil Spill Modelling – Variation 1

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TERMS AND ABBREVIATIONS

AMP	Australian Marine Park
ANZECC	Australian and New Zealand Environment and Conservation Council
API	American Petroleum Institute gravity. A measure of how heavy or light a petroleum liquid is compared to water.
ARMCANZ	Agriculture and Resource Management Council of Australia and New Zealand
ASTM	American Society for Testing and Materials
BIA	Biologically Important Areas
Bonn Agreement	An agreement for cooperation in dealing with pollution of the North Sea by oil and other harmful substances, 1983, includes: Governments of the Kingdom of Belgium, the Kingdom of Denmark, the French Republic, the Federal Republic of Germany, the Republic of Ireland, the Kingdom of the Netherlands, the Kingdom of Norway, the Kingdom of Sweden, the United Kingdom of Great Britain and Northern Ireland and the European Union.
BP	Boiling point. The temperature at which the vapor pressure of the liquid is equal to the pressure exerted on it by the surrounding atmosphere
BTEX	Benzene, Toluene, Ethylbenzene, and Xylenes
CFSR	Climate Forecast System Reanalysis
Decay	The process where oil components are changed either chemically or biologically (biodegradation) to another compound. It includes breakdown to simpler organic carbon compounds by bacteria and other organisms, photo-oxidation by solar energy, and other chemical reactions.
Deterministic oil spill modelling	Oil spill modelling involving a computer simulation of a single hypothetical oil spill event subject to a single sequence of wind, current and other sea conditions over time. Single oil spill modelling, also referred to as “deterministic modelling” provides a simulation of one possible outcome of a given spill scenario, subject to the metocean conditions that are imposed. Single oil spill modelling is commonly used to consider the fate and effects of ‘worst-case’ oil spill scenarios that are carefully selected in consideration of the nature and scale of the offshore petroleum activity and the local environment (NOPSEMA, 2017). Because the outcomes of a single oil spill simulation can only represent the outcome of that scenario under one sequence of metocean conditions, worst-case conditions are often identified from stochastic modelling. It is impossible to calculate the likelihood of any outcome from a single oil spill simulation. Single oil spill modelling is generally used for response planning, preparedness planning and for supporting oil spill response operations in the event of an actual spill
Dynamic viscosity	The dynamic viscosity of a fluid expresses its resistance to shearing flows, where adjacent layers move parallel to each other with different speeds.
Floating oil exposure	Contact by floating oil on the sea surface at concentrations equal to or exceeding defined threshold concentrations. The consequence will vary depending on the threshold and the receptors
GODAE	Global Ocean Data Assimilation Experiment
HYCOM	Hybrid Coordinate Ocean Model. A data-assimilative, three-dimensional ocean model
HYDROMAP	Advanced ocean/coastal tidal model used to predict tidal water levels, current speed and current direction.
IBRA	Interim Biogeographic Regionalisation for Australia bioregions
IMCRA	Integrated marine and coastal regionalisation areas
IOA	Index of Agreement
ITOPF	International Tanker Owners Pollution Federation Limited
KEF	Key Ecological Feature
LGA	Local Government Areas
MAE	Mean Absolute Error
MAHs	Monoaromatic Hydrocarbons
MDO	Marine diesel oil
MEG	Mono-Ethylene Glycol
MNP	Marine National Park

MP	Marine Park
MS	Marine Sanctuary
NASA	National Aeronautics and Space Administration (USA)
NCEP	National Centres for Environmental Prediction (USA)
NOAA	National Oceanic and Atmospheric Administration (USA)
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NP	National Park
NR	Nature Reserve
PAH	Polynuclear Aromatic Hydrocarbons
Pour Point	The pour point of a liquid is the temperature below which the liquid loses its flow characteristics
ppb	Parts per billion (concentration)
psu	Practical salinity units
Ramsar site	A site listed under the Ramsar Convention on wetlands which is an international intergovernmental treaty that provides the framework for the conservation and wise use of wetlands and their resources.
RSB	Reefs, Shoals and Banks
Shoreline accumulation	Arrival of oil at or near shorelines at on-water concentrations equal to or exceeding defined threshold concentrations. Shoreline contact is judged for floating oil arriving within a 2 km buffer zone from any shoreline as a conservative measure
SIMAP	Spill Impact Model Application Package. SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for surface or subsea releases
SRTM	Shuttle Radar Topography Mission
State Waters	Low water mark seaward for three nautical miles
Stochastic oil spill modelling	Stochastic oil spill modelling is created by overlaying and statistically analysing the outcomes of many single oil-spill simulations of a defined spill scenario, where each simulation was subject to a different sequence of metocean conditions, selected objectively (typically by random selection) from a long sequence of historic conditions for the study area. Analysis of this larger set of simulations provides a more accurate indication of the environment that maybe affected (EMBA) and indicates which locations are more likely to be affected (as well as other statistics). Stochastic oil spill modelling avoids biases that affect single oil spill modelling (due to the reliance on only one possible sequence of conditions). However, when interpreting stochastic modelling, which is based on a wide range of potential conditions that might happen to occur, it is essential to understand that calculations will encompass a much larger area than could be affected in any single spill event, where a more limited set of conditions will occur. Consequently, it is misleading to imply that the region derived from stochastic modelling indicate the outcomes expected from a single spill event (NOPSEMA, 2017) Stochastic modelling is generally used for risk assessment and preparedness planning by indicating locations that could be exposed and may require response or subsequent impact assessment
Sub-LGA	Sub-Local Government Areas
TOPEX/Poseidon	A joint satellite mission between NASA and CNES to map ocean surface topography using an array of satellites equipped with detailed altimeters
US EPA	United States Environmental Protection Agency
US CG	United States Coast Guard
World Ocean Atlas	A collection of physicochemical parameters (e.g. temperature, salinity, oxygen, phosphate, silicate, and nitrate) based on profile data from the World Ocean Database (NCEI, 2021) established by NOAA's National Centers for Environmental Information (NCEI)
WGS 1984	World Geodetic System 1984 (WGS84); reference coordinate system

EXECUTIVE SUMMARY

Background

Beach Energy (Operations) Limited (Beach) plans to tie-in production from four new wells in the Thylacine field (T/L2) to the existing Otway Gas Production Pipeline (OGPP) and to extend the Mono-Ethylene Glycol (MEG) and control systems from the Thylacine Wellhead Platform (WHP) to the new wells.

The construction support vessel (CSV), *Acergy Skandi*, will be used for the installation and commissioning activities in Q1 2023. The largest marine diesel oil (MDO) fuel tank on the CSV is 603.7 m^3, however Beach has been in discussion with the operator of this vessel to fill the tanks only partially to either 200 or 300 m^3.

The locations of the well head platforms (WHP) and wells are shown in Table 1-1. Installation activities will require a buffer around these infrastructure components, thus for the purposes of this modelling study, an Activity Area was established using the infrastructure locations and the position closest to shore was selected as the release location for the modelling study.

In order to inform the offshore environmental impact and risk assessments Beach commissioned a detailed oil spill modelling study assessing the following hypothetical scenarios:

- **Scenario 1**: A 300 m^3 surface release of marine diesel oil over 6 hours following a vessel collision; and
- **Scenario 2**: A 200 m^3 surface release of marine diesel oil over 6 hours following a vessel collision.

The modelling assessment was undertaken on a seasonal basis as follows:

- Summer (November through to March); and
- Winter (April to October)

The purpose of the modelling is to provide an understanding of a conservative ‘outer envelope’ of the potential area that may be affected in the unlikely event of hydrocarbon spill. The modelling does not take into consideration any of the spill prevention, mitigation and response capabilities that would be implemented in response to the spill. Therefore, the modelling results represent the maximum extent that the released hydrocarbon may influence.

The spill modelling was performed using an advanced three-dimensional trajectory and fates model; Spill Impact Model Application Program (SIMAP). The SIMAP model calculates the transport, spreading, entrainment and evaporation of spilled hydrocarbons over time, based on the prevailing wind and current conditions and the physical and chemical properties.

Methodology

The modelling study was carried out in several stages. Firstly, a ten-year wind and current dataset (2010–2019) was generated and the currents included the combined influence of three-dimensional large-scale ocean currents and tidal currents. Secondly, the currents, winds and detailed hydrocarbon characteristics were used as inputs in the three-dimensional oil spill model (SIMAP) to simulate the drift, spread, weathering and fate of the spilled oil.

As spills can occur during any set of wind and current conditions, modelling was conducted using a stochastic (random or non-deterministic) approach, which involved running 100 randomly selected single trajectory simulations per season, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times from the selected location closest to shore based on the location of Beach’s Thylacine operations activity area. This ensured that each spill simulation was subject to a unique set of wind and current conditions

The SIMAP system, the methods and analysis presented herein, use modelling algorithms which have been anonymously peer reviewed and published in international journals. Further, RPS warrants that this work meets and exceeds the ASTM Standard F2067-13 “*Standard Practice for Development and Use of Oil Spill Models*”.

Oil Properties

The MDO has an API of 37.6 and a density of 829.1 kg/m^3 (at 25ºC) with a viscosity value (4.0 cP) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications. Six percent of the oil mass should evaporate within the first 12 hours (BP < 180 C), a further 34.6% should evaporate within the first 24 hours (180°C < BP < 160°C) and a further 54.4% should evaporate over several days (160°C < BP < 380°C). Approximately 5.0% of the oil is shown to be persistent.

Results

Scenario: 300 m³ loss of containment caused by vessel collision

- The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 39.3 km (east-southeast) during summer conditions, 15.3 km (east-southeast) during winter conditions and 2.7 km (west-southwest) during winter conditions, respectively.
- The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 0% during summer conditions and 5% during winter conditions. The minimum time before oil accumulation at, or above, the low threshold was 7.58 days winter conditions.
- The maximum total volume ashore for a single spill trajectory during winter conditions was 4.3 m^3, and the maximum length of shoreline accumulation at the low threshold was 11 km. No shoreline accumulation was observed for the summer season nor the moderate or high thresholds for winter.
- A total of 14 BIAs were shown to be exposed to dissolved hydrocarbons above the low and moderate thresholds during both the summer and winter conditions. During the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor(s) was predicted to be 57 ppb and 58 ppb, respectively, which occurred within receptors containing the release location.
- During both summer and winter conditions entrained hydrocarbon exposures at, or above, the low threshold was predicted for AMP, BIA, IBRA, IMCRA, KEF, MNP, RSB, nearshore waters (LGA and sub-LGA) and State Water receptors. The maximum entrained hydrocarbon concentration predicted during the summer and winter conditions was 6,323 ppb and 7,007 ppb, respectively, which occurred within the receptors containing the release location.

Scenario: 200 m³ loss of containment caused by vessel collision

- The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 36.5 km (east-southeast) during summer conditions, 9.4 km (southeast) during winter conditions and 0.5 km (southwest) during winter conditions, respectively.
- The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 0% during summer conditions and 2% during winter conditions.
- The minimum time before oil accumulation at, or above, the low threshold was 8.13 days during the winter conditions. The maximum total volume ashore for a single spill trajectory during the winter conditions was 2.7 m^3, and the maximum length of shoreline accumulation at the low threshold was 5 km. No shoreline accumulation was observed for the summer season nor the moderate or high thresholds for winter.
- A total of 14 BIAs were shown to be exposed to dissolved hydrocarbons above the low threshold during both the summer and winter conditions. During the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor(s) was predicted to be 45 ppb and 43 ppb, respectively, which occurred within receptors containing the release location.
- During both summer and winter conditions entrained hydrocarbon exposures at, or above, the low and high threshold was predicted for AMP, BIA, IBRA, IMCRA, KEF, MNP, RSB, nearshore waters (LGA and sub-LGA) and State Water receptors. The maximum entrained hydrocarbon concentration predicted during the summer and winter conditions was 4,243 ppb and 4,604 ppb, respectively, which occurred within receptors containing the release location.

1 INTRODUCTION

1.1 Background

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Note that the oil spill model, the method and analysis presented herein uses modelling algorithms which have been anonymously peer reviewed and published in international journals. Furthermore, RPS warrants that this work meets and exceeds the American Society for Testing and Materials (ASTM) Standard F2067-13 “*Standard Practice for Development and Use of Oil Spill Models*”.

Table 1-1 Location of Thylacine operations infrastructure used to define the Activity Area.

Infrastructure	Latitude	Longitude
Thylacine-A WHP	39º 14.241' S	142º 54.126' E
Thylacine North-1 (TN-1) well	39° 12.510' S	142° 52.496' E
Thylacine North-2 (TN-2) well	39° 12.284’ S	142° 51.557’ E
Thylacine West-1 (TW-1) well	39° 13.338' S	142° 50.318' E
Thylacine West-2 (TW-2) well	39° 13.332' S	142° 50.310' E

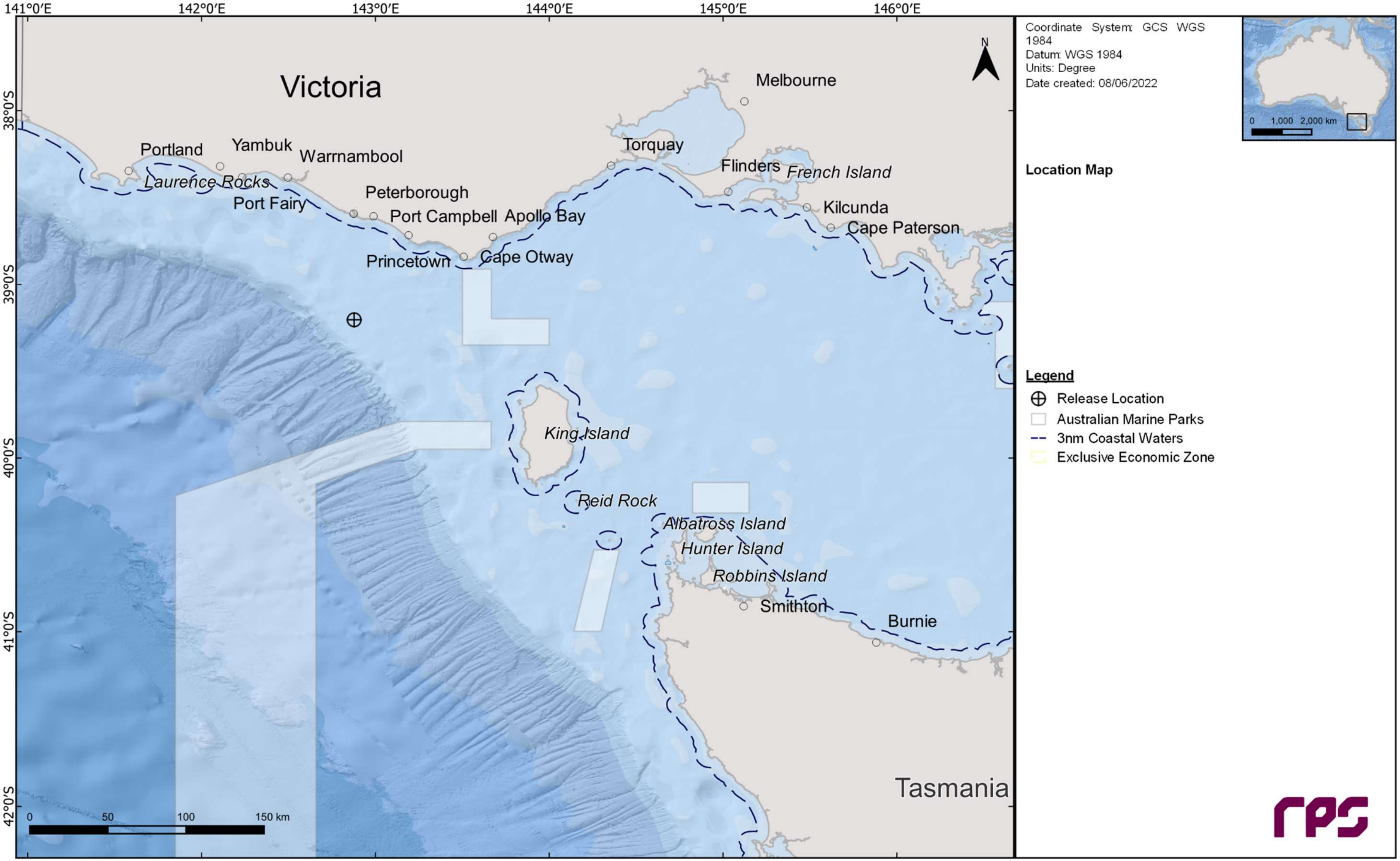

Figure 1-1 Map of the Thylacine Activity Area release location.

1.2 What is Oil Spill Modelling?

Oil spill modelling is a valuable tool widely used for risk assessment, emergency response and contingency planning where it can be particularly helpful to proponents and decision makers. By modelling a series of the most likely oil spill scenarios, decisions concerning suitable response measures and strategic locations for deploying equipment and materials can be made, and the locations at most risk can be identified. The two types of oil spill modelling often used are stochastic (Section 1.2.1) and deterministic (Section 1.2.2) modelling.

1.2.1 Stochastic Modelling (Multiple Spill Simulations)

Stochastic oil spill modelling is created by overlaying a great number (often hundreds) of individual, computer-simulated hypothetical spills (NOPSEMA, 2018; Figure 1.2).

Stochastic modelling is a common means of assessing the potential risks from oil spills related to new projects and facilities. Stochastic modelling typically utilises hydrodynamic data for the location in combination with historic wind data. Typically, 100 iterations of the model will be run utilising the data that is most relevant to the season or timing of the project.

The outcomes are often presented as a probability of exposure and is primarily used for risk assessment purposes in view to understand the range of environments that may be affected or impacted by a spill. Elements of the stochastic modelling can also be used in oil spill preparedness and planning.

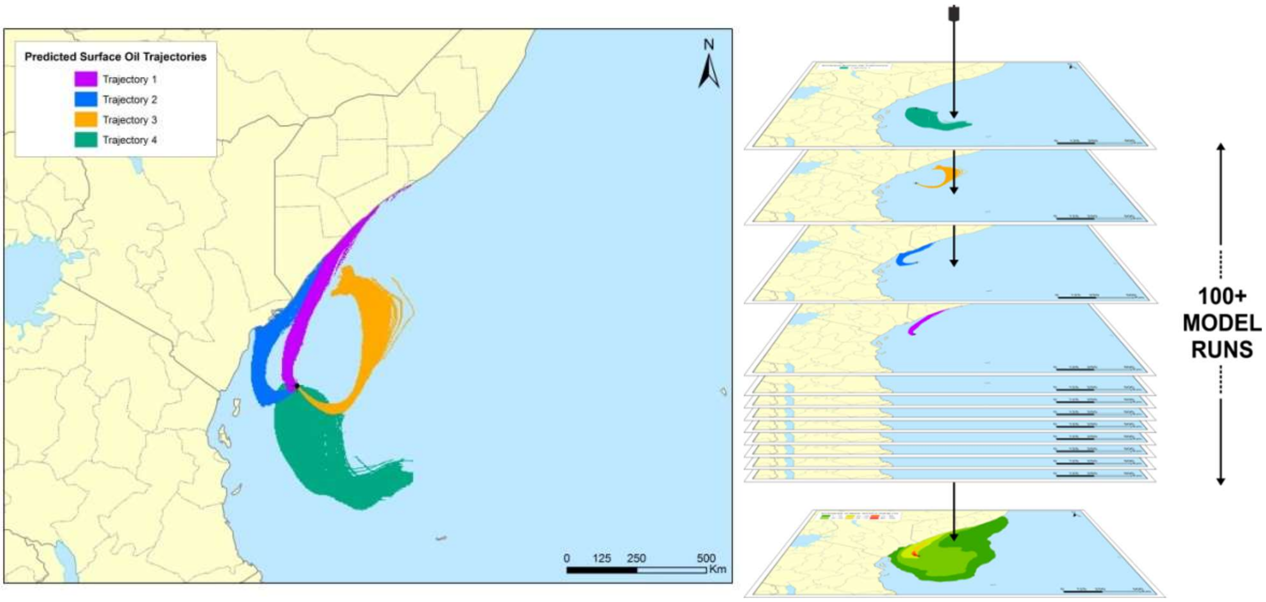

Figure 1-2 Examples of four individual spill trajectories (four replicate simulations) predicted by SIMAP for a spill scenario. The frequency of contact with given locations is used to calculate the probability of impacts during a spill. Essentially, all model runs are overlain (shown as the stacked runs on the right) and the number of times that trajectories contact a given location at a concentration is used to calculate the probability.

1.2.2 Deterministic Modelling (Single Spill Simulation)

Deterministic modelling is the predictive modelling of a single incident subject to a single sample of wind and weather conditions over time (NOPSEMA, 2018; Figure 1-3).

Deterministic modelling is often paired with stochastic modelling to place the large stochastic footprint into perspective. This deterministic analysis is generally a single run selected from the stochastic analysis and serves as the basis for developing the plans and equipment needs for a realistic spill response. Deterministic spills can be selected on several basis such as minimum time to shoreline, largest swept area, maximum volume ashore, longest length of shoreline contacted by oil or largest area of entrained or dissolved hydrocarbons.

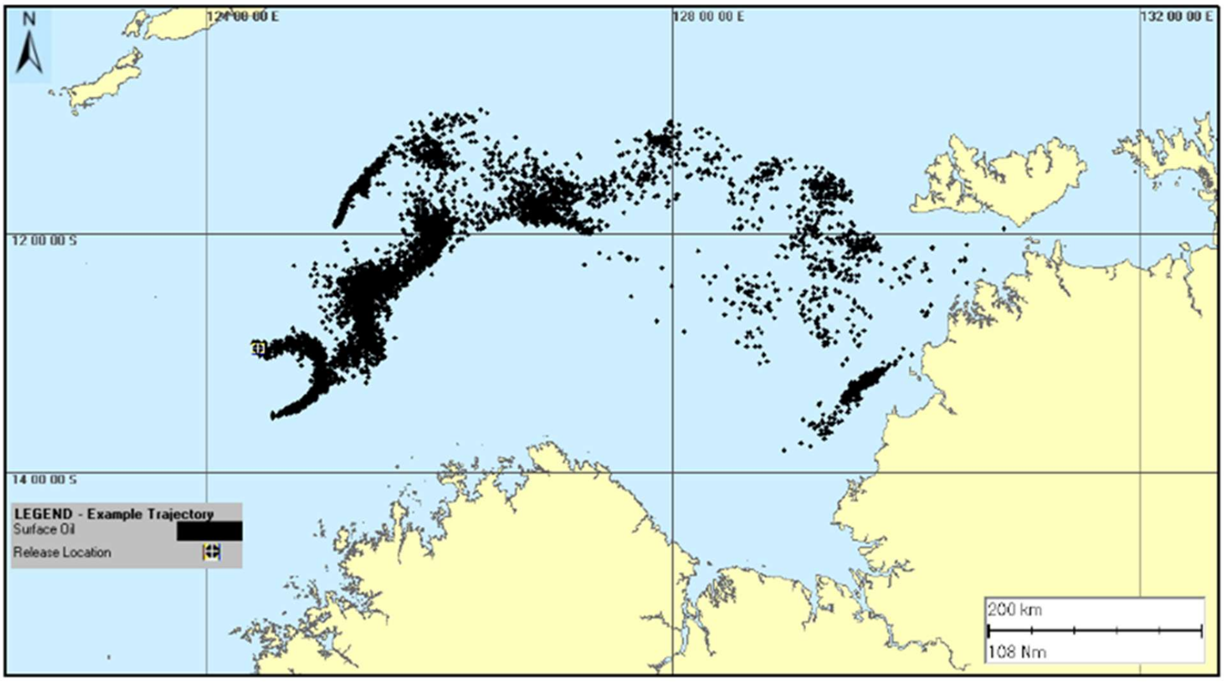

Figure 1-3 Example of an individual spill trajectory predicted by SIMAP for a spill scenario. Note, this image represents surface oil as spillets and do not take any thresholds into consideration.

2 SCOPE OF WORK

The scope of work included the following components:

- Generate 10 years of winds and three-dimensional currents from 2010 to 2019 (inclusive). The currents included the combined influence of tidal and ocean currents;
- Include the wind and current data and characteristics of the MDO as input into the three-dimensional oil spill model (SIMAP), to model the movement, spreading, weathering and shoreline contact by hydrocarbons over time;
- Use SIMAP's stochastic model (also known as a probability model) to calculate exposure to surround waters and shorelines. This involved running 100 randomly selected single trajectory simulations per season, with each simulation having the same spill information (spill volume, duration and composition of hydrocarbons) but varying start times from the selected location closest to shore based on the location of Beach's Thylacine operations Activity Area (see Figure 1-1 and Table 1-1). This ensured that each spill simulation was subject to a unique set of wind and current conditions;
- Results were assessed to determine the exposure to waters and contact to shorelines based upon the NOPSEMA thresholds; and
- The stochastic modelling results were reviewed, and the "worst case" deterministic runs were identified and presented based on the following criteria (if applicable):
  a. Largest volume of oil ashore;
  b. Longest length of oil accumulation on shorelines above 100 g/m^2;
  c. minimum time before shoreline contact above 10 g/m^2.

3 REGIONAL CURRENTS

Bass Strait is a body of water separating Tasmania from the southern Australian mainland, specifically the state of Victoria. The strait is a relatively shallow area of the continental shelf, connecting the southeast Indian Ocean with the Tasman Sea. Currents within the straight are primarily driven by tides, winds, incident continental shelf waves and density driven flows; high winds and strong tidal currents are frequent within the area (Jones, 1980).

The varied geography and bathymetry of the region, in addition to the forcing of the south-eastern Indian Ocean and local meteorology lead to complex shelf and slope circulation patterns (Middleton & Bye, 2007). Figure 3-1 displays seasonal current trends within the Bass Strait. During winter there is a strong eastward water flow due to the strengthening of the South Australian Current (fed by the Leeuwin Current in the Northwest Shelf), which bifurcates with one extension moving though the Bass Strait, and another forming the Zeehan Current off western Tasmania (Sandery & Kämpf, 2007). During summer, water flow reverses off Tasmania, King Island and the Otway Basin travelling eastward, as the coastal current develops due to south-easterly winds.

To accurately describe the variability in currents between the inshore and offshore region, a hybrid regional dataset was developed by combining deep ocean predictions obtained from HYCOM (Hybrid Coordinate Ocean Model) with surface tidal currents developed by RPS. The following sections provide a summary of the hybrid regional dataset.

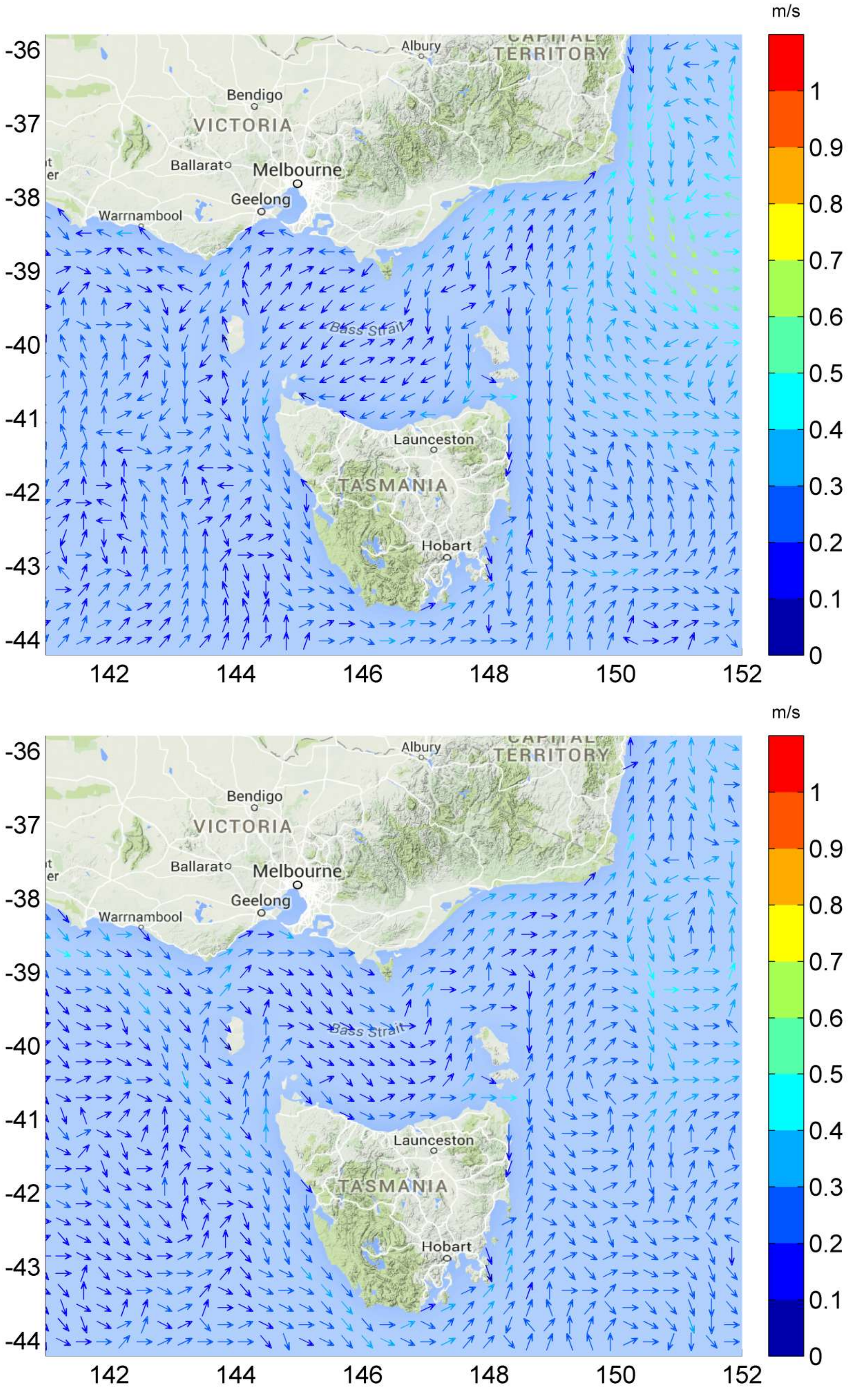

Figure 3-1 HYCOM averaged seasonal surface drift currents during summer (upper image) and winter (lower image).

3.1 Tidal currents

Tidal current data was generated using RPS's advanced ocean/coastal model, HYDROMAP. The HYDROMAP model has been thoroughly tested and verified through field measurements throughout the world for more than 30 years (Isaji & Spaulding, 1984; Isaji, et al., 2001; Zigic, et al., 2003). HYDROMAP tidal current data has been used as input to forecast (in the future) and hindcast (in the past) pollutant spills in Australian waters and forms part of the Australian National Oil Spill Emergency Response System operated by AMSA (Australian Maritime Safety Authority).

HYDROMAP employs a sophisticated sub-gridding strategy, which supports up to six levels of spatial resolution, halving the grid cell size as each level of resolution is employed. The sub-gridding allows for higher resolution of currents within areas of greater bathymetric and coastline complexity, and/or of interest to a study.

The numerical solution methodology follows that of Davies (1977a and 1977b) with further developments for model efficiency by Owen (1980) and Gordon (1982). A more detailed presentation of the model can be found in Isaji and Spaulding (1984) and Isaji et al. (2001).

3.1.1 Grid Setup

The tidal model domain is sub-gridded to a resolution of 500 m for shallow and coastal regions, starting from an offshore (or deep water) resolution of 8 km. The finer grids are progressively allocated in a step-wise fashion to more accurately resolve flows along the coastline, around islands and over regions with more complex bathymetry. Figure 3-2 shows the tidal model grid covering the study domain.

A combination of datasets was used and merged to describe the shape of the seabed within the grid domain (Figure 3-3). These included spot depths and contours which were digitised from nautical charts released by the hydrographic offices as well as Geoscience Australia database and depths extracted from the Shuttle Radar Topography Mission (SRTM30_PLUS) Plus dataset (see Becker et al., 2009).

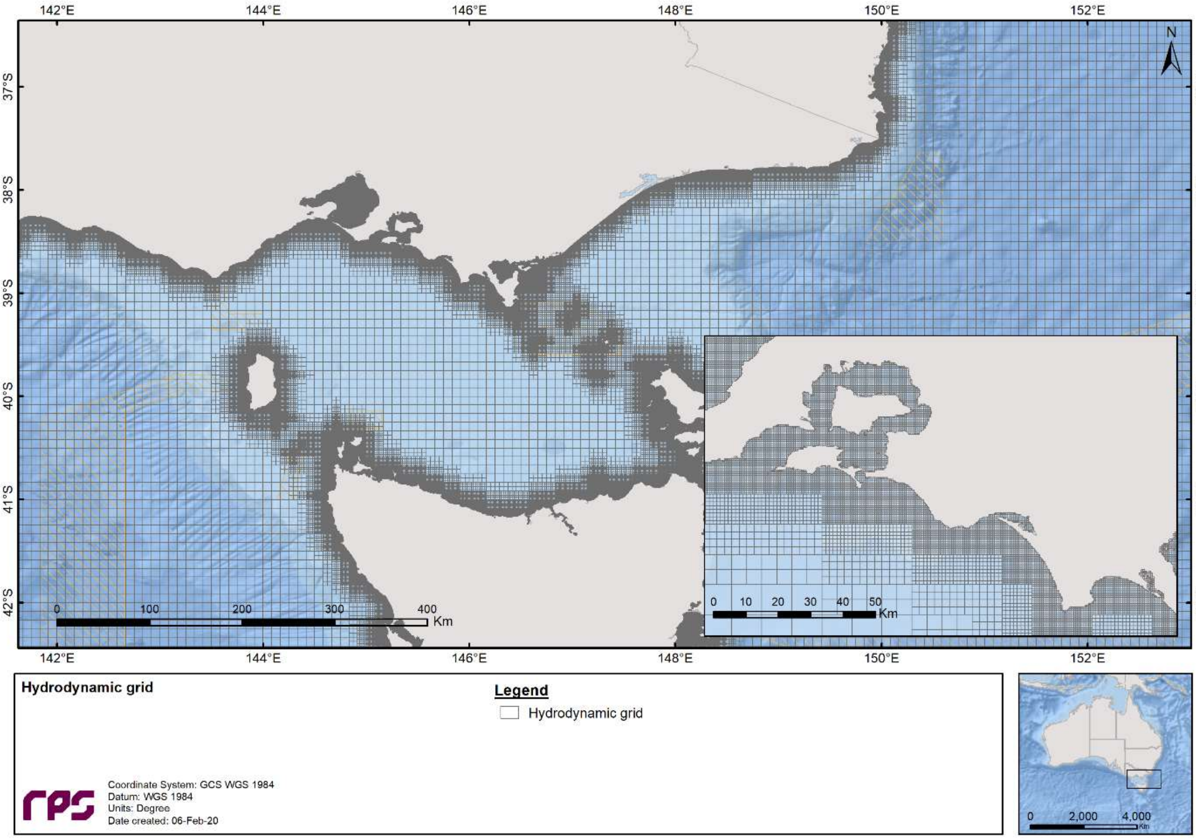

Figure 3-2 Sample of the model grid used to generate the tidal currents for the study region. Higher resolution areas are shown by the denser mesh.

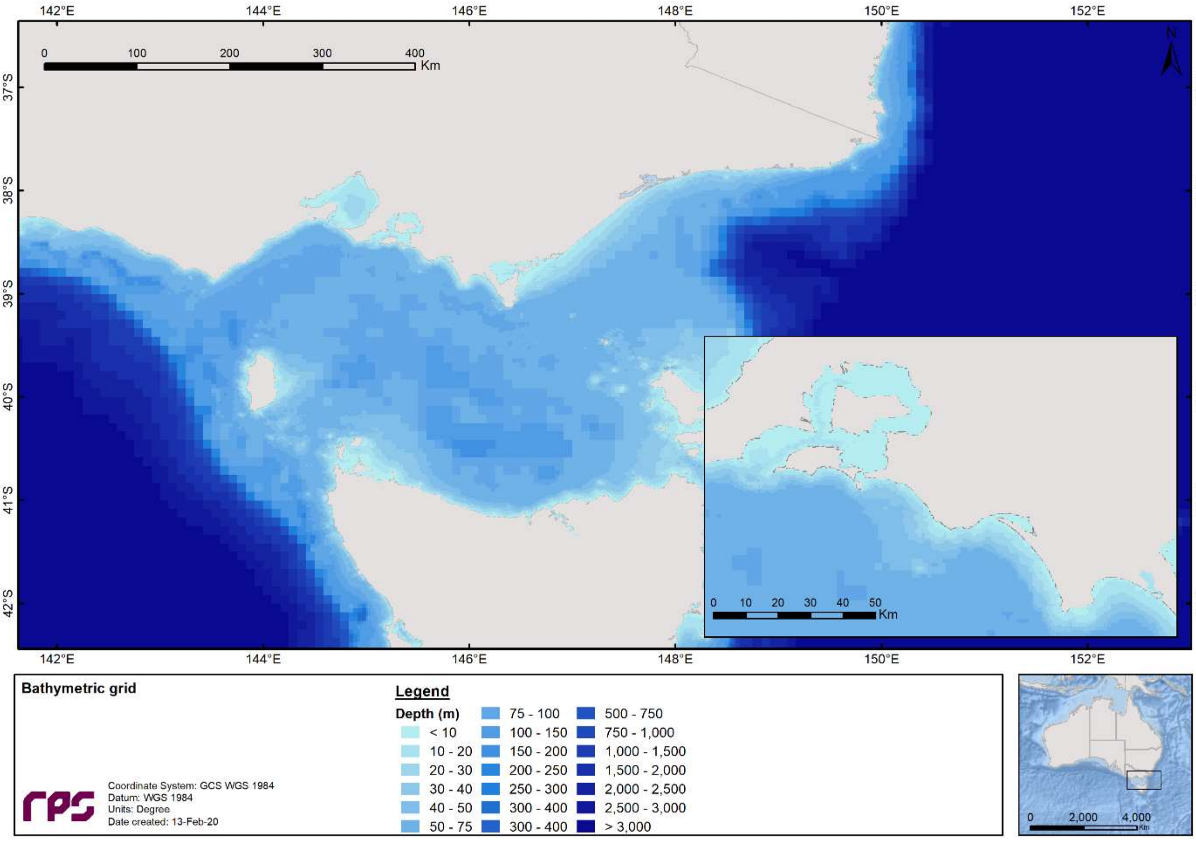

Figure 3-3 Bathymetry defined throughout the tidal model domain.

3.1.2 Tidal Conditions

The ocean boundary data for the regional model was obtained from satellite measured altimetry data (TOPEX/Poseidon 8.0) which provided estimates of the eight dominant tidal constituents at a horizontal scale of approximately 0.25 degrees. The eight major tidal constituents used were K_2, S_2, M_2, N_2, K_1, P_1, O_1 and Q_1. Using the tidal data, time series surface heights were calculated along the open boundaries for the simulation period.

The Topex/Poseidon satellite data has a resolution of 0.25 degrees globally, with higher resolution in coastal regions, and is produced and quality controlled by NASA (National Aeronautics and Space Administration). The data capturing satellites, equipped with two altimeters capable of taking sea level measurements accurate to less than ± 5 cm, measured oceanic surface elevations (and the resultant tides) for the period 1992–2005. In total these satellites carried out 62,000 orbits of the planet. The Topex/Poseidon tidal data has been widely used amongst the oceanographic community, being refereced in more than 2,100 research publications (e.g. Andersen, 1995; Ludicone et al., 1998; Matsumoto et al., 2000; Kostianoy et al., 2003; Yaremchuk & Tangdong, 2004; Qiu & Chen 2010). The Topex/Poseidon tidal data is considered suitably accurate for this study.

3.1.3 Surface Elevation Validation

To ensure that tidal predictions were accurate, predicted surface elevations were compared to data observed at a location situated within the study area (Figure 3-4).

To provide a statistical measure of the model performance, the Index of Agreement (IOA – Willmott, 1981) and the Mean Absolute Error (MAE – Willmott, 1982; Willmott & Matsuura, 2005) were used.

The MAE (Eq.1) is simply the average of the absolute values of the difference between the model-predicted (P) and observed (O) variables. It is a more natural measure of the average error (Willmott and Matsuura, 2005) and more readily understood. The MAE is determined by:

$$MAE = N^{-1} \sum_{i=1}^{N} |P_i - O_i| \qquad \text{Eq.1}$$

Where: N = Number of observations

P_i = Model predicted surface elevation

O_i = Observed surface elevation

The Index of Agreement (IOA; Eq. 2) in contrast, gives a non-dimensional measure of model accuracy or performance. A perfect agreement between the model predicted and observed surface elevations exists if the index gives an agreement value of 1, and complete disagreement between model and observed surface elevations will produce an index measure of 0 (Wilmott, 1981). Willmott et al. (1985) also suggests that values larger than 0.5 may represent good model performance. The IOA is determined by:

$$IOA = 1 - \frac{\sum |X_{model} - X_{obs}|^2}{\sum (|X_{model} - \overline{X_{obs}}| + |X_{obs} - \overline{X_{obs}}|)^2} \qquad \text{Eq.2}$$

Where: X_{model} = Model predicted surface elevation

X_{obs} = Observed surface elevation

Clearly, a greater IOA and lower MAE represent a better model performance.

Figure 3-5 and Figure 3-6 illustrate a comparison of the predicted and observed surface elevations in February 2017. As shown on the graph, the model accurately reproduced the phase and amplitudes throughout the spring and neap tidal cycles.

Table 3-1 shows the IOA and MAE values for the selected tide station locations indicating that the model is performing well.

Table 3-1 Statistical comparison between the observed and HYDROMAP predicted surface elevations.

Tide Station	IOA	MAE (m)
Gabo Island	0.98	0.08
Port MacDonnell	0.98	0.05
Port Welshpool	0.92	0.30
Portland	0.97	0.07
Stack Island	0.96	0.22

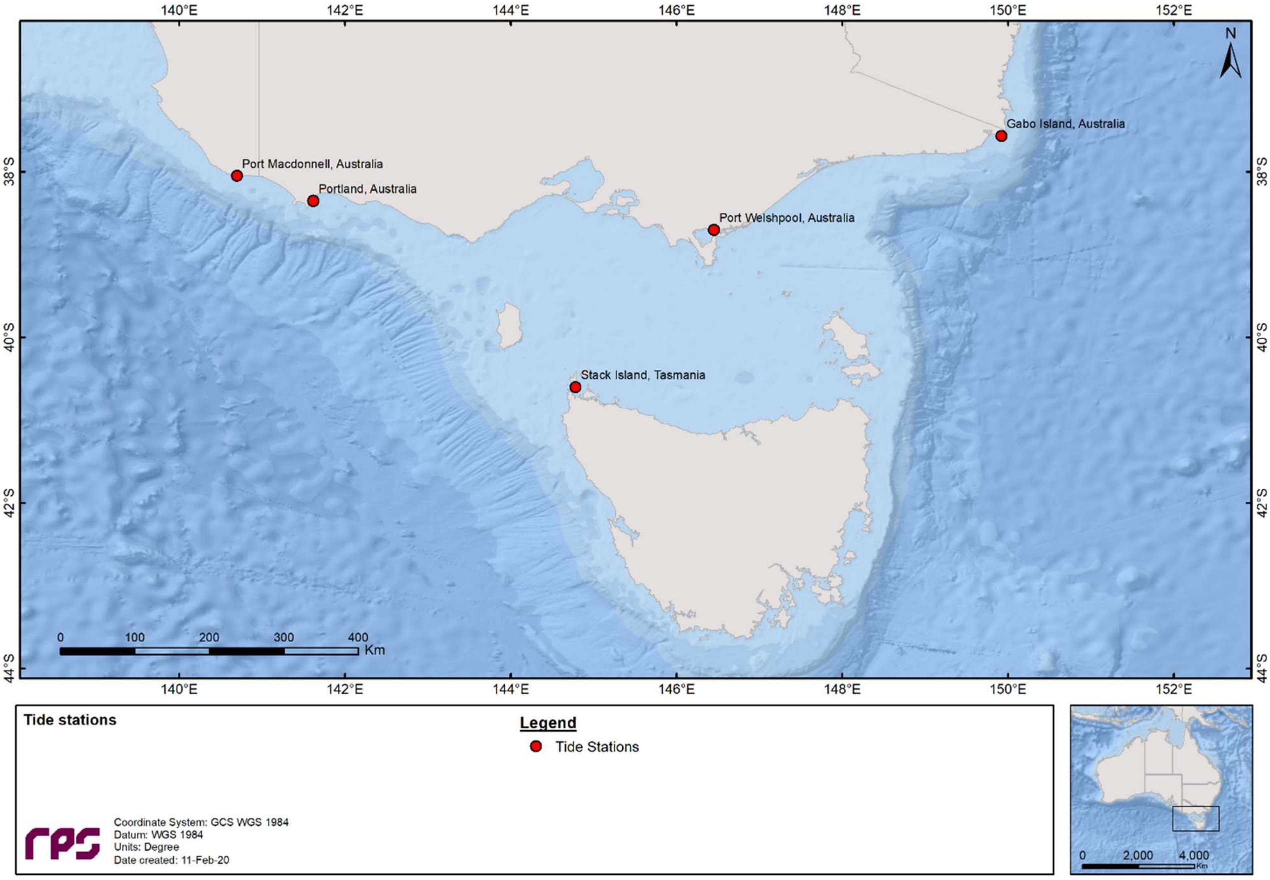

Figure 3-4 Location of the tide stations used in the surface elevation validation.

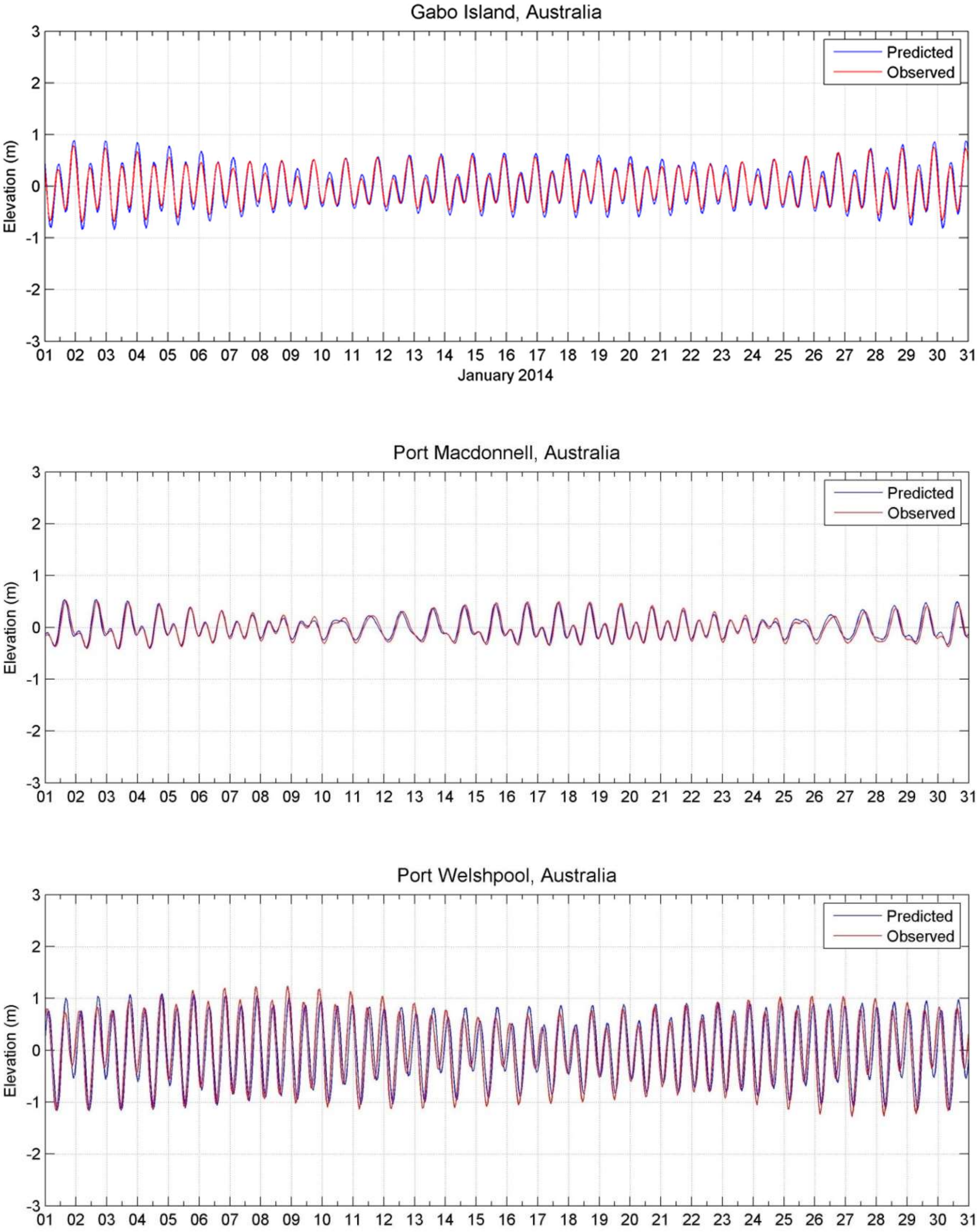

Figure 3-5 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Gabo Island (upper image), Port MacDonnell (middle image) and Port Welshpool (lower image).

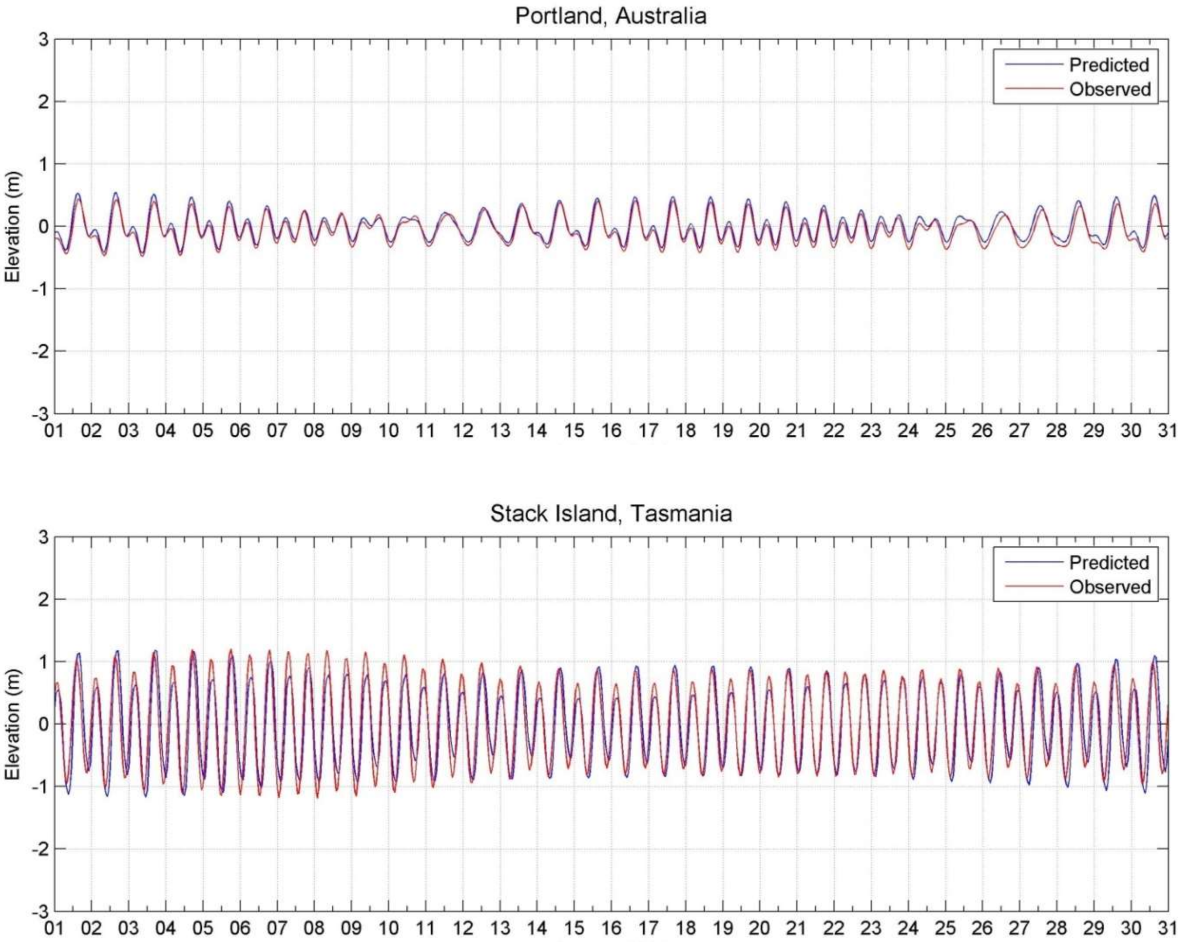

Figure 3-6 Comparison between HYDROMAP predicted (blue line) and observed (red line) surface elevation at tidal stations Portland (upper image) and Stack Island (lower image).

3.2 Ocean Currents

Data describing the flow of ocean currents for the years 2010 to 2019 (inclusive) was obtained from HYCOM (Hybrid Coordinate Ocean Model, (Chassignet et al., 2007), which is operated by the HYCOM Consortium, sponsored by the Global Ocean Data Assimilation Experiment (GODAE). HYCOM is a data-assimilative, three-dimensional ocean model that is run as a hindcast (for a past period), assimilating time-varying observations of sea surface height, sea surface temperature and in-situ temperature and salinity measurements (Chassignet et al., 2009). The HYCOM predictions for drift currents are produced at a horizontal spatial resolution of approximately 8.25 km (1/12th of a degree) over the region, at a frequency of once per day. HYCOM uses isopycnal layers in the open, stratified ocean, but uses the layered continuity equation to make a dynamically smooth transition to a terrain-following coordinate in shallow coastal regions, and to z-level coordinates in the mixed layer and/or unstratified seas. Figure 3-7 illustrates the spatial resolution of HYCOM currents.

For this study, the HYCOM hindcast currents were obtained.

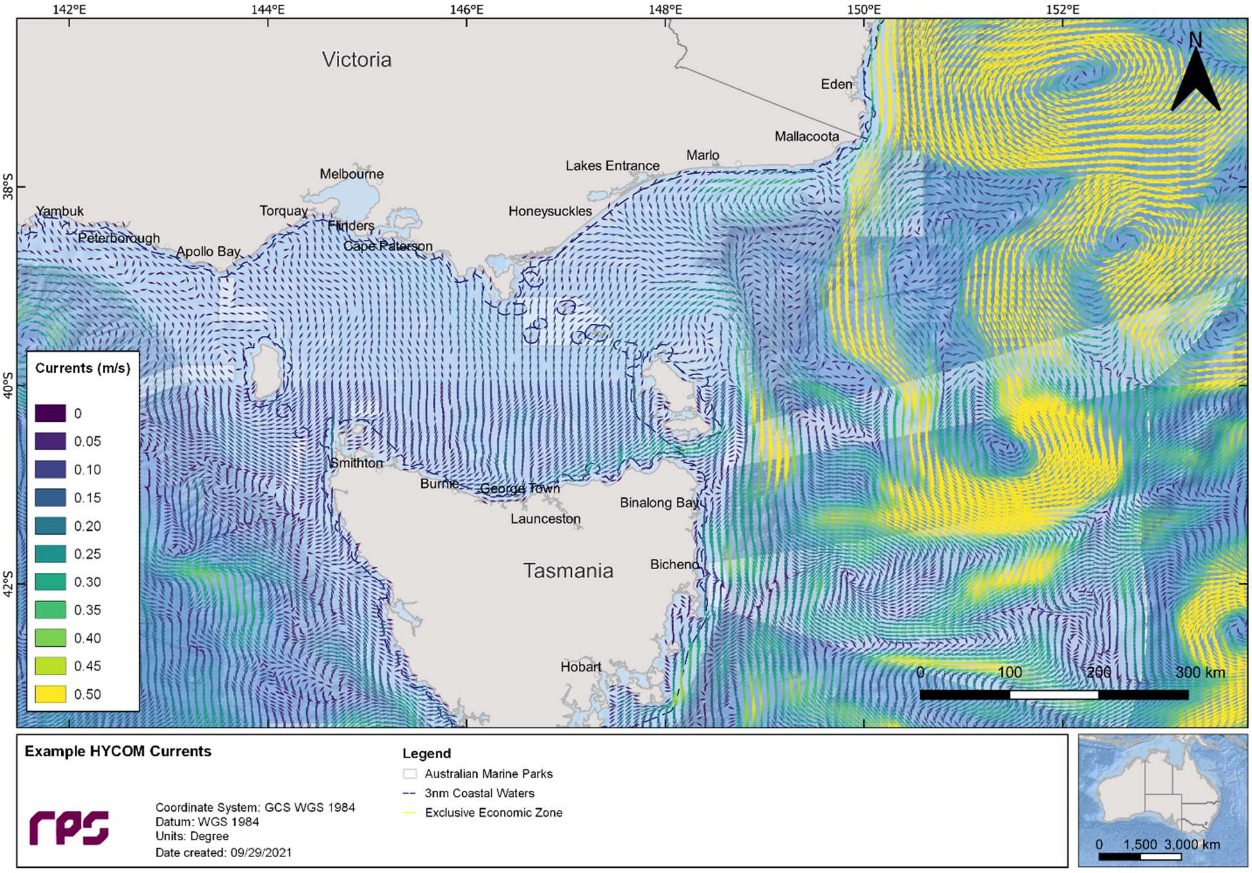

Figure 3-7 **Map illustrating the spatial resolution of HYCOM currents.**

3.3 Surface Currents

Table 3-2 presents the average and maximum net surface current speeds nearby the release location by combining the ocean and tidal currents. Current speeds varied throughout the year with peak current speeds ranging between approximately 0.81 m/s (October) and 1.15 m/s (August). The dominant surface current directions throughout the year were identified as (towards) east-southeast and west-northwest.

Figure 3-8 and Figure 3-9 show the monthly and total surface current rose distributions for the selected location.

Note the convention for defining current direction is the direction the current flows towards, which is used to reference current direction throughout this report. Each branch of the rose represents the currents flowing to that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent the current speed ranges for each direction. Speed intervals of 0.1 m/s are predominantly used in these current roses. The length of each coloured segment is relative to the proportion of currents flowing within the corresponding speed and direction.

Table 3-2 Predicted monthly average and maximum surface current speeds for the selected location. The data was derived by combining the HYCOM ocean data and HYDROMAP tidal data from 2010–2019 (inclusive).

Month	Average current speed (m/s)	Maximum current speed (m/s)	General direction(s) (Towards)
January	0.20	0.90	East-northeast and West-southwest
February	0.21	1.00	East-northeast and West-southwest
March	0.22	1.14	East-northeast and West-southwest
April	0.22	0.90	East
May	0.27	1.03	East
June	0.25	0.99	East
July	0.29	0.94	East
August	0.26	1.15	East
September	0.23	0.98	East
October	0.22	0.81	East
November	0.21	0.83	East
December	0.22	0.82	East-northeast and West-southwest
Minimum	**0.20**	**0.81**	
Maximum	**0.29**	**1.15**	

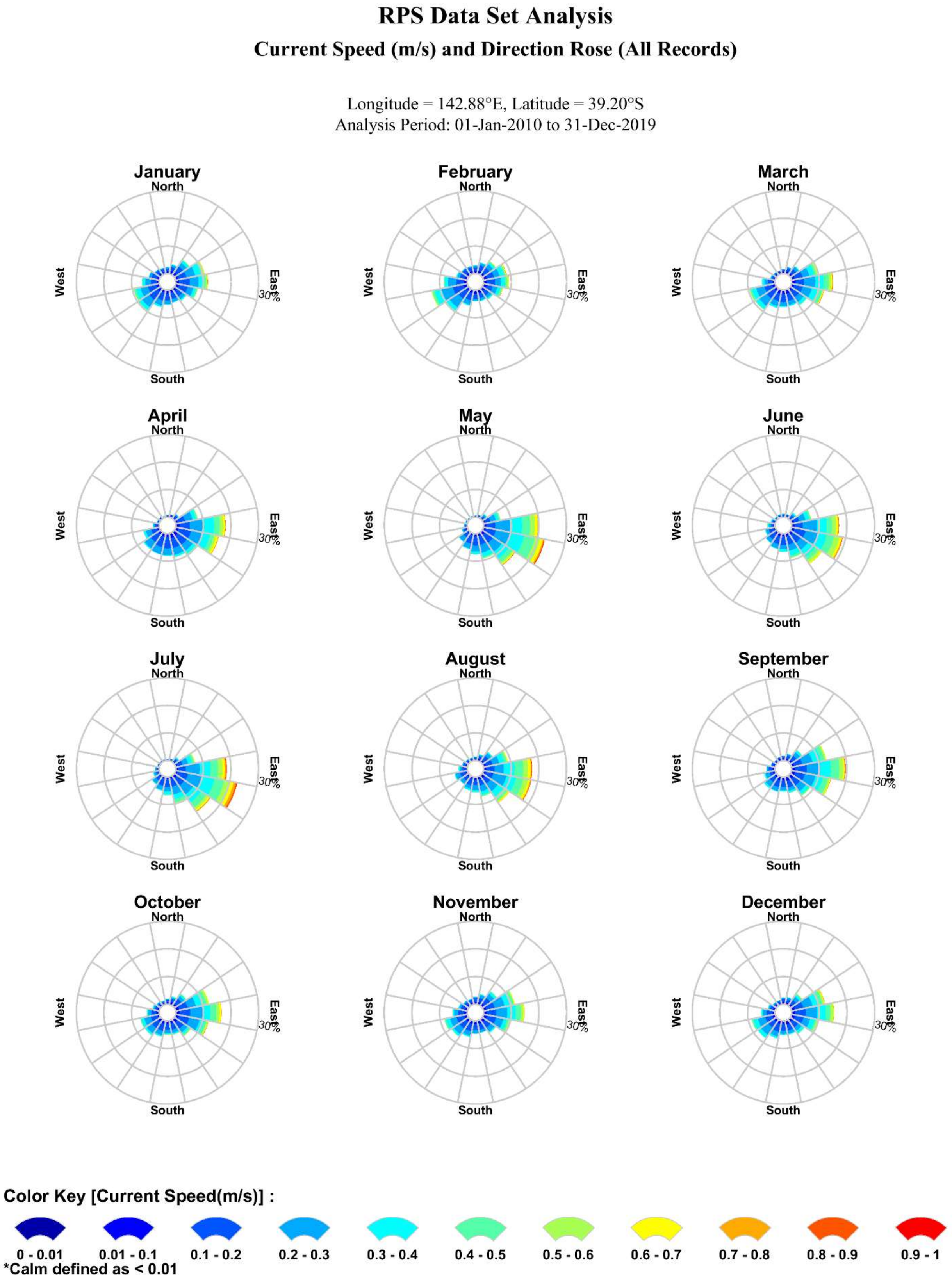

Figure 3-8 Monthly surface current rose plots nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

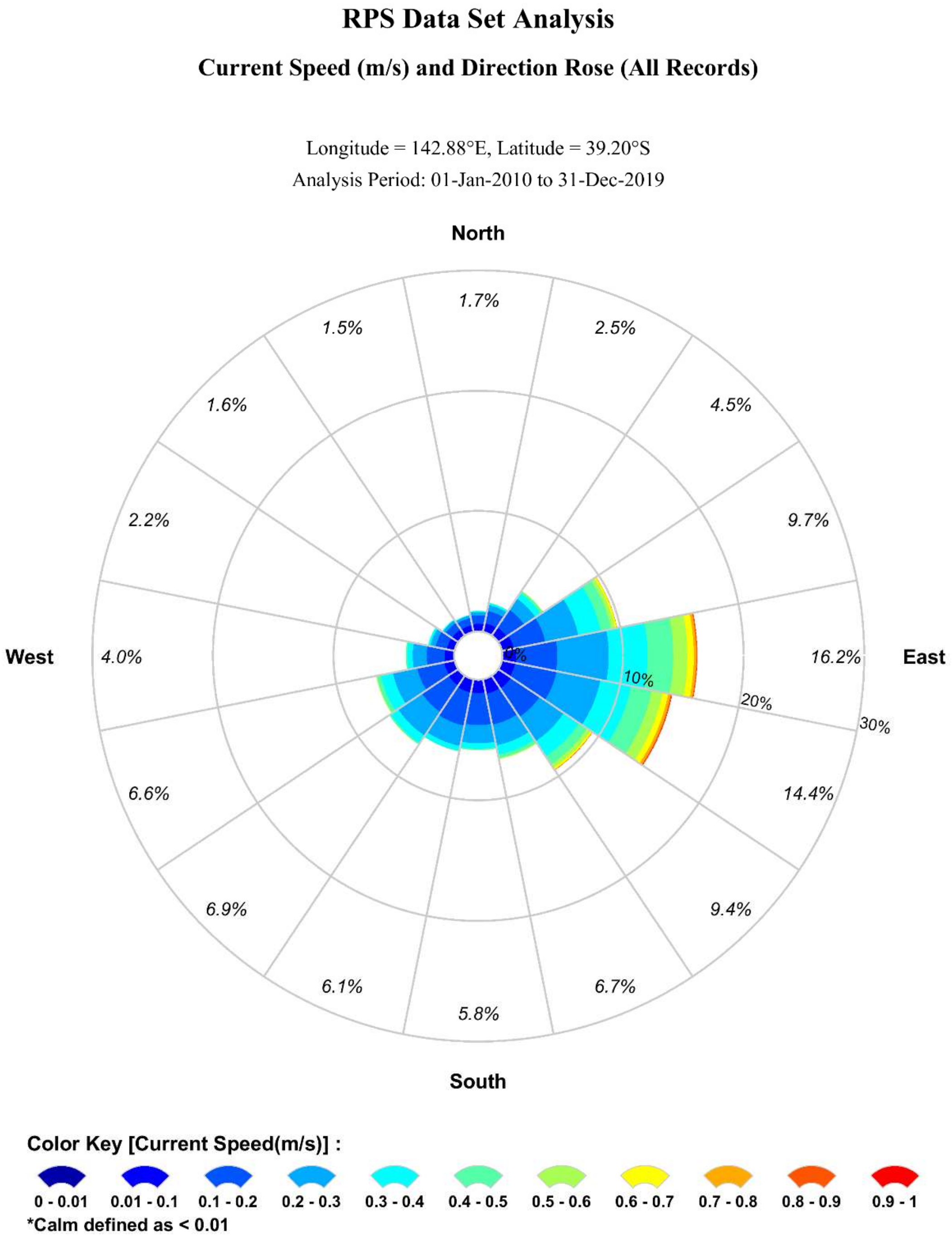

Figure 3-9 Total surface current rose plot nearby the release location (derived by combining the HYDROMAP tidal currents and HYCOM ocean currents for 2010–2019 (inclusive).

4 WIND DATA

High resolution wind data for the years 2010 to 2019 (inclusive) was sourced from the National Centre for Environmental Prediction (NCEP) Climate Forecast System Reanalysis dataset (CFSR; see Saha et al., 2010). The CFSR wind model is a fully coupled, data-assimilative hindcast model representing the interaction between the earth's oceans, land and atmosphere. The gridded wind data output is available at ¼ of a degree resolution (~33 km) and 1-hourly time intervals. Figure 4-1 shows the spatial resolution of the wind field used as input into the oil spill model.

Table 4-1 presents the monthly average and maximum winds derived from a CFSR wind node nearby the release location. The wind data demonstrated average monthly wind speeds ranging from 14.2 knots (January) to 20.1 knots (July) with maximums ranging between 58.9 knots (February) and 65.8 knots (December. The dominant wind direction throughout the year was from the west, whilst maximum wind speeds were typically associated with westerly winds during all months of the year.

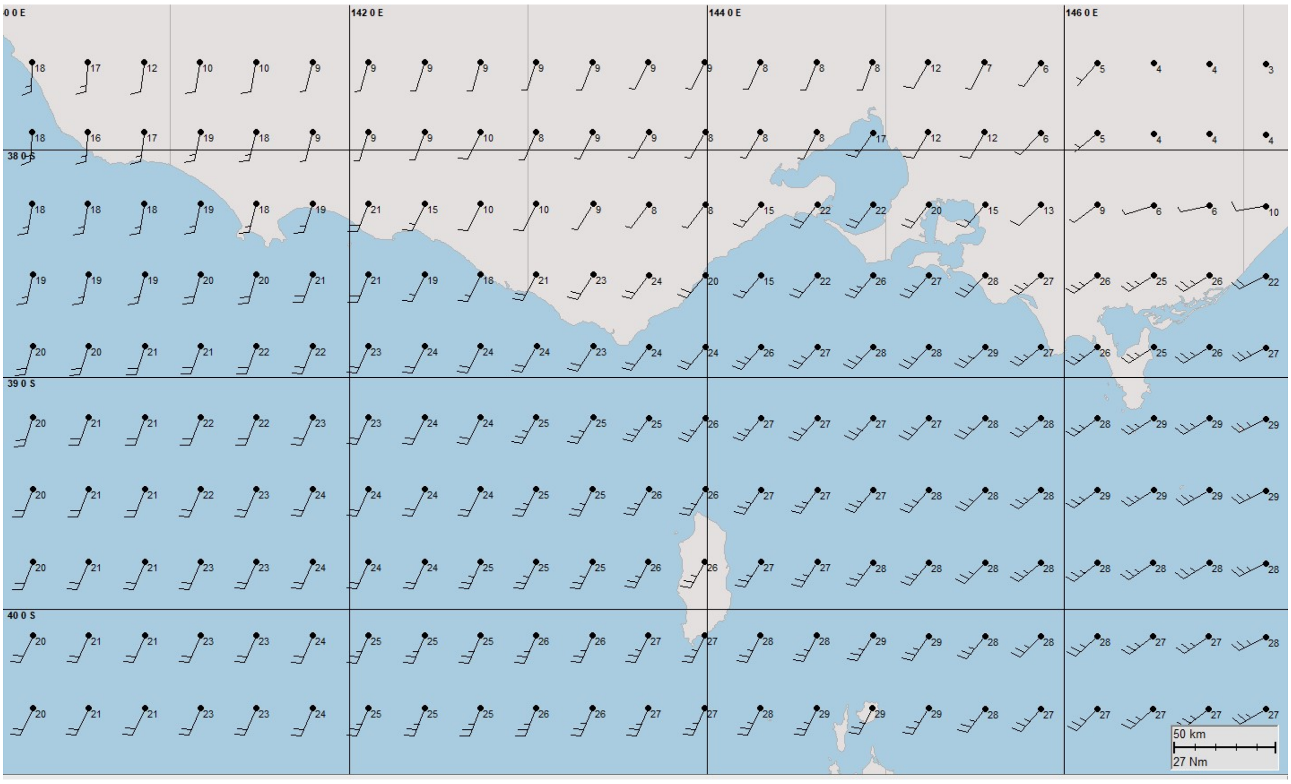

Figure 4-1 **Spatial resolution of the CFSR modelled wind data used as input into the oil spill model.**

Figure 4-2 and Figure 4-3 show the monthly and total wind rose distributions derived from the CFSR data for the selected node nearby the release location.

Note that the atmospheric convention for defining wind direction, that is, the direction the wind blows from, is used to reference wind direction throughout this report. Each branch of the rose represents wind coming from that direction, with north to the top of the diagram. Sixteen directions are used. The branches are divided into segments of different colour, which represent wind speed ranges from that direction. Speed ranges of 3 knots are predominantly used in these wind roses. The length of each segment within a branch is proportional to the frequency of winds blowing within the corresponding range of speeds from that direction.

Table 4-1 Predicted average and maximum winds representative for the selected node nearby the release location. Data derived from CFSR hindcast model from 2010–2019 (inclusive).

Month	Average wind speed (knots)	Maximum wind speed (knots)	General direction(s) (From)
January	14.2	62.8	East-southeast and West-southwest
February	14.8	58.9	Southeast
March	14.8	64.7	East and West
April	14.6	61.2	West
May	17.3	62.2	West
June	17.5	60.5	West to North
July	20.1	60.5	West to North
August	19.5	65.1	West to North
September	17.4	60.8	West
October	16.4	61.8	West
November	15.3	60.8	West
December	14.9	65.8	West and East-southeast
Minimum	**14.2**	**58.9**	
Maximum	**20.1**	**65.8**	

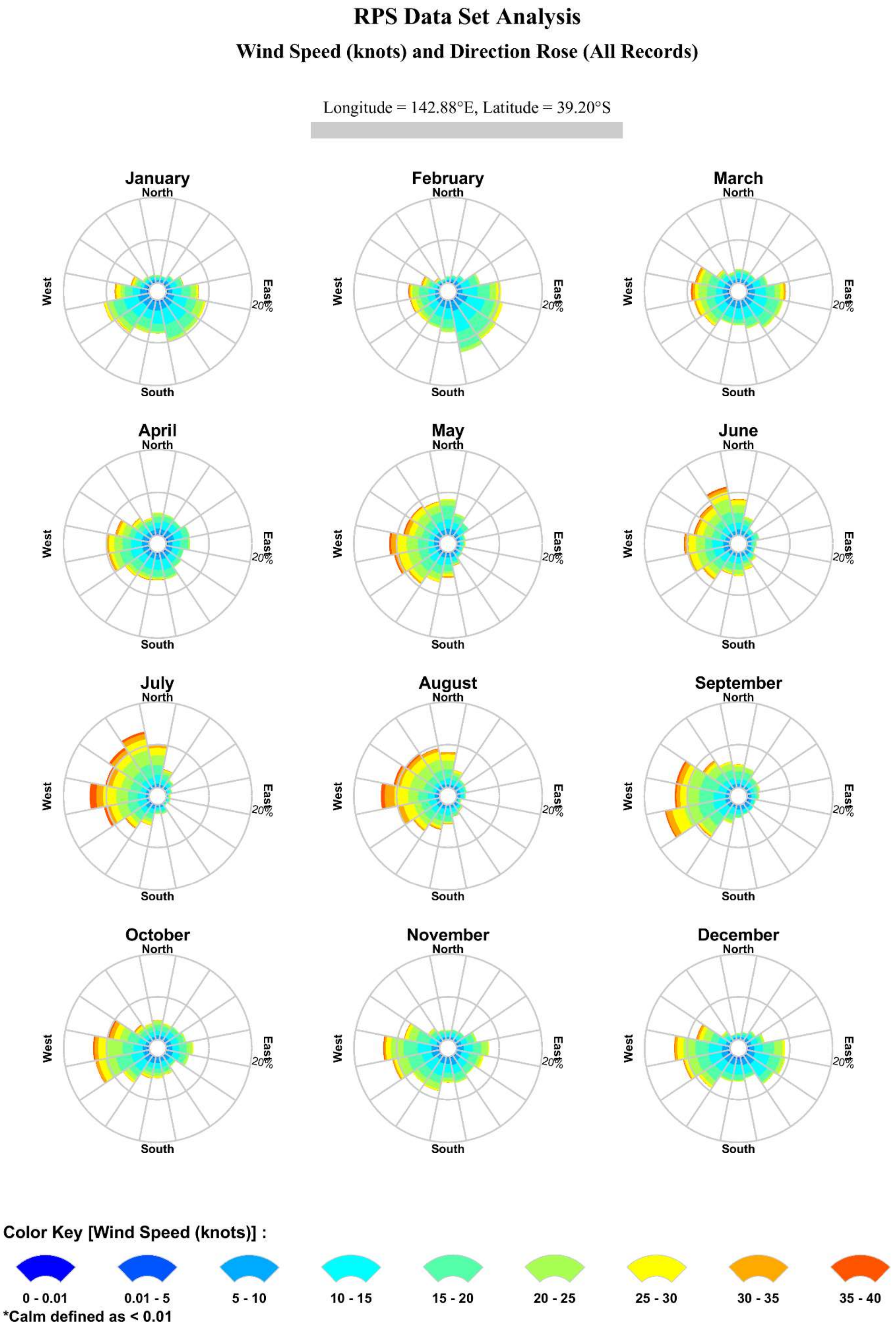

Figure 4-2 Modelled monthly wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.

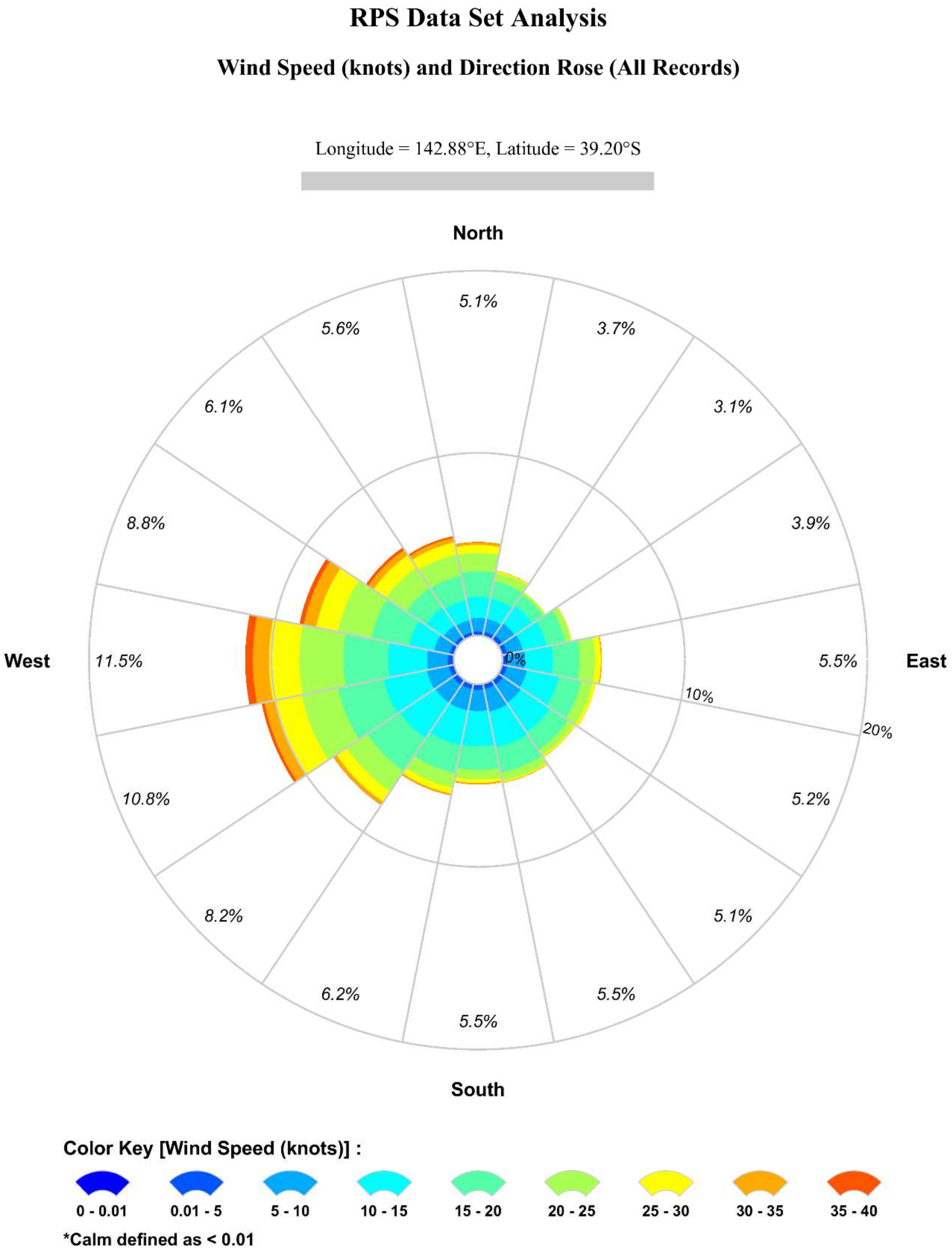

Figure 4-3 **Modelled total wind rose distributions from 2010–2019 (inclusive) for the node nearby the release location.**

5 WATER TEMPERATURE AND SALINITY

The monthly sea temperature and salinity profiles of the water column within the study was obtained from the World Ocean Atlas 2013 database produced by the National Oceanographic Data Centre (National Oceanic and Atmospheric Administration) and its co-located World Data Center for Oceanography (see Levitus et al., 2013). These parameters were used as factors to inform the weathering, movement and evaporative loss of hydrocarbon spills in the surface and sub-surface layers.

Figure 5-1 illustrates the vertical profile of sea temperature and salinity nearby the release location.

Table 5-1 presents the sea temperature and salinity of the surface layer nearby the selected location. The monthly average sea surface temperatures ranged between 13.2°C (September) and 17.8°C (March). The monthly average salinity values remain relatively consistent ranging between 35.1 psu (February) and 35.6 psu (July).

Table 5-1 Monthly average sea surface temperature and salinity in the study area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature (ºC)	17.7	17.2	17.8	16.3	16.0	16.0	14.8	13.5	13.2	14.3	14.3	15.9
Salinity (psu)	35.3	35.1	35.4	35.3	35.3	35.4	35.6	35.3	35.3	35.4	35.4	35.4

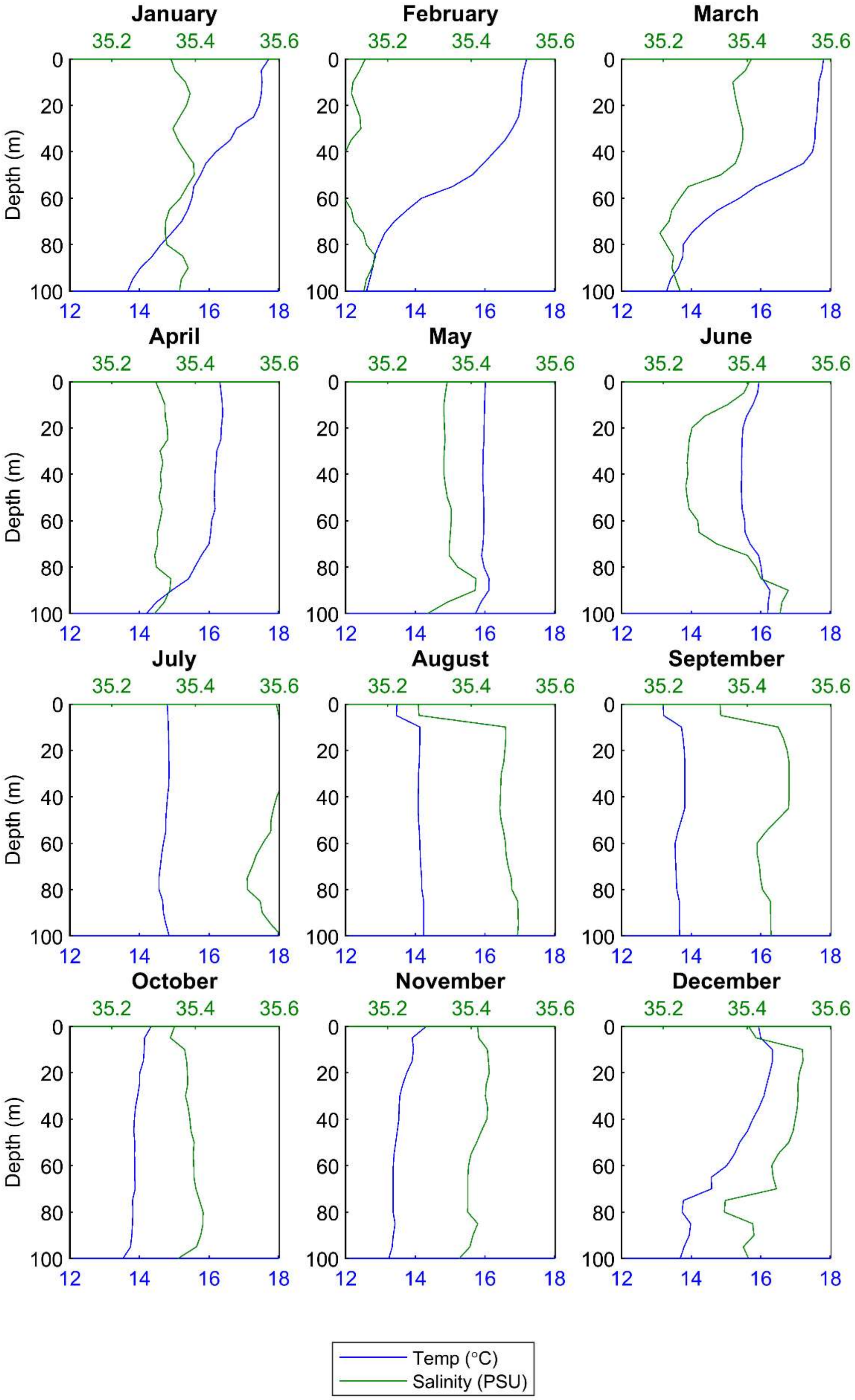

Figure 5-1 **Temperature and salinity profiles nearby the selected location within the study area.**

6 OIL SPILL MODEL – SIMAP

Modelling of the fate of oil was performed using the Spill Impact Mapping Analysis Program (SIMAP). SIMAP is designed to simulate the fate and effects of spilled hydrocarbons for both the surface and subsurface releases (Spaulding et al., 1994; French et al., 1999; French-McCay, 2003, 2004; French-McCay et al., 2004).

SIMAP has been used to predict the weathering and fate of oil spills during and after major incidents including: Montara (Australia) well blowout August 2009 in the Timor Sea (Asia-Pacific ASA, 2010); Macondo (USA) well blowout April 2010 in the Gulf of Mexico; Bohai Bay (China) oil spill August 2011; and the pipeline oil spill July 2013 in the Gulf of Thailand.

The SIMAP model calculates the transport, spreading, entrainment, evaporation and decay of surface hydrocarbon slicks as well as the entrained and dissolved oil components in the water column, either from surface slicks or from oil discharged subsea. The movement and weathering of the spilled oil is calculated for specific oil types. Input specifications for oil mixtures include the density, viscosity, pour point, distillation curve (volume lost versus temperature) and the aromatic/aliphatic component ratios within given boiling point (BP) ranges.

SIMAP is a three-dimensional model that allows for various response actions to be modelled including oil removal from skimming, burning, or collection booms, and surface and subsurface dispersant application.

The SIMAP oil spill model includes advanced weathering algorithms, specifically focussed on unique oils that tend to form emulsions and/or tar balls. The weathering algorithms are based on 5 years of extensive research conducted in response to the Deepwater Horizon oil spill in the Gulf of Mexico (French-McCay et al., 2015).

Biodegradation is included in the oil spill model. In the model, SIMAP, degradation is calculated for the surface slick, deposited oil on the shore, the entrained oil and dissolved constituents in the water column, and oil in the sediments. For surface oil, water column oil and sedimented oil a first order degradation rate is specified. Biodegradation rates are relatively high for hydrocarbons in dissolved state or in dispersed small droplets.

6.1 Stochastic Modelling

For the stochastic modelling presented herein, **200 oil spills** (100 per season) were modelled for the scenario using the same spill information (release location, spill volume, duration and oil type) but with varied start dates. During each simulation, the model records whether any grid cells are exposed to any oil concentrations, the concentrations involved and the elapsed time before exposure. The results of all 100 oil spill simulations per season were analysed to determine the following statistics for every grid cell:

- Exposure load (concentrations and volumes);
- Minimum time before exposure;
- Probability of contact above defined concentrations;
- Volume of oil that may accumulate on shorelines from any single simulation;
- Concentration that might occur on sections of individual shorelines;
- Exposure (instantaneous and/or over a specified duration) to dissolved hydrocarbons in the water column; and
- Exposure (instantaneous and/or over a specified duration) to entrained hydrocarbons in the water column.

6.1 Floating, Shoreline and In-Water Thresholds

The thresholds and their relationship to exposure for the sea surface, shoreline and water column (entrained and dissolved hydrocarbons) are presented in Sections 6.1.1 to 6.1.3. Supporting justifications of the adopted thresholds applied during the study and additional context relating to the area of influence are also provided. It is important to note that the thresholds herein are based on NOPSEMA (2019).

6.1.1 Floating Oil Exposure Thresholds

The modelling results can be presented to any levels; therefore, thresholds have been specified (based on scientific literature) to record floating oil exposure to the sea-surface at meaningful levels only, described in the following paragraphs.

The low threshold to assess the potential for floating oil exposure, was 1 g/m^2, which equates approximately to an average thickness of 1 µm, referred to as visible oil. Oil of this thickness is described as rainbow sheen in appearance, according to the Bonn Agreement Oil Appearance Code (Bonn Agreement, 2009; AMSA, 2014) (see Table 6-1). Figure 6-1 shows photographs highlighting the difference in appearance between a silvery sheen, rainbow sheen and metallic sheen. This threshold is considered below levels which would cause environmental harm and it is more indicative of the areas perceived to be affected due to its visibility on the sea surface and potential to trigger temporary closures of areas (i.e. fishing grounds) as a precautionary measure. Table 6-1 provides a description of the appearance in relation to exposure zone thresholds used to classify the zones of floating oil exposure.

Ecological impact has been estimated to occur at 10 g/m^2 (a film thickness of approximately 10 µm or 0.01 mm) according to French et al. (1996) and French-McCay (2009) as this level of fresh oiling has been observed to mortally impact some birds through adhesion of oil to their feathers, exposing them to secondary effects such as hypothermia. The appearance of oil at this average thickness has been described as a metallic sheen (Bonn Agreement, 2009).

Scholten et al. (1996) and Koops et al. (2004) indicated that at oil concentrations on the sea surface of 25 g/m^2 (or greater), would be harmful for all birds that have landed in an oil film due to potential contamination of their feathers, with secondary effects such as loss of temperature regulation and ingestion of oil through preening. The appearance of oil at this thickness is also described as metallic sheen (Bonn Agreement, 2009). For this study the high exposure threshold was set to 50 g/m^2 and above based on NOPSEMA (2019). This threshold can also be used to inform response planning.

Table 6-2 defines the thresholds used to classify the zones of floating oil exposure reported herein.

Table 6-1 The Bonn Agreement Oil Appearance Code.

Code	Description Appearance	Layer Thickness Interval (g/m^2 or µm)	Litres per km^2
1	Sheen (silvery/grey)	0.04 – 0.30	40 – 300
2	Rainbow	0.30 – 5.0	300 – 5,000
3	Metallic	5.0 – 50	5,000 – 50,000
4	Discontinuous True Oil Colour	50 – 200	50,000 – 200,000
5	Continuous True Oil Colour	≥ 200	≥ 200,000

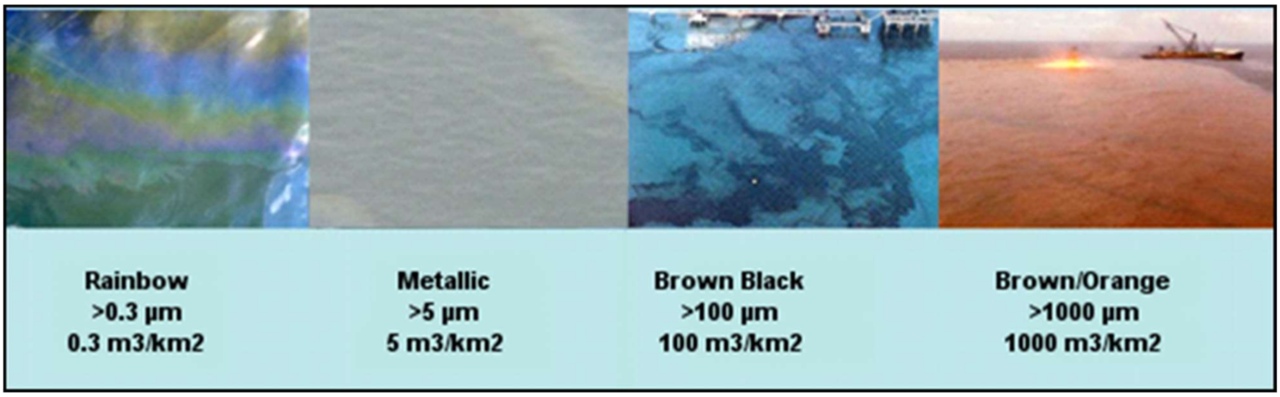

Figure 6-1 Photographs showing the difference between oil colour and thickness on the sea surface (source: adapted from Oil Spill Solutions, 2015).

Table 6-2 Floating oil exposure thresholds used in this report (in alignment with NOPSEMA (2019)).

Threshold level	Floating oil (g/m^2)	Description
Low	1	Approximates range of socioeconomic effects and establishes planning area for scientific monitoring
Moderate	10	Approximates lower limit for harmful exposures to birds and marine mammals
High	50	Approximates surface oil slick and informs response planning

6.1.2 Shoreline Accumulation Thresholds

There are many different types of shorelines, ranging from cliffs, rocky beaches, sandy beaches, mud flats and mangroves, and each of these influences the volume of oil that can remain stranded ashore and its thickness before the shoreline saturation point occurs. For instance, a sandy beach may allow oil to percolate through the sand, thus increasing its ability to hold more oil ashore over tidal cycles and various wave actions than an equivalent area of water; hence oil can increase in thickness onshore over time. A sandy beach shoreline was assumed as the default shoreline type for the modelling herein, as it allows for the highest carrying capacity of oil (of the available open/exposed shoreline types). Hence the results contained herein would be indicative of a worst-case scenario, where the highest volume of oil may be stranded on the shoreline (when compared to other shoreline types, such as exposed rocky shores).

In previous risk assessment studies, French-McCay et al. (2005a; 2005b) used a threshold of 10 g/m^2 to assess the potential for shoreline accumulation. This is a conservative threshold used to define regions of socio-economic impact, such as triggering temporary closures of adjoining fisheries or the need for shore clean-up on beaches or man-made features/amenities (breakwaters, jetties, marinas, etc.). It would equate to approximately 2 teaspoons of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a stain/film. On that basis, the 10 g/m^2 shoreline accumulation threshold has been selected to define the zone of potential “low shoreline accumulation”.

French et al. (1996) and French-McCay (2009) define a shoreline oil accumulation threshold of 100 g/m^2, or above, would potentially harm shorebirds and wildlife (furbearing aquatic mammals and marine reptiles on or along the shore) based on studies for sub-lethal and lethal impacts. This threshold has been used in previous environmental risk assessment studies (see French-McCay, 2003; French-McCay et al., 2004, French-McCay et al., 2011; 2012; NOAA, 2013). Additionally, a shoreline concentration of 100 g/m^2, or above, is the minimum limit that the oil can be effectively cleaned according to the AMSA (2015) guideline. This threshold equates to approximately ½ a cup of oil per square meter of shoreline accumulation. The appearance is described as a thin oil coat. Therefore, 100 g/m^2 has been selected to define the zone of potential “moderate shoreline accumulation”.

Observations by Lin & Mendelssohn (1996), demonstrated that loadings of more than 1,000 g/m^2 of hydrocarbon during the growing season would be required to impact marsh plants significantly. Similar thresholds have been found in studies assessing hydrocarbon impacts on mangroves (Grant et al., 1993; Suprayogi & Murray, 1999). Hence, 1,000 g/m^2 has been selected to define the zone of potential "high shoreline accumulation". It equates to approximately 1 litre of hydrocarbon per square meter of shoreline accumulation. The appearance is described as a hydrocarbon cover.

It is worth noting that the shoreline accumulation thresholds derived from extensive literature review (outlined in Table 6-3) agree with the commonly used threshold values for oil spill modelling specified in NOPSEMA (2019).

Table 6-3 Thresholds used to assess shoreline accumulation.

Threshold level	Shoreline loading (g/m^2)	Description
Low (socioeconomic/sublethal)	10	Predicts potential for some socio-economic impact
Moderate	100	Loading predicts area likely to require clean-up effort
High	> 1,000	Loading predicts area likely to require intensive clean-up effort

6.1.3 In-water Exposure Thresholds

Oil is a mixture of thousands of hydrocarbons of varying physical, chemical, and toxicological characteristics, and therefore, demonstrate varying fates and impacts on organisms. As such, for in-water exposure, the SIMAP model provides separate outputs for dissolved and entrained hydrocarbons from oil droplets. The consequences of exposure to dissolved and entrained components will differ because they have different modes and magnitudes of effect.

Entrained hydrocarbon concentrations were calculated based on oil droplets that are suspended in the water column, though not dissolved. The composition of this oil would vary with the state of weathering (oil age) and may contain soluble hydrocarbons when the oil is fresh. Calculations for dissolved hydrocarbons specifically calculates oil components which are dissolved in water, which are known to be the primary source of toxicity exerted by oil.

6.1.3.1 Dissolved Hydrocarbons

Laboratory studies have shown that dissolved hydrocarbons exert most of the toxic effects of oil on aquatic biota (Carls et al., 2008; Nordtug et al., 2011; Redman, 2015). The mode of action is a narcotic effect, which is positively related to the concentration of soluble hydrocarbons in the body tissues of organisms (French-McCay, 2002). Dissolved hydrocarbons are taken up by organisms directly from the water column by absorption through external surfaces and gills, as well as through the digestive tract. Thus, soluble hydrocarbons are termed "bioavailable".

Hydrocarbon compounds vary in water-solubility and the toxicity exerted by individual compounds is inversely related to solubility, however bioavailability will be modified by the volatility of individual compounds (Nirmalakhandan & Speece, 1988; Blum & Speece, 1990; McCarty, 1986; McCarty et al., 1992a, 1992b; Mackay et al., 1992; McCarty & Mackay, 1993; Verhaar et al., 1992, 1999; Swartz et al., 1995; French-McCay, 2002; McGrath and Di Toro, 2009). Of the soluble compounds, the greatest contributor to toxicity for water-column and benthic organisms are the lower-molecular-weight aromatic compounds, which are both volatile and soluble in water. Although they are not the most water-soluble hydrocarbons within most oil types, the polynuclear aromatic hydrocarbons (PAHs) containing 2-3 aromatic ring structures typically exert the largest narcotic effects because they are semi-soluble and not highly volatile, so they persist in the environment long enough for significant accumulation to occur (Anderson et al., 1974, 1987; Neff & Anderson, 1981; Malins & Hodgins, 1981; McAuliffe, 1987; NRC, 2003). The monoaromatic hydrocarbons (MAHs), including the BTEX compounds (benzene, toluene, ethylbenzene, and xylenes), and the soluble alkanes (straight chain hydrocarbons) also contribute to toxicity, but these compounds are highly volatile, so that their contribution will be low when oil is exposed to evaporation and higher when oil is discharged at depth where volatilisation does not occur (French-McCay, 2002).

French-McCay (2002) reviewed available toxicity data, where marine biota was exposed to dissolved hydrocarbons prepared from oil mixtures, finding that 95% of species and life stages exhibited 50% population mortality (LC_{50}) between 6 and 400 ppb total PAH concentration after 96 hrs exposure, with an average of 50 ppb. Hence, concentrations lower than 6 ppb total PAH value should be protective of 97.5% of species and life stages even with exposure periods of days (at least 96 hours). Early life-history stages of fish appear to be more sensitive than older fish stages and invertebrates.

Exceedances of 10, 50 or 400 ppb over a 1 hour timestep (see Table 6-4) was applied to indicate increasing potential for sub-lethal to lethal toxic effects (or low to high), based on NOPSEMA (2019).

6.1.3.2 Entrained Hydrocarbons

Entrained hydrocarbons consist of oil droplets that are suspended in the water column and insoluble. As such, insoluble compounds in oil cannot be absorbed from the water column by aquatic organisms, hence are not bioavailable through absorption of compounds from the water. Exposure to these compounds would require routes of uptake other than absorption of soluble compounds. The route of exposure of organisms to whole oil alone include direct contact with tissues of organisms and uptake of oil by direct consumption, with potential for biomagnification through the food chain (NRC, 2005).

The 10 ppb threshold represents the very lowest concentration and corresponds generally with the lowest trigger levels for chronic exposure for entrained hydrocarbons in the ANZECC & ARMCANZ (2000) water quality guidelines. Due to the requirement for relatively long exposure times (> 24 hours) for these concentrations to be significant, they are likely to be more meaningful for juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes, or when entrained hydrocarbons adhere to organisms or trapped against a shoreline for periods of several days or more.

This exposure zone is not considered to be of significant biological impact and is therefore outside the adverse exposure zone. This exposure zone represents the area contacted by the spill. This area does not define the area of influence as it is considered that the environment will not be affected by the entrained hydrocarbon at this level.

Thresholds of 10 ppb and 100 ppb were applied over a 1 hour time exposure (Table 6-4), to cover the range of thresholds outlined in ANZECC & ARMCANZ (2000) water quality guidelines, the incremental change for greater potential effect and is per NOPSEMA (2019).

A complicating factor that should be considered when assessing the consequence of dissolved and entrained oil distributions is that there will be some areas where both physically entrained oil droplets and dissolved hydrocarbons co-exist. Higher concentrations of each will tend to occur close to the source where sea conditions can force mixing of relatively unweathered oil into the water column, resulting in more rapid dissolution of soluble compounds.

Table 6-4 Dissolved and entrained hydrocarbon exposure values assessed over a 1-hour time step, as per NOPSEMA (2019).

Threshold level	Dissolved hydrocarbon concentration (ppb)	Entrained hydrocarbon concentrations (ppb)
Low	10	10
Moderate	50	-
High	400	100

7 MARINE DIESEL PROPERTIES

7.1 Physical Properties

Table 7-1 and Table 7-2 present the physical properties and boiling point ranges of the MDO used in this study.

Table 7-1 Physical properties for MDO.

Characteristic	Marine Diesel Oil (MDO)
Density (kg/m^3)	829.1 (at 25 °C)
API	37.6
Dynamic viscosity (cP)	4.0 (at 25 °C)
Pour point (°C)	-14
Hydrocarbon property category	Group II
Hydrocarbon property classification	Light - Persistent

Table 7-2 Boiling point ranges for MDO.

Oil Type	Component	Volatile (%)	Semi-volatile (%)	Low-volatility (%)	Residual (%)
	Boiling point (°C)	<180 C_4 to C_{10}	180-265 C_{11} to C_{15}	265-380 C_{16} to C_{20}	>380 $>C_{20}$
MDO	% of total	6.0	34.6	54.4	5.0

The BP are dictated by the length of the carbon chains, with the longer and more complex compounds having a higher boiling point, and therefore lower volatility and evaporation rate.

Typical evaporation times once the hydrocarbons reach the surface and are exposed to the atmosphere are:

- Up to 12 hours for the C_4 to C_{10} compounds (or less than 180°C BP).
- Up to 24 hours for the C_{11} to C_{15} compounds (180-265°C BP).
- Several days for the C_{16} to C_{20} compounds (265-380°C BP).
- Not applicable for the residual compounds (BP > 380°C), which will resist evaporation, persist in the marine environment for longer periods, and be subject to relatively slow degradation.

The actual fate of oil will depend greatly on the amount that reaches the surface.

The MDO has an API of 37.6 and a density of 829.1 kg/m^3 (at 25ºC) with a viscosity value (4.0 cP) classifying it as a Group II (light-persistent) oil according to the International Tankers Owners Pollution Federation (ITOPF, 2014) and US EPA/USCG classifications.

The MDO is a mixture of volatile and persistent hydrocarbons with high proportions of volatile and semi- to low-volatile components. In favourable evaporation conditions, about 6.0% of the oil mass should evaporate within the first 12 hours (BP < 180°C), a further 34.6% should evaporate within the first 24 hours (180°C < BP < 265°C) and a further 54.4% should evaporate over several days (265°C < BP < 380°C). Approximately 5.0% of the oil is shown to be persistent.

7.2 Weathering Properties

A series of model weather tests were conducted to illustrate the potential behaviour of the MDO when exposed to idealised and representative environmental conditions:

- A 50 m^3 surface release over 1-hour under calm wind conditions (constant 5 knots), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.
- A 50 m^3 surface release over 1-hour under variable wind conditions (1-12 knots, drawn from representative data files), assuming low seasonal water temperature (15°C) and ambient tidal and drift currents.

The first case is indicative conditions that would not generate entrainment, while the second case may represent conditions that could cause a minor degree of entrainment. Both scenarios provide examples of potential behaviour during a spill once the oil reaches the surface.

The mass balance for the MDO under the constant 5 knot (~2.5 m/s) wind case (Figure 7-1) shows that 40.3% of the oil is predicted to evaporate within 24 hours. Under calm conditions, the majority of the remaining oil on the water surface will weather at a slower rate due to being comprised of the longer-chain compounds with higher boiling points. Evaporation shall cease when the residual compounds remain, and they will be subject to more gradual decay through biological and photochemical processes.

Under the variable-wind case (Figure 7-2), where the winds are of greater strength on average, entrainment of MDO into the water column is predicted to increase. Approximately 24 hours after the spill, 60.1% of the oil mass is forecast to have entrained and a further 38.4% is forecast to have evaporated, leaving only a small proportion of the oil floating on the water surface (<0.1%).

The increased level of entrainment in the variable-wind case result in a higher percentage decaying at an approximate rate of 1.5% per day with or ~10.5% after 7 days, compared to <0.1% per day and a total of 0.9% after 7 days for the constant-wind case. Given the proportion of entrained oil and the tendency for it to remain mixed in the water column, the remaining hydrocarbons will decay over time scales of several weeks.

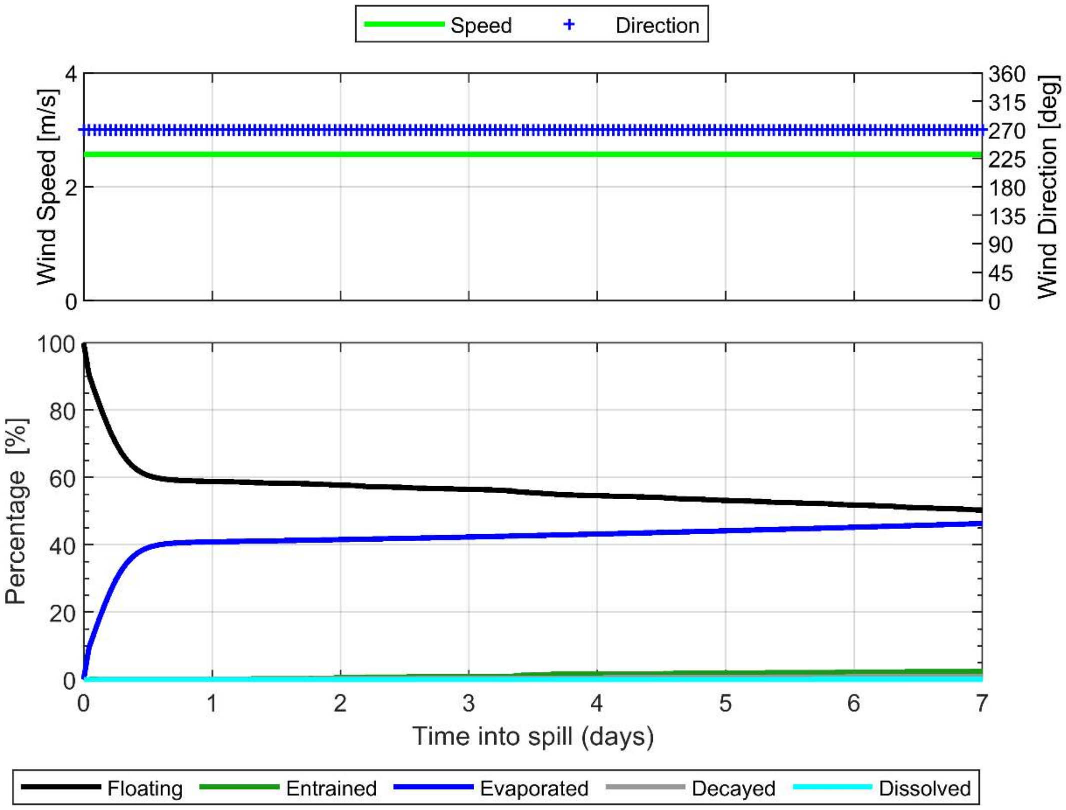

Figure 7-1 Proportional mass balance plot representing the weathering of MDO spilled onto the water surface over 1 hour and subject to a constant 5 knots (2.6 m/s) wind speed at 15°C water temperature and 20°C air temperature.

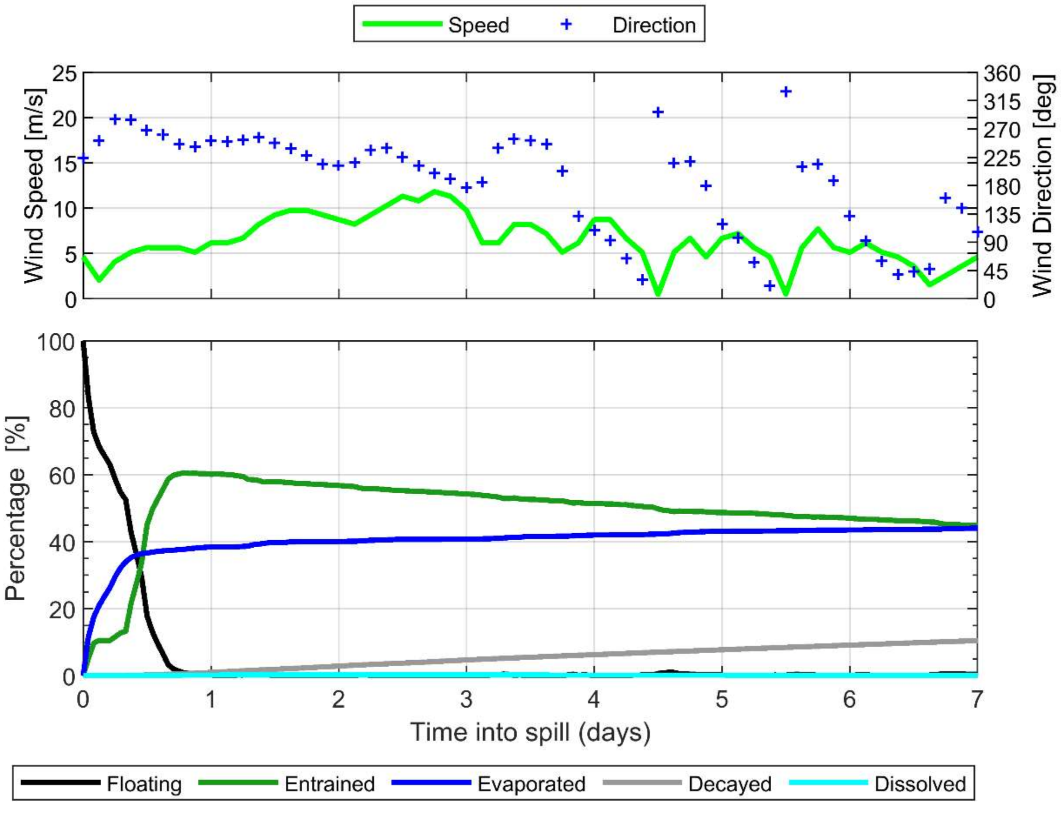

Figure 7-2 Proportional mass balance plot representing the weathering of MDO spilled onto the water over 1 hour and subject to variable wind speeds (1-12 knots) at 15°C water temperature and 20°C air temperature.

8 MODEL SETTINGS

Table 8-1 provides a summary of the oil spill model settings.

Table 8-1 Summary of the oil spill model settings and thresholds used in this assessment.

Parameter	Scenario 1	Scenario 2
Description	Vessel collision	Vessel collision
Number of randomly selected spill start times	200 (100 per season)	200 (100 per season)
Model period	Summer (November through to March) Winter (April to October)	
Oil type	MDO	MDO
Spill volume (m^3)	300	200
Release type	Surface	
Release duration	6 hours	
Simulation length (days)	30	
Surface oil concentration thresholds and exposure risk (g/m^2) ^	1 (low); 10 (moderate); 50 (high)	
Shoreline oil accumulation thresholds and exposure risk (g/m^2) ^	10 (low); 100 (moderate); 1,000 (high)	
Dissolved hydrocarbon concentrations and exposure risk (ppb) ^	10 (low); 50 (moderate); 400 (high)	
Entrained hydrocarbon concentrations and exposure risk (ppb) ^	10 (low); 100 (high)	

^Thresholds based on NOPSEMA (2019)

9 PRESENTATION AND INTERPRETION OF MODEL RESULTS

The results from the modelling study are presented in a number of tables and figures, which aim to provide an understanding of the predicted sea-surface and water column (subsurface) exposure and shoreline accumulation (if predicted).

9.1 Annual Analysis

9.1.1 Statistics

The statistics are based on the following principles:

- The ***greatest distance travelled by a spill trajectory*** – is determined by a) recording the maximum and b) second greatest distance travelled (or 99th percentile) by a single trajectory, within a scenario, from the release location to the identified exposure thresholds.
- The ***probability of oil exposure to a receptor*** – is determined by recording the number of spill trajectories to reach a specified sea surface or subsea threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***minimum time before oil exposure to a receptor*** – is determined by ranking the elapsed time before sea surface exposure, at a specified threshold, to grid cells within a receptor polygon and recording the minimum value.
- The ***probability of oil accumulation at a receptor*** – is determined by recording the number of spill trajectories to reach a specified shoreline accumulation threshold within a receptor polygon, divided by the total number of spill trajectories within that scenario.
- The ***maximum potential oil loading within a receptor*** – is determined by identifying the maximum loading to any grid cell within a receptor polygon, for a scenario.
- The ***dissolved and entrained hydrocarbon exposure*** – is determined by recording the maximum instantaneous concentrations at each grid cell.

9.2 Deterministic Trajectories

The stochastic modelling results were assessed for each scenario, and the deterministic runs were identified and are presented in the result section based on the following criteria;

a. Largest volume of oil ashore;

b. Longest length of oil accumulation above 100 g/m^2;

c. Minimum time before shoreline accumulation above 10 g/m^2;

9.2.1 Receptors Assessed

A range of environmental receptors and shorelines were assessed for floating oil exposure, shoreline accumulation and water column exposure as part of the study (see Figure 9-1 to Figure 9-10). Receptor categories (see Table 9-1) include sections of shorelines which are defined by local government areas (LGAs), sub-LGAs and offshore islands. All other sensitive receptors other than submerged reefs, shoals and banks (RSB) were sourced from Australian Government Department of Agriculture, Water and the Environment (http://www.environment.gov.au/). Risks of exposure were separately calculated for each sensitive receptor area and have been tabulated. Note, due to the volume and geographical extent of Biologically Important Areas (BIAs) predicted to receive potential impacts from spilled hydrocarbon, it is recommended to use the following website to obtain detailed maps on all BIAs assessed: http://www.environment.gov.au/webgis-framework/apps/ncva/ncva.jsf.

Table 9-2 summarises the receptors that the release locations reside within.

Table 9-1 Summary of receptors used to assess floating oil, shoreline and in-water exposure to hydrocarbons.

Receptor Category	Acronym	Hydrocarbon Exposure Assessment		
		Water Column	Floating oil	Shoreline
Australian Marine Park	AMP	✓	✓	×
Biologically Important Areas	BIA	✓	✓	×
Interim Biogeographic Regionalisation for Australia bioregions	IBRA	✓	✓	×
Integrated marine and coastal regionalisation areas	IMCRA	✓	✓	×
Marine National Park	MNP	✓	✓	×
Marine Park	MP	✓	✓	×
Marine Sanctuary	MS	✓	✓	×
Nature Reserve	NR	✓	✓	×
Ramsar Sites	Ramsar	✓	✓	×
Reefs, Shoals and Banks	RSB	✓	✓	×
Key Ecological Feature	KEF	✓	✓	×
State Waters	State Waters	✓	✓	×
Local and Sub-Local Government Area	LGA and Sub-LGA	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Nearshore Waters)	✓ (Reported as: Shore)

Table 9-2 Summary of the receptors that the release locations reside within.

Acronym	Receptor
BIA	Antipodean Albatross - Foraging
	Black-browed Albatross - Foraging
	Bullers Albatross - Foraging
	Campbell Albatross - Foraging
	Common Diving-petrel - Foraging
	Indian Yellow-nosed Albatross - Foraging
	Pygmy Blue Whale – Distribution
	Pygmy Blue Whale - Foraging
	Short-tailed Shearwater - Foraging
	Shy Albatross - Foraging
	Southern Right Whale - Migration
	Wandering Albatross - Foraging
	Wedge-tailed Shearwater - Foraging
	White Shark - Distribution
IMCRA	Otway

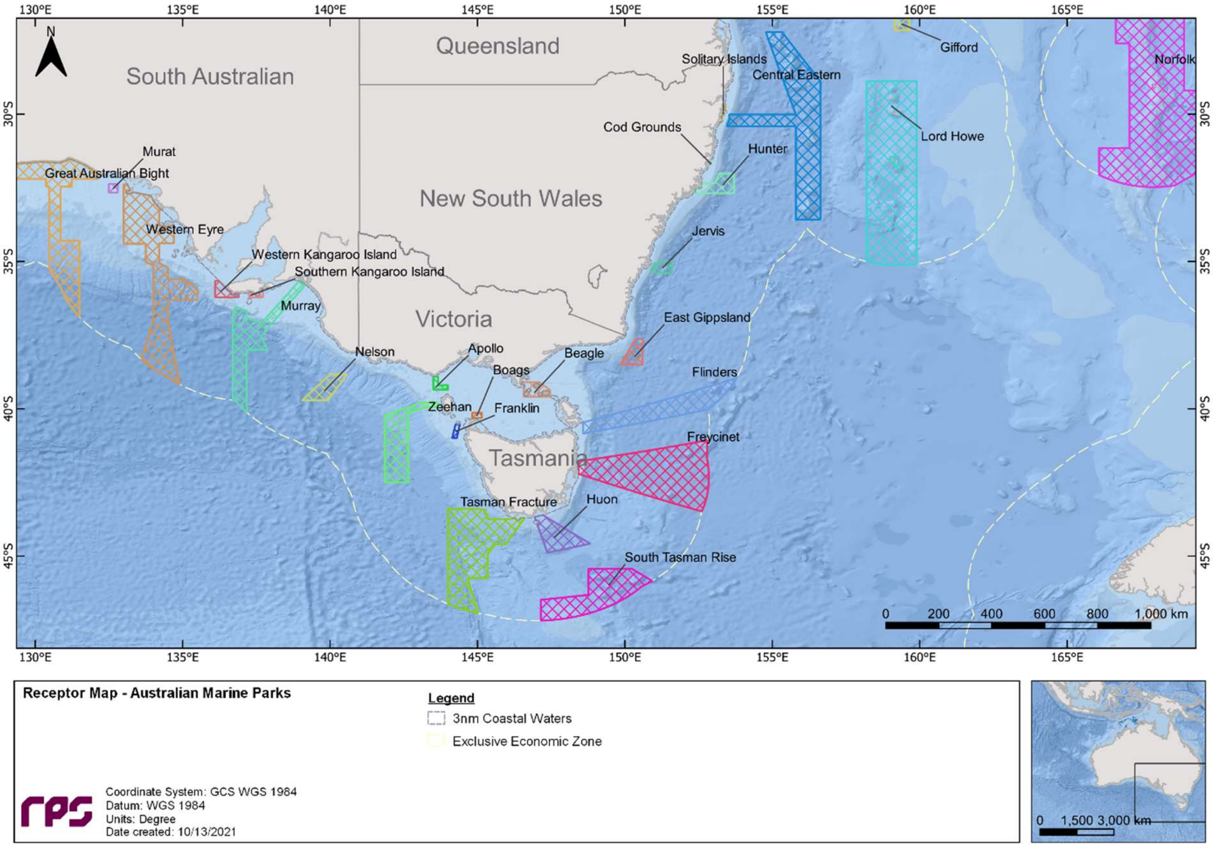

Figure 9-1 Receptor map for Australian Marine Parks (AMP).

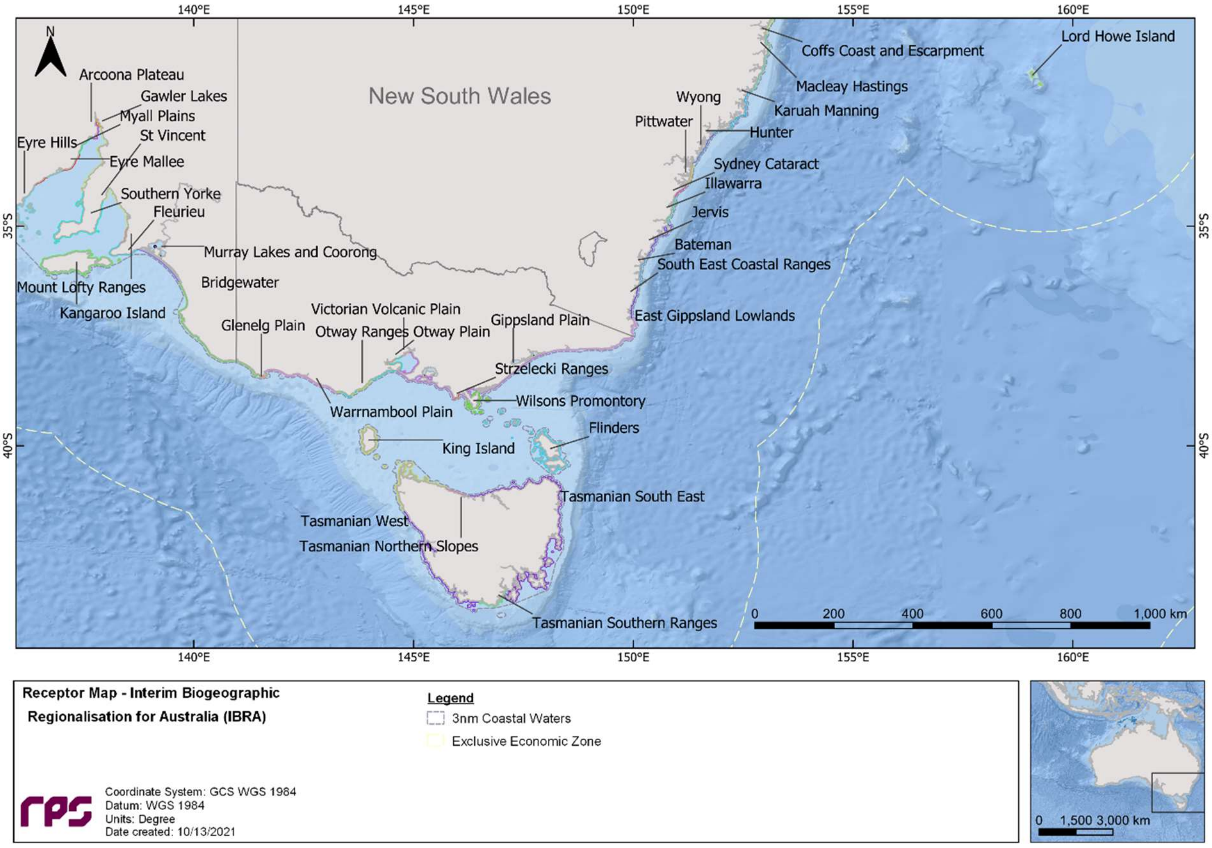

Figure 9-2 Receptor map for the Interim Biogeographic Regionalisation for Australia (IBRA) bioregions.

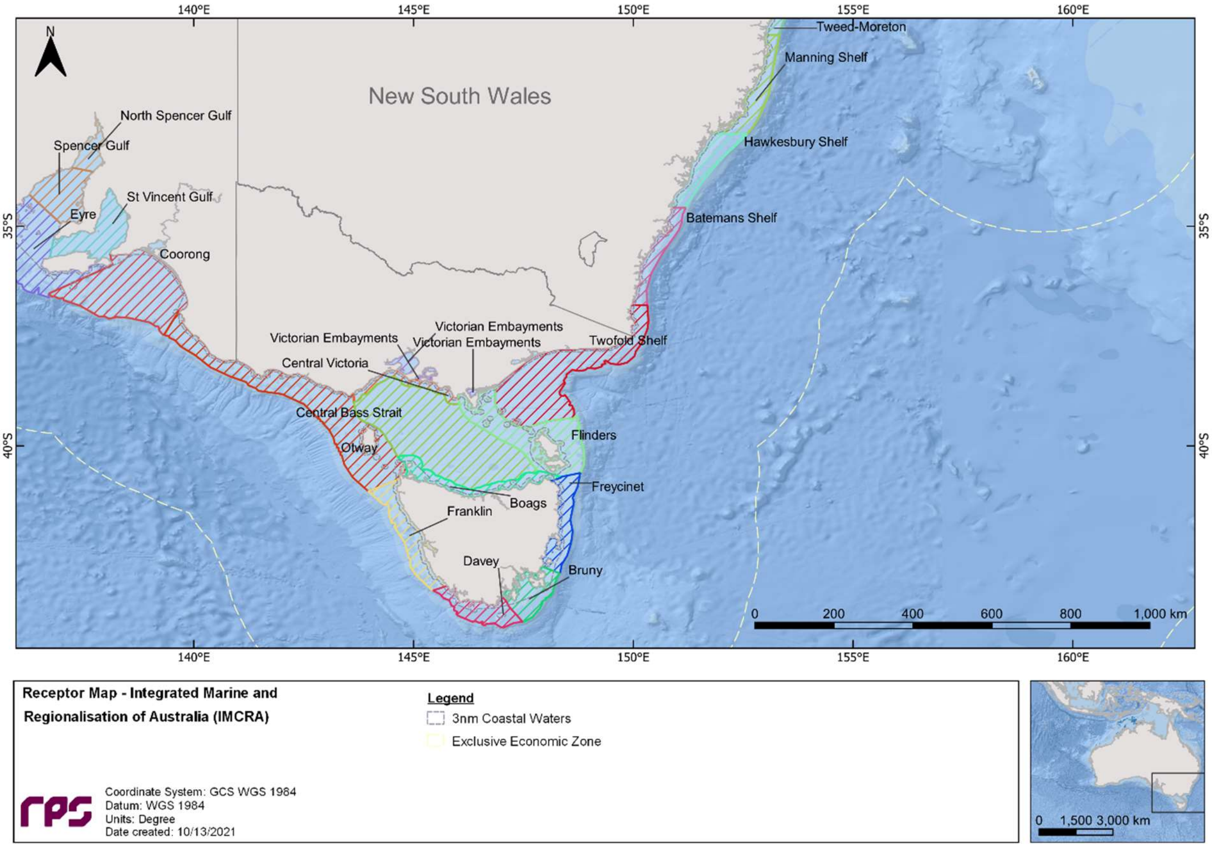

Figure 9-3 Receptor map for integrated marine and coastal regionalisation (IMCRA) areas.

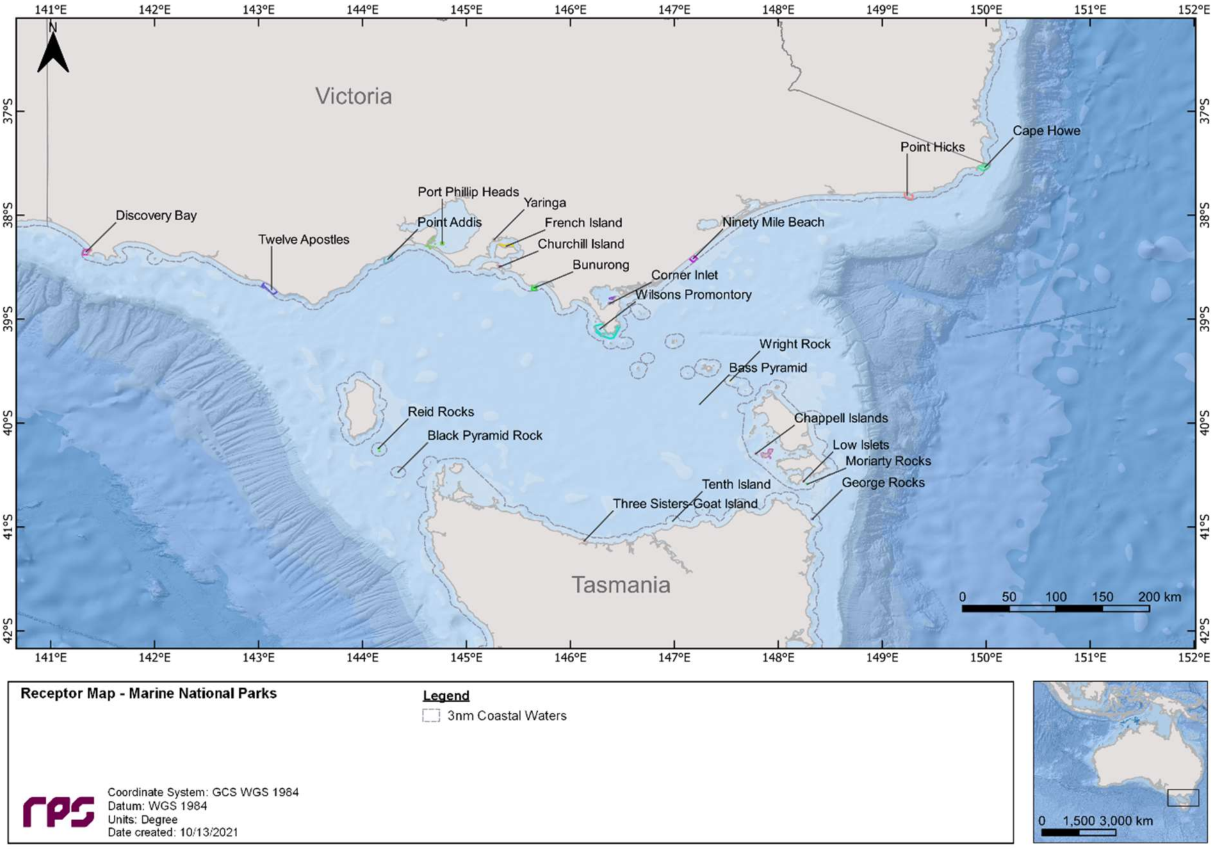

Figure 9-4 Receptor map for Marine National Parks (MNP).

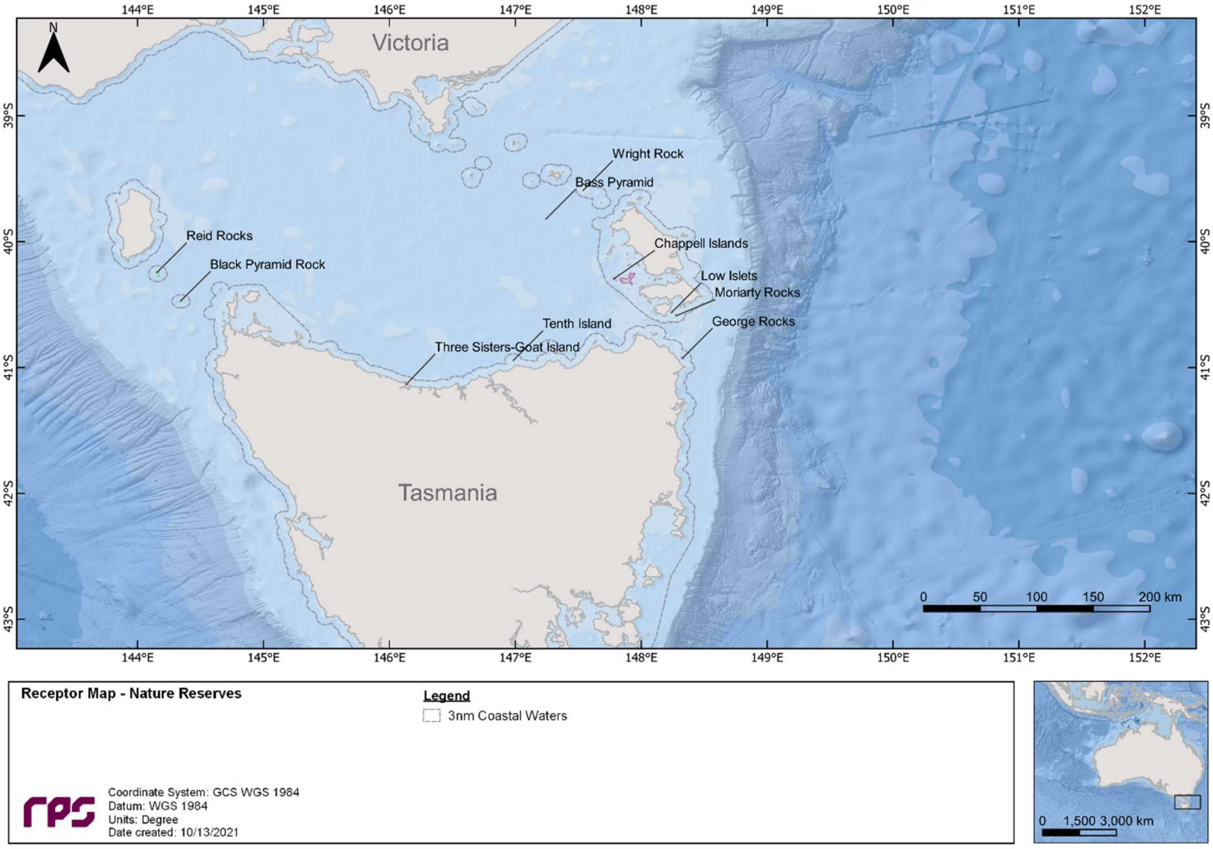

Figure 9-5 Receptor map for Nature Reserves (NR).

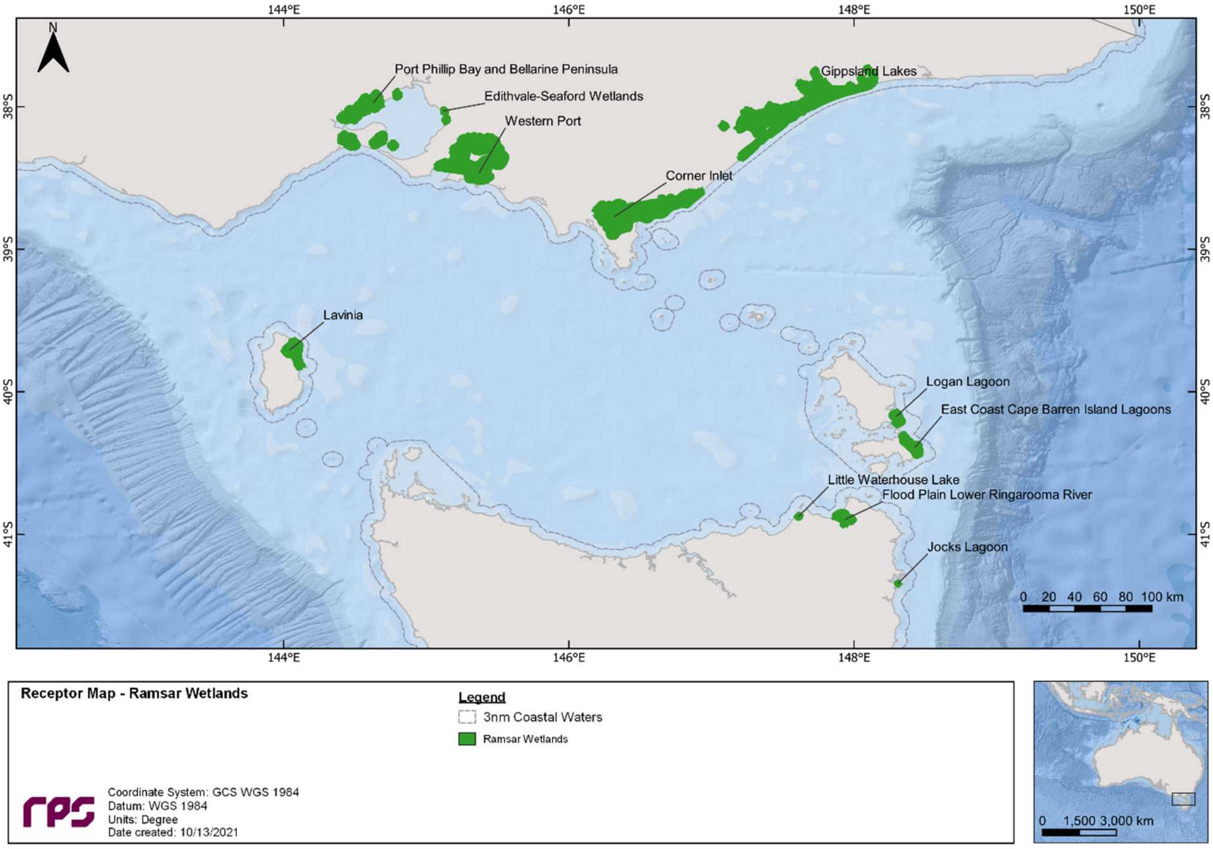

Figure 9-6 Receptor map for Ramsar Sites (Ramsar).

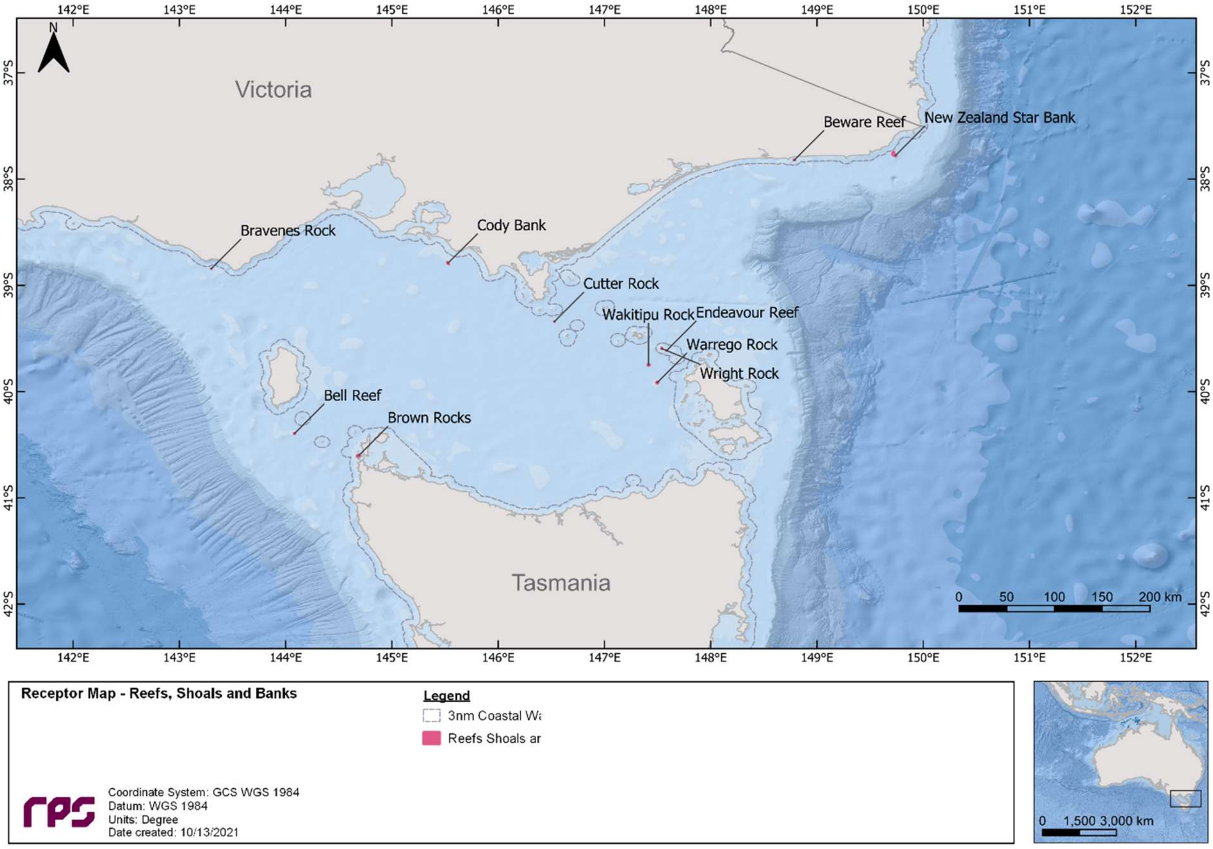

Figure 9-7 Receptor map for Reefs, Shoals and Banks (RSB).

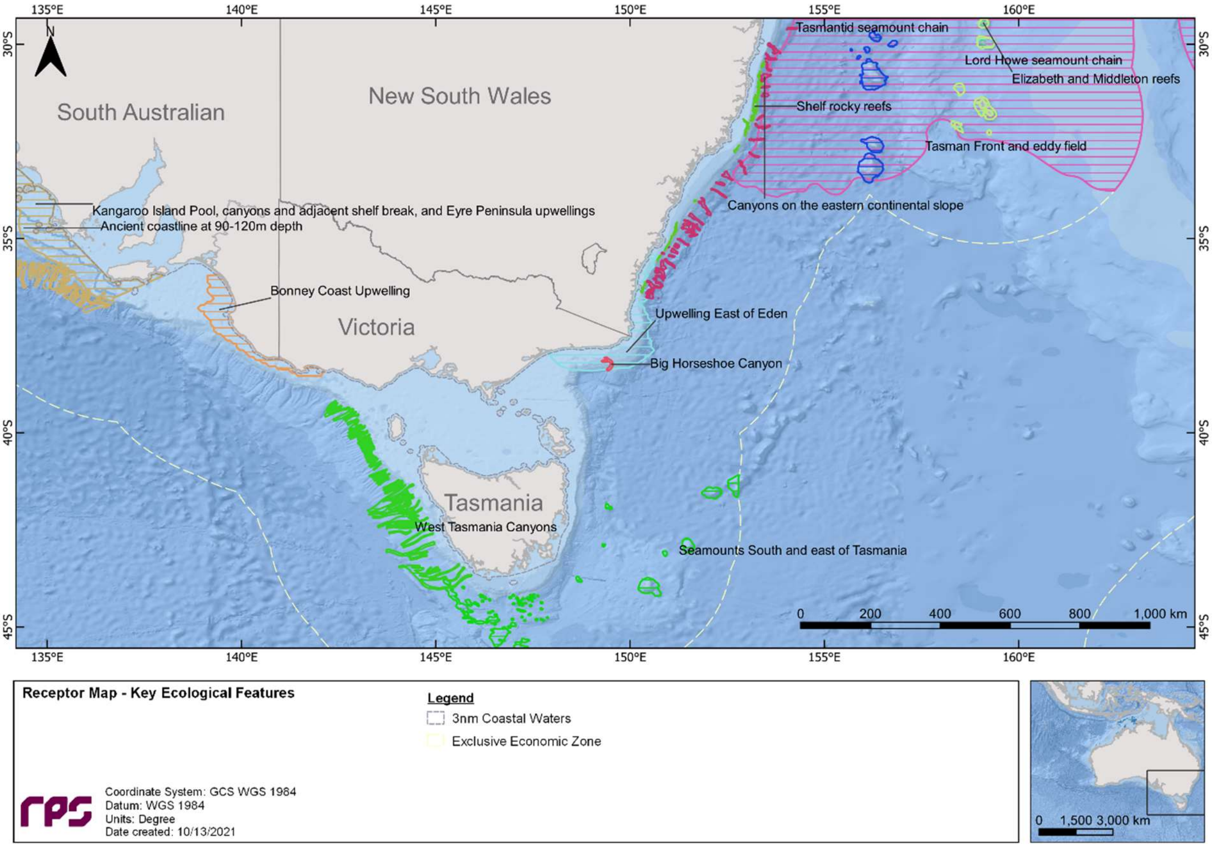

Figure 9-8 Receptor map for Key Ecological Features (KEF).

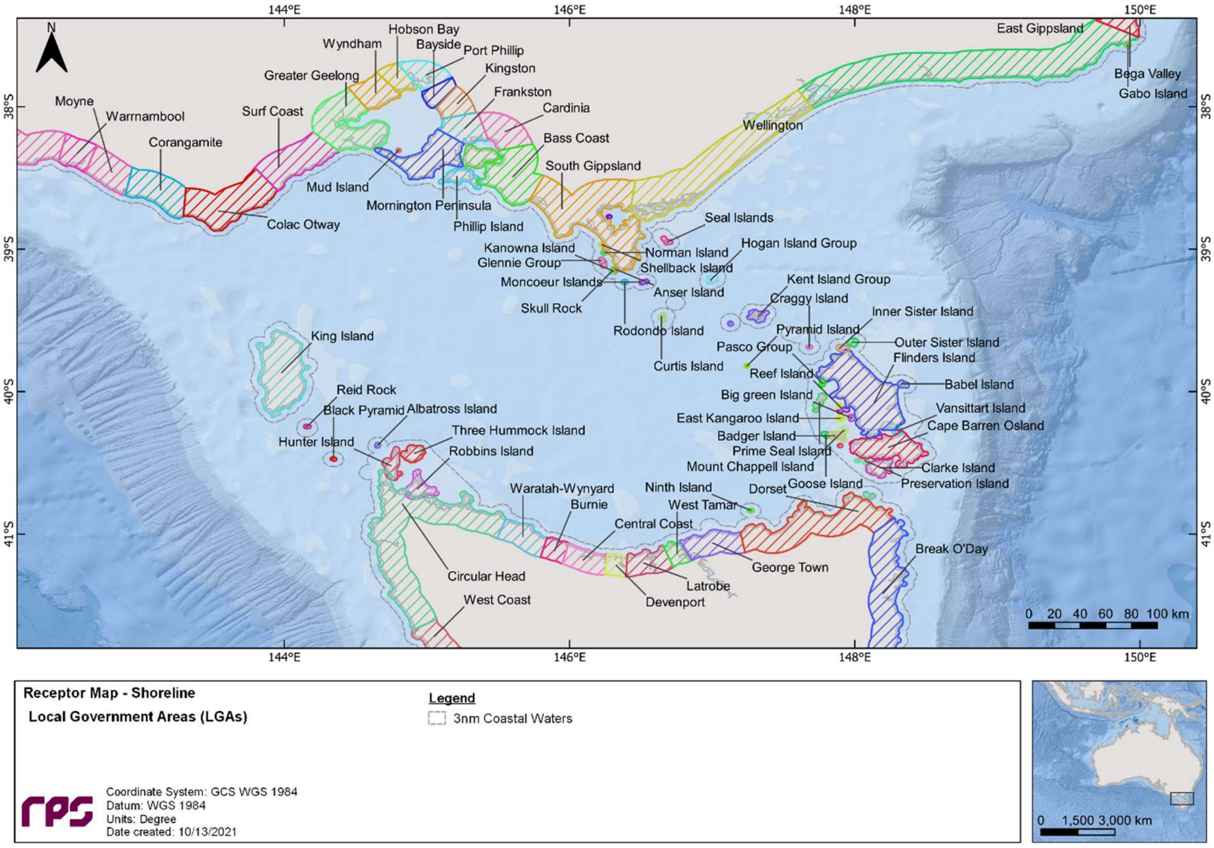

Figure 9-9 Receptor map for Local Government Areas (LGA).

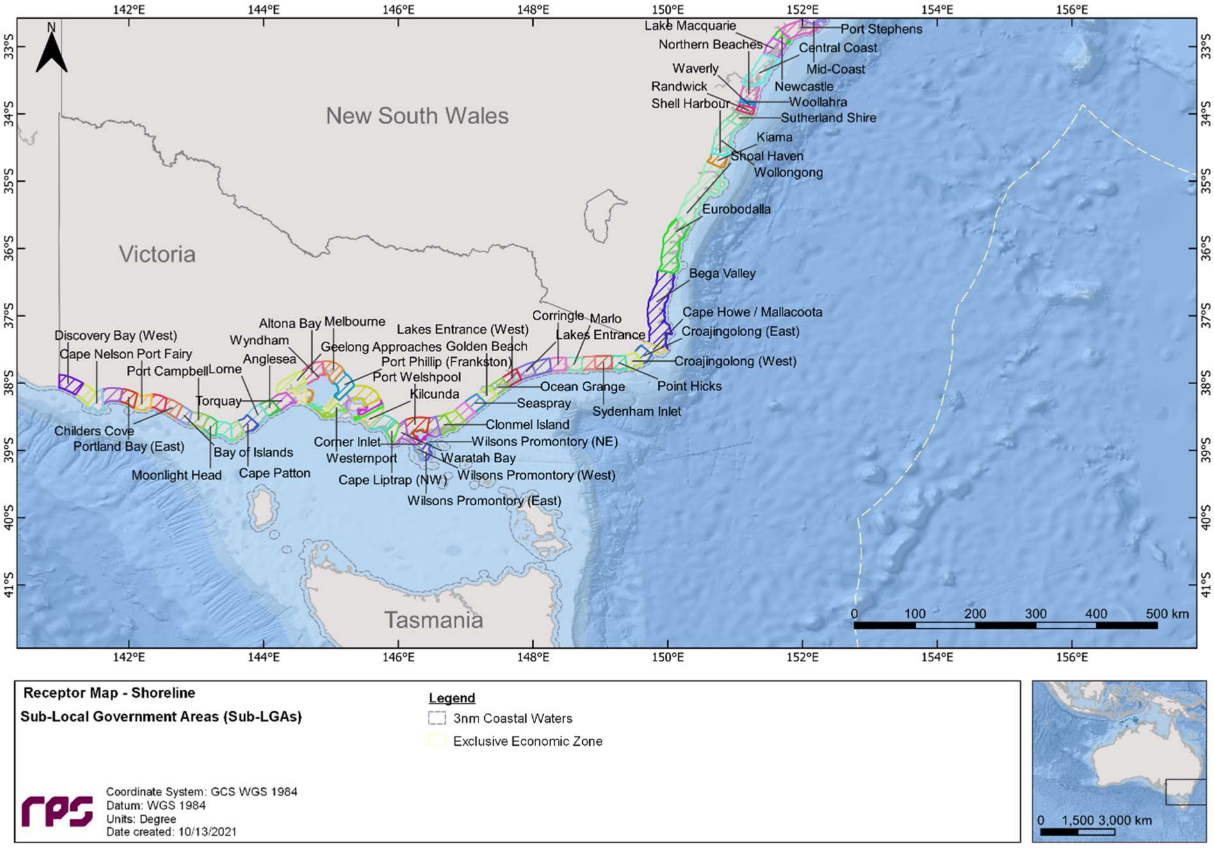

Figure 9-10 Receptor map for Sub Local Government Areas (Sub-LGA).

10 RESULTS – 300 m³ LOSS OF CONTAINMENT CAUSED BY VESSEL COLLISION

This scenario examined a 300 m^3 surface release of MDO over 6 hours to represent a loss of containment caused by vessel collision. A total of 200 spill simulations were run (i.e. 100 spills per season) and tracked for 30 days. The results for all 100 simulations per season were combined and are presented on a seasonal basis (i.e. summer and winter).

Sections 10.1 and 10.2 present the annual stochastic analysis and deterministic analysis results, respectively.

10.1 Stochastic Analysis

10.1.1 Environment that may be affected (EMBA)

Figure 10-1 presents the low threshold environment that maybe affected (EMBA) produced by overlaying the results from all 200 simulations (i.e. 100 per season) during summer and winter conditions.

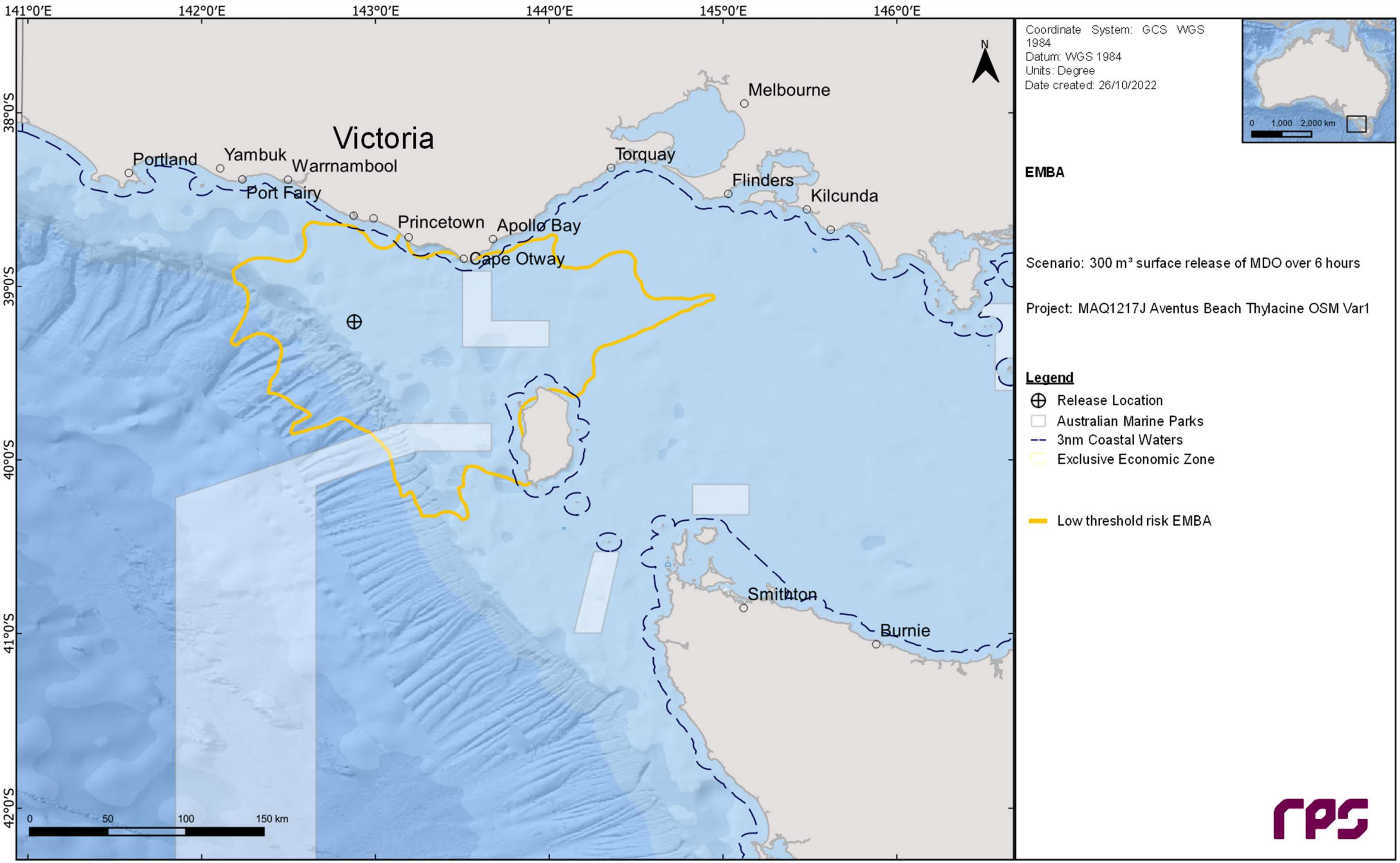

Figure 10-1 Predicted low threshold risk EMBA produced by overlaying the results from all 200 simulations, resulting from a 300 m^3 surface release of MDO over 6 hours during summer and winter conditions.

10.1.2 Floating Oil Exposure

Table 10-1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 39.3 km (east-southeast) during summer conditions, 15.3 km (east-southeast) during winter conditions and 2.7 km (west-southwest) during winter conditions, respectively.

Table 10-2 summarises the potential floating oil exposure to individual receptors during the summer and winter conditions.

A total of 14 BIAs were shown to be exposed to floating oil at, or above, the low threshold during the summer and winter conditions. Additionally, the Otway IMCRA was shown to be exposed to floating oil at, or above, the low threshold during both summer and winter conditions (see Table 10-2). The release locations reside within all 16 receptors listed in Table 10-2.

Figure 10-2 and Figure 10-3 present the zones of potential floating oil exposure for all thresholds under summer and winter conditions, respectively.

Table 10-1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Season	Distance and direction travelled	Zones of potential floating oil exposure		
		Low	Moderate	High
Summer	Maximum distance (km) from release location	39.3	11.7	1.4
	Maximum distance (km) from release location (99th percentile)	37.6	11	1.4
	Direction	East-southeast	Southeast	West-southwest
Winter	Maximum distance (km) from release location	33.1	15.3	2.7
	Maximum distance (km) from release location (99th percentile)	31.1	13.8	2.7
	Direction	Southeast	East-southeast	West-southwest

Table 10-2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)						Winter (April to October)					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (hours)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (hours)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Black-browed Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Bullers Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Campbell Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Common Diving-petrel – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Indian Yellow-nosed Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Pygmy Blue Whale – Distribution*	100	100	9	1	1	3	100	100	11	1	1	2
	Pygmy Blue Whale – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Short-tailed Shearwater – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Shy Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Southern Right Whale – Migration*	100	100	9	1	1	3	100	100	11	1	1	2
	Wandering Albatross – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	Wedge-tailed Shearwater – Foraging*	100	100	9	1	1	3	100	100	11	1	1	2
	White Shark – Distribution*	100	100	9	1	1	3	100	100	11	1	1	2
EEZ	Australian Exclusive Economic Zone*	100	100	9	1	1	3	100	100	11	1	1	2
IMCRA	Otway*	100	100	9	1	1	3	100	100	11	1	1	2

*The release location resides within the receptor boundaries.

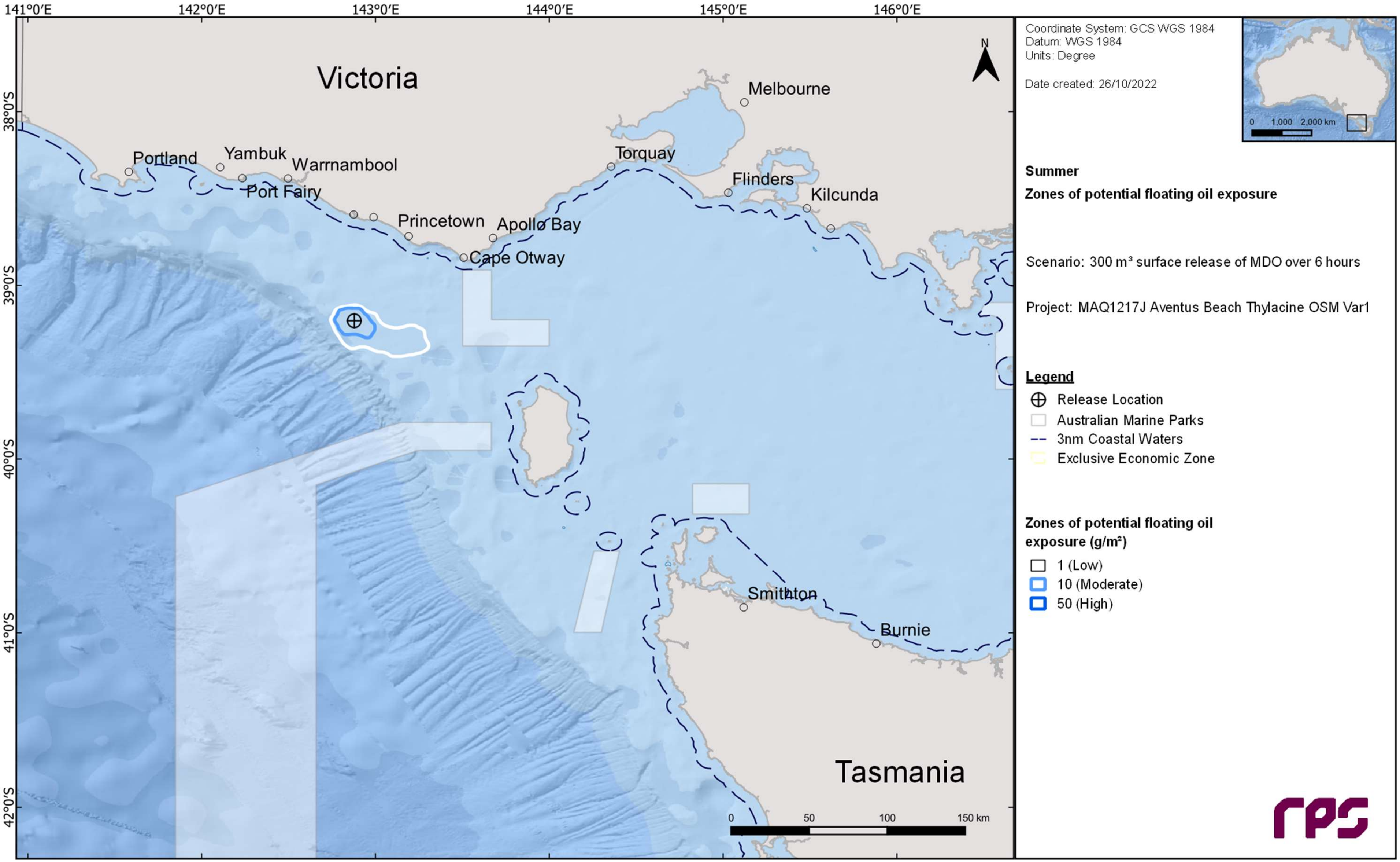

Figure 10-2 Zones of potential floating oil exposure in the event of a 300 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

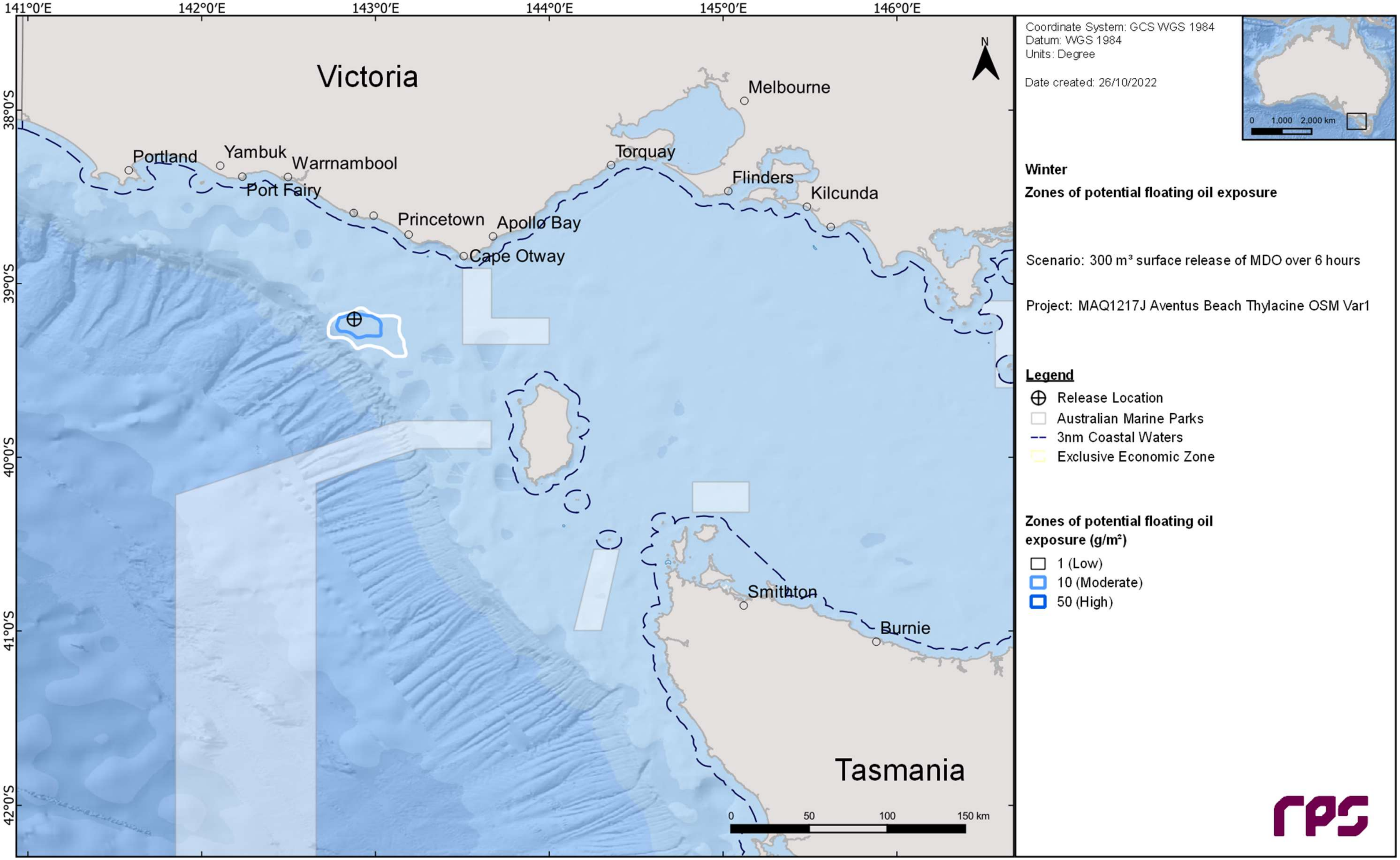

Figure 10-3 Zones of potential floating oil exposure in the event of a 300 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

10.1.3 Shoreline Accumulation

Table 10-3 presents a summary of the predicted potential shoreline accumulation during the summer and winter conditions. The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 0% during summer conditions and 5% during winter conditions. The minimum time before oil accumulation at, or above, the low threshold was 7.58 days winter conditions. The maximum total volume ashore for a single spill trajectory during winter conditions was 4.3 m^3, and the maximum length of shoreline accumulation at the low threshold was 11 km. No shoreline accumulation was observed for the summer season nor the moderate or high thresholds for winter.

Table 10-4 summarises the shoreline accumulation on individual receptors during the summer and winter conditions. During winter conditions one sub-LGA shorelines was shown to have shoreline accumulation above the low threshold with probability of 1%. The minimum time for low threshold shoreline accumulation was 7.58 days for King Island, where the maximum shoreline accumulation (4.3 m^3) also occurred.

The maximum potential shoreline loading above the low shoreline thresholds for winter conditions are presented in Figure 10-4.

Table 10-3 Summary of oil accumulation across all shorelines. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	0	5
Absolute minimum time for visible oil to shore (days)	-	7.58
Maximum total volume of hydrocarbons ashore (m^3)	-	4.3
Average total volume of hydrocarbons ashore (m^3)	-	0.4
Maximum length of the shoreline at **10 g/m^2** (km)	-	11
Average shoreline length (km) at **10 g/m^2** (km)	-	3.6
Maximum length of the shoreline at **100 g/m^2** (km)	-	-
Average shoreline length (km) at **100 g/m^2** (km)	-	-
Maximum length of the shoreline at **1,000 g/m^2** (km)	-	-
Average shoreline length (km) at **1,000 g/m^2** (km)	-	-

Table 10-4 Summary of oil accumulation on individual shoreline receptors. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Shoreline Receptor		Summer																Winter															
		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)			Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
LGA	Colac Otway	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	9.92	-	-	1	15	< 0.1	0.5	1	-	-	1	-	-
	King Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	7.58	-	-	2	48	< 0.1	4.3	4.3	-	-	11	-	-
Sub-LGA	Cape Otway West	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	9.92	-	-	1	15	< 0.1	0.4	1	-	-	1	-	-

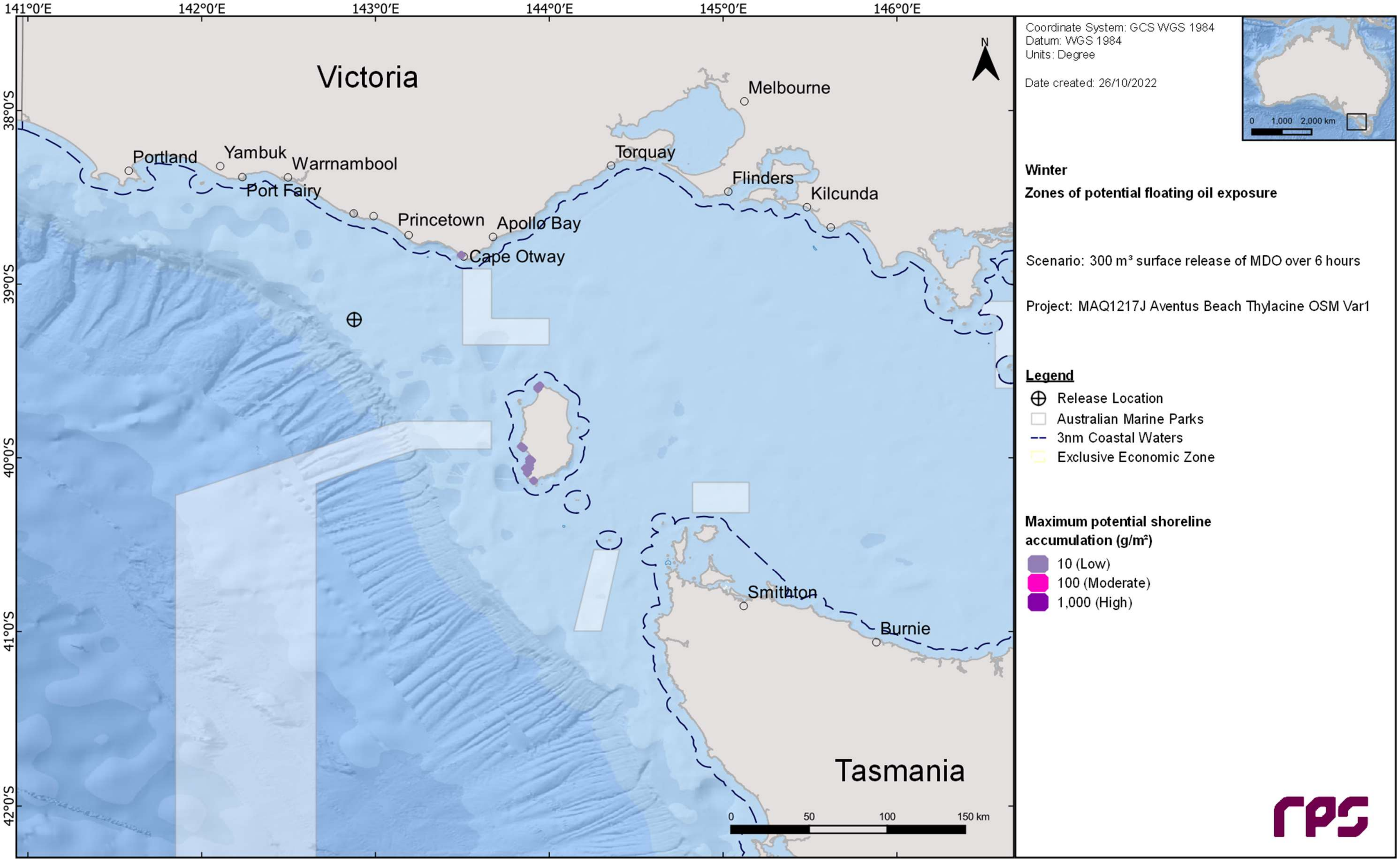

Figure 10-4 Maximum potential shoreline loading in the event of a 300 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

10.1.4 In-water exposure

10.1.4.1 Dissolved Hydrocarbons

Table 10-5 summarises the probability of exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer during the summer and winter conditions.

A total of 14 BIAs were shown to be exposed to dissolved hydrocarbons above the low and moderate thresholds during both the summer and winter conditions. Furthermore, the Apollo AMP, the Otway IMCRA and the West Tasmania Canyons KEF were also predicted to be exposed above the low threshold during both summer and winter conditions. The maximum probability of exposure for the low threshold for any receptor during either summer and winter was 60% and 58%, respectively. During the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor(s) was predicted to be 57 ppb and 58 ppb, respectively, which occurred within receptors containing the release location.

Figure 10-5 and Figure 10-6 presents the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions.

Table 10-5 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m dept. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)				Winter (April to October)			
		Maximum instantaneous dissolved hydrocarbon exposure	Probability of instantaneous dissolved hydrocarbon exposure			Maximum instantaneous dissolved hydrocarbon exposure	Probability of instantaneous dissolved hydrocarbon exposure		
			Low	Moderate	High		Low	Moderate	High
AMP	Apollo	21	1	0	0	15	1	0	0
BIA	Antipodean Albatross – Foraging*	60	57	1	0	64	58	2	0
	Black-browed Albatross – Foraging*	60	57	1	0	64	58	2	0
	Bullers Albatross – Foraging*	60	57	1	0	64	58	2	0
	Campbell Albatross – Foraging*	60	57	1	0	64	58	2	0
	Common Diving-petrel – Foraging*	60	57	1	0	64	58	2	0
	Indian Yellow-nosed Albatross – Foraging*	60	57	1	0	64	58	2	0
	Pygmy Blue Whale – Distribution*	60	57	1	0	64	58	2	0
	Pygmy Blue Whale – Foraging*	60	57	1	0	64	58	2	0
	Short-tailed Shearwater – Foraging*	60	57	1	0	64	58	2	0
	Shy Albatross – Foraging*	60	57	1	0	64	58	2	0
	Southern Right Whale – Migration*	60	57	1	0	64	58	2	0
	Wandering Albatross – Foraging*	60	57	1	0	64	58	2	0
	Wedge-tailed Shearwater – Foraging*	60	57	1	0	64	58	2	0
	White Shark – Distribution*	60	57	1	0	64	58	2	0
EEZ	Australian Exclusive Economic Zone*	60	57	1	0	64	58	2	0
IMCRA	Otway*	60	57	1	0	64	58	2	0
KEF	West Tasmania Canyons	8	0	0	0	17	1	0	0

*The release location resides within the receptor boundaries.

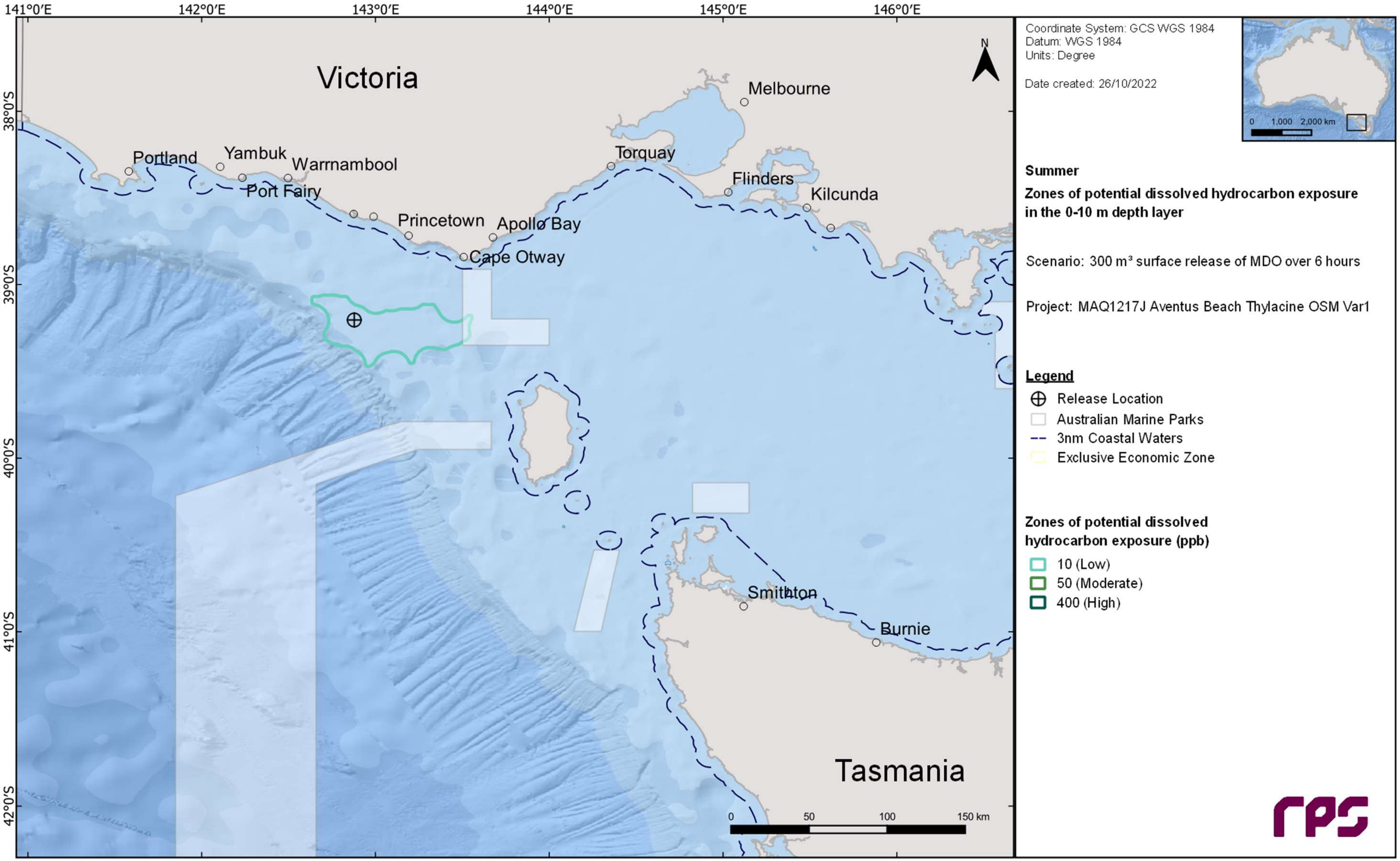

Figure 10-5 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 300 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

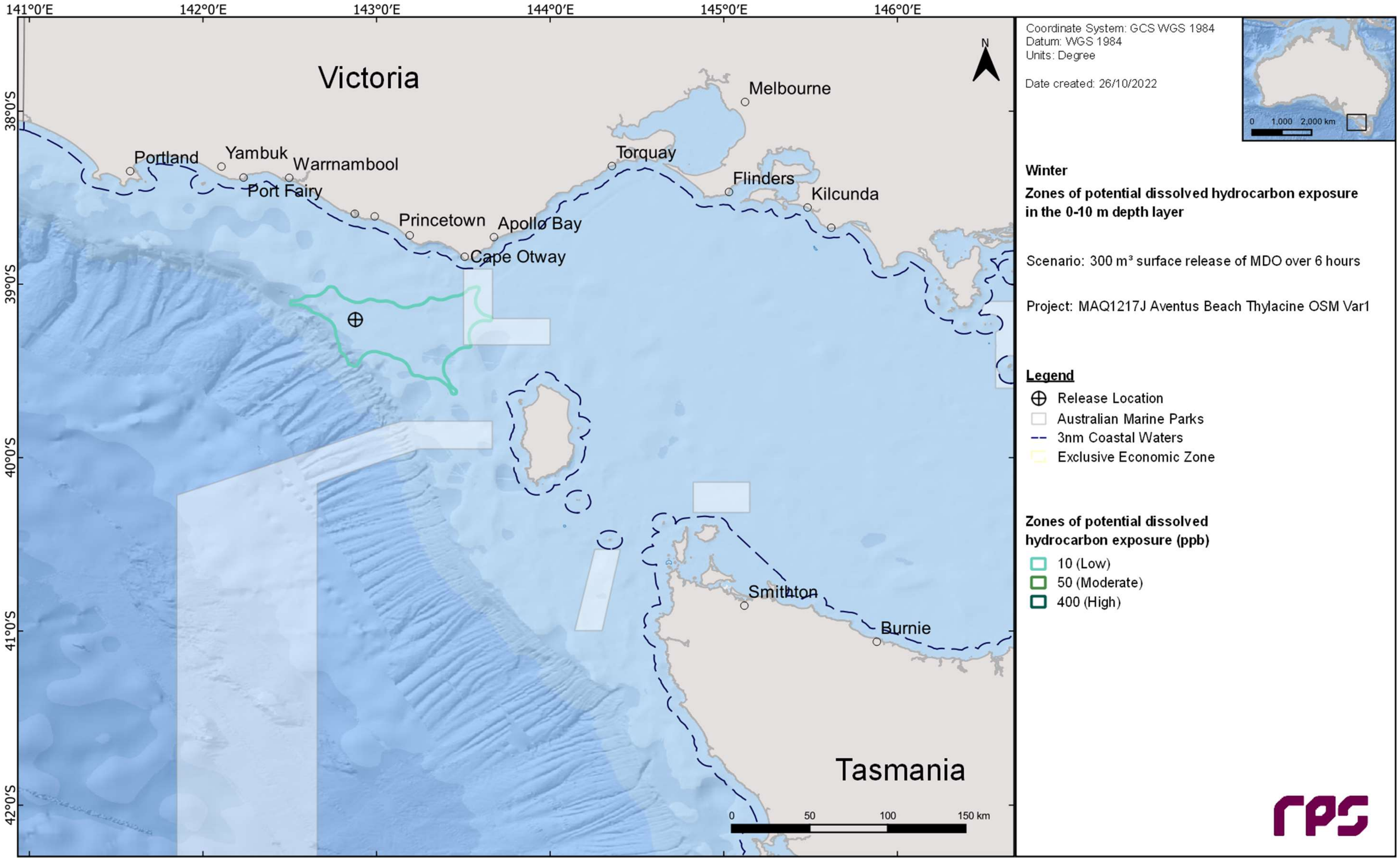

Figure 10-6 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 300 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

10.1.4.2 Entrained Hydrocarbons

Table 10-6 presents the probability of exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer for the summer and winter conditions.

During both summer and winter conditions entrained hydrocarbon exposures at, or above, the low threshold was predicted for AMP, BIA, IBRA, IMCRA, KEF, MNP, RSB, nearshore waters (LGA and sub-LGA) and State Water receptors. The maximum probability of exposure for the low threshold for any receptor during summer and winter was 95% and 98%, respectively and 89% for the high threshold for both seasons. The maximum entrained hydrocarbon concentration predicted during the summer and winter conditions was 6,323 ppb and 7,007 ppb, respectively, which occurred within the receptors containing the release location.

Figure 10-7 and Figure 10-8 presents the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions, respectively

Table 10-6 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure	
			Low	High		Low	High
AMP	Apollo	238	15	2	230	37	3
	Zeehan	28	9	0	43	8	0
BIA	Antipodean Albatross – Foraging*	6,323	95	89	7,007	98	89
	Black-browed Albatross – Foraging*	6,323	95	89	7,007	98	89
	Black-faced Cormorant – Foraging	16	3	0	35	9	0
	Bullers Albatross – Foraging*	6,323	95	89	7,007	98	89
	Campbell Albatross – Foraging*	6,323	95	89	7,007	98	89
	Common Diving-petrel – Foraging*	6,323	95	89	7,007	98	89
	Indian Yellow-nosed Albatross – Foraging*	6,323	95	89	7,007	98	89
	Little Penguin - Foraging	14	2	0	34	9	0
	Pygmy Blue Whale – Distribution*	6,323	95	89	7,007	98	89
	Pygmy Blue Whale – Foraging*	6,323	95	89	7,007	98	89
	Short-tailed Shearwater – Foraging*	6,323	95	89	7,007	98	89
	Shy Albatross – Foraging*	6,323	95	89	7,007	98	89
	Southern Right Whale - Aggregation	1	0	0	10	1	0
	Southern Right Whale - Connecting Habitat	9	0	0	19	3	0
	Southern Right Whale – Migration*	6,323	95	89	7,007	98	89
	Wandering Albatross – Foraging*	6,323	95	89	7,007	98	89
	Wedge-tailed Shearwater – Foraging*	6,323	95	89	7,007	98	89
	White Shark – Distribution*	6,323	95	89	7,007	98	89
	White Shark - Foraging	6	0	0	12	2	0
	White-faced Storm-petrel - Foraging	108	7	1	110	11	1
EEZ	Australian Exclusive Economic Zone*	6,323	95	89	7,007	98	89
IBRA	King Island	9	0	0	18	3	0
	Otway Plain	2	0	0	12	1	0

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure	
			Low	High		Low	High
	Warrnambool Plain	1	0	0	10	1	0
IMCRA	Central Bass Strait	196	9	1	165	26	2
	Central Victoria	66	7	0	113	11	1
	Otway*	6,323	95	89	7,007	98	89
KEF	West Tasmania Canyons	275	35	2	267	10	2
MNP	Twelve Apostles	2	0	0	10	1	0
SHORE	Colac Otway	2	0	0	12	1	0
	Corangamite	1	0	0	10	1	0
	King Island	9	0	0	18	3	0
SUB-LGA	Apollo Bay	2	0	0	11	1	0
	Cape Otway West	2	0	0	12	1	0
	Moonlight Head	1	0	0	10	1	0
State Waters	Tasmania State Waters	14	2	0	32	8	0
	Victoria State Waters	5	0	0	22	2	0

*The release location resides within the receptor boundaries.

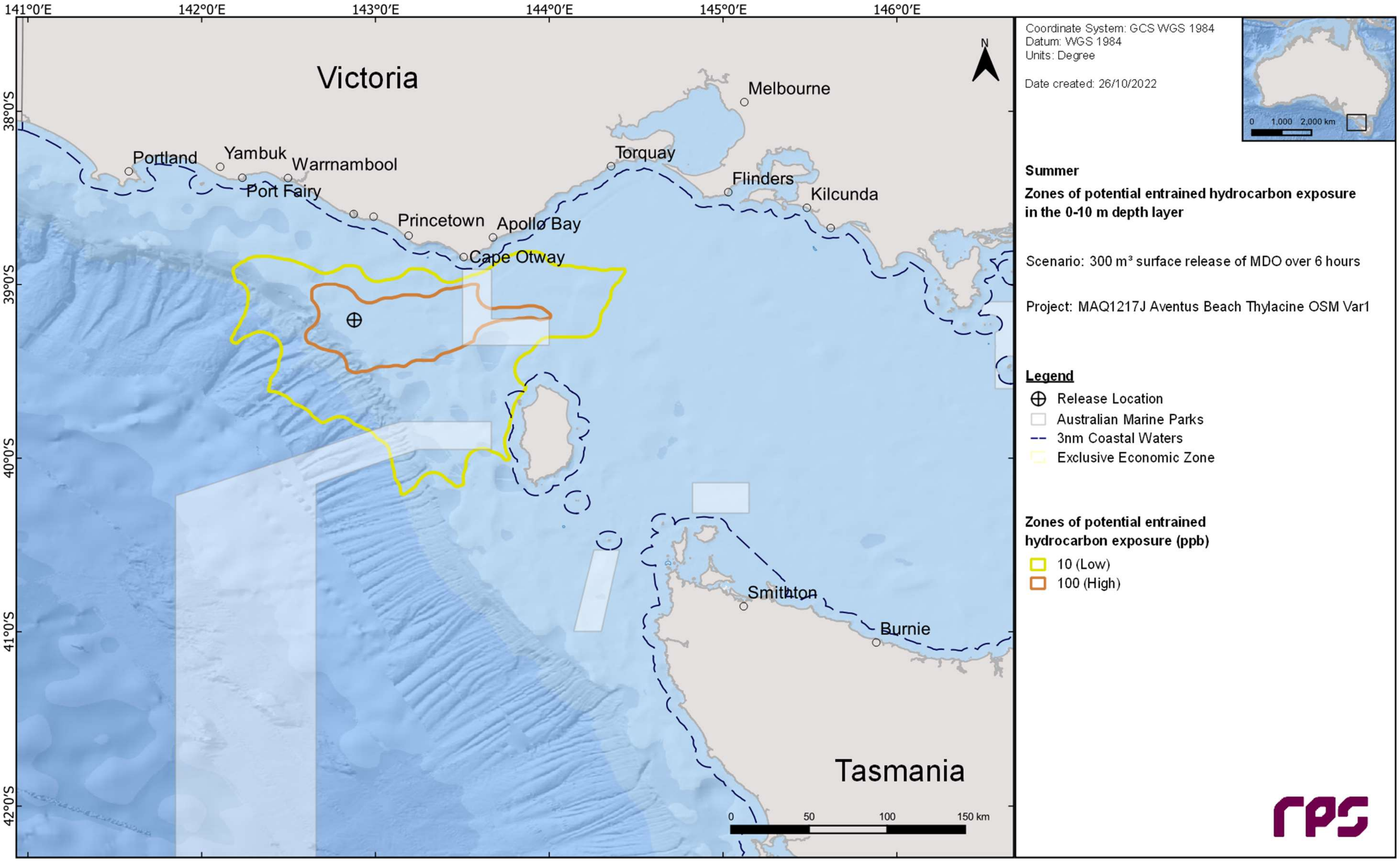

Figure 10-7 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 300 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

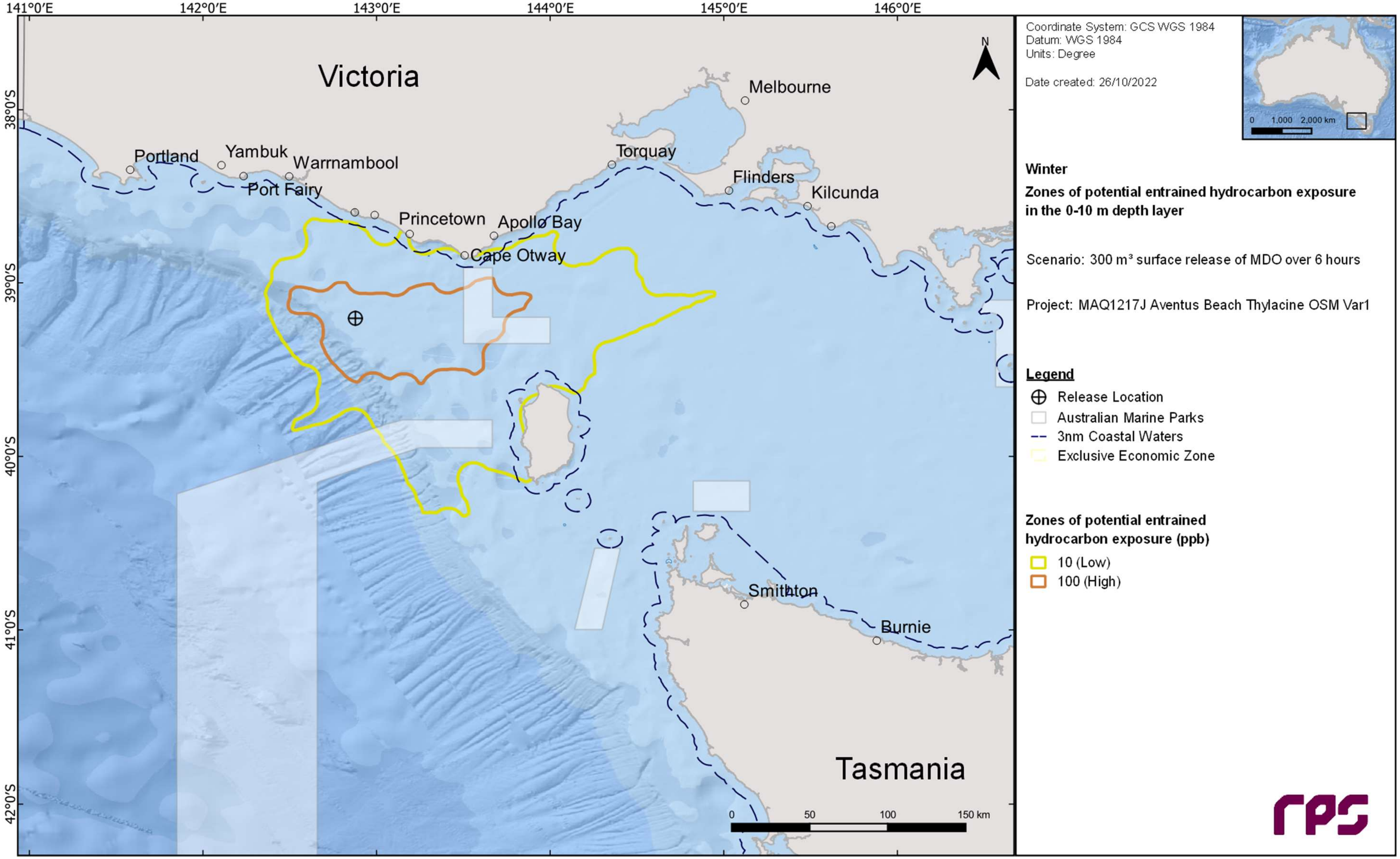

Figure 10-8 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 300 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

10.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below. The deterministic analysis assessed the largest volume of oil ashore (Section 10.2.1), the longest length of shoreline accumulation above 100 g/m², and the minimum time before shoreline accumulation above 10 g/m² (see Section 10.2.2).

Please note there was no shoreline accumulation above the 100 g/m² threshold, so this deterministic case is not presented.

Table 10-7 presents a summary of shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 10-7 Summary of the worst-case deterministic analysis based on the scenario presented in the Stochastic Analysis Section.

Variable	Threshold	Deterministic Analysis Criteria	
		Largest volume of oil ashore	Minimum time before shoreline accumulation above 10 g/m²
Season		Winter	Winter
Run Number		5	66
Total area of floating Oil exposure (km²)	**1 g/m²**	6	1.0
	10 g/m²	2.0	1.0
	50 g/m²	-	-
Total length of shoreline accumulation (km)	**10 g/m²**	11	3.0
	100 g/m²	NC	NC
	1,000 g/m²	NC	NC
Minimum time before accumulation on any shoreline (days)	**10 g/m²**	8.67	**7.58**
	100 g/m²	NC	NC
	1,000 g/m²	NC	NC
Total volume of oil ashore (m³)		**4.3**	1.1
Total area of entrained hydrocarbon exposure (km²)	**10 ppb**	2,238	2,297
	100 ppb	407	503
Total area of dissolved hydrocarbon exposure (km²)	**10 ppb**	37.7	6.0
	50 ppb	-	-
	400 ppb	-	-
Start Date		6th June 2019	28th July 2013

NC = No contact at, or above the specified shoreline accumulation threshold.

10.2.1 Deterministic Case: Largest volume of oil ashore

The deterministic trajectory that resulted in the largest volume of oil ashore was identified as run number 5 during winter conditions, which started on 6th June 2019.

Figure 10.9 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 10.10 displays the time series of the volume of oil accumulating on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 30-day simulation.

Error! Reference source not found. displays the time series of the length of oil accumulation on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 30-day simulation.

Figure 10.11 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.8 summarises the mass balance at the end of the simulation.

Table 10.8 Summary of the mass balance for the trajectory that resulted in the largest volume of oil ashore. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	40.9	0.1	0.0
Entrained (m^3)	224.1	0.4	60.7
Dissolved (m^3)	1.4	0.7	0.1
Evaporation (m^3)	94.0	29.8	94.0
Decay (m^3)	146.6	30.0	146.6
Ashore (m^3)	3.0	10.0	0.7

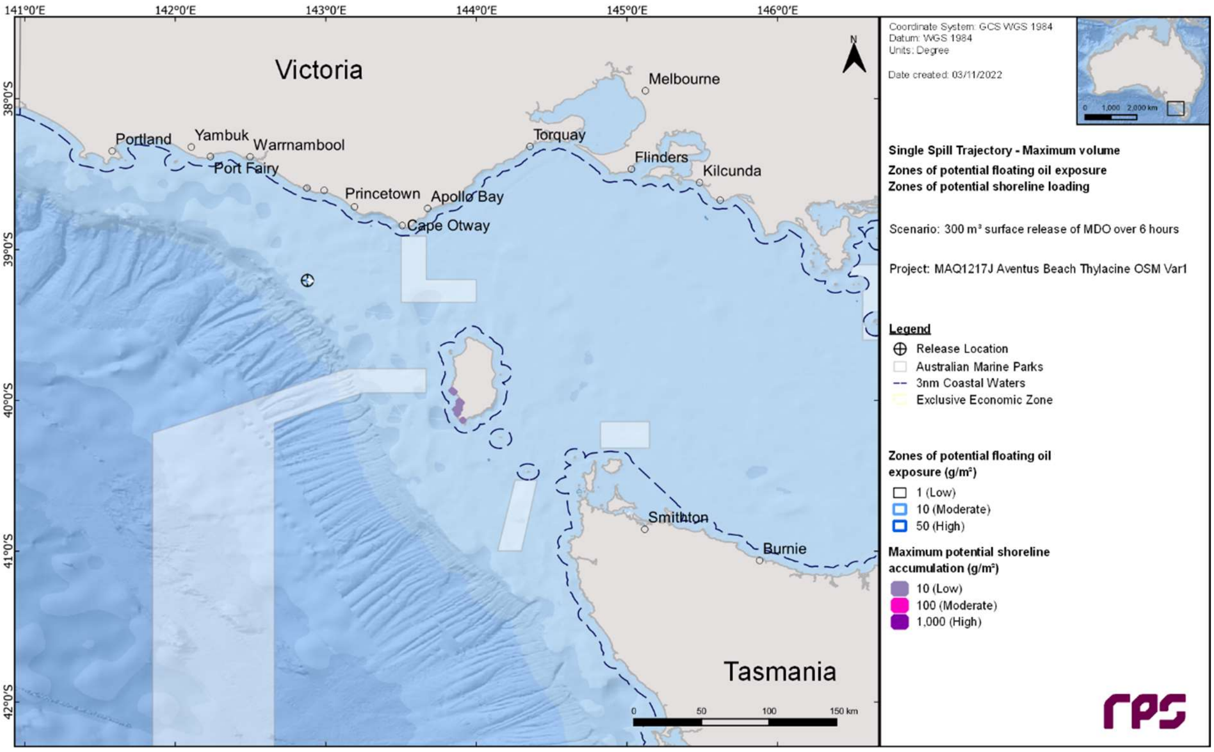

Figure 10.9 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume of oil ashore. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days.

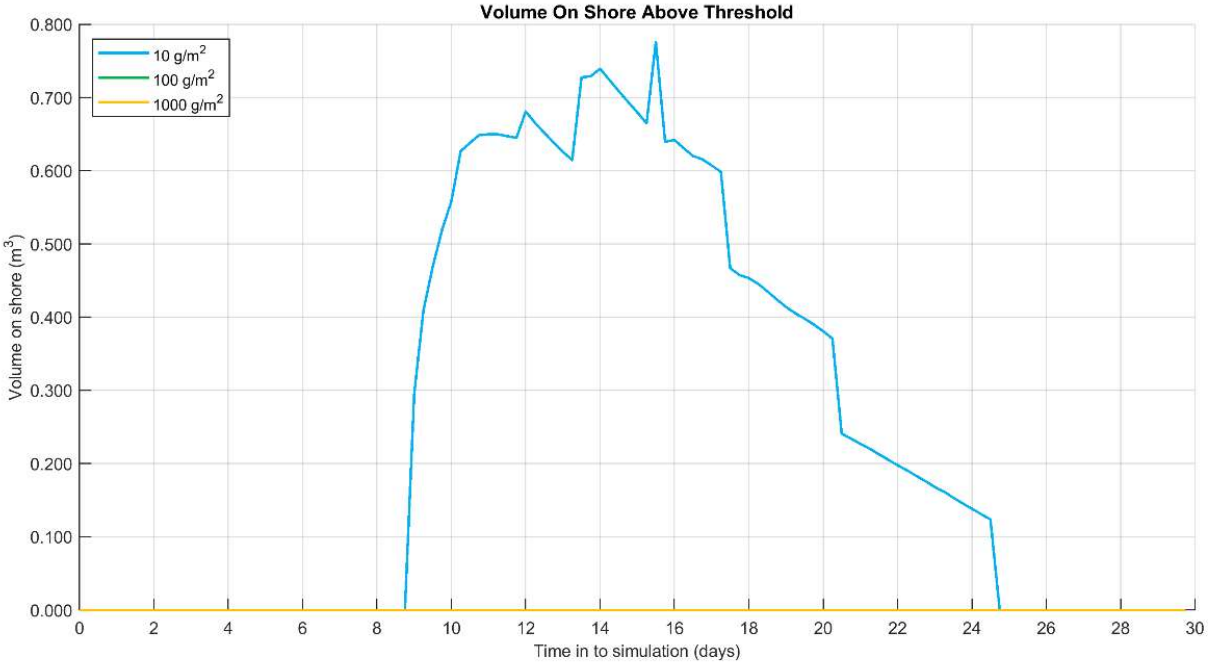

Figure 10.10 Time series of the volume of oil accumulating on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds for the trajectory with the largest volume of oil ashore. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days.

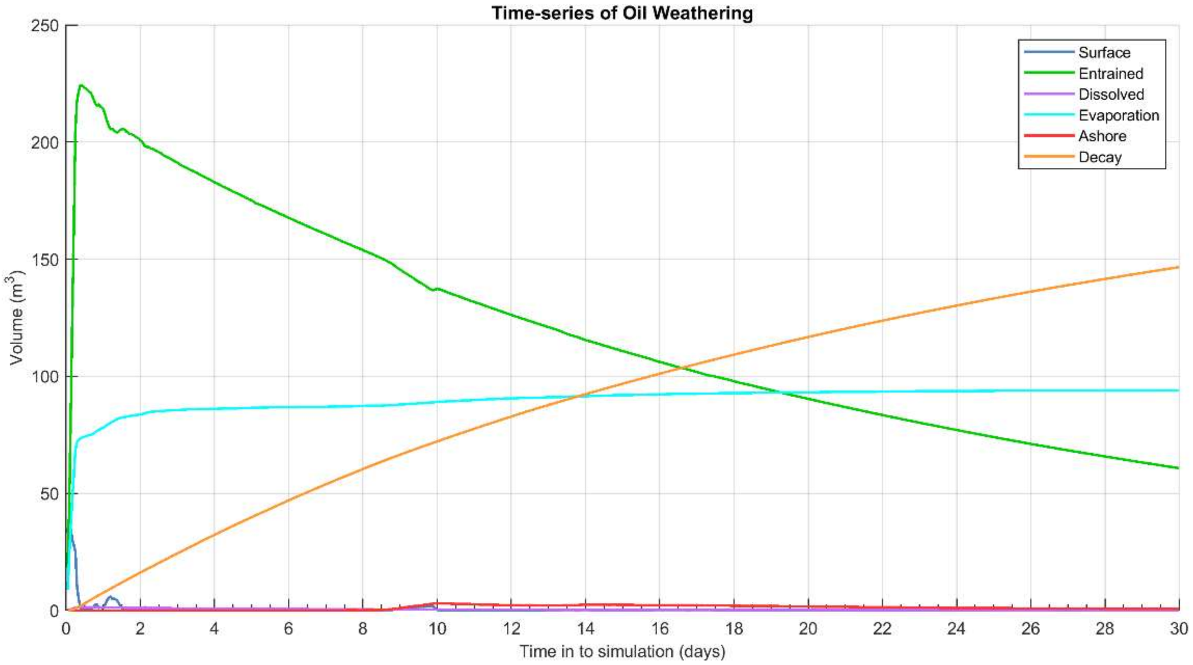

Figure 10.11 Predicted weathering and fates graph for the trajectory with the largest volume of oil ashore. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days.

10.2.2 Deterministic Case: Minimum time before shoreline accumulation above 10 g/m²

The deterministic trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m²) was identified as run number 66 during winter conditions which started on 28th July 2013.

Figure 10.12 illustrates the floating oil exposure and shoreline accumulation over the 30 days.

Figure 10.13 presents the fates and weathering graph for the corresponding single spill trajectory and Table 10.9 summarises the mass balance at the end of the 30-day simulation.

Table 10.9 Summary of the mass balance for the trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m²). Results are based on a 300 m³ surface release of MDO over 6 hours, tracked for 30 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m³)	13.4	0.1	0.0
Entrained (m³)	272.7	0.3	59.1
Dissolved (m³)	1.0	0.9	0.1
Evaporation (m³)	83.0	30.0	83.0
Decay (m³)	159.6	30.0	159.6
Ashore (m³)	1.0	10.2	0.2

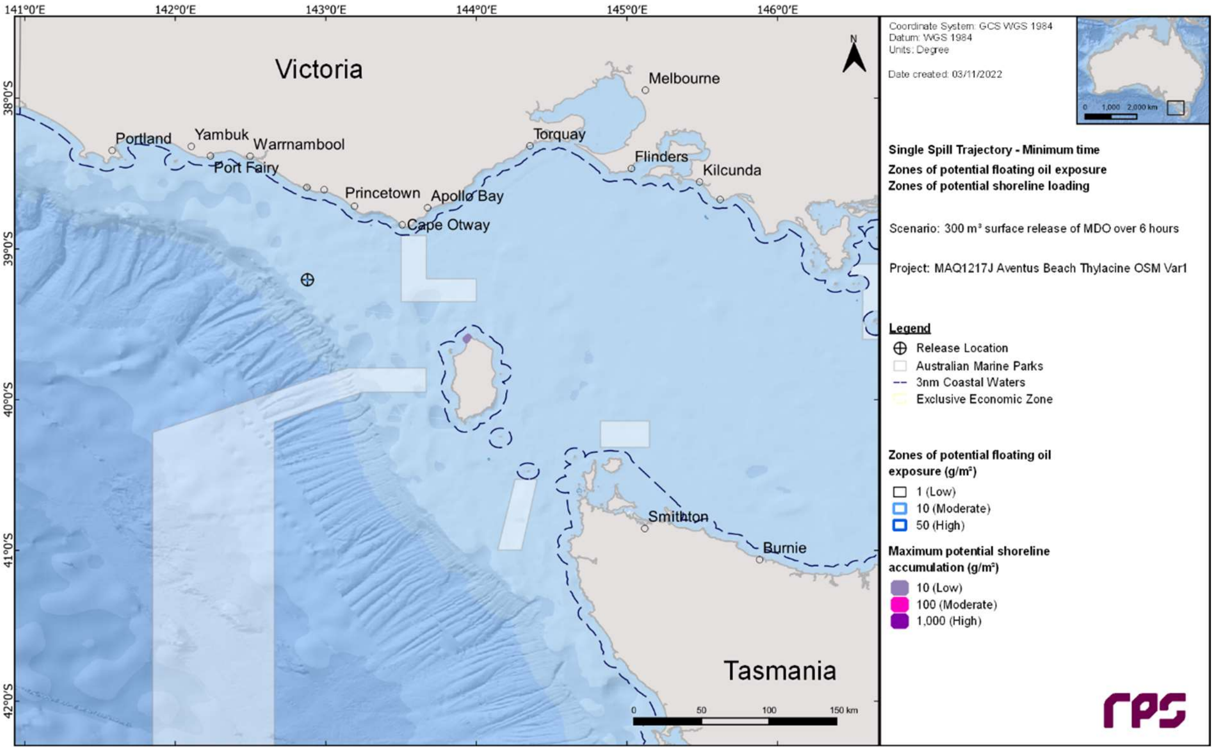

Figure 10.12 Zones of potential floating oil exposure and shoreline accumulation over the 30-day simulation, for the trajectory with the minimum time before shoreline accumulation above 10 g/m². Results are based on a 300 m³ surface release of MDO over 6 hours, tracked for 30 days.

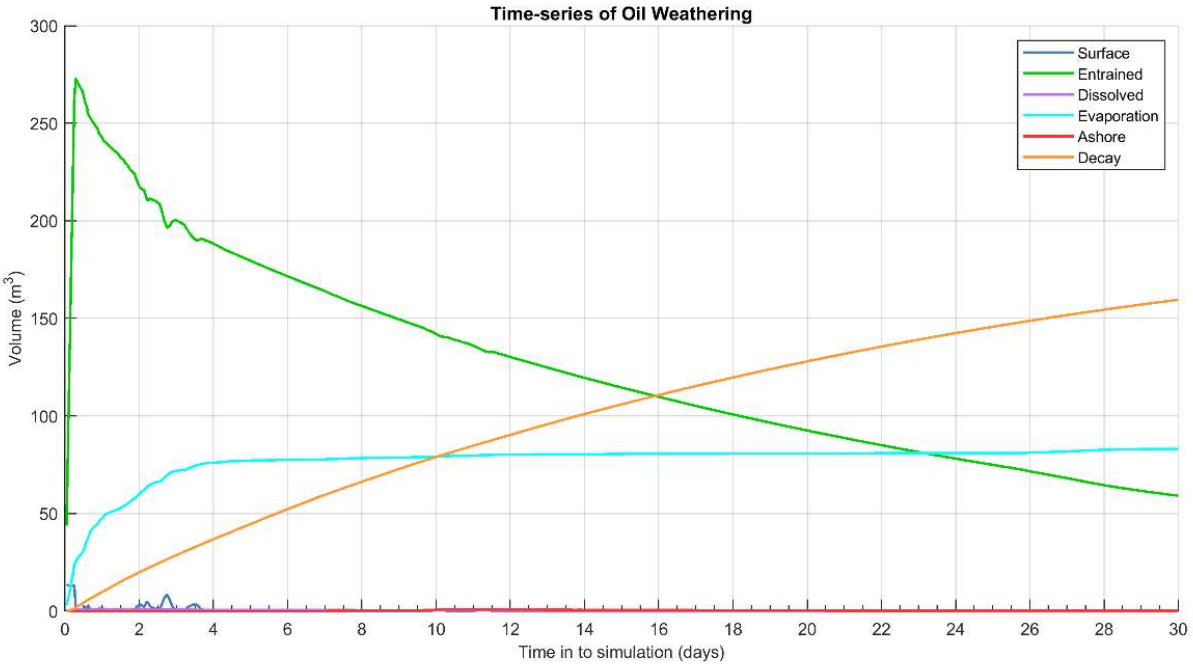

Figure 10.13 Predicted weathering and fates graph for the trajectory with the minimum time before shoreline accumulation above 10 g/m^2. Results are based on a 300 m^3 surface release of MDO over 6 hours, tracked for 30 days.

11 RESULTS – 200 m³ LOSS OF CONTAINMENT CAUSED BY VESSEL COLLISION

This scenario examined a 200 m^3 surface release of MDO over 6 hours to represent a loss of containment caused by vessel collision. A total of 200 spill simulations were run (i.e. 100 spills per season) and tracked for 30 days. The results for all 100 simulations per season were combined and are presented on a seasonal basis (i.e. summer and winter).

Sections 11.1 and 11.2 present the annual stochastic analysis and deterministic analysis results, respectively.

11.1 Stochastic Analysis

11.1.1 Environment that may be affected (EMBA)

Figure 11-1 presents the low threshold environment that maybe affected (EMBA) produced by overlaying the results from all 200 simulations (i.e. 100 per season) during summer and winter conditions.

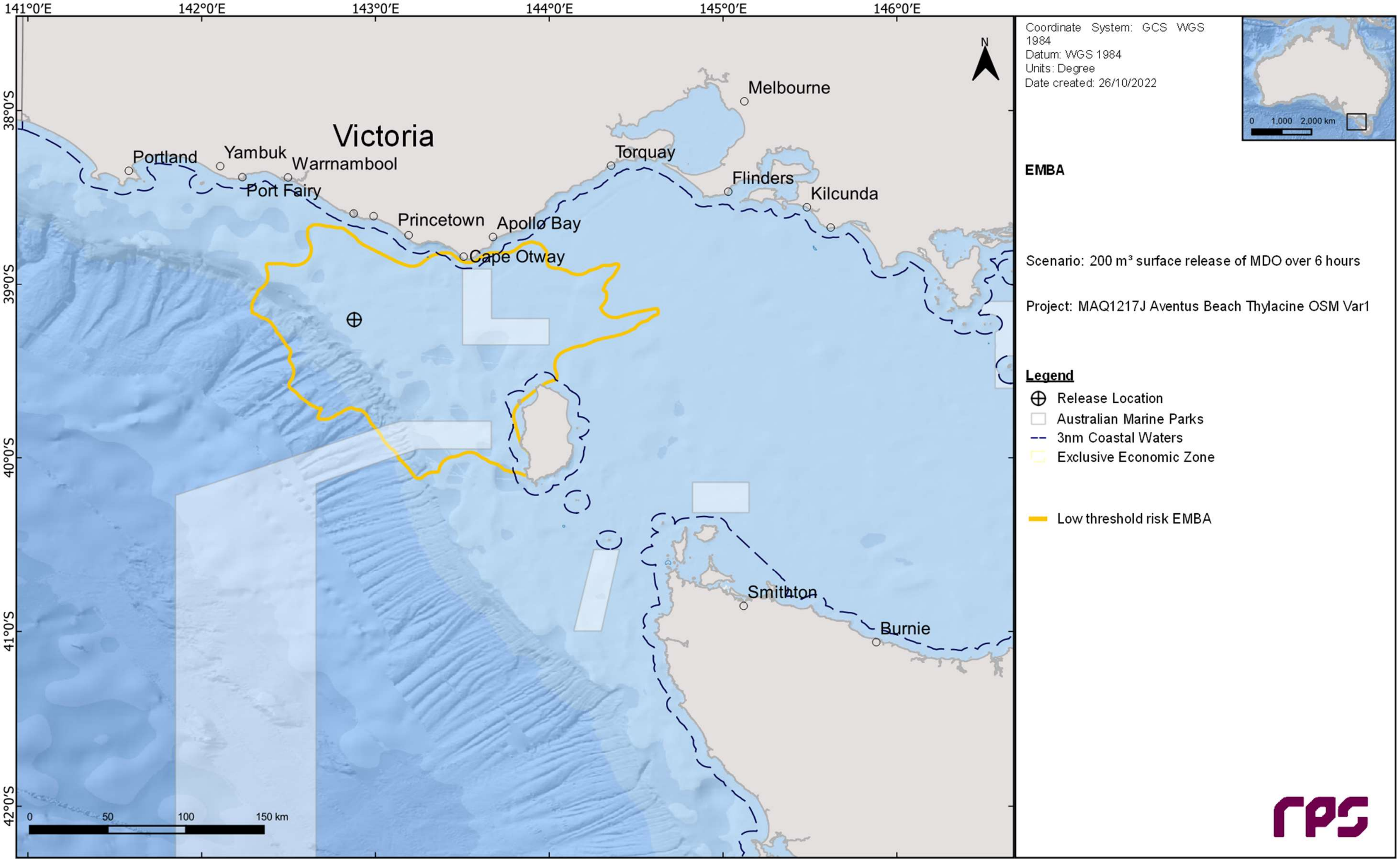

Figure 11-1 Predicted low threshold risk EMBA produced by overlaying the results from all 200 simulations, resulting from a 200 m^3 surface release of MDO over 6 hours during summer and winter conditions.

11.1.2 Floating Oil Exposure

Table 11-1 summarises the maximum distance travelled by floating oil on the sea surface at each threshold. The maximum distance from the release location to the low (1–10 g/m^2), moderate (10–50 g/m^2) and high (> 50 g/m^2) exposure zones was 36.5 km (east-southeast) during summer conditions, 9.4 km (southeast) during winter conditions and 0.5 km (southwest) during winter conditions, respectively.

Table 11-2 summarises the potential floating oil exposure to individual receptors during the summer and winter conditions.

A total of 14 BIAs were predicted to be exposed to floating oil at, or above, the low threshold during the summer and winter conditions. Additionally, the Otway IMCRA was shown to be exposed to floating oil at, or above, the low and moderate threshold during both summer and winter conditions (see Table 10-2). The release location resides within all receptors shown to be exposed to floating oil.

Figure 11-2 and Figure 11-3 present the zones of potential floating oil exposure for all thresholds under summer and winter conditions, respectively.

Table 11-1 Maximum distance and direction from the release location to the edge of floating oil exposure. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Season	Distance and direction travelled	Zones of potential floating oil exposure		
		Low	Moderate	High
Summer	Maximum distance (km) from release location	36.5	8.6	-
	Maximum distance (km) from release location (99th percentile)	34.2	8.1	-
	Direction	East-southeast	East-southeast	-
Winter	Maximum distance (km) from release location	31.6	9.4	0.5
	Maximum distance (km) from release location (99th percentile)	30.2	9.3	0.5
	Direction	Southeast	Southeast	Southwest

Table 11-2 Summary of the potential floating oil exposure to individual receptors. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)						Winter (April to October)					
		Probability of floating oil exposure (%)			Minimum time before floating oil exposure (hours)			Probability of floating oil exposure (%)			Minimum time before floating oil exposure (hours)		
		Low	Moderate	High	Low	Moderate	High	Low	Moderate	High	Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Black-browed Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Bullers Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Campbell Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Common Diving-petrel – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Indian Yellow-nosed Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Pygmy Blue Whale – Distribution*	100	75	-	1	1	-	100	50	3	1	1	3
	Pygmy Blue Whale – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Short-tailed Shearwater – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Shy Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Southern Right Whale – Migration*	100	75	-	1	1	-	100	50	3	1	1	3
	Wandering Albatross – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	Wedge-tailed Shearwater – Foraging*	100	75	-	1	1	-	100	50	3	1	1	3
	White Shark – Distribution*	100	75	-	1	1	-	100	50	3	1	1	3
EEZ	Australian Exclusive Economic Zone*	100	75	-	1	1	-	100	50	3	1	1	3
IMCRA	Otway*	100	75	-	1	1	-	100	50	3	1	1	3

*The release location resides within the receptor boundaries.

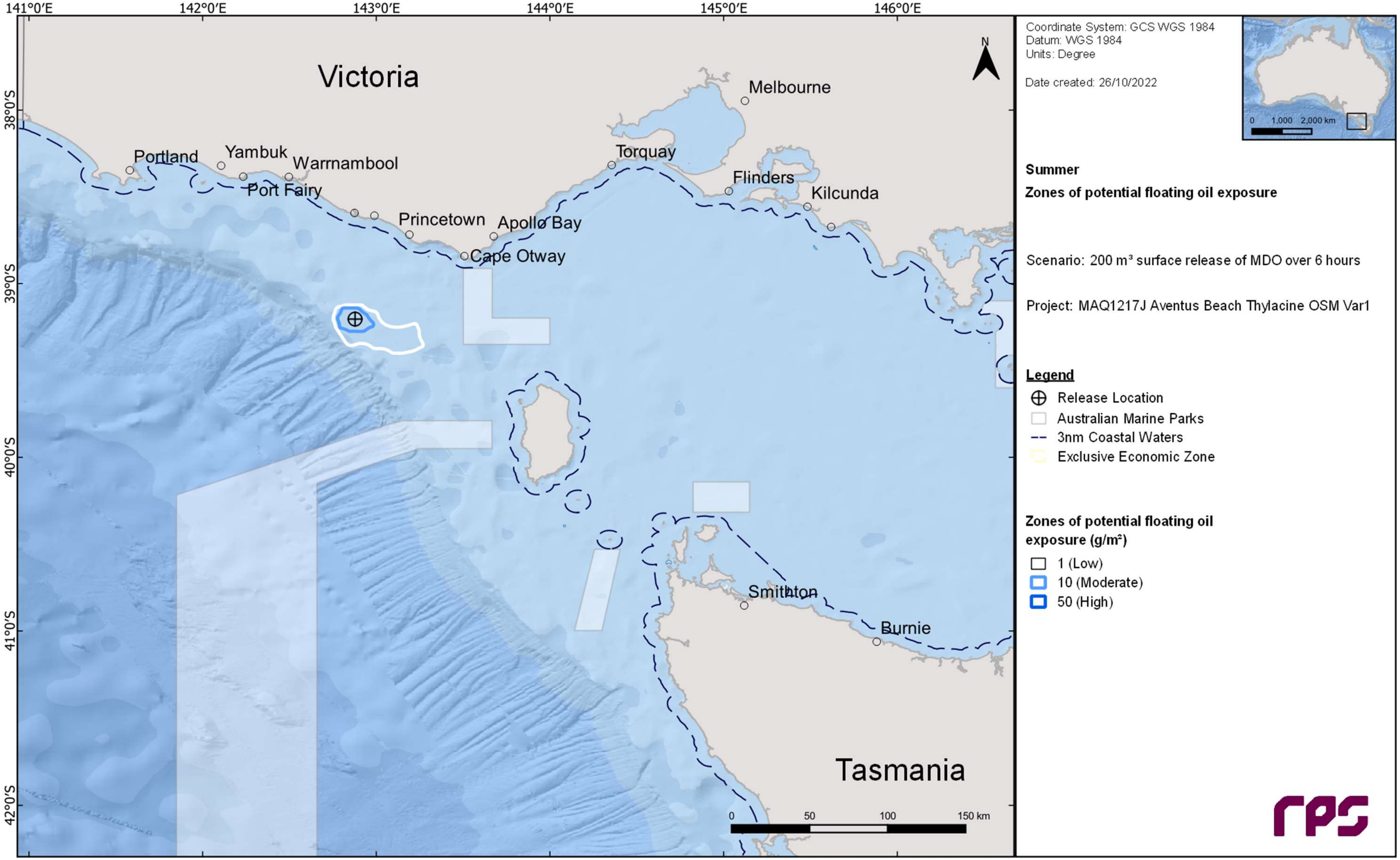

Figure 11-2 Zones of potential floating oil exposure in the event of a 200 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

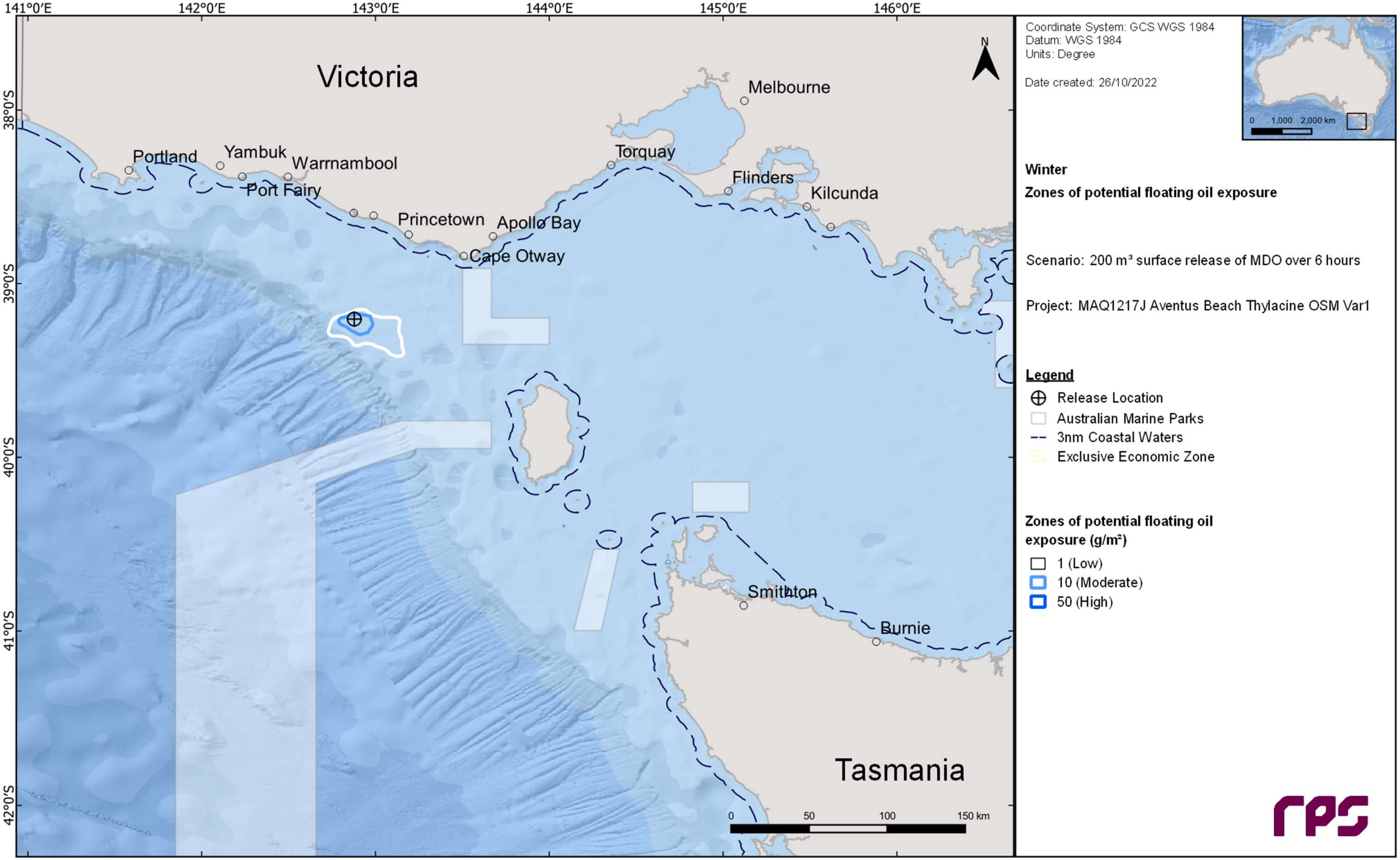

Figure 11-3 Zones of potential floating oil exposure in the event of a 200 m³ of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.3 Shoreline Accumulation

Table 11-3 presents a summary of the predicted potential shoreline accumulation during the summer and winter conditions. The probability of accumulation to any shoreline at, or above, the low level (10 g/m^2) threshold was 0% during summer conditions and 2% during winter conditions. The minimum time before oil accumulation at, or above, the low threshold was 8.13 days during the winter conditions. The maximum total volume ashore for a single spill trajectory during the winter conditions was 2.7 m^3, and the maximum length of shoreline accumulation at the low threshold was 5 km. No shoreline accumulation was predicted for the moderate (100 g/m^2) or high (1,000 g/m^2) threshold.

Table 11-4 summarises the shoreline accumulation on individual receptors during the summer and winter conditions. During the winter conditions, King Island was the only shoreline receptor that was predicted to have shoreline accumulation above the low threshold (10 g/m^2) with a probability of low accumulation of 2%. The minimum time before shoreline accumulation at King Island during winter conditions was 8.13 days, whilst the maximum shoreline accumulation volume was 2.7 m^3.

The maximum potential shoreline loading above the low, moderate and high shoreline thresholds for winter conditions are presented in Figure 11-4.

Table 11-3 Summary of oil accumulation across all shorelines. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Shoreline Statistics	Summer	Winter
Probability of accumulation on any shoreline (%)	0	2
Absolute minimum time for visible oil to shore (days)	-	8.13
Maximum total volume of hydrocarbons ashore (m^3)	-	2.7
Average total volume of hydrocarbons ashore (m^3)	-	0.2
Maximum length of the shoreline at **10 g/m^2** (km)	-	5
Average shoreline length (km) at **10 g/m^2** (km)	-	4
Maximum length of the shoreline at **100 g/m^2** (km)	-	-
Average shoreline length (km) at **100 g/m^2** (km)	-	-
Maximum length of the shoreline at **1,000 g/m^2** (km)	-	-
Average shoreline length (km) at **1,000 g/m^2** (km)	-	-

Table 11-4 Summary of oil accumulation on individual shoreline receptors. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Shoreline Receptor		Summer																Winter															
		Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)			Maximum probability of shoreline loading (%)			Minimum time before shoreline accumulation (days)			Load on shoreline (g/m^2)		Volume on shoreline (m^3)		Mean length of shoreline accumulation (km)			Maximum length of shoreline accumulation (km)		
		Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High	Low	Mod	High	Low	Mod	High	Mean	Peak	Mean	Peak	Low	Mod	High	Low	Mod	High
Shoreline	King Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	8.13	-	-	<1	35	< 0.1	2.7	4	-	-	5	-	-

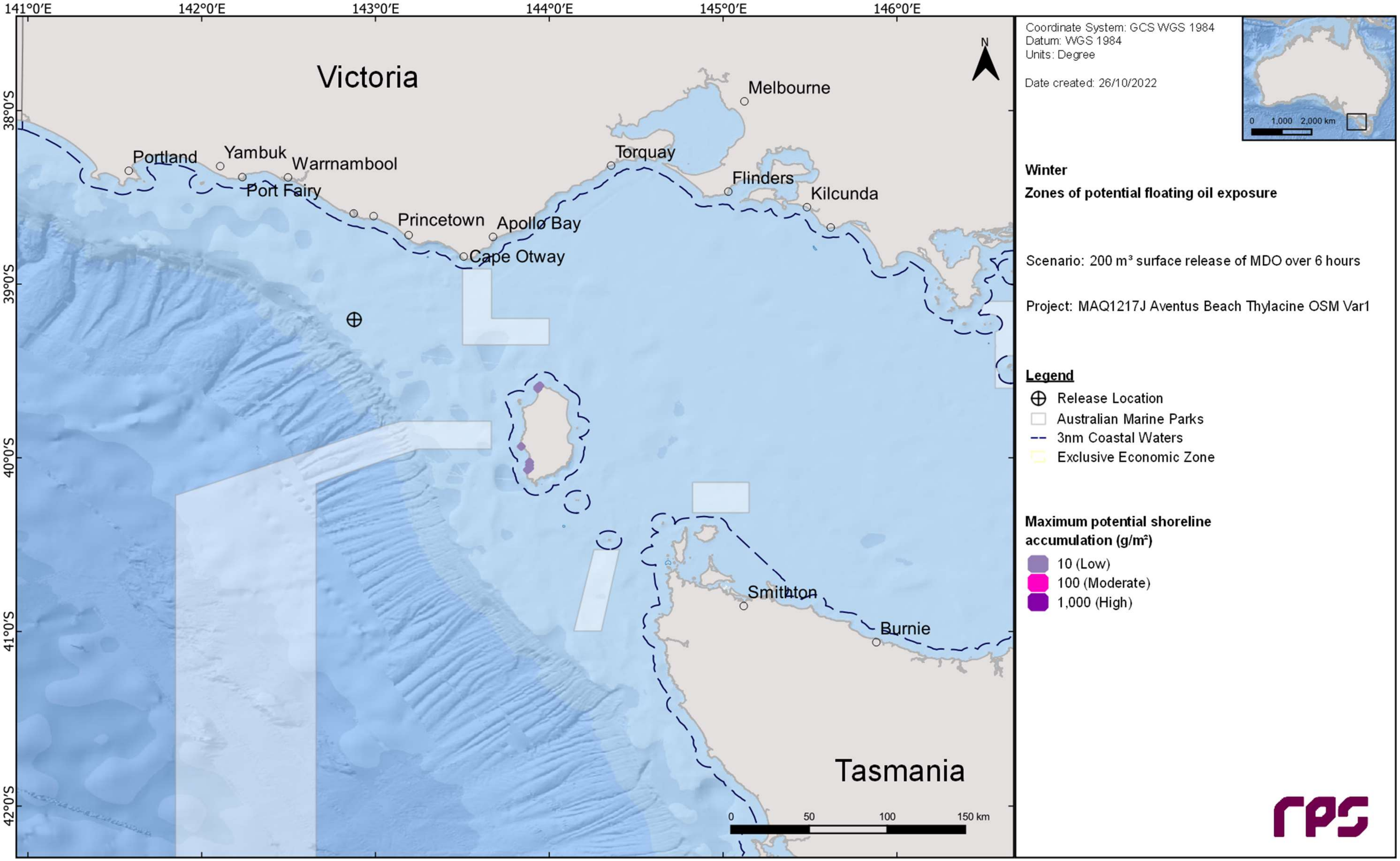

Figure 11-4 Maximum potential shoreline loading in the event of a 200 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.4 In-water exposure

11.1.4.1 Dissolved Hydrocarbons

Table 11-5 summarises the probability of exposure to individual receptors from dissolved hydrocarbons in the 0-10 m layer during the summer and winter conditions.

A total of 14 BIAs were shown to be exposed to dissolved hydrocarbons above the low threshold during both the summer and winter conditions. Furthermore, the Otway IMCRA was also shown to be exposed above the low threshold during both summer and winter conditions. The maximum probability of exposure for the low threshold for any receptor during either summer and winter was 43%. During the summer and winter conditions the maximum dissolved aromatic concentrations at any given receptor(s) was predicted to be 45 ppb and 43 ppb, respectively, which occurred within receptors containing the release location.

Figure 11-5 and Figure 11-6 presents the zones of potential dissolved hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions, respectively.

Table 11-5 Probability of dissolved hydrocarbons exposure to marine based receptors in the 0–10 m dept. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)				Winter (April to October)			
		Maximum instantaneous dissolved hydrocarbon exposure	Probability of instantaneous dissolved hydrocarbon exposure			Maximum instantaneous dissolved hydrocarbon exposure	Probability of instantaneous dissolved hydrocarbon exposure		
			Low	Moderate	High		Low	Moderate	High
BIA	Antipodean Albatross – Foraging*	45	43	0	0	38	43	0	0
	Black-browed Albatross – Foraging*	45	43	0	0	38	43	0	0
	Bullers Albatross – Foraging*	45	43	0	0	38	43	0	0
	Campbell Albatross – Foraging*	45	43	0	0	38	43	0	0
	Common Diving-petrel – Foraging*	45	43	0	0	38	43	0	0
	Indian Yellow-nosed Albatross – Foraging*	45	43	0	0	38	43	0	0
	Pygmy Blue Whale – Distribution*	45	43	0	0	38	43	0	0
	Pygmy Blue Whale – Foraging*	45	43	0	0	38	43	0	0
	Short-tailed Shearwater – Foraging*	45	43	0	0	38	43	0	0
	Shy Albatross – Foraging*	45	43	0	0	38	43	0	0
	Southern Right Whale – Migration*	45	43	0	0	38	43	0	0
	Wandering Albatross – Foraging*	45	43	0	0	38	43	0	0
	Wedge-tailed Shearwater – Foraging*	45	43	0	0	38	43	0	0
	White Shark – Distribution*	45	43	0	0	38	43	0	0
EEZ	Australian Exclusive Economic Zone*	45	43	0	0	38	43	0	0
IMCRA	Otway*	45	43	0	0	38	43	0	0

*The release location resides within the receptor boundaries.

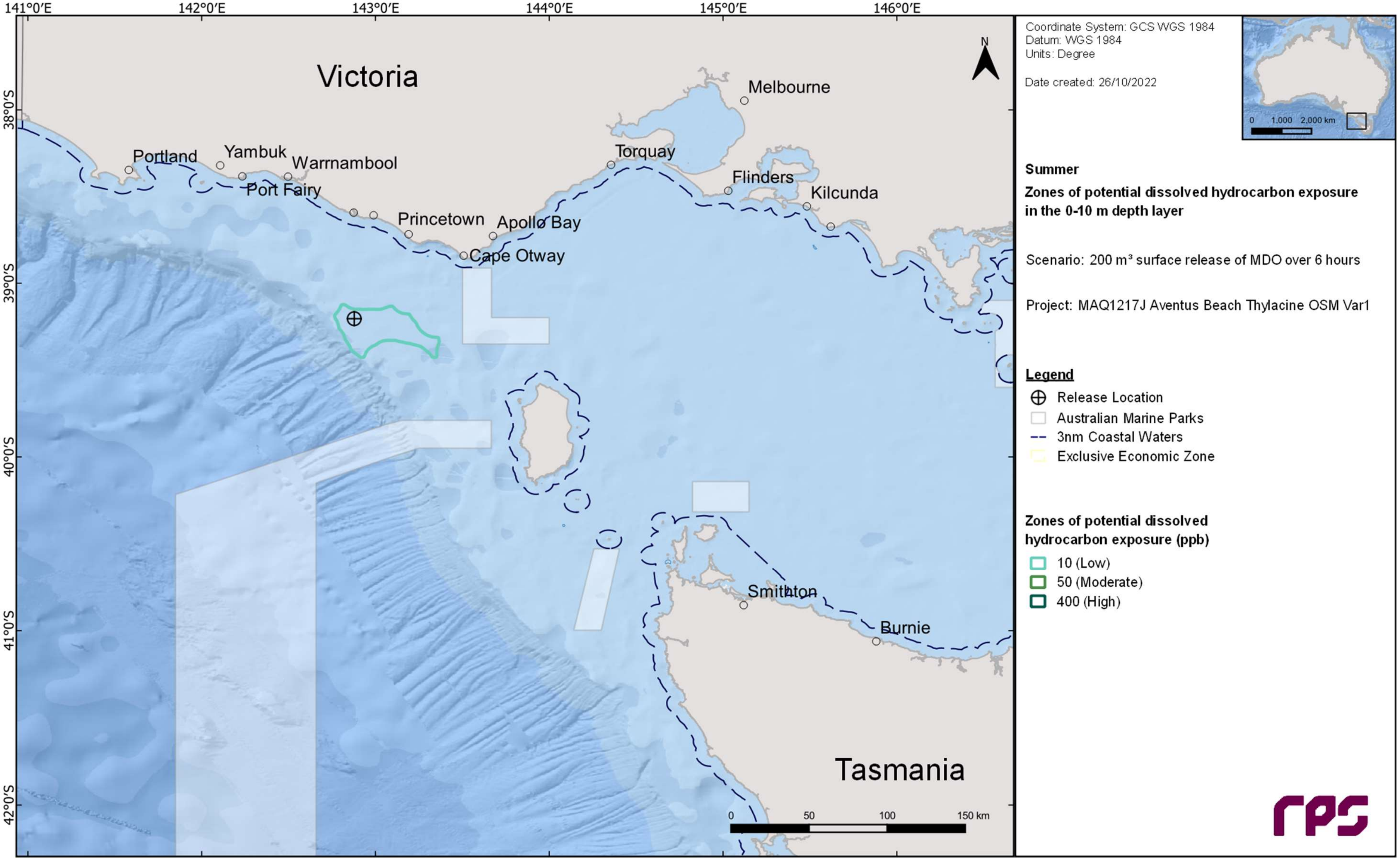

Figure 11-5 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 200 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

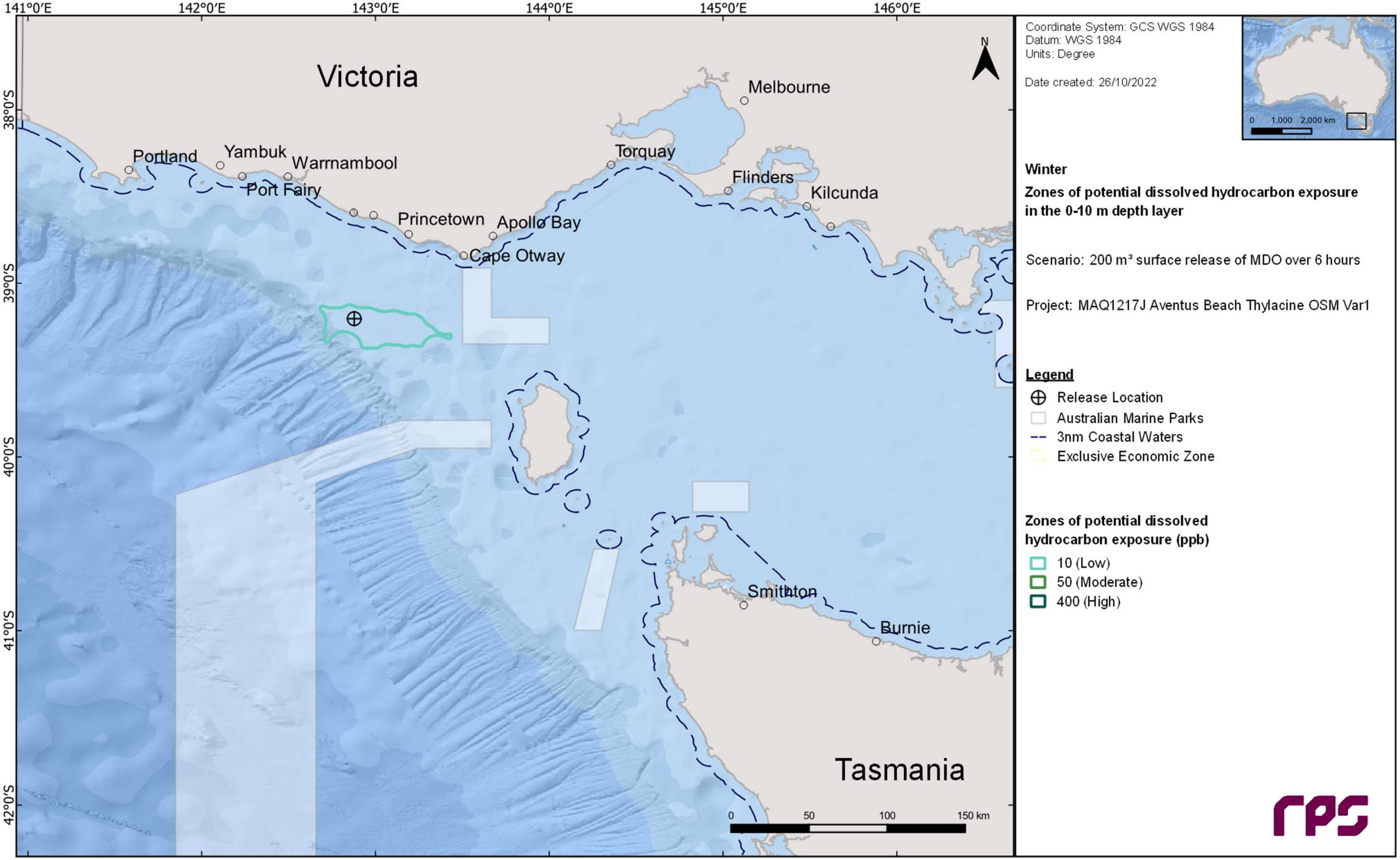

Figure 11-6 Zones of potential dissolved hydrocarbon exposure at 0-10 m below the sea in the event of a 200 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

11.1.4.2 Entrained Hydrocarbons

Table 11-6 presents the probability of exposure to individual receptors from entrained hydrocarbons in the 0-10 m depth layer for the summer and winter conditions.

During both summer and winter conditions entrained hydrocarbon exposures at, or above, the low and high threshold was predicted for AMP, BIA, IBRA, IMCRA, KEF, MNP, RSB, nearshore waters (LGA and sub-LGA) and State Water receptors. The maximum probability of exposure for the low threshold for any receptor during summer and winter was 95% during summer and 98% during winter. The maximum entrained hydrocarbon concentration predicted during the summer and winter conditions was 4,243 ppb and 4,604 ppb, respectively, which occurred within receptors containing the release location.

Figure 11-7 and Figure 11-8 presents the zones of potential entrained hydrocarbon exposure for the 0-10 m depth layer, for each threshold assessed under summer and winter conditions, respectively

Table 11-6 Probability of entrained hydrocarbons exposure to marine based receptors in the 0–10 m depth layer. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days. The results were calculated from 100 spill simulations per season.

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure	
			Low	High		Low	High
AMP	Apollo	162	14	2	155	30	3
	Zeehan	18	5	0	27	6	0
BIA	Antipodean Albatross – Foraging*	4,243	95	86	4,604	98	87
	Black-browed Albatross – Foraging*	4,243	95	86	4,604	98	87
	Black-faced Cormorant - Foraging	11	1	0	24	4	0
	Bullers Albatross – Foraging*	4,243	95	86	4,604	98	87
	Campbell Albatross – Foraging*	4,243	95	86	4,604	98	87
	Common Diving-petrel – Foraging*	4,243	95	86	4,604	98	87
	Indian Yellow-nosed Albatross – Foraging*	4,243	95	86	4,604	98	87
	Little Penguin - Foraging	9	0	0	22	4	0
	Pygmy Blue Whale – Distribution*	4,243	95	86	4,604	98	87
	Pygmy Blue Whale – Foraging*	4,243	95	86	4,604	98	87
	Short-tailed Shearwater – Foraging*	4,243	95	86	4,604	98	87
	Shy Albatross – Foraging*	4,243	95	86	4,604	98	87
	Southern Right Whale - Connecting Habitat	7	0	0	12	2	0
	Southern Right Whale – Migration*	4,243	95	86	4,604	98	87
	Wandering Albatross – Foraging*	4,243	95	86	4,604	98	87
	Wedge-tailed Shearwater – Foraging*	4,243	95	86	4,604	98	87
	White Shark - Distribution	4,243	95	86	4,604	98	87
	White-faced Storm-petrel - Foraging	70	5	0	75	7	0
EEZ	Australian Exclusive Economic Zone*	4,243	95	86	4,604	98	87
IBRA	King Island	7	0	0	12	2	0
IMCRA	Central Bass Strait	133	7	1	110	19	1
	Central Victoria	44	3	0	72	7	0
	Otway*	4,243	95	86	4,604	98	87

Receptor		Summer (November through to March)			Winter (April to October)		
		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure		Maximum instantaneous entrained hydrocarbon exposure	Probability of instantaneous entrained hydrocarbon exposure	
			Low	High		Low	High
KEF	West Tasmania Canyons	182	31	1	175	9	1
Nearshore Waters	King Island	7	0	0	12	2	0
State Waters	Tasmania State Waters	9	0	0	21	4	0
	Victoria State Waters	3	0	0	16	2	0

*The release location resides within the receptor boundaries.

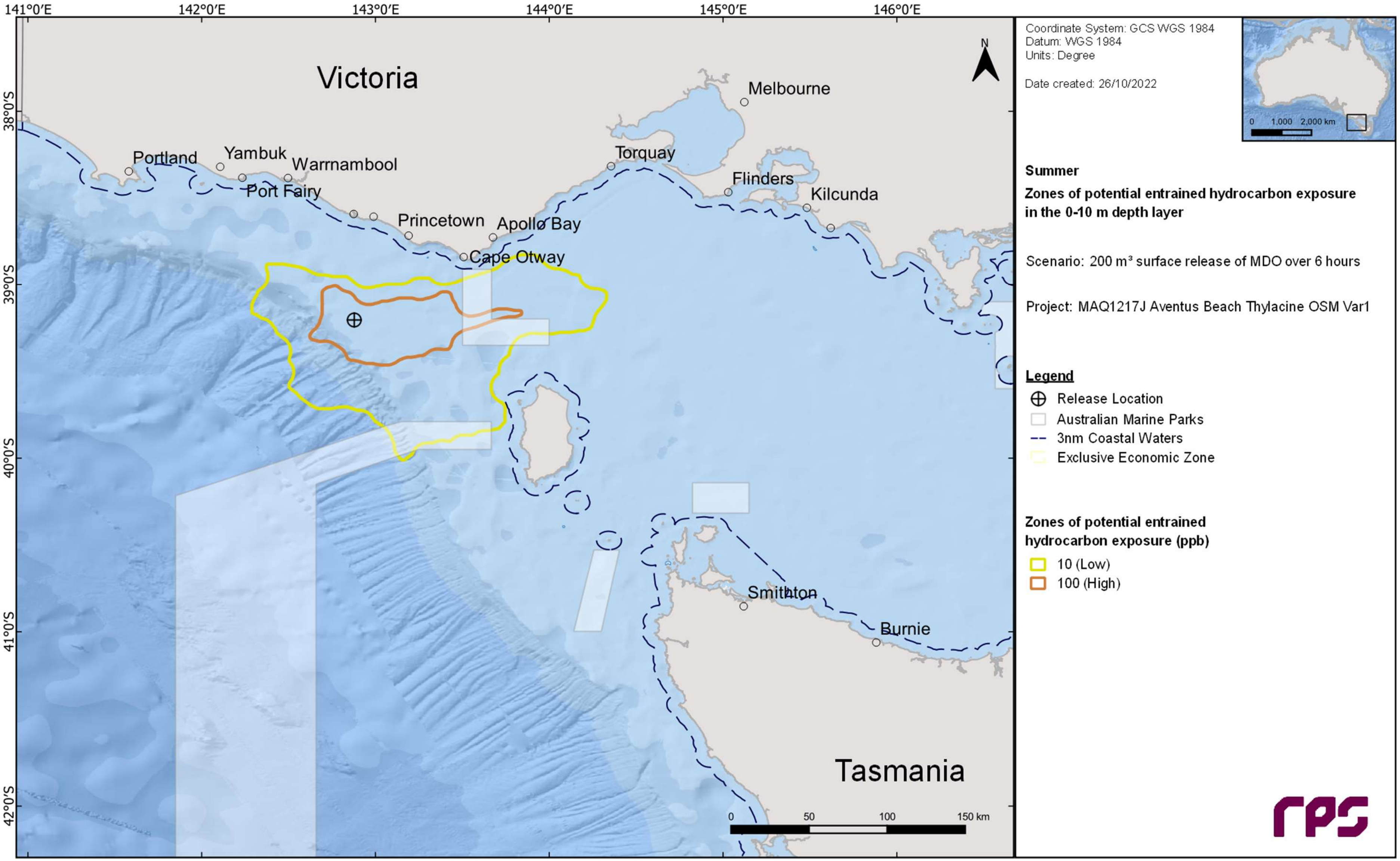

Figure 11-7 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 200 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during summer conditions.

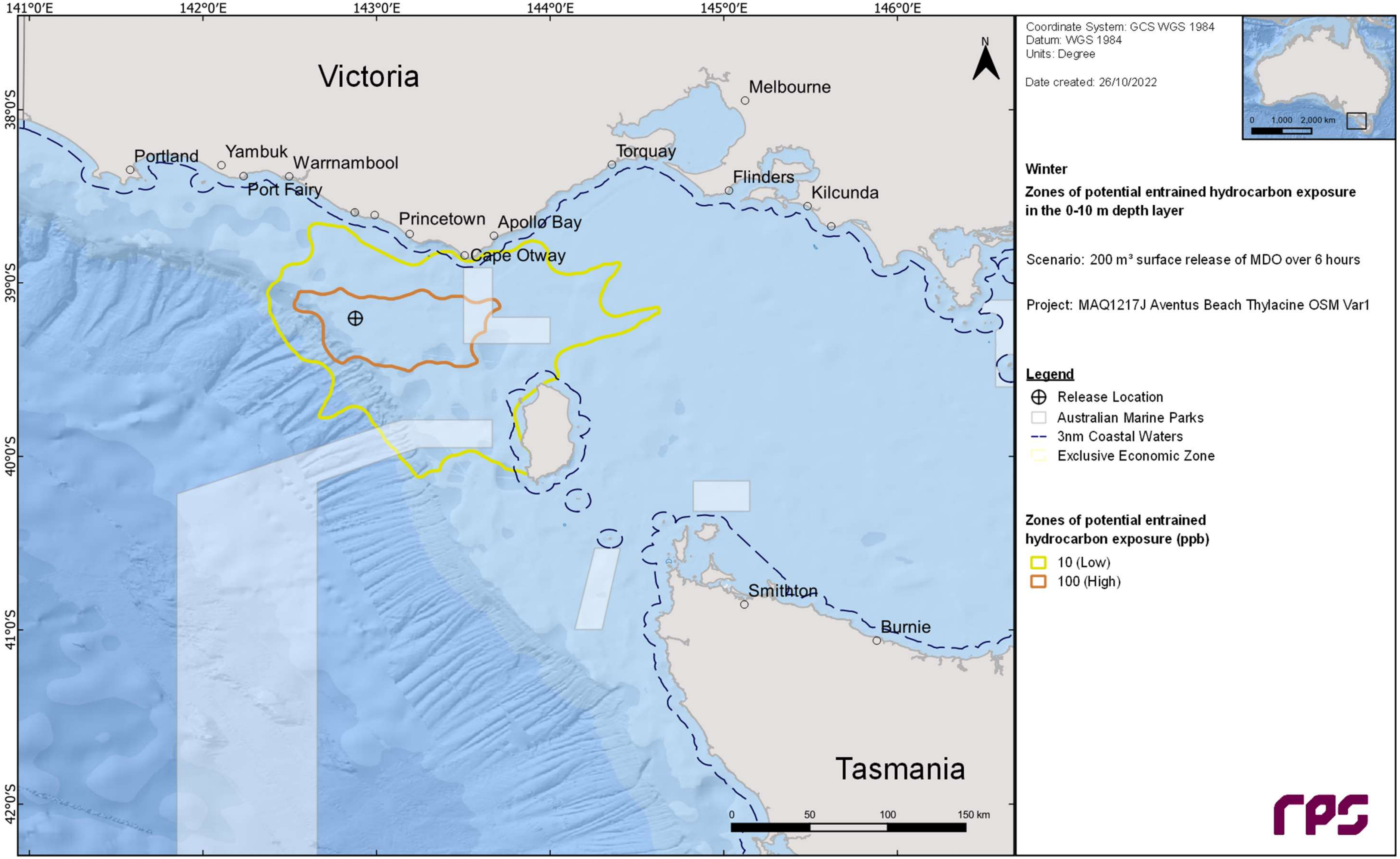

Figure 11-8 Zones of potential entrained hydrocarbon exposure at 0-10 m below the sea surface in the event of a 200 m^3 of MDO containment loss over 6 hours tracked for 30 days. The results were calculated from 100 spill simulations during winter conditions.

11.2 Deterministic Analysis

The stochastic modelling results were assessed, and the “worst case” deterministic runs were identified and are presented below. The deterministic analysis assessed the largest volume of oil ashore (Section 11.2.1), the longest length of shoreline accumulation above 100 g/m², and the minimum time before shoreline accumulation above 10 g/m² (see Section 11.2.2).

Please note there was no shoreline accumulation above the 100 g/m² threshold, so this deterministic case is not presented.

Table 11-7 presents a summary of shoreline accumulation at the assessed thresholds for the identified deterministic simulations.

Table 11-7 Summary of the worst-case deterministic analysis based on the scenario presented in the Stochastic Analysis Section.

Variable	Threshold	Deterministic Analysis Criteria	
		Largest volume of oil ashore	Minimum time before shoreline accumulation above 10 g/m²
Season		Winter	Winter
Run Number		5	66
Total area of floating Oil exposure (km²)	**1 g/m²**	5.0	1.0
	10 g/m²	1.0	-
	50 g/m²	-	-
Total length of shoreline accumulation (km)	**10 g/m²**	5.0	3.0
	100 g/m²	NC	NC
	1,000 g/m²	NC	NC
Minimum time before accumulation on any shoreline (days)	**10 g/m²**	8.83	**8.13**
	100 g/m²	NC	NC
	1,000 g/m²	NC	NC
Total volume of oil ashore (m³)		**2.7**	0.8
Total area of entrained hydrocarbon exposure (km²)	**10 ppb**	1,896	1,886
	100 ppb	268	397
Total area of dissolved hydrocarbon exposure (km²)	**10 ppb**	12.2	**-**
	50 ppb	-	-
	400 ppb	-	-
Start Date		6th June 2019	28th July 2013

NC = No contact at, or above the specified shoreline accumulation threshold.

11.2.1 Deterministic Case: Largest volume of oil ashore

The deterministic trajectory that resulted in the largest volume of oil ashore was identified as run number 5 during winter conditions, which started on 6th June 2019. Figure 11.9 illustrates the floating oil exposure and shoreline accumulation over the 30-day simulation.

Figure 11.10 displays the time series of the volume of oil accumulating on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 30-day simulation.

Error! Reference source not found. displays the time series of the length of oil accumulation on shorelines at the low (10 g/m^2), moderate (100 g/m^2) and high (1,000 g/m^2) thresholds over the 30-day simulation.

Figure 11.11 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.8 summarises the mass balance at the end of the simulation.

Table 11.8 Summary of the mass balance for the trajectory that resulted in the largest volume of oil ashore. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	27.1	0.1	0.0
Entrained (m^3)	148.1	0.4	40.3
Dissolved (m^3)	0.8	0.6	0.1
Evaporation (m^3)	63.8	29.8	63.8
Decay (m^3)	96.8	30.0	96.8
Ashore (m^3)	1.9	10.0	0.4

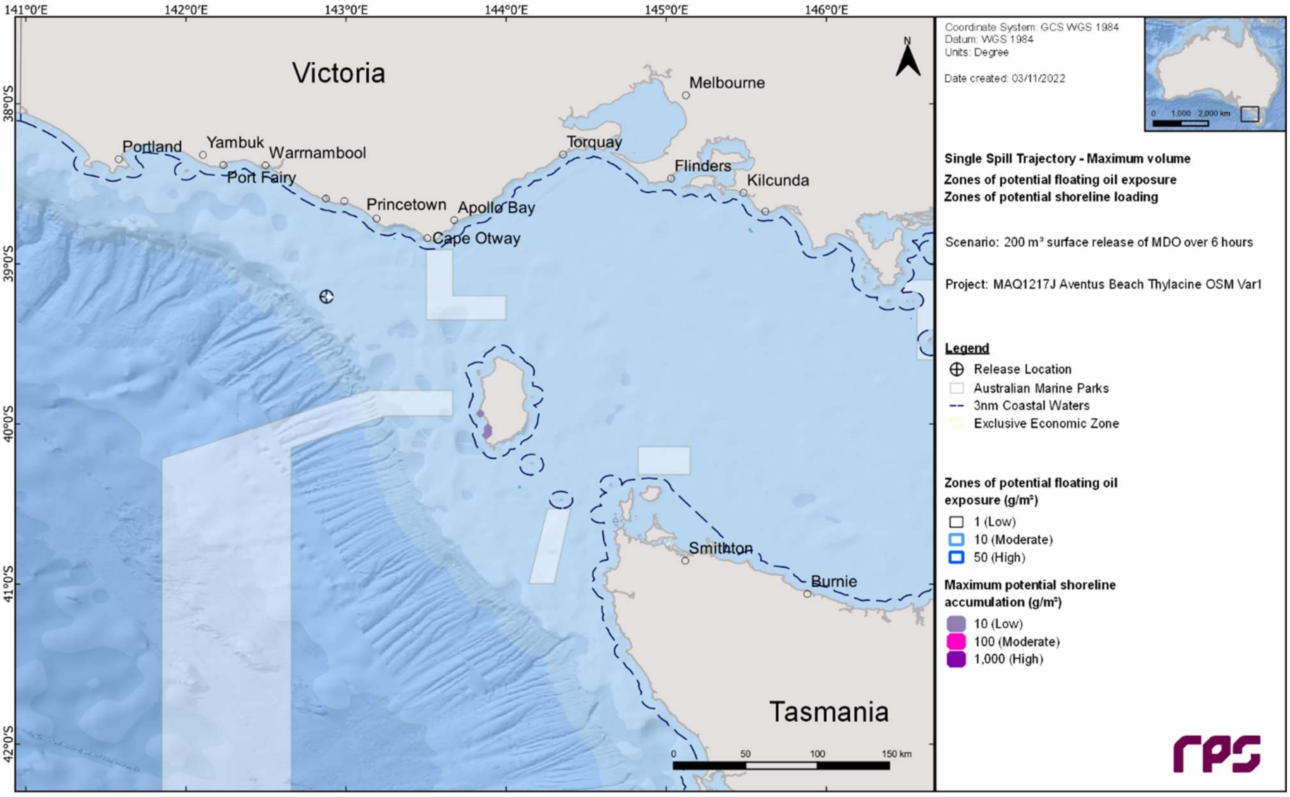

Figure 11.9 Zones of potential floating oil exposure and shoreline accumulation, for the trajectory with the largest volume of oil ashore. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days.

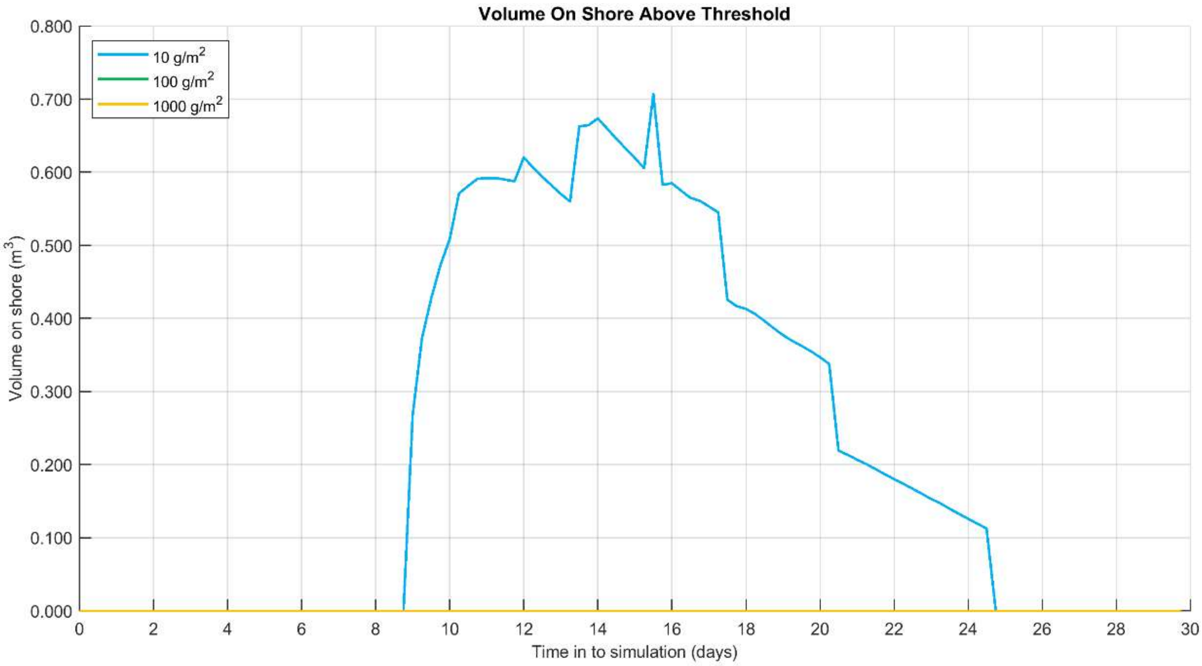

Figure 11.10 Time series of the volume of oil accumulating on shorelines at the low (10 g/m²), moderate (100 g/m²) and high (1,000 g/m²) thresholds for the trajectory with the largest volume of oil ashore. Results are based on a 200 m³ surface release of MDO over 6 hours, tracked for 30 days.

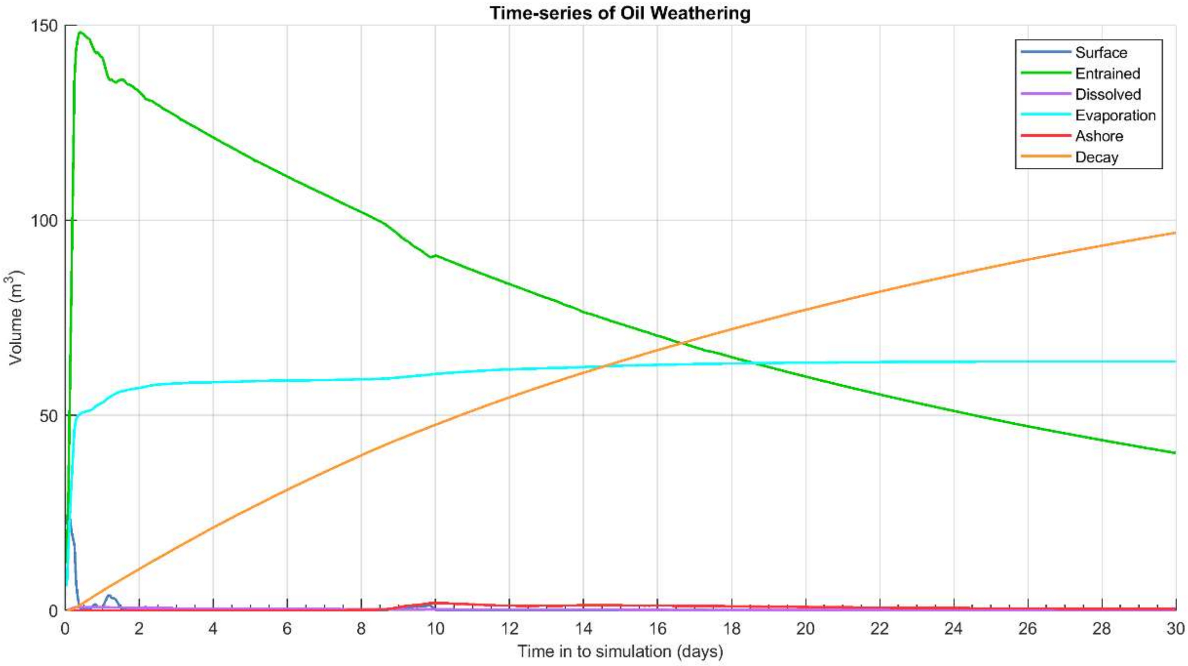

Figure 11.11 Predicted weathering and fates graph for the trajectory with the largest volume of oil ashore. Results are based on a 200 m³ surface release of MDO over 6 hours, tracked for 30 days.

11.2.2 Deterministic Case: Minimum time before shoreline accumulation above 10 g/m^2

The deterministic trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m^2) was identified as run number 66 during winter conditions which started on 28th July 2013. Figure 11.12 illustrates the floating oil exposure and shoreline accumulation over the 30 days.

Figure 11.13 presents the fates and weathering graph for the corresponding single spill trajectory and Table 11.9 summarises the mass balance at the end of the 30-day simulation.

Table 11.9 Summary of the mass balance for the trajectory that resulted in the minimum time before shoreline accumulation above the low threshold (10 g/m^2). Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days.

Exposure Metrics	Peak Volume	Day of occurrence	Volume at day 30
Surface (m^3)	8.8	0.1	0.0
Entrained (m^3)	180.8	0.3	39.5
Dissolved (m^3)	0.5	1.5	0.0
Evaporation (m^3)	55.4	30.0	55.4
Decay (m^3)	106.3	30.0	106.3
Ashore (m^3)	0.7	10.3	0.1

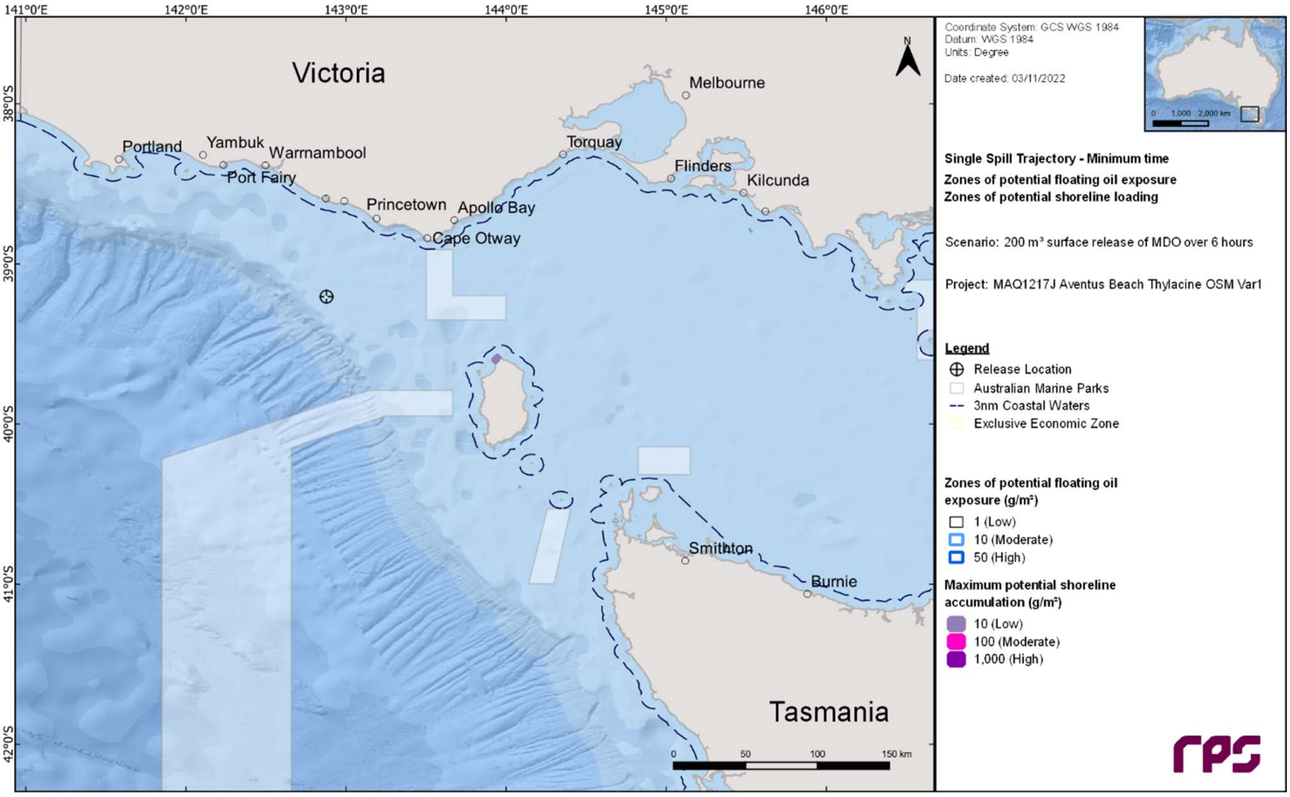

Figure 11.12 Zones of potential floating oil exposure and shoreline accumulation over the 30-day simulation, for the trajectory with the minimum time before shoreline accumulation above 10 g/m^2. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days.

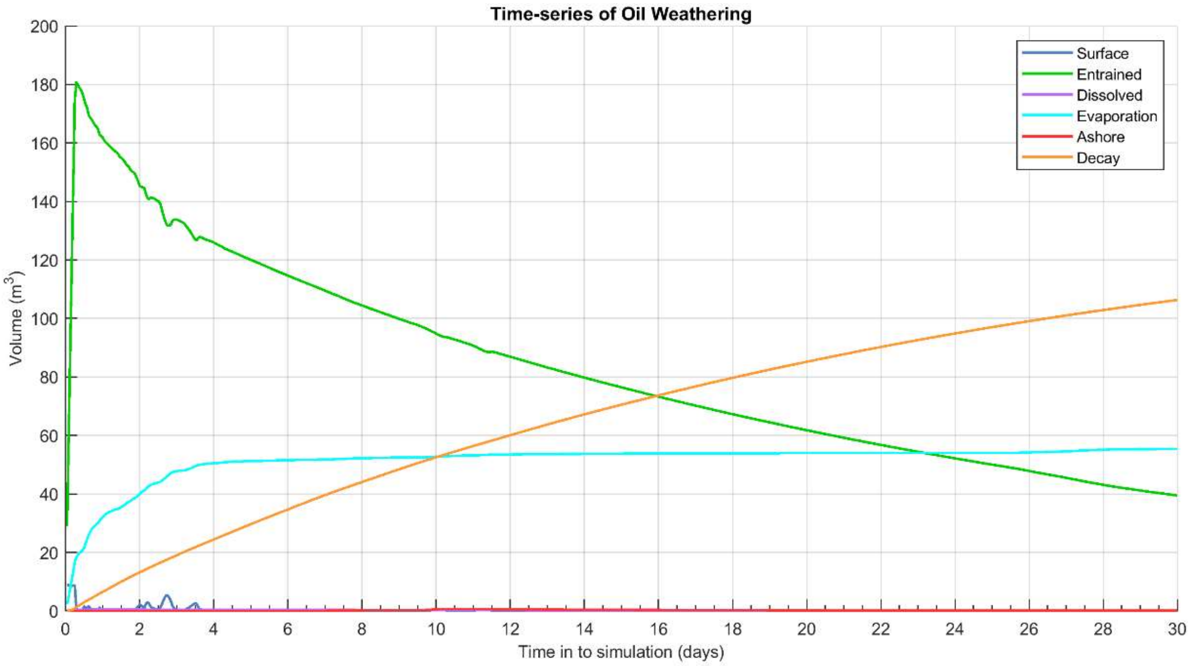

Figure 11.13 Predicted weathering and fates graph for the trajectory with the minimum time before shoreline accumulation above 10 g/m^2. Results are based on a 200 m^3 surface release of MDO over 6 hours, tracked for 30 days.

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Appendix F Otway Offshore Stakeholder Consultation Information Sheet

Otway Offshore Project

Revision of Operations Environment Plan

Information Sheet | February 2023

Natural gas is widely recognised as integral in emissions reduction ambitions being achieved globally and in Australia. It is also a vital aspect of energy security.

Natural gas produced by Beach Energy supplies the ongoing needs of Victorian homes, business and industry.

In the offshore Otway Basin, Beach is continuing development of natural gas to ensure ongoing production at the Otway Gas Plant near Port Campbell.

The Otway Offshore Project commenced production in 2006 from the Thylacine and Geographe fields.

Completion of Drilling Campaign

Phase 4 project activities commenced in 2019 with assessment of seabed locations, followed by a drilling program from February 2021 to July 2022 in which one exploration well and six production wells were drilled.

The drilling campaign saw outstanding safety and environmental compliance, positive engagement with the commercial fishing sector and minimal disruption to their activities, and successful management of safety and logistical challenges due to COVID-19.

Two of the new production wells (Geographe 4 & 5) have already been connected to the existing offshore-to-onshore pipeline to the Otway Gas Plant, processing gas for the Australian east coast gas market. The Otway Offshore Operations Environment Plan (EP) was reviewed last year to include the new Geographe wells.


Thylacine Offshore Platform

Connection of Thylacine production wells

Phase 5 project activities commenced on 10 February 2023 and will take approximately nine weeks. Activities include the installation of additional seabed infrastructure to connect the four new Thylacine production wells (see map) to the existing offshore-to-onshore pipeline.

A specialist construction support vessel will use a submersed remote operated vehicle to install the seabed equipment, connect and commission the production wells.

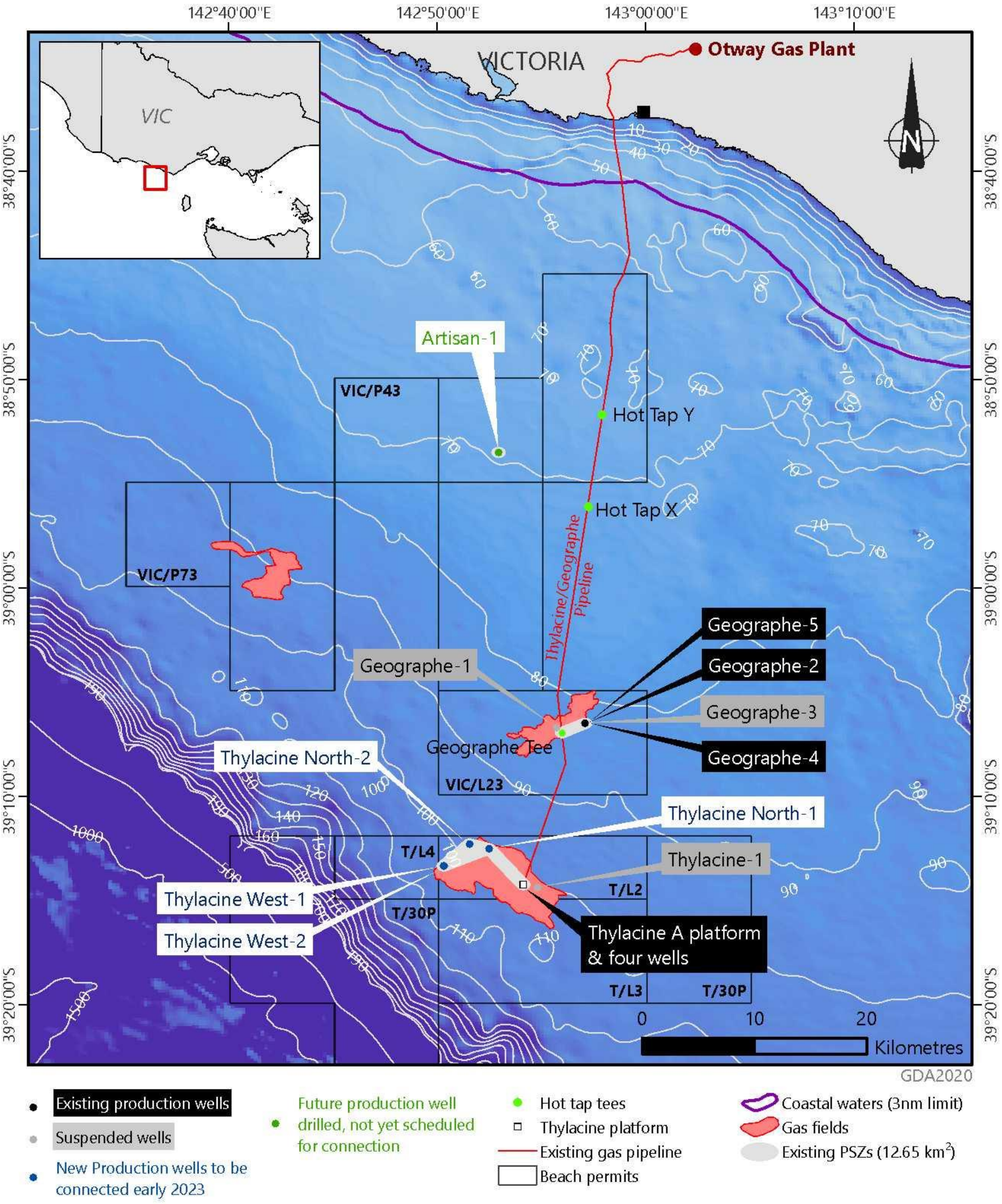
Otway Offshore Operations EP Review

The existing Otway Offshore Operations EP will be reviewed to include the four new Thylacine projection wells.

This information sheet provides an overview of:

- Current offshore operations and the additional wells and infrastructure to be included in the revised EP
- Regulatory framework for safety and environment protection, and consultation with relevant persons
- Potential impacts and risks in carrying out these operations, and measures to reduce and manage in accordance with the Environment Regulations.

Project area map



15/11/2022 *The locations on this map are accurate at the time of publication and are subject to change* OT22-0010 R5

Activity Location

The Thylacine platform and new Thylacine wells are located approximately 68 to 80 km south of Port Campbell, in Commonwealth waters.

Environmental regulations and approvals

Offshore petroleum activities are regulated by the National Offshore Petroleum Safety and Environmental Management Authority (NOPSEMA), in accordance with the *Offshore Petroleum and Greenhouse Gas Storage Act (2006) (OPGGS Act)* and associated regulations that require Safety Cases, EP and Well Operations Management Plans. The EP must:

- Be appropriate for the nature and scale of the activity
- Include a comprehensive description of the activities
- Describe the existing environment (including social, economic and cultural features) that may be affected by the activities
- Include details of the particular relevant values and sensitivities (if any) of that environment
- Identify and evaluate environmental impacts and risks from the operational activities, including potential emergency conditions
- Include appropriate environmental performance outcomes and control measures to reduce any potential impacts and risks
- Include an appropriate implementation strategy and monitoring, recording and reporting arrangements
- Set out a method to identify "*a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan*" (*Relevant Persons*)
- Demonstrate that consultations have been carried out in accordance with the regulations, and appropriate measures adopted, because of the consultations.

The EP must demonstrate to NOPSEMA how the activities will be conducted to ensure that potential impacts and any residual risks will be managed and reduced to '*As Low As Reasonably Practicable*' (*ALARP*) and an acceptable level.

If NOPSEMA is satisifed that the EP meets the criteria set out in the Environment Regulations, it will accept the EP and publish it on its website.

Over the course of the Otway Offshore Project Beach has consulted *Relevant Persons* in the preparation of several EPs.

Beach is currently reviewing the existing Otway Offshore Operations EP to include the four new Thylacine wells. A similar revision was completed last year to include the two new Geographe wells.

Consultation and Feedback

This information sheet has been prepared to inform *Relevant Persons* whose functions, interests or activities may be affected by the activities to be carried out under the environment plan.

Please contact us if you would like further information or to consult with us about how this project may impact your functions, interests or activities.

Beach will consider and respond to all feedback, questions and concerns.

All consultation records and emails will be provided to NOPSEMA in the EP.

Relevant Persons may request that the information they provide not be published, and it will be identified as sensitive information and not published in the EP.

First Nations Peoples

Beach respectfully acknowledges the Eastern Maar Peoples who are the traditional custodians of the land and sea country on which the Otway Gas Development operates.

Beach respects the Eastern Maar Peoples historical and ongoing connection to land and sea country through cultural and spiritual sites, language and ceremony. Beach pays respect to Eastern Maar Elders past, present and emerging.

Activity description

The EP includes a detailed description of the infrastructure and activities, summarised below.

Thylacine Platform

The existingThylacine platform is a steel jacket structure with topsides consisting of an integrated deck on four levels. The platform is designed to be operated as a 'normally unattended installation'.

It is remotely operated from the Otway Gas Plant central control room via duplicated communication links ensuring high availability for the control and safety shutdown systems. The platform can continue to operate safely and autonomously upon a loss of communications.

Wells and connections

The Thylacine gas field currently consists of four production wells which are connected to the platform and pipeline, and one suspended subsea well (Thylacine-1). Four new Thylacine wells are being connected through new seabed infrastructure including:

- Integration module of approximately $14m^2$ placed on the seabed near the Thylacine platform
- Flowlines and subsea infrastructure to connect the production wells to the existing platform and pipeline
- Electrical and hydraulic controls within cables that enable monitoring and control of the production wells.

The Geographe gas field consists of three subsea production wells (Geographe 2, 4 and 5), connected to a subsea manifold with an umbilical to the Thylacine platform and a flowline to the existing offshore to onshore pipeline, and two suspended subsea wells (Geographe-1 and Geographe-3). Control and services to the Geographe production well are provided via the main umbilical from the Thylacine Platform.

The Thylacine platform, wells, and subsea manifolds are controlled and monitored 24/7 by the Otway Gas Plant control room. The new wells will be managed in the same manner as the existing offshore wells and will be included in existing inspection and maintenance schedules to ensure their ongoing integrity.

All wells and associated seabed infrastructure are within existing Petroleum Safety Zones.

Pipeline

The existing offshore to onshore gas pipeline and MEG (mono-ethelyene glycole) pipeline, which are piggybacked, run from the platform to the Otway Gas Plant. The MEG pipeline supplies MEG and chemicals for injection into the Otway Gas Pipeline at the platform. The pipelines are approximately 80 km in total length, including the offshore section approximately 69 km long.

Maintenance

Routine maintenance of the platform is undertaken by work crews transported by helicopter approximately once a fortnight during daylight hours. Regular activities include: routine operational checks; instrument and mechanical maintenance; shutdown resets, corrosion monitoring; and chemical replenishment. Specific maintenance and upgrade activities are also carried out to complete requirements identified during the routine checks.

Supply and support vessels

The platform is also visited approximately once per month by a supply vessel for the provision of fuel, chemicals, maintenance consumables and equipment. Vessels are also required for specific activities such as subsea inspection work using Remotely Operated Vehicles (ROVs) and/or divers.

Key matters in the EP review

- Revised impact and risk assessment that will meet any NOPSEMA guidelines released since acceptance of the current Otway Offshore Operations EP, and will demonstrate that the environmental impacts and risks are of an acceptable level and ALARP. See summary of risk assessment and mitigation measures.
- Revised environmental performance outcomes and environmental performance standards that reflect Beach's sustainability goals and emissions reduction target, and will allow Beach to measure and report on its environmental performance.

Environment description

The EP includes a detailed description of the existing environment in the immediate operational area and in the broader emergency planning area where there is a variety of marine fauna including the presence of:

- Blue, humpback and fin whales, particularly during the summer months
- Southern right and minke whales, particularly during the winter months
- Common dolphins and shark species throughout the year
- New Zealand and Australian fur seals throughout the year
- Loggerhead, green turtle and leatherback turtles throughout the year.

There are no marine parks within the activity area. However, within the broader emergency planning area, there are Australian Marine Parks and State Marine Protected areas (see map).

Socio-economic and cultural values within the activity and planning areas include:

- Commonwealth managed fisheries, including southern and eastern scalefish and shark; and southern squid jig fishery
- Victorian managed fisheries, including rock lobster and giant crab
- Commercial shipping activity
- Sea Country values and sensitivities held by First Nation peoples
- Shipwrecks in close shoreline proximity
- Recreational fishing, usually within close shoreline proximity
- Recreational diving focussed on shipwrecks and reefs close to the shoreline
- Signficant tourism features and activities associated with the Great Ocean Road, Twelve Apostles and Bay of Islands Coastal Park.

Beach recognises the environmental, cultural, heritage, social and economic values in our activity and planning areas. The Thylacine offshore platform, associated pipeline, gas plant and associated exploration and drilling activities have operated safely in close proximity to sensitive coastal areas such as the Twelve Apostles Marine National Park since 2007.

Mitigation and management

Beach has a proud track record for safety and environmental performance, adhering to performance measures set out in EPs and Safety Cases accepted by regulators.

The Otway Offshore Operations EP details a range of controls to reduce and manage environmental impacts and potential risks to ALARP and acceptable levels. These include:

- The Thylacine Platform, offshore pipeline and wells are marked on navigational charts and the platform, wells and infrastructure have existing 500 metre petroleum safety zones
- Vessels utilised by Beach are required to comply with all applicable marine regulations and observe the minimum approach distances to whales and dolphins set out in national guidelines
- Gas venting at the Thylacine Platform is limited to the minimum required for safe operations. Fuel burning equipment on the platform and vessels is designed and maintained to reduce pollutant emissions to atmosphere
- Beach operates in compliance with the NOSPEMA accepted Safety Cases (click here for more information) and Well Operations Management Plans (click here)
- The risk of a loss of containment of hydrocarbons or chemicals is managed through the equipment design process and the implementation of asset integrity and maintenance programs. In addition, process parameters are monitored 24/7 by trained and competent personnel who must follow documented procedures
- Contractors utilised by Beach are subject to a prequalification process and assurance over their activities to ensure compliance with the EP.

Emergency Planning

When conducting any offshore activity, there is an extremely unlikely risk of release of hydrocarbons from a well (which are primarily gas) or a spill of marine diesel from vessels in the event of an accident.

Beach standard operating procedures include an Oil Pollution Emergency Plan (OPEP), which is also included in the EP and required to be accepted by NOPSEMA.

Preparing an OPEP involves hydrocarbon and marine diesel release modelling for the local area using a worst-case spill scenario, assuming no control measures are in place. The modelling calculates the transport, spreading, entrainment and evaporation over time, using data on the prevailing metocean conditions (wind, wave and climate), the volume released, and the physical and chemical properties of the hydrocarbons.

The plans also assess the likelihood and consequences of any hydrocarbon release which must be reduced to ALARP through a range of control measures and include detailed response plans.

The OPEP describes the arrangements for responding to and monitoring any release of hydrocarbon and includes:

- 24/7 on-call team for rapid response clean-up actions including mobilisation of personnel and equipment
- 24/7 on-call team for modelling and monitoring of a hydrocarbon release to inform response activities, and monitoring of effectiveness of response activities
- Control measures necessary for ensuring rapid response and maintenance of capabilities (personnel and equipment).

These arrangements are based on the worse case event associated with the proposed activities to ensure that Beach has the appropriate level of response arrangements and capability. Beach maintains a current contract with Australian Marine Oil Spill Centre (AMOSC) based in Geelong for access to spill response resources and personnel. In Victoria, the Department of Transport is the control agency for marine pollution emergencies.

For more information on oil spill modelling and why it is required for the preparation of environment plans, click here to watch a video on the NOPSEMA website.

Maritime safety protocols

At Beach, safety takes precedence in everything we do. Support vessels attending the Thylacine platform for supplies and maintenance activities will operate in accordance with standards, regulated by the Australian Maritime Safety Authority (AMSA) including:

- issuing notifications to the Australian Hydrographic Office before mobilising to the operational area and when demobilising for construction or extended maintenance activities
- providing advanced notice of vessel contact details to Relevant Persons for inspection and maintenance activities
- communicating with other vessels using standard maritime protocols
- maintaining safe operating distances.

Safety exclusion and cautionary zones

Petroleum Safety Zones (PSZs) are administered by NOPSEMA under Section 616 of the *OPGGS Act*. PSZs extend for a radius of up to 500 metres and are gazetted around wells, structures and equipment.

Entry into PSZs is prohibited to all except those vessels authorised to do so by NOPSEMA (as detailed in the gazetted notice) or exempt under *Section 615 of the OPGGS Act*. PSZs are shown as a 'Restricted Area' on navigation charts.

PSZs are currently in place around the Thylacine platform, all wells and infrastructure (see map).

Questions and Answers

What's Beach's approach to climate change?

As an oil and natural gas explorer and producer across Australia and New Zealand, Beach is committed to sustainably delivering energy for communities. Beach recognises that climate change is one of the global challenges of this century and understands the role we must play in managing our carbon emissions.

Beach has an aspiration to reach net zero Scope 1 and 2 emissions by 2050 and a target to reduce emissions intensity by 35% from its entire portfolio by 2030. See further information in Beach's Sustainability Report.

Why is Beach continuing gas development in the Otway Basin?

Natural gas from the Otway Basin has been supplying Australia's east coast gas market for many years. Beach holds several permits in the area near its existing Thylacine platform, which flows raw gas to the Otway Gas Plant for processing and supply to the Australian east coast gas market.

Beach has continued development of the Thylacine and Geographe fields in accordance with requirements set out by the National Offshore Petroleum Titles Administrator (NOPTA).

Industry and regulators continue to see gas shortages for south-east Australia. To positively impact declining production from existing fields as reservoirs deplete, new gas projects need to be undertaken.

Why do we still need natural gas?

Natural gas has a wide variety of uses in our daily lives. This includes generating electricity, residential heating, hot water and cooking. In the industrial sector, gas is a primary heat source for manufacturing glass, steel, cement, bricks, wood, ceramics, tiles, paper and in producing food. Gas is a common ingredient in the manufacturing of fertilisers, plastics, pharmaceuticals and fabrics.

The Australian Energy Market Operator's (AEMO) latest Victorian Gas Planning Report in March 2022 forecasts demand shortfall risks as soon as 2023.

What role is natural gas playing as Australia transitions to renewable energy?

Carbon emissions of natural gas are 50% to 70% lower than coal. As old coal fired power stations are removed from Australia's energy mix, electricity powered from natural gas ensures a stable energy supply as our economy transitions to renewable energies. AEMO's 2022 Integrated System Plan (ISP) forecasts more gas will be required in all modelled scenarios. In the most ambitious "Step Change" scenario, a 90% reduction in carbon emissions from power generation is achieved by 2041-42 as a result of 33% more gas fired electricity generation, enabling generation from renewables to increase by 285%.

Is Beach Energy increasing retail gas prices?

No. Beach Energy is a gas wholesaler and supplies the majority of its gas under contract to energy retailers in Australia. Beach does not set retail prices.

Is Beach exporting gas from the Otway Basin?

No. Beach does not export gas from the Otway Basin. The gas processed at the Otway Gas Plant in Victoria is supplied via an existing pipeline to the Victorian gas market to meet residential, business and industry demands.

How will you ensure that you operate safely?

Safety takes precedence in everything we do. Beach has over 60 years' experience in the oil and gas industry and our marine exploration, development and operations teams have extensive local and international experience. Beach personnel undertake regular competency assessments and training to ensure their knowledge and skills meet strict operational requirements.

Beach has stringent procedures for assessing, selecting and managing specialist contractors to conduct our marine activities to ensure they will keep our operations safe, operating in accordance with Safety Cases, Wells Operation Management Plans and EPs.

What is ALARP?

ALARP stands for "As Low As Reasonably Practicable". It is an assessment principle commonly used in the oil and gas industry to assess and reduce potential impacts and risks that cannot be completely eliminated. For information on how NOPSEMA assesses ALARP click here.

What about impacts on commercial fishing?

The Otway Offshore Project is located within existing designated Commonwealth and State fisheries. Each fishery covers a vast area, whereas the wells, platform and seabed infrastructure cover a very small area.

Prior to developing EPs for the Otway Offshore Project, Beach assessed commercial fishing in the area, consulted with the commercial fishing industry, and has continued consultation throughout the activities to minimise the risk of disruption to commercial fishing.

Beach has a Fair Ocean Access procedure which sets out Beach's commitment to consultation, minimising impacts of its activities, circumstances in which a fisher may claim compensation, evidence required and how to make a claim.

What about impacts to whales?

Based on the low intensity sound generated from marine vessels, any impacts to whales will be minor and temporary. Avoidance and disturbance of whales will be managed in accordance with the *Environment Protection and Biodiversity Conservation (EPBC) Regulations 2000*. This includes adhering to required speeds and distances from whales, and in accordance with mitigation measures set out in EPs, which include independent Marine Mammal Observers on drilling rigs, construction support vessels, and maintenance vessels operating for extended periods.

About Beach Energy

Beach Energy is an ASX listed oil and gas, exploration and production company headquartered in Adelaide. It has operated and non-operated, onshore and offshore, oil and gas production from five production basins across Australia and New Zealand and is a key supplier to the Australian east coast gas market.

In Victoria, Beach is the operator of all onshore and offshore assets held in joint venture by: Beach (60%) and O.G. Energy (40%).

We welcome your questions and feedback. Please contact us:

P: 1800 797 011
E: community@beachenergy.com.au
www.beachenergy.com.au

All consultation records will be provided to NOPSEMA in accordance with regulations.

Please advise us if you do not want any consultation information published by NOPSEMA.