



Environment Plan

Otway Phase 5 Early Dive Installation Campaign

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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

<i>Terms/acronym</i>	<i>Definition/Expansion</i>
AARNO	Australian Agriculture and Natural Resources Online
AFMA	Australian Fisheries Management Authority
AHO	Australian Hydrographic Office
ALARP	As Low as Reasonably Practicable
AMOSOC	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
ARS	Age-restricted searches
ASAP	As Soon as Practicable
Bass Strait CZSF	Bass Strait Central Zone Scallop Fishery
Bbl	Barrel
Beach	Beach Energy (Operations) Limited
BHP Billiton	BHP Petroleum (Australia) Pty Ltd
BIA	Biologically Important Area
BOM	Bureau of Meteorology
BTEX	Benzene, Toluene, Ethylbenzene and Xylene
Cd	Cadmium
CH ₄	Methane
CMMS	Computerised Maintenance Management System
CMT	Crisis Management Team
COLREG	Convention on The International Regulations for Preventing Collisions at Sea
CO	Carbon monoxide
Co	Cobalt
CO ₂	Carbon Dioxide
CoP	Cessation of Production
Cr	Chromium
CSV	Construction Support Vehicle
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DAWR	Commonwealth Department of Agriculture and Water Resources now Department of Agriculture, Water and Environment
DELWP	Victorian Department of Environment, Land, Water and Planning
DEWHA	Department of the Environment, Water, Heritage, and the Arts

Terms/acronym	Definition/Expansion
DEWNR	Department of the Environment, Water and Natural Resource
DIIS	Department of Industry, Innovation and Science
DISER	Department of Industry, Science, Energy and Resources
DJPR	Victorian Department of Jobs, Precincts and Regions
DJPR: ERR	Victorian Department of Jobs, Precincts and Regions: Earth Resources Regulation
DNP	Commonwealth Director of National Parks
DNRE	Department of Natural Resources and Environment
DO	Dissolved Oxygen
DoE	Department of Environment
DotEE	Commonwealth Department of the Environment and Energy now Department of Agriculture, Water and Environment
DP	Dynamic Positioning
DPI	Department of Primary Industries
DPIPWE	Tasmanian Department of Primary Industries, Parks, Water and Environment
DSE	Department of Sustainability and Environment
DSEWPaC	Commonwealth Department of Sustainability, Environment, Water, Population and Communities
ECC	Environmental Conservation Council
EES	Environmental Effects Statement
EIS	Environmental Impact Statement
EMBA	Environment That May Be Affected
EMPCA	<i>Environmental Management and Pollution Control Act 1994</i>
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 gases
GIS	Geographic Information Systems
GSACUS	Great Southern Australian Coastal Upwelling System

Terms/acronym	Definition/Expansion
H ₂ S	Hydrogen Sulphide
ha	Hectare
HFC	Hydrofluorocarbons
Hg	Mercury
HISC	Hydrogen Induced Stress Cracking
HRV	Hyperbaric Rescue Vehicle
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
IMOS	Integrated Marine Observing System
IMS	Invasive Marine Species
IMT	Incident Management Team
IOGP	International Association of Oil and Gas Producers
ISQC	International Standard on Quality Control
IUCN	International Union for Conservation of Nature
JRCC	Joint Rescue Coordination Centre
KEF	Key Ecological Feature
Lattice	Lattice Energy Limited
LOC	Loss of Containment
LOR	Level of Reporting
MARPOL	International Convention for The Prevention of Pollution from Ships
MC	Measurement Criteria
MCS	Master Control Station
MDO	Marine Diesel Oil
MEG	Monoethylene Glycol
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 ₂ O	Nitrous oxide

Terms/acronym	Definition/Expansion
NatPlan	National Plan for Maritime Environmental Emergencies
NEBA	Net Environmental Benefit Analysis
Ni	Nickel
NMFS	(US) National Marine Fisheries Service
NNTT	National Native Title Tribunal
NOO	National Oceans Office
NOOA	(US) National Oceanic and Atmospheric Administration
NOPSEMA	National Offshore Petroleum Safety and Environmental Management Authority
NOX	Nitrous Oxides
NO ₂	Nitrogen dioxide
NSW	New South Wales
O ₃	Ozone
OCS	Offshore Constitutional Settlement
OEMS	Operations Excellence Management System
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
OSMP	Operational and Scientific Monitoring Plan
OSTM	Oil Spill Trajectory Modelling
OWR	Oiled Wildlife Response
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PFC	Perfluorocarbons
PLONOR	Posing little or no risk to the environment
PMST	Protected Matters Search Tool
POLREP	Marine Pollution Report
POWBONS Act	Pollution of Waters by Oil and Noxious Substances Act 1986
ppb	Parts Per Billion
ppm	Parts Per Million
PSV	Platform Supply Vessel
PSZ	Petroleum Safety Zone

<i>Terms/acronym</i>	<i>Definition/Expansion</i>
PTS	Permanent Threshold Shift
PWS	Parks and Wildlife Service
ROV	Remotely Operated Vehicle
SBTF	Southern Bluefin Tuna Fishery
SCCP	Source Control Contingency Plan
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	Sulfur hexafluoride
SIMAP	Spill Impact Mapping Analysis Program
SIV	Seafood Industry Victoria
SMPEP	Shipboard Marine Pollution Emergency Plan
SMS	Short Message Service
SO ₂	Sulphur dioxide
SOX	Sulphur Oxides
SPF	Small Pelagic Fishery
SPL	Sound Pressure Level
SPRAT	Species Profile and Threats Database
SST	Sea surface temperature
TEC	Threatened Ecological Community
TRH	Total Recoverable Hydrocarbon
TSC Act	Tasmanian Threatened Species Conservation Act
TSSC	Threatened Species Scientific Committee
TTS	Temporary Threshold Shift
UNESCO	United Nations Education, Scientific, and Cultural Organisation
USBL	Ultra-short baseline
VLSFO	Very Low Sulphur Fuel Oil
VWMS	Victorian Waterway Management Strategy
WGCA	West Gippsland Catchment Management Authority
WMO-GAW	World Meteorological Organisation-Global Atmosphere Watch
WOMP	Well Operations Management Plan
Woodside	Woodside Petroleum Ltd

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.

The scope of this Environment Plan (EP) is the early dive installation campaign in the vicinity of the Thylacine wellhead platform (Figure 1-1). The early dive installation campaign is required to prepare for the future tie-in of the Thylacine Development wells, which are expected to be drilled in 2021 – 2022 and were approved under a separate EP (Otway Development Drilling and Well Abandonment EP – accepted Feb 2021).

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

- Hook-up and commissioning of infrastructure required for production from the Thylacine development wells (subject to a separate EP);
- Operations of the Otway Offshore development including Thylacine wellhead platform which is covered by the Otway Offshore Operations EP (CDN/ID 8255348); and
- Maintenance and decommissioning of any assets/facilities, which will be covered by the Otway Operations EP and specific EPs as necessary.

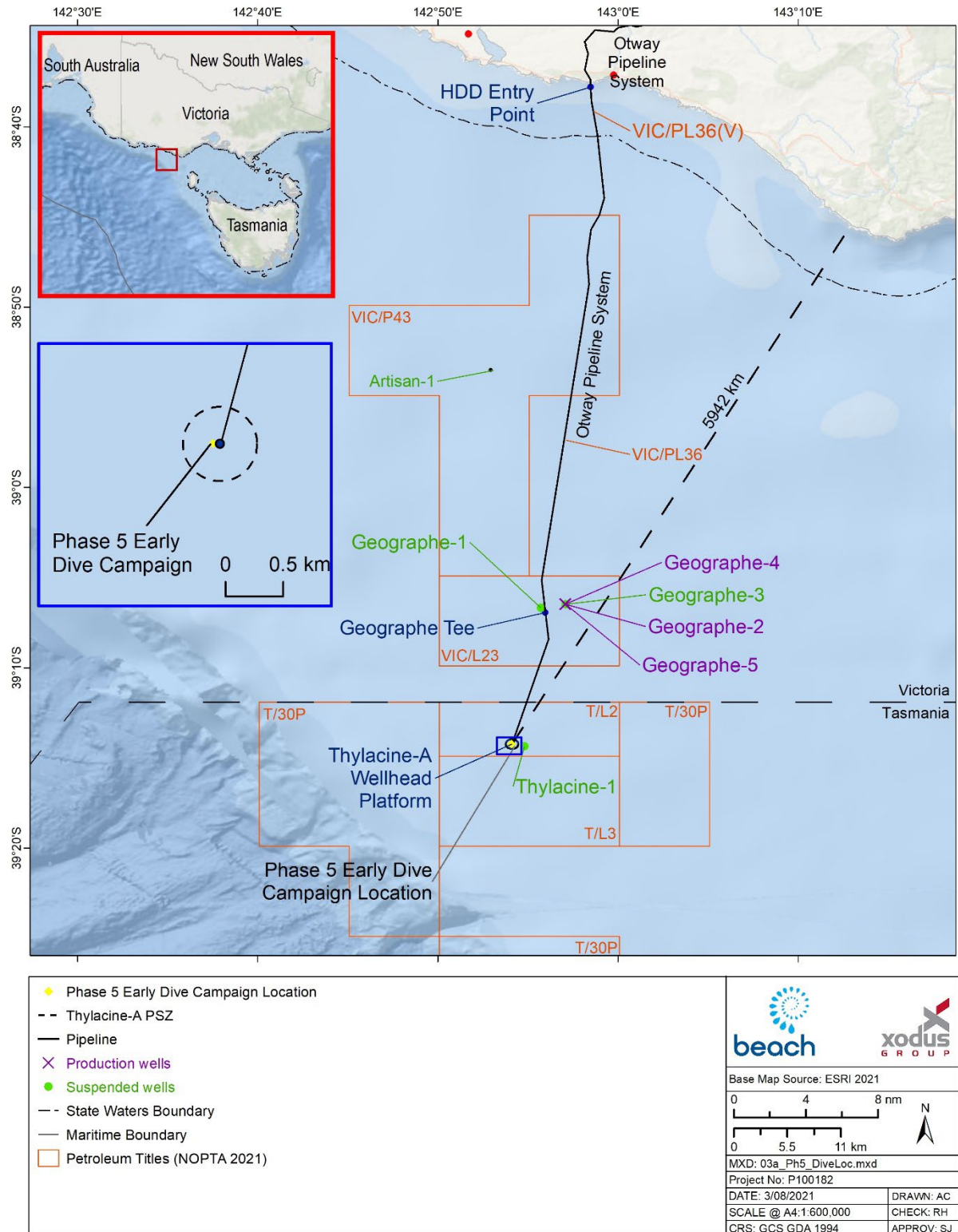


Figure 1-1: Otway Phase 5 Early Dive Installation Campaign location

1.1 Environment Plan Summary

The 'Otway Phase 5 Early Dive Installation Campaign 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(ER)).

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
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 8
Details of the titleholders nominated liaison person for the activity	Section 1.2

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. Beach is 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 the Victorian Department of Jobs, Precincts and Regions: Earth Resources Regulation (DJPR (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.

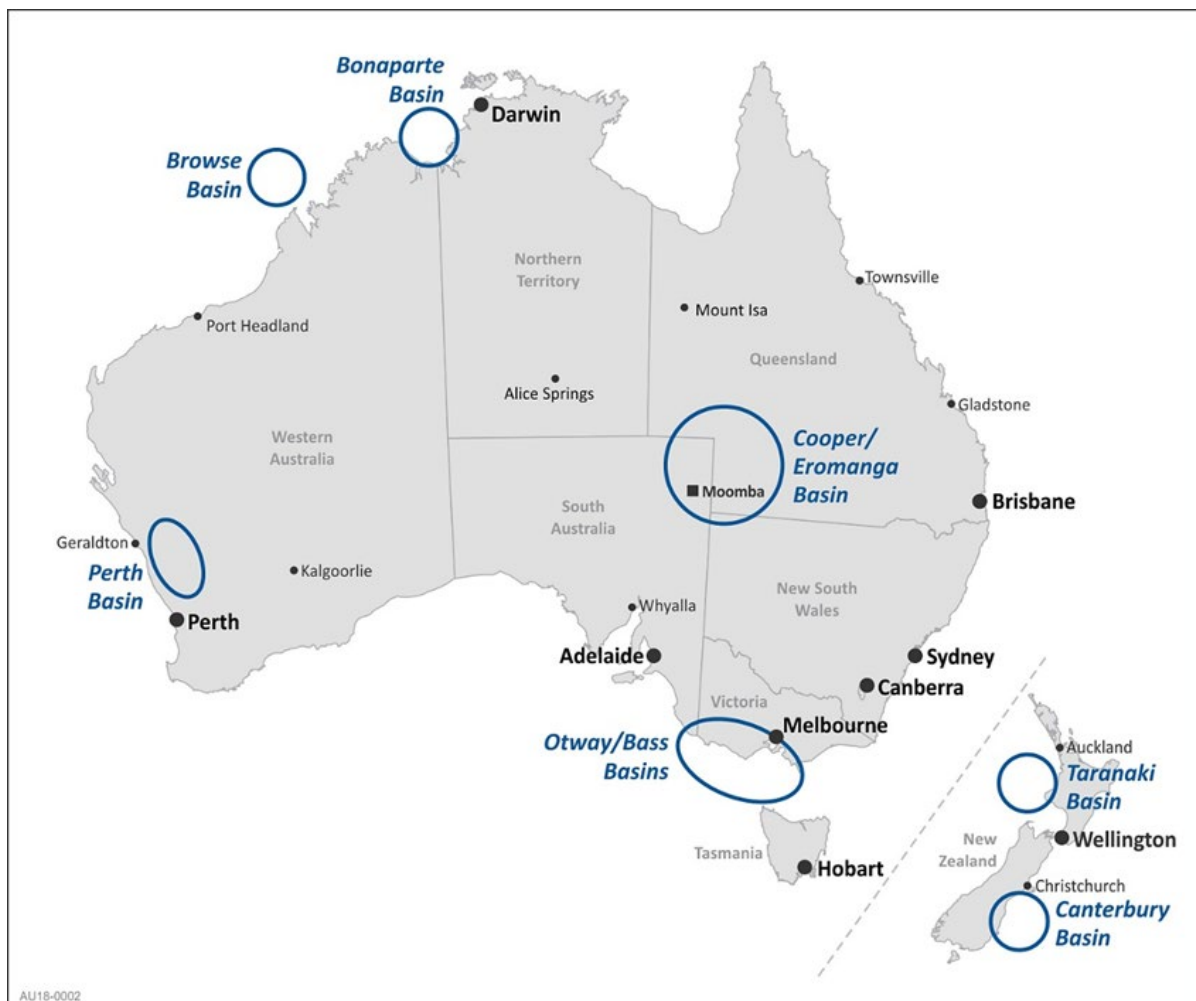


Figure 1-2: Beach operations

Table 1-2: Details of titleholder and liaison person.

Petroleum Title	Details	
T/L2	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
	Fax number	(08) 8338 2336
	Email address	info@beachenergy.com.au
	Australian Company Number	ACN: 007 845 338
	Titleholder Liaison Person	
Mr Rod McKellar Project Manager Otway Offshore Phase 5	Business address	Level 15 150 Lonsdale Street Melbourne Victoria 3001
	Telephone number	(08) 8338 2833
	Fax number	(08) 8338 2336
	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. 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 waters. Relevant Commonwealth requirements are summarised in Table 2-2. On the basis that a worst-case credible oil spill has the potential to intersect Victorian and Tasmanian waters, relevant Victorian and Tasmanian requirements are described in Table 2-3 and Table 2-4 respectively.

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

The scope of this EP consists of:

- Early works to support tie-in of new subsea wells for the purpose of extracting gas from the Thylacine field.

The activities 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 Thylacine field is 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; and
- The consequence evaluation for environmental impacts associated with the activity 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 through an OPP) 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 Agriculture, Water and the Environment (DAWE), are detailed in the applicable sections within Section 4 as part of the description of the existing environment.

Recovery plans, threat abatement plans and species conservation advices applicable to species identified in Section 4.6.2 are detailed in Table 2-5.

Table 2-1: Conditions from the Otway Development (2002/621) applicable to the Otway Phase 5 Early Dive Installation Campaign

Condition No.	Condition	Relevant Section of EP
8	<p>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.</p> <p>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."</p> <p>Conditions dated 22 June 2015 do not have conditions 3 or 4.</p>	This EP.
11	<p>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 measures (as specified in the relevant condition) are included in an environment plan (or environment plans) relating to the taking of the action that:</p> <p>a) was submitted to NOPSEMA after 27 February 2014;</p> <p>b) either:</p> <p>(i) is in force under the OPGGS(E)R; or</p> <p>(ii) has ended in accordance with regulation 25A of the OPGGS(E)R.</p>	This EP.
11B	<p>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.</p>	<p>This EP.</p> <p>Section 6.16 Environmental Performance Outcomes, Standards and Measurement Criteria</p> <p>Section 7 – Implementation Strategy</p>

Table 2-2: Commonwealth environmental legislation relevant to the Otway Phase 5 Early Dive Installation Campaign

Legislation	Scope	Related International Conventions	Administering Authority
<i>Australian Maritime Safety Authority Act 1990</i>	<p>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.</p> <p>Requirements are effected through Australian Maritime Safety Authority (AMSA) who administers the National Plan for Maritime Environmental Emergencies (NatPlan).</p> <p>Application to activity: AMSA is the designated Control Agency for oil spills from vessels in Commonwealth waters. <i>These arrangements are detailed in the OPEP.</i></p>	<p>International Convention on Oil Pollution Preparedness, Response and Cooperation 1990</p> <p>Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances, 2000</p> <p>International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties 1969</p> <p>Articles 198 and 221 of the United Nations Convention on the Law of the Sea 1982</p>	Australian Maritime Safety Authority (AMSA)
Australian Ballast Water Management Requirements (Commonwealth of Australia, 2020)	<p>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.</p> <p>Application to activity: Provides requirements on how vessel operators should manage ballast water when operating within Australian seas to comply with the Biosecurity Act.</p> <p><i>Section 6.9 details these requirements in relation to the management of ballast water.</i></p>	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, Water and the Environment (DAWE)
<i>Biosecurity Act 2015</i> Biosecurity Regulations 2016	<p>This Act replaced the <i>Quarantine Act 1908</i> in 2015 and 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.</p> <p>The objects of this Act are to provide for:</p> <p>(a) managing biosecurity risks; human disease; risks related to ballast water; biosecurity emergencies and human biosecurity emergencies;</p>	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)	DAWE

Legislation	Scope	Related International Conventions	Administering Authority
	<p>(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.</p> <p>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.</p> <p>For the activity the Act regulates vessels entering Australian territory regarding ballast water and hull fouling.</p> <p><i>Biosecurity risks associated with the activity are detailed in Section 6.9.</i></p>		
<p><i>Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)</i></p>	<p>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.</p> <p>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:</p> <ul style="list-style-type: none"> • 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; and • water trigger for coal seam gas and coal mining developments. <p>Application to activity: Petroleum activities are excluded from within the boundaries of a World Heritage Area (Sub regulation 10A(f)).</p> <p><i>The activity is not within a World Heritage Area.</i></p>	<p>1992 Convention on Biological Diversity and 1992 Agenda 21</p> <p>Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973</p> <p>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</p> <p>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</p> <p>Agreement between the Government of Australia and the Government of the Republic of Korea on The Protection of Migratory Birds 2006</p> <p>Convention on Wetlands of International Importance especially as Waterfowl Habitat 1971 (Ramsar)</p>	<p>DAWE</p>

Legislation	Scope	Related International Conventions	Administering Authority
	<p>The EP must describe matters protected under Part 3 of the EPBC Act and assess any impacts and risks to these.</p> <p><i>Section 3 describes matters protected under Part 3 of the EPBC Act.</i></p> <p>The EP must assess any actual or potential impacts or risks to MNES from the activity.</p> <p><i>Section 6 provides an assessment of the impacts and risks from the activity to matters protected under Part 3 of the EPBC Act.</i></p>	<p>International Convention for the Regulation of Whaling 1946</p> <p>Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979</p>	
Environment Protection and Biodiversity Conservation Regulations 2000	<p>Part 8 of the regulations provide distances and actions to be taken when interacting with cetaceans.</p> <p>Application to activity: The interaction requirements are applicable to the activity in the event that a cetacean is sighted.</p> <p><i>Section 2.2 details how these requirements will be applied.</i></p>	-	DAWE
Marine Pest Plan 2018–2023: National Strategic Plan for Marine Pest Biosecurity	<p>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.</p> <p>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</p> <p><i>Section 6.9 details how these requirements will be applied.</i></p>	-	DAWE
National Biofouling Management Guidelines for the Petroleum Production and Exploration Industry 2009	<p>The guidance document provides recommendations for the management of biofouling risks by the petroleum industry.</p> <p>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.</p>	<p>Certain sections of International Convention for The Prevention of Pollution from Ships (MARPOL)</p> <p>International Convention for the Safety of Life at Sea 1974</p>	DAWE

Legislation	Scope	Related International Conventions	Administering Authority
	<i>Section 6.9 details the requirements applicable to vessel activities.</i>	Convention on the International Regulations for Preventing Collisions at Sea (COLREG) 1972	
National Light Pollution Guidelines for Wildlife Including marine turtles, seabirds and migratory shorebirds (CoA 2020)	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. <i>Section 6.2 details the requirements applicable to the activity.</i>		DAWE
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. <i>Section 6.10 details the requirements applicable to vessel activities.</i>		DAWE
<i>Navigation Act 2012</i>	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: <ul style="list-style-type: none"> • MO 21: Safety and emergency arrangements. • MO 30: Prevention of collisions. • MO 31: SOLAS and non-SOLAS certification. Application to activity: The CSV (according to class) will adhere to the relevant MO with regard to navigation and preventing collisions in Commonwealth waters. <i>Section 6.5 details the requirements applicable to vessel activities.</i>	Certain sections of MARPOL International Convention for the Safety of Life at Sea 1974 COLREG 1972	AMSA

Legislation	Scope	Related International Conventions	Administering Authority
<p><i>Offshore Petroleum and Greenhouse Gas Storage Act 2006</i> (OPGGG Act) OPGGG(E)R</p>	<p>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.</p> <p>Part 2 of the OPGGG(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.</p> <p>Application to activity: The OPGGG Act provides the regulatory framework for all offshore petroleum exploration and production activities in Commonwealth waters, to ensure that these activities are carried out:</p> <ul style="list-style-type: none"> • 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. <p><i>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.</i></p>	<p>-</p>	<p>NOPSEMA</p>
<p><i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i></p>	<p>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.</p> <p>Application to activity: All ships involved in petroleum activities in Australian waters are required to abide to the requirements under this Act.</p> <p>Several MOs are enacted under this Act relating to offshore petroleum activities, including:</p>	<p>Various parts of MARPOL</p>	<p>AMSA</p>

Legislation	Scope	Related International Conventions	Administering Authority
	<ul style="list-style-type: none"> • 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. <p><i>Section 6 details the requirements applicable to vessel activities.</i></p>		
<p><i>Protection of the Sea (Harmful Antifouling Systems) Act 2006</i></p>	<p>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.</p> <p>Application to activity: All ships involved in offshore petroleum activities in Australian waters are required to abide to the requirements under this Act.</p> <p>The MO 98: Marine Pollution Prevention – Anti-fouling Systems is enacted under this Act.</p> <p><i>Section 6 details the requirements applicable to vessel activities.</i></p>	<p>International Convention on the Control of Harmful Anti-fouling Systems on Ships 2001</p>	<p>AMSA</p>
<p><i>Underwater Cultural Heritage Act 2018</i></p>	<p>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).</p> <p>The Act allows for protection through the designation of protection zones. Activities / conduct prohibited within each zone will be specified.</p> <p>Application to activity: In the event of removal, damage or interference to shipwrecks, sunken aircraft or relics declared to be</p>	<p>Agreement between the Netherlands and Australia concerning old Dutch Shipwrecks 1972</p>	<p>DAWE</p>

Legislation	Scope	Related International Conventions	Administering Authority
	<p>historic under the legislation, activity is proposed with declared protection zones, or there is the discovery of shipwrecks or relics. <i>Section 4.8.1 identifies no known shipwrecks or sunken aircraft in the EMBA.</i></p>		

Table 2-3: Victorian environment legislation relevant to potential impacts and risks to State waters and lands

Legislation	Scope	Application to Activity	Administering Authority
<p><i>Environment Protection Act 1970</i> (& various regulations)</p>	<p>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.</p> <hr/> <p>The State Environment Protection Policy (Waters of Victoria) designates:</p> <ul style="list-style-type: none"> • spill response responsibilities by Victorian Authorities to be undertaken in the event of spills (DJPR) with EPA enforcement consistent with the <i>Environment Protection Act 1970</i> and the <i>Pollution of Waters by Oil & Noxious Substances Act 1986</i>. • 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. <p>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 <i>Environment Protection (Ships' Ballast Water) Regulations 2006</i>, <i>Waste Management Policy (Ships' Ballast Water)</i> and the <i>Protocol for Environmental Management</i>. 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.</p>	<p>Oil pollution management in Victorian State waters</p> <hr/> <p>Discharge of domestic ballast water from emergency response vessels into Victorian State waters must comply with these requirements.</p>	<p>Environment Protection Authority (EPA)</p>

Legislation	Scope	Application to Activity	Administering Authority
<i>Emergency Management Act 2013</i> (& Regulations 2003)	<p>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.</p> <p>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.</p>	<p>Emergency response structure for managing emergency incidents within Victorian State waters.</p> <p>Emergency management structure will be triggered in the event of a spill impacting or potentially impacting State waters.</p> <p>See OPEP.</p>	<p>Department of Justice and Regulation (Inspector General for Emergency Management)</p>
<i>Flora and Fauna Guarantee Act 1988</i> (& Regulations 2011)	<p>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.</p> <p>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.</p>	<p>Action Statement controls for threatened species present in the zone of potential impact (Environment that May Be Affected (EMBA)) as adopted (as relevant) within this EP.</p> <p>Triggered if an incident results in the injury or death of a FFG Act listed species (e.g. collision with a whale).</p>	<p>Department of Environment, Land, Water and Planning (DELWP)</p>
<i>Heritage Act 1995</i>	<p>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).</p> <p>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.</p>	<p>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.</p>	<p>Heritage Victoria (DELWP)</p>

Legislation	Scope	Application to Activity	Administering Authority
<i>Marine Safety Act 2010</i> (& Regulations 2012)	<p>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 - <i>Convention on the International Regulations for Preventing Collisions at Sea & International Convention for the Safety of Life at Sea</i>.</p> <p>The Act also defines marine incidents and the reporting of such incidents to the Victorian Director of Transport Safety.</p>	Applies to vessel masters, owners, crew operating vessels in Victorian State waters.	Maritime Safety Victoria
<i>National Parks Act 1975</i>	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 <i>National Parks Act 1975</i> and activities within these areas require Ministerial consent before activities are carried out.	Applies where there are activities within marine reserve areas.	DELWP
<i>Pollution of Waters by Oil and Noxious Substances Act 1986</i> (POWBONS) (& Regulations 2002)	<p>The purpose of the <i>Pollution of Waters by Oils and Noxious Substances Act 1986</i> (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.</p> <p>Requires mandatory Reporting of marine pollution incidents.</p> <p>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.</p>	Triggered in the event of a spill impacting or potentially impacting State waters.	Jointly administered by DJPR and EPA

Legislation	Scope	Application to Activity	Administering Authority
<i>Wildlife Act 1975</i> (& Regulations 2013)	<p>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).</p> <p>The <i>Wildlife (Marine Mammal) Regulations 2009</i> 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).</p>	<p>Applies where vessels are within State waters responding to a spill event.</p> <p>Prescribed minimum proximity distances to whales, dolphins and seals will be maintained.</p> <p>Triggered if an incident results in the injury or death of whales, dolphins or seals.</p>	DELWP

Table 2-4: Tasmanian Environment Legislation Relevant to potential impacts to State waters and lands

Legislation	Scope	Application to Activity	Administering Authority
<i>Environmental Management and Pollution Control Act 1994 (EMPCA)</i> (& Regulations)	<p>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.</p> <p>Relevant regulations under the EMPCA include:</p> <ul style="list-style-type: none"> Environmental Management and Pollution Control (General) Regulations 2017 Environmental Management and Pollution Control (Waste Management) Regulations 2010 <p>The EPA Division Compliance Policy provides the Director of the EPA powers of compliance.</p>	<p>Defines the EPA’s jurisdiction during a spill event.</p> <p>Prescribes the fee structure to waste events and environmental protection notices.</p> <p>Regulates the management and control of controlled wastes.</p> <p>See OPEP</p>	Department of Primary Industries, Parks, Water and Environment (DPIPWE)
<i>Pollution of Waters by Oil and Noxious Substances Act 1987</i>	<p>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.</p>	<p>Gives effect to MARPOL in Tasmanian waters.</p>	DPIPWE

Table 2-5: Recovery plans, threat abatement plans and species conservation advices relevant to the Otway Phase 5 Early Dive Installation Campaign

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
The 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.	Marine debris Evaluate risk of marine debris (including risk of entanglement and/or ingestion) and, if required, appropriate mitigation measures are implemented.
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.	Habitat degradation/ modification (oil pollution)
Draft Wildlife Conservation Plan for Seabirds (Commonwealth of Australia, 2019c)	The Plan aims to provide a strategic 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.	Habitat modification Evaluate the risk of oil spill impacts on the ability of a seabird to use an area for breeding, roosting or foraging.
National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011–2016 (DSEWPaC, 2011a)	The recovery plan is a co-ordinated conservation strategy for albatrosses and giant petrels listed as threatened.	Marine pollution Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented. Marine debris Evaluate risk of marine debris (including risk of entanglement and/or ingestion) and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for <i>Pterodroma mollis</i> (soft-plumaged petrel) (TSSC, 2015c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the soft-plumaged petrel.	None identified.
Approved Conservation Advice for <i>Sternula nereis nereis</i> (Australian fairy tern) (DSEWPC, 2011c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the fairy tern.	Marine pollution Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented.

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
Draft National Recovery Plan for the Australian Fairy Tern (<i>Sternula nereis nereis</i>) (Commonwealth of Australia, 2019b)	Draft recovery plan for actions so species no longer qualifies for listing as threatened under any of the EPBC Act listing criteria.	Habitat degradation and loss of breeding habitat Pollution
Conservation Advice for <i>Numenius madagascariensis</i> (eastern curlew) (DoE, 2015e)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the eastern curlew.	Habitat degradation/ loss (oil pollution)
Conservation Advice <i>Limosa lapponica baueri</i> (bar-tailed godwit (western Alaskan)) (TSSC, 2016a)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the bar-tailed godwit (western Alaskan).	Habitat degradation/ loss
Approved Conservation Advice for <i>Pachyptila subantarctica</i> (fairy prion (southern)) (TSSC, 2015d)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the fairy prion (southern).	None identified.
Approved Conservation Advice for <i>Rostratula australis</i> (Australian painted snipe) (DSEWPaC, 2013c)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Australian painted snipe.	None identified.
Draft National Recovery Plan for the Australian Painted Snipe (Commonwealth of Australia, 2019e)	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure the species' long-term viability in the wild, and the parties that will undertake those actions.	Deterioration of water quality, human disturbance.
Conservation Advice for <i>Charadrius leschenaultia</i> (greater sand plover) (TSSC, 2016b)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the greater sand plover.	Habitat degradation/ loss (oil pollution)

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
Conservation Advice <i>Calidris ferruginea</i> (curlew sandpiper) (DoE, 2015f)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the curlew sandpiper.	Habitat degradation/ loss (oil pollution)
Approved Conservation Advice for <i>Calidris canutus</i> (red knot) (TSSC, 2016d)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the red knot.	Marine pollution Evaluate risk of oil spill impact to nest locations and, if required, appropriate mitigation measures are implemented.
Approved Conservation Advice for <i>Botaurus poiciloptilus</i> (Australasian bittern) (TSSC, 2019)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Australasian bittern.	None identified.
National Recovery Plan for <i>Pterodroma leucoptera leucoptera</i> (Gould's petrel) (DEC NSW, 2006)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the Gould's petrel.	None identified.
National Recovery Plan for the <i>Neophema chrysogaster</i> (orange-bellied parrot) (DELWP, 2016)	The recovery plan is a co-ordinated conservation strategy for the orange-bellied parrot.	Illuminated boats and structures: evaluate risk of lighting on vessels and offshore structures.
National Recovery Plan for the <i>Lathamus discolor</i> (swift parrot) (Saunders and Tzaros, 2011)	The recovery plan is a co-ordinated conservation strategy for the swift parrot.	None identified.
Draft National Recovery Plan for the Swift Parrot (<i>Lathamus discolor</i>) (CoA, 2019d)		
Approved Conservation Advice for the <i>Halobaena caerulea</i> (blue petrel) (TSSC, 2015e)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the blue petrel	None identified.

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
National Recovery Plan for the <i>Prototroctes maraena</i> (Australian grayling) (Backhouse et al., 2008)	The recovery plan is a co-ordinated conservation strategy for the Australian grayling.	Poor water quality and siltation: Typically, from onshore sources. Impact of introduced fish: Typically, from onshore sources.
Recovery Plan for the <i>Carcharodon carcharias</i> (white shark) (DSEWPac, 2013a)	The recovery plan is a co-ordinated conservation strategy for the white shark.	None identified.
Approved Conservation Advice for the <i>Rhincodon typus</i> (whale shark) (TSSC, 2015b)	Conservation advice provides management actions that can be undertaken to ensure the conservation of the whale shark	Vessel strike.
Recovery Plan for Marine Turtles in Australia, 2017-2027 (Commonwealth of Australia, 2017b)	The long-term recovery plan objective for marine turtles is to minimise anthropogenic threats to allow for the conservation status of marine turtles	<ul style="list-style-type: none"> • chemical and terrestrial discharge. • marine debris. • light pollution. • habitat modification. • vessel strike. • noise interference. • vessel disturbance.
Approved Conservation Advice for <i>Dermochelys coriacea</i> (leatherback turtle) (DEWHA, 2008)	See above for the recovery plan for marine turtles in Australia, 2017-2027.	
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	<p>Noise interference Evaluate risk of noise impacts and, if required, appropriate mitigation measures are implemented.</p> <p>Vessel disturbance Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented.</p>
Approved Conservation Advice for <i>Balaenoptera borealis</i> (sei whale) (TSSC, 2015g)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the sei whale.	<p>Noise interference Evaluate risk of noise impacts to cetaceans and, if required, appropriate mitigation measures are implemented.</p> <p>Vessel disturbance</p>

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
Approved Conservation Advice for <i>Megaptera novaeangliae</i> (humpback whale) (TSSC, 2015a)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the humpback whale.	Evaluate risk of vessel strikes and, if required, appropriate mitigation measures are implemented. 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.
Conservation Management Plan for the Southern Right Whale 2011-2021 (DSEWPaC, 2012a)	Conservation management plan provides threat abatement activities that can be undertaken to ensure the conservation of the southern right whale.	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.
Approved Conservation Advice for <i>Balaenoptera physalus</i> (fin whale) (TSSC, 2015f)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the fin whale.	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.
Conservation Listing Advice for the <i>Neophoca cinerea</i> (Australian sea lion) (TSSC, 2010)	Conservation advice provides threat abatement activities that can be undertaken to ensure the conservation of the Australian sea lion.	Known threats to this species include habitat and prey availability, competition with other seals, fisheries bycatch (bottom-set gillnet, rock lobster), entanglement in marine debris, disturbance, harassment and displacement, predation and direct killing. Potential threats to this species include habitat degradation, oil spills, pollution, toxins and climate change
Recovery Plan for the <i>Neophoca cinerea</i> (Australian sea lion) (DSEWPaC, 2013b).	The plan considers the conservation requirements of the species across its range and identifies the actions to be taken to ensure its long-term viability in nature and the parties that will undertake those actions.	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

Relevant Plan/Advice	Description	Applicable Threats or Management Advice
		No explicit relevant management actions

3 Description of the Activity

3.1 Activity Location

The activity is located in the Thylacine field (Petroleum Title T/L2), entirely within Commonwealth waters approximately 70 km offshore from Port Campbell, Victoria. Water depth at the activity location is approximately 100 m.

Early dive Installation activities will be centred around the Thylacine Diverless Integration Skid (T-DIS), which is located approximately 30 m from the base of the Thylacine-A Wellhead Platform. Indicative co-ordinates of the T-DIS installation location and the Thylacine-A Wellhead Platform are shown in Table 3-1.

Table 3-1 Indicative co-ordinates of the T-DIS and Thylacine-A Wellhead Platform

Location	Eastings	Northings	Latitude	Longitude
T-DIS	664 110.4	5 655 154.3	39° 14.245'	142° 54.091'
Thylacine-A Wellhead Platform	664 161.0	5 655 160.0	39° 14.241'	142° 54.126'

Datum GDA94 Zone 54S, Grid MGA54

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 1 km radius around the T-DIS (Figure 3-1). The operational area is located partially within the Thylacine-A Wellhead Platform Petroleum Safety Zone (PSZ).

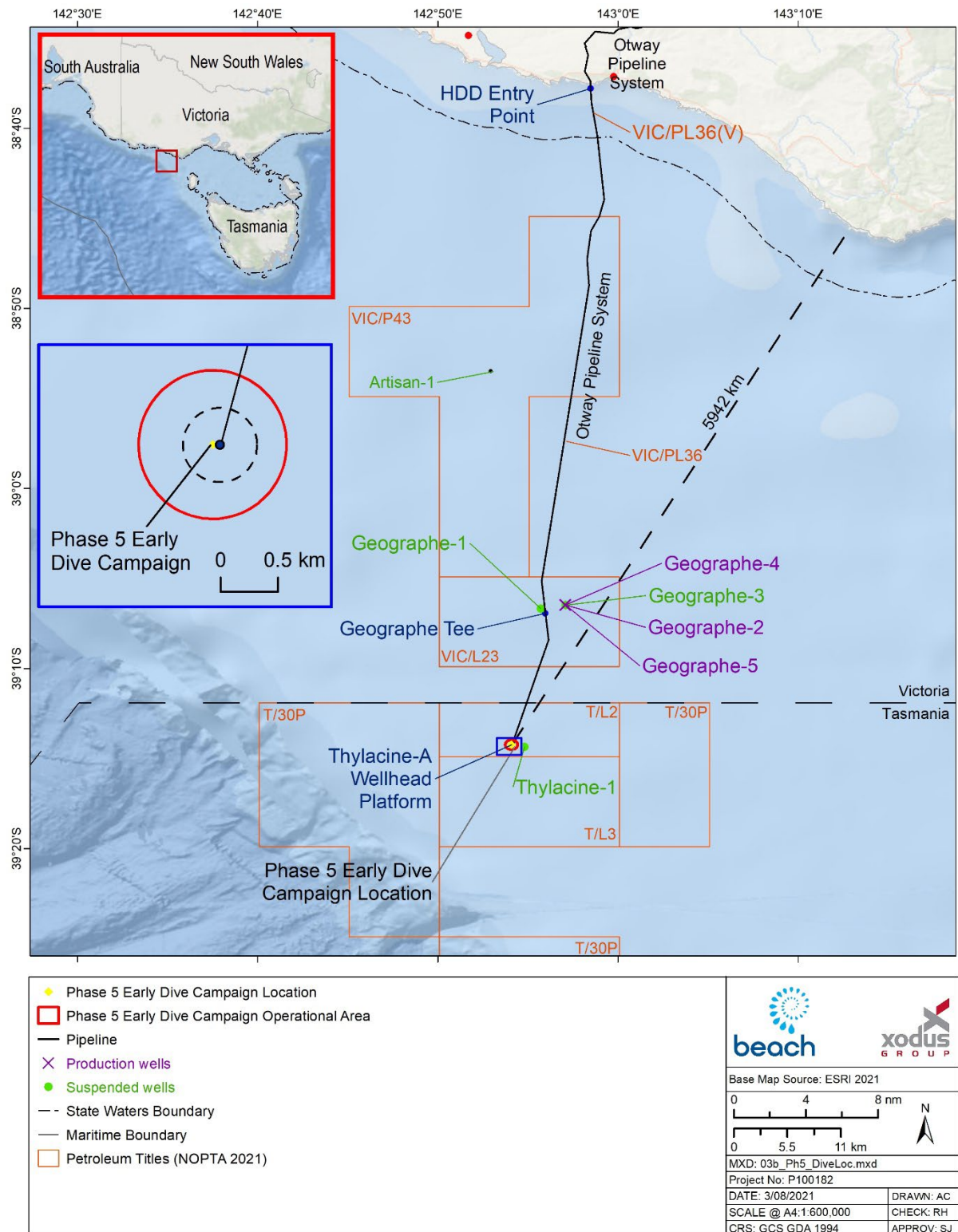


Figure 3-1: T-DIS location and Operational Area

3.3 Activity Timing

The early dive installation will be undertaken in a single campaign, expected to take approximately 7 to 21 days (accounting for potential weather delays). The campaign is planned to be undertaken during an offshore campaign window in Q4 2022, however could occur at any time up to end of Q2 2023.

Vessel based activities will be conducted on a 24-hour basis for the duration of the campaign. Platform support will likely be limited to daylight operations, but may extend to 24-hr.

3.4 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, leading to impacts to receptors.

3.4.1 Installation of new subsea infrastructure

The T-DIS will be installed approximately 30 m to the west of the Thylacine-A Wellhead Platform (Figure 3-2). Installation of the T-DIS will allow future connection of flowlines to the field to be undertaken using an ROV, without the need for divers. Rigid spools will be installed connecting the T-DIS to the existing production and MEG facilities at the Thylacine-A Wellhead Platform.

The installation sequence will be:

- Mark out T-DIS & spool termination target box locations (divers walk the area and check for debris)
- Install production spool sections (riser end 1st)
- Install MEG spool sections (riser/tee branch end 1st)
- Install T-DIS structure
- Complete flange make-ups.

New infrastructure will be overboarded from the installation vessel (refer to Section 3.4.4.1) away from the installation location but within the operational area, and then lowered into position using ultra-short baseline (USBL) transponders positioned on the infrastructure and installation vessel hull near the sea surface. If the window for overboarding is short, the vessel may lower new infrastructure directly onto the seabed away from the installation location, and temporarily wet-park items prior to installation. Wet parking will occur within the operational area and will be temporary.

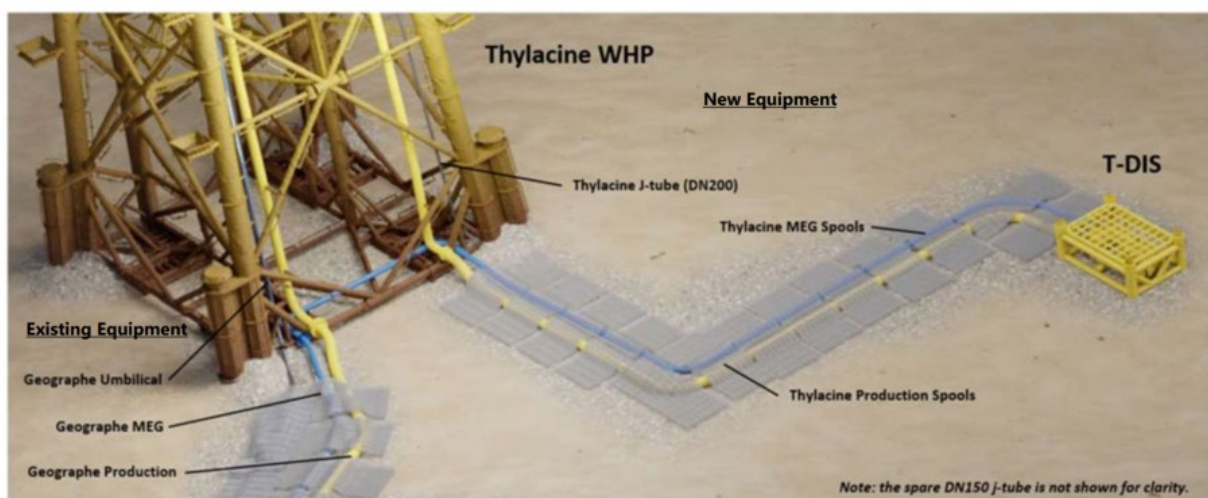


Figure 3-2 T-DIS Tie-in General Arrangement

Property brought onto title for the purpose of this activity is summarised in Table 3-2.

Table 3-2 Inventory of Property brought onto title for the purpose of this activity

Property / Equipment	Description	Purpose	Quantity
T-DIS to Production Riser Tie-In Spool	Approximately 33.7 m long, 8" diameter Z-shaped steel rigid spool	To allow product flow from new T-DIS to existing production riser	1
T-DIS to MEG Riser/Tee Branch Tie-in Spool	Approximately 36.2 m long, 4" diameter Z-shaped steel rigid spool	To allow MEG flow from existing MEG riser / tee branch to new T-DIS	1
Concrete stabilisation mattresses for rigid spools	Each mattress typically covers an area of 18 m ² (6 m x 3 m x 0.5 m).	To stabilise tie-in spools against environmental factors	9
Dropped object frames for flanges	Frames are yet to be designed but will be no larger than the concrete stabilisation mattresses (maximum footprint of 18 m ²).	To protect flanges from dropped objects while still allowing inspection.	2
T-DIS structure	Gravity based structure with a seabed footprint of 47 m ² , approximate dimensions 7.4 m x 6.4 m x 2.7 m. Pressure caps installed on the diverless hubs for future installation.	To allow future connection of flowlines to the field to be undertaken using an ROV, without the need for divers	1

3.4.1.1 Spool Installation

Two rigid tie-in spools will be installed between the T-DIS and the Thylacine-A Wellhead Platform:

- T-DIS to Production Riser Tie-In Spool; and
- T-DIS to MEG Riser/Tee Branch Tie-in Spool.

The rigid production spool will connect the T-DIS to the spare DN200 production riser on the Thylacine-A Wellhead Platform. It will be ~ 33.7 m long (9.7, 20, 4 m sections of the Z-shape). The rigid MEG spool will connect to the Thylacine-A Wellhead Platform MEG riser / tee branch. It will be ~ 36.2 m long (11.2, 20, 5 m sections of the Z-shape).

Cutting tools (such as diamond wire cutter or disk cutter) may be required to prepare the Thylacine J-tube (DN200) for connection to the new rigid production spool.

The production and MEG spools will be strength / hydrotest tested onshore prior to installation, and pre-filled with preservation fluid (40% MEG solution).

The spools will be installed next to each other, with sufficient space to accommodate spool movement. The rigid spools will have misalignment flanges to allow installation without requiring metrology.

The divers will use pipe handling frames to support the spool sections during installation. Each frame has a footprint on the seabed of approximately 6 m². Multiple frames will be required to effect pipe alignment and flange make-up.

Spools may require span rectification (either pre or post spool installation) via jetting or grout bag/sand cement bag installation.

Once installed, the rigid spools will be covered with concrete stabilisation mattresses for dropped object protection. Concrete mattresses are lowered over the spools by the vessel and each mattress typically cover an area of 18 m² (6 m x 3 m x 0.5 m). Similarly, flanges will be covered by dropped object frames for dropped object protection, which will be lowered over the flanges by the vessel. Each dropped object frame will have a smaller footprint than the concrete mattresses. In total, 9 concrete mattresses and two dropped object frames will be

required, with a total combined maximum footprint of 198 m². Sand/cement filled bags will be used to fill any gaps in the dropped object protection, if required.

3.4.1.2 T-DIS Installation

The T-DIS structure is likely to have the dimensions of 7.4 m x 6.4 m x 2.7 m, and a seabed footprint of 47 m². It is a gravity based structure, as opposed to relying on skirts to provide sliding resistance and will have an integrated foundation to enable installation in a single lift. Piling is not required for installation.

The T-DIS structure piping will be strength/hydrotest tested onshore prior to installation, and pre-filled with preservation fluid (40% MEG solution). Pressure caps will be installed on the diverless hubs, which allow future installation and commissioning activities to be undertaken diverless i.e. with an ROV.

A T-DIS alignment frame will be lowered into position by the Construction Support Vessel (CSV; refer to Section 3.4.4.1), and clump weights will be used to retain alignment frame position. The T-DIS structure will then be lowered onto the alignment frame and checked for correct positioning, then the alignment frame and clump weights will be recovered to the vessel.

3.4.2 Pre-commissioning Philosophy

The purpose of pre-commissioning is to verify the integrity of the installation, and to preserve the infrastructure or future activities. The pre-commissioning philosophy for the Phase 5 Early Dive Installation Campaign has been designed to eliminate discharging chemically treated spool fluids by installing pipework pre-flooded, however flushing has been retained as a contingency option as described below.

Pre-commissioning will require personnel to be onboard the Thylacine-A Wellhead Platform, and therefore will be conducted during daylight hours.

Production Spool

The rigid production spool will be connected to an existing production riser on the Thylacine- A wellhead platform. The production riser is currently air filled (confirmed via flooded member detection in February 2021), and will be flooded with a mix of inhibited potable water or seawater (oxygen scavengers, biocide, corrosion inhibitors and tracer dye) and MEG (40%) at the beginning of the campaign from IBCs on the Thylacine-A wellhead platform. The riser will be filled to the natural seawater level, requiring approximately 4 m³ of fluid.

The production spool will be installed in three sections. Each section will be pre-filled with a mix of inhibited potable water (oxygen scavengers, biocide, corrosion inhibitors and tracer dye) and 40% MEG solution (total of ~1 m³), with temporary blinds sealing the section during positioning. Sections will be installed sequentially from the production riser to the T-DIS. For each spool connection, the divers will remove the temporary blind (resulting in a small release of MEG solution; less than 1 litre) and insert a dissolvable chemical stick. The dissolvable chemical stick contains preservation chemicals (corrosion inhibitors, biocides etc) to ensure preservation of the spool until commissioning. Once the dissolvable chemical sticks are inserted, the next spool piece will be connected and no discharge of chemicals from the dissolvable chemical stick are expected.

MEG Spool

The MEG spool will connect to the MEG riser on the Thylacine-A wellhead platform. This is a 'live' system, with operating pressures inside the MEG riser of approximately 200 bar. Prior to commencing installation, the MEG manifold will be isolated and tested to verify seal integrity. This might result in a small release of MEG (less than 1 litre), while isolation is verified.

If the necessary isolation cannot be provided, the valves will be replaced (diver installation) to allow safe diver installation of the MEG tie-in spool. In the event that the MEG riser has to be depressurised, approximately 100 m³

of MEG would be discharged at the base of the Thylacine MEG riser for system testing, flushing and contingency purposes.

Once isolated, the MEG spool sections will be installed in the same way as the production spool sections; 3 x spool sections, pre-filled with a mix of inhibited potable water (oxygen scavengers, biocide, corrosion inhibitors and tracer dye) and 40% MEG solution (total of ~0.5 m³). Sections will be installed from the riser to the T-DIS, with divers inserting a dissolvable chemical stick before connection.

T-DIS

The T-DIS will be installed fluid filled with preservation fluid, a mix of inhibited potable water (oxygen scavengers, biocide, corrosion inhibitors and tracer dye) and 40% MEG solution, to minimise the egress of raw seawater during installation.

The pre-commissioning philosophy has been design to avoid flushing, however in the unlikely event that flushing to sea is required, flushing of the T-DIS and spools will take place in a loop through the MEG and production lines, with flushing fluid (MEG and inhibited seawater or potable water) pumped from the vessel (via a flexible line overboarded from an IBC on the vessel) or from the Thylacine-A Wellhead Platform. The total volume of flushing fluid (MEG and inhibited seawater) discharged would be up to 200% of the total volume of the system, which totals ~ 11 m³.

Post Tie-In Leak Test

The T-DIS and associated production and MEG spools include a number of new connections which need to be tested to ensure they will be leak free during operation.

The leak test can be undertaken separately for the production and MEG systems or combined (preferred option) using a temporary crossover loop (Figure 3-3). During the leak test, the system will be pressurised to a set testing pressure to confirm integrity of connections, before depressurising back to ~2 bar above seabed ambient pressure and isolated. Leak testing will occur within a closed-system, with fluids either returning to the platform or a vessel and resulting in no discharges to the marine environment.

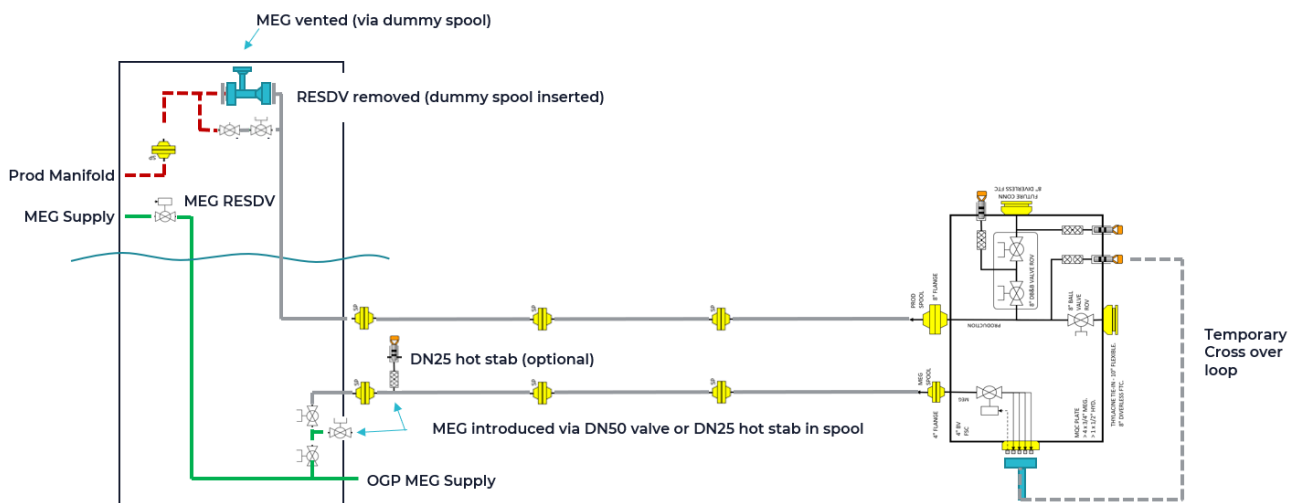


Figure 3-3 Combined pressure test

3.4.3 As-left survey

Following installation, an as-left survey will be undertaken to document the final position and orientation of the T-DIS and position of the rigid spools, concrete mattresses and sand/cement bags, as well as any spool span rectification. The as-left survey will be a visual survey, conducted using ROV.

The new infrastructure (Table 3-2) will be added to the Operations CMMS system and maintained under the Otway Operations EP.

3.4.4 Routine Operations

3.4.4.1 Vessel Operations

The activity will be undertaken by a construction support vessel (CSV), likely to be the Skandi Singapore or similar (Figure 3-4), utilising saturation diving operations (Section 3.4.4.2) and ROV operations (Section 3.4.4.3).



Figure 3-4: Skandi Singapore Construction Support Vessel

A safety exclusion zone will be established around the vessel for the duration of the activity, and the activity will be listed in a Notice to Mariners.

The CSV will use dynamic positioning (DP) to maintain position during activities, therefore no anchoring is required. No refuelling or bunkering will occur in the field. Crew change will not be required.

3.4.4.2 Diving Operations

The CSV has an integrated saturation diving spread to support diving for installation activities. The 18-man integrated saturation diving system is rated to a water depth of 350 m and has one diving bell to transport divers to and from the surface to the work area.

A hypobaric rescue vessel (HRV) will be on standby close to the CSV (outside of the Operational Area) throughout the activity. The HRV will likely be the same size as a platform supply vessel (PSV), such as the TEK-Ocean Spirit or similar (Figure 3-5).

The HRV is required to remain within 2 hrs transit time to support safe operations of the diving system. No anchoring is required. No refuelling or bunkering will occur in the field.



Figure 3-5: TEK-Ocean Spirit Platform Support Vessel

3.4.4.3 ROV Operations

Underwater remotely operated vehicles (ROVs) are deployed and controlled from the CSV to undertake and or assist installation activities. In the event that an ROV is required to temporarily park on the seabed, it will be within the Operational Area.

The CSV will be equipped with two work class ROVs. These ROVs are equipped with a video camera and lighting and have the ability to monitor the subsea infrastructure and 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, without being released, to move components.

3.4.4.4 SIMOPS

The Thylacine-A Wellhead Platform and Otway pipeline system will remain operational throughout the activity, unless a shutdown is required (such as if MEG riser / tee branch valve replacement is required). The section of the Otway pipeline system close to the Thylacine-A Wellhead Platform is protected from dropped objects by concrete mattresses.

Brownfield construction activities on the Thylacine-A Wellhead Platform may be undertaken concurrently with the Phase 5 Early Dive Campaign. This will involve daily helicopter flights to the platform and the presence of a platform supply vessel (PSV).

3.5 Future activities

Following completion of the activities described in this EP, the T-DIS and associated infrastructure will remain on the seabed in preparation for future tie-in of the Thylacine development wells, and will be managed under the Otway Operations EP. The equipment that forms part of this EP will be added to Beach's CMMS to facilitate inspection and maintenance of the equipment to ensure it remains in good condition and repair and so as to facilitate future removal and decommissioning. This meets the requirements of the OPGGS Act s572(2). The Otway Operations EP will also detail the requirements to meet OPGGS Act s572(3) to remove all structures when they are no longer used.

3.6 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 2035.

3.6.1 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; and
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.

3.6.2 Decommissioning Environmental Approvals

Decommissioning guidelines will be considered during the decommissioning planning process, including the former Commonwealth Department of Industry, Innovation and Science (DIIS) (now the Department of Industry,

Science, Energy and Resources, DISER) released an Offshore Petroleum Decommissioning Guideline (January 2018); and the NOPSEMA Decommissioning Compliance Strategy (April 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); and
- 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.

3.6.3 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.

3.7 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 3-3.

Table 3-3 Planned Emissions, Discharges and Disturbances

Activity	Description	Planned Emission, Discharge or Disturbance
Installation of new subsea infrastructure		
Lowering of infrastructure into position	Transponders	Benthic disturbance
	Temporary wet-parking (contingency)	
	USBL transponders used for positioning	Underwater sound emissions
T-DIS installation	Installation of the T-DIS on the seabed Installation aids such as alignment frame and clump weights.	Benthic disturbance
Rigid spool installation	Installation of rigid spools	Benthic disturbance
	Installation of concrete mattresses, flange dropped object protection frames, sand / cement bags and grout bags and jetting for stabilisation and span rectification Installation aids such as pipe handling frames and clump weights	
	Cutting tools	Underwater sound emissions
Pre-commissioning Philosophy	Minor discharges of MEG and inhibited potable water or seawater Flushing fluid - MEG and inhibited potable water or seawater (contingency)	Planned marine discharges – pre-commissioning
As-left survey	Visual survey with ROV	None
Support Operations		
Vessels (CSV and HRV)	<ul style="list-style-type: none"> 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
	Deck and navigational lighting	Light emissions
	Hold position and standby	Underwater sound emissions
	Safety exclusion zone (CSV only)	Physical presence – other marine users
ROV operations	Hydraulic control fluid - closed system	None

4 Description of the Environment

The physical, biological and socio-economic environment that may be affected (EMBA) is described in this section, together with the values and sensitivities.

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 EMBA (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 4.4.13 for Key Ecological Features (KEFs) as they are considered as conservation values of the Commonwealth marine area; and in Section 4.4.2 for Australian Marine Parks (AMPs) as they are enacted under the EPBC Act.

4.2 Environment that may be affected

The EMBA by the activity 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 EMBA zones 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 EMBA Zones

EMBA Zones	Description
Operational area	<p>For the activity, the Operational Area is a 1 km radius around the T-DIS installation location (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.</p> <p>The EPBC Protected Matters Report for the operational area is in Appendix A.2.</p>
Spill EMBA	<p>The spill EMBA extends between approximately Wilsons Prom (VIC) in the east, Beachport (SA) in the west and King Island in the south (Figure 4-1).</p> <p>Section 6.14.2 details how the spill EMBA was developed.</p> <p>The EPBC Protected Matters Report for the spill EMBA is in Appendix A.1.</p>

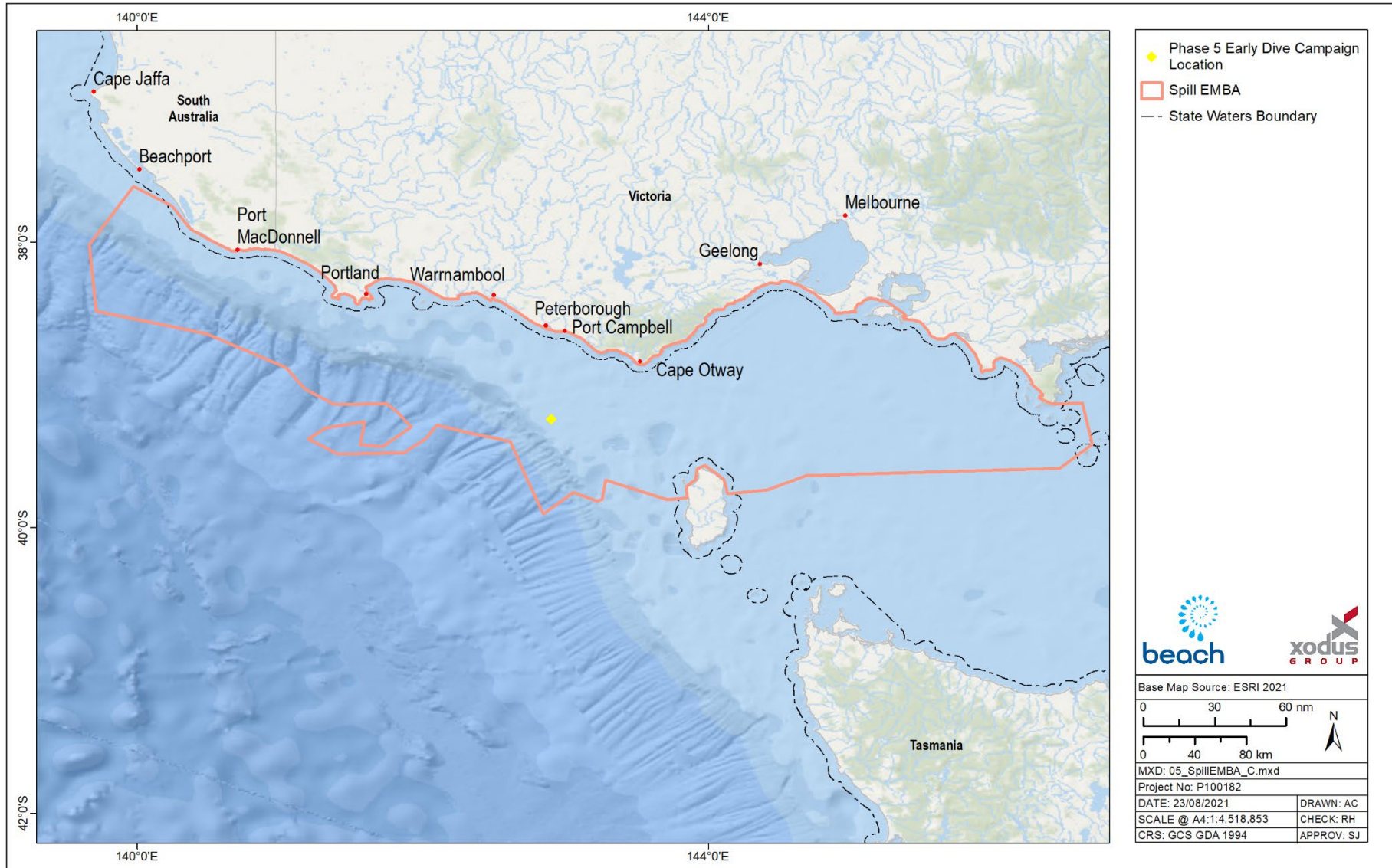


Figure 4-1: Spill EMBA for the Otway Phase 5 Early Dive Installation Campaign

4.3 Regional environmental setting

The operational area and spill EMBA are located within the South-East Commonwealth Marine Region (SEMR), which extends from the south coast of New South Wales to Kangaroo Island in South Australia and around Tasmania (DNP, 2013).

There are significant variations in seafloor features throughout the SEMR including seamounts, canyons, escarpments, soft sediments and rocky reefs, which support high levels of biodiversity and species endemism (DoE 2015a). Compared to other marine areas, the SEMR is relatively low in nutrients and primary production; however localised areas of high productivity are known to occur. There are areas of continental shelf, which includes Bass Strait and Otway Shelf, which have rocky reefs and soft sediments that support a wide range of species. The shelf break increases currents, eddies and upwelling, and the area is especially biodiverse, including species that are fished recreationally and commercially. There are seafloor canyons along the continental shelf which provide habitat for sessile invertebrates such as temperate corals. The Bonney Coast Upwelling KEF is an area of seasonally higher primary productivity which attracts baleen whales and other species (including EPBC-listed species) which feed on the plankton swarms (krill).

The SEMR has a high diversity of species and also a large number of endemic species. The fish fauna in the region includes around 600 species, of which 85% are thought to be endemic. Additionally, approximately 95% of molluscs, 90% of echinoderms, and 62% of macroalgae (seaweed) species are endemic to these waters (DNP, 2013).

4.4 Conservation values and sensitivities

The following section details the conservation values and sensitivities identified within the spill EMBA.

No conservation values or sensitivities were identified in the operational area.

4.4.1 World Heritage Properties

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

4.4.2 Australian Marine Parks

The South-east Commonwealth Marine Reserves (SEMR) Network was designed to include examples of each of the provincial bioregions and the different seafloor features in the region (DNP, 2013). Provincial bioregions are large areas of the ocean where the fish species and ocean conditions are broadly similar. Ten provincial bioregions in the SEMR are represented in the network. As there is a lack of detailed information on the biodiversity of the deep ocean environment, seafloor features were used as surrogates for biodiversity to design the Marine Reserves Network. The SEMR network contains representative examples of the 17 seafloor features found in the Commonwealth waters of the region.

No Australian Marine Parks (AMPs) were identified within the operational area (Appendix A). Three AMPs were identified within the spill EMBA PMST report and are shown in Figure 4-2, the AMPs are:

- Apollo
- Beagle
- Zeehan

All the AMPs, (excluding a Section of Zeehan Marine Park) in whole or part, are classified as International Union for Conservation of Nature (IUCN) VI – Multiple Use Zones, 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 Commonwealth Marine Reserve 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 SEMR are managed under the (SEMR) Network Management Plan (DNP, 2013).

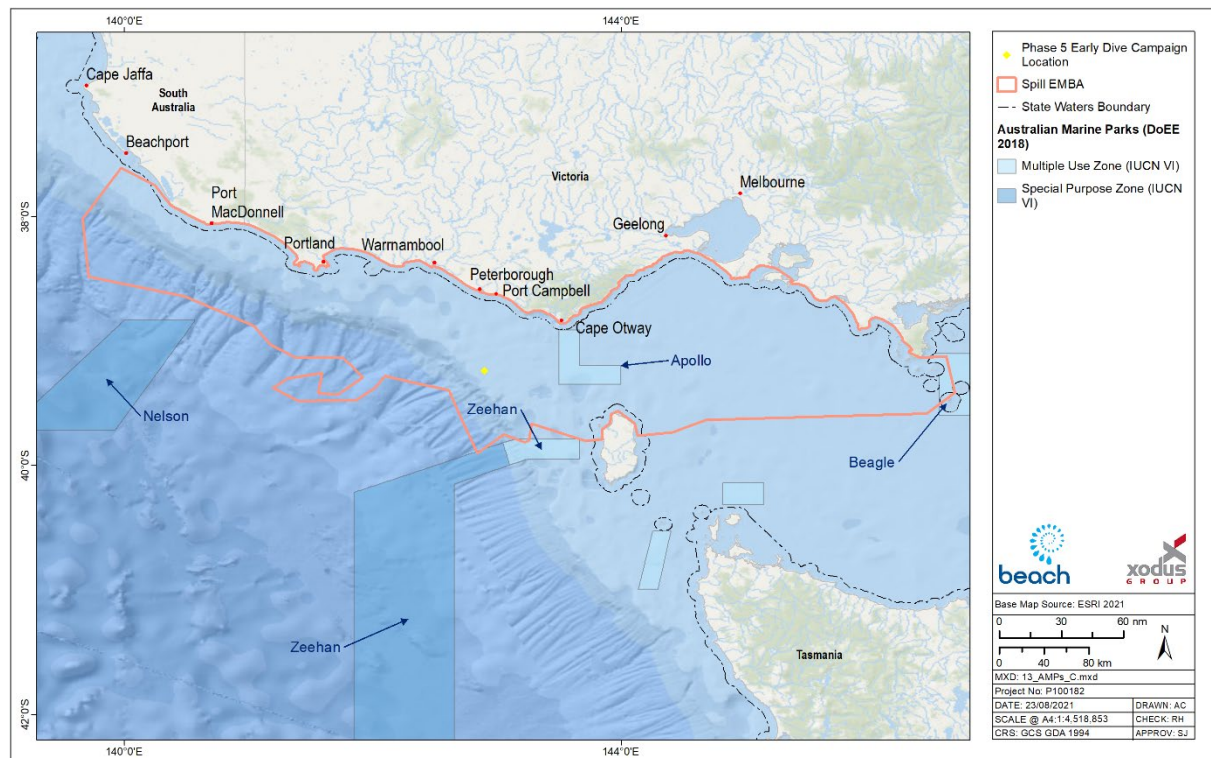


Figure 4-2: Australian Marine Parks within the spill EMBA

4.4.2.1 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 km² 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 rested tern.
- cultural and heritage site - wreck of the MV City of Rayville (DNP, 2013).

4.4.2.2 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 km² (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).

4.4.2.3 Zeehan AMP

The Zeehan AMP covers an area of 19,897 km² to the west and south-west of King Island in Commonwealth waters surrounding north-western Tasmania (DNP, 2013). It covers a broad depth range from the shallow continental shelf depth of 50 m to the abyssal plain which is over 3,000 m deep. The reserve spans the continental shelf, continental slope and deeper water ecosystems of the major biological zone that extends from South Australia to the west of Tasmania. Four submarine canyons incise the continental slope, extending from the shelf edge to the abyssal plains. A rich community made up of large sponges and other permanently attached or fixed invertebrates is present on the continental shelf, including giant crab (*Pseudocarcinus gigas*). Concentrations of larval blue wahoo (*Seriola lalandi*) 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).

4.4.3 National Heritage Places

The places of National Heritage that were identified in the spill EMBA PMST Report (Appendix A) are located onshore, outside the spill EMBA (Figure 4-3), and do not include marine or coastal components. These are:

- Great Ocean Road and Scenic Environs (historic);
- Point Nepean Defence Sites and Quarantine Station Area (historic); and
- Quarantine Station and Surrounds (historic).

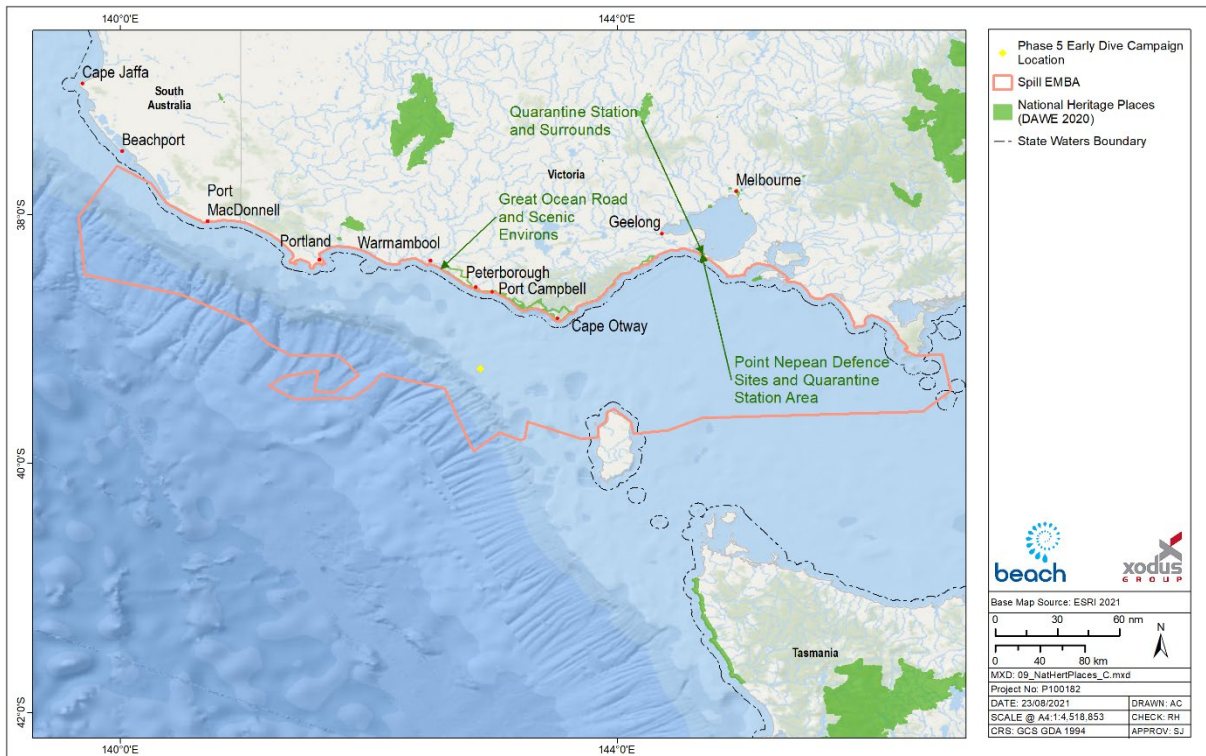


Figure 4-3: National Heritage Places present within the EMBA.

4.4.4 Commonwealth Heritage Places

The spill EMBA PMST Report (Appendix A) identified three Commonwealth Heritage Places, most of which are historic heritage places located on land and therefore are outside the spill EMBA (Figure 4-4). The three heritage places are:

- HMAS Cerberus Marine and Coastal Area (Natural, Listed place);
- Cape Northumberland Lighthouse (Historic, Listed place); and
- Sorrento Post Office VIC (Historic, Listed place).

The HMAS Cerberus Marine and Coastal Area includes natural coastal areas within the spill EMBA and is discussed further below.

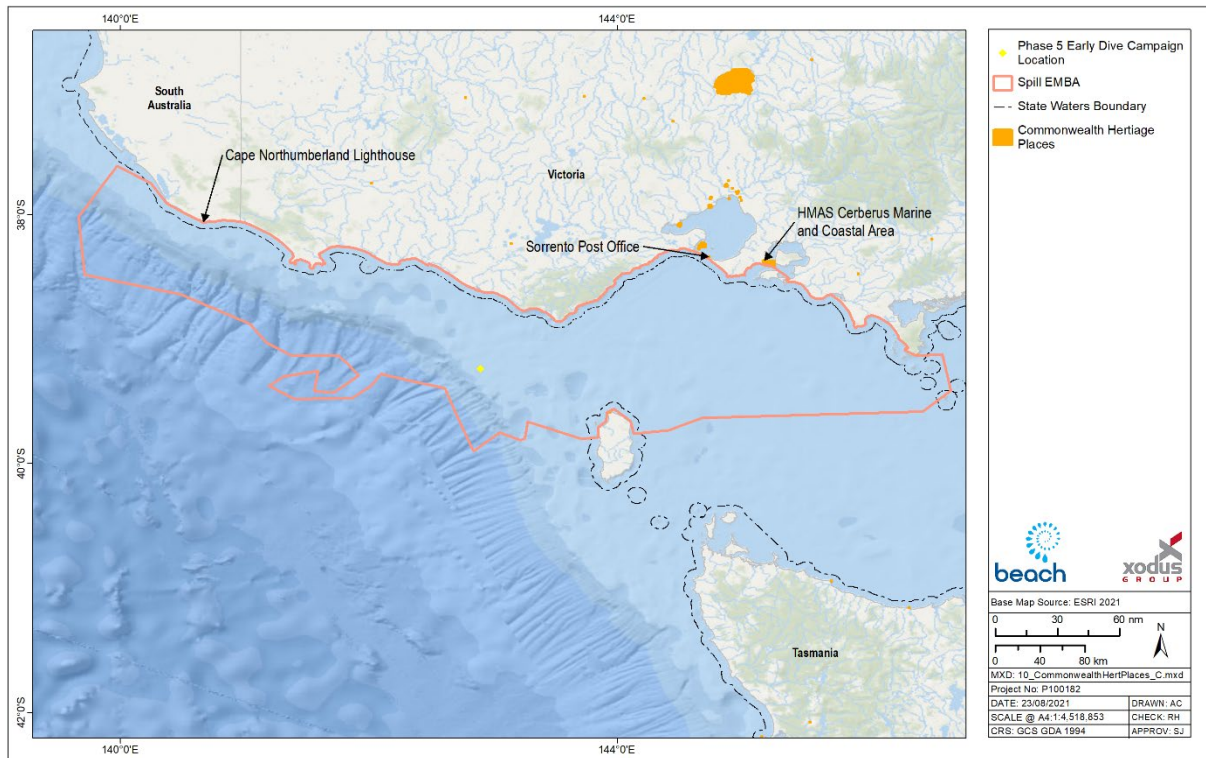


Figure 4-4: Commonwealth Heritage Places present within the spill EMBA

4.4.4.1 HMAS Cerberus Marine and Coastal Area

The Sandy Point/HMAS Cerberus area has high geomorphological, botanical and zoological significance. Sandy Point is one of the largest spit systems on the Victorian coast and one of the State's most dynamic shorelines. Western Port as a whole is a wetland of international significance listed under the Ramsar Convention on Wetlands. It is recognised as the third most important site for migratory and resident waders in Victoria behind Corner Inlet and Swan Bay. The official values of the area include (DotEE, 2004a):

- Relict spits in Hanns Inlet indicate that the sediment regime at the site has changed rapidly, possibly due to the extension of Sandy Point.
- Sandy Point supports some of the best remaining examples of Coastal Banksia Woodland, Coastal Grassy Forest, and Coastal Dune Scrub in the Greater Melbourne region. These communities have been extensively cleared and degraded in the Westernport Catchment and on the Mornington Peninsula.
- Sandy Point is one of the largest spit systems on the Victorian coast and one of the States most dynamic shorelines.
- Continuing shoreline progradation at Sandy Point reveals several stages in sand dune succession.

4.4.5 Wetlands of International Importance

The spill EMBA PMST Report (Appendix A) identified six marine or coastal Wetlands of International Importance (Ramsar-listed wetlands) (Figure 4-5). The ecological character and values of these Ramsar listed wetlands areas are described in the following sections. 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.

Ecological character is the combination of the ecosystem components, processes, benefits and services that characterise the wetland at a given point in time (Ramsar Convention 2005a). Changes to the ecological character

of the wetland outside natural variations may signal that uses of the site or externally derived impacts on the site are unsustainable and may lead to the degradation of natural processes, and thus the ultimate breakdown of the ecological, biological and hydrological functioning of the wetland (Ramsar Convention 1996).

The ecological character description of a wetland provides the baseline description of the wetland at a given point in time and can be used to assess changes in the ecological character of these sites. Therefore, the baseline ecological character description of the Ramsar wetlands are described below. The potential to impact the ecological character of the wetlands is evaluated in the impact and risk assessments in Section 6.

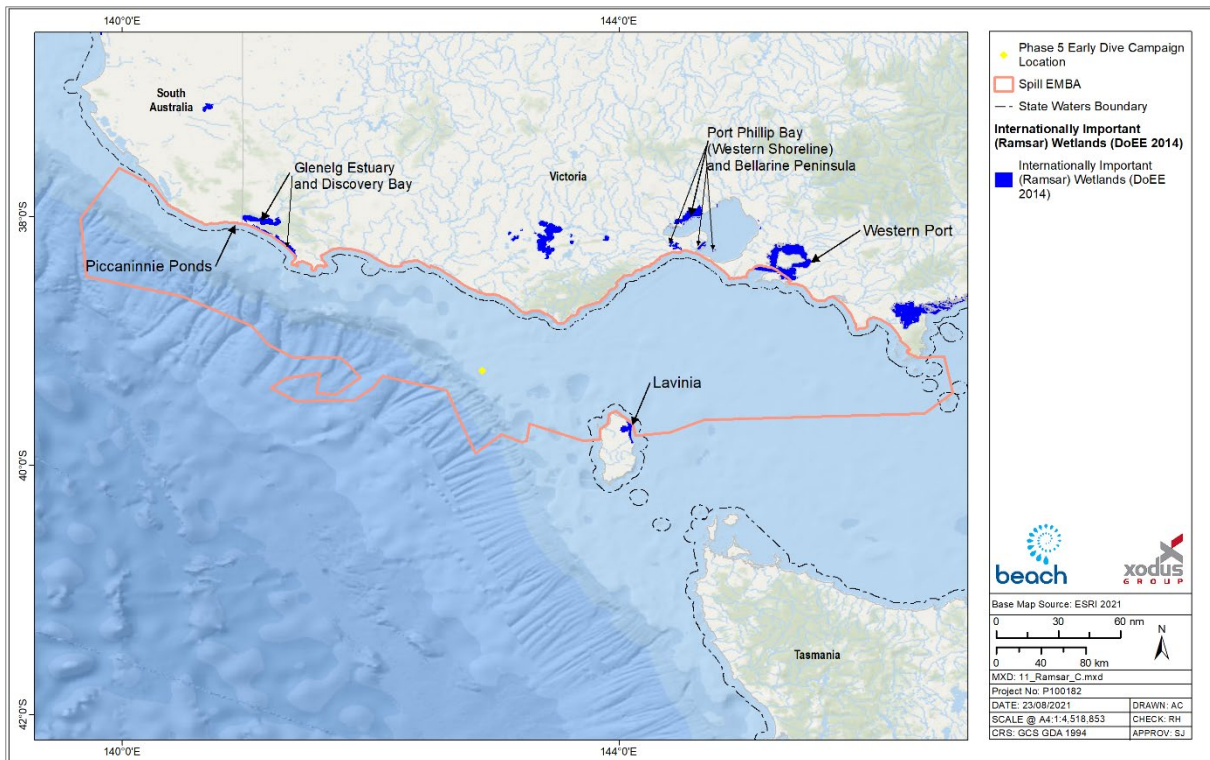


Figure 4-5: Ramsar wetlands within the spill EMBA

4.4.5.1 Corner Inlet

The Corner Inlet Ramsar Site is located approximately 250 km south-east of Melbourne and includes Corner Inlet and Nooramunga Marine and Coastal Parks, and the Corner Inlet Marine National Park. It covers 67,192 ha and represents the most southerly marine embayment and intertidal system of mainland Australia.

The major features of Corner Inlet that form its ecological character are its large geographical area, the wetland types present (particularly the extensive subtidal seagrass beds), diversity of aquatic and semi-aquatic habitats and abundant flora and fauna, including significant proportions of the total global population of a number of waterbird species (BMT WBM, 2011). The description below provides the values and baseline ecological character of the Corner Inlet Ramsar Site.

It is protected by the Corner Inlet Ramsar Site Strategic Management Plan (WGCMA, 2014), which identifies the key values as including:

- A substantially unmodified wetland which supports a range of estuarine habitats (seagrass, mud and sand flats, mangroves, saltmarsh and permanent marine shallow water).

- Presence of nationally threatened species including orange-bellied parrot, Australian grayling, fairy tern and growling grass frog.
- Non-breeding habitats for migratory shorebird species and breeding habitat for variety of waterbirds including several threatened species.
- Important habitats, feeding areas, dispersal and migratory pathways and spawning sites for numerous fish species of direct or indirect fisheries significance.
- Over 390 species of indigenous flora (15 listed species) and 160 species of indigenous terrestrial fauna (22 threatened species) and over 390 species of marine invertebrates.
- A wide variety of cetaceans and pinnipeds including bottlenose dolphins and Australian fur-seals, as well as occasional records of common dolphins, New Zealand fur-seals, leopard seals and southern right whales.
- Significant areas of mangrove and saltmarsh which are listed nationally as vulnerable ecological communities and provide foraging, nesting and nursery habitat for many species.
- Sand and mudflats, when exposed at low tide, which provide important feeding grounds for migratory and resident birds and at high tide provide food for aquatic organisms including commercial fish species (CSIRO, 2005).
- Ports and harbours – the four main ports (Port Albert, Port Franklin, Port Welshpool and Barry's Beach) service the commercial fishing industry, minor coastal trade, offshore oil and gas production and boating visitors.
- Fishing – the area supports the third largest commercial bay and inlet fishery in Victoria, including 18 licensed commercial fishermen, within an economic value of between 5 and 8 million dollars annually (DPI, 2008).
- Recreation and tourism – Corner Inlet provides important terrestrial and aquatic environments for tourism and recreational activities such as fishing, boating, sightseeing, horse riding, scuba diving, bird watching and bushwalking. Corner Inlet attracts at least 150,000 visitors each year (DNRE, 2002).
- Cultural significance to the Gunaikurnai people, with the Corner Inlet and Nooramunga area located on the traditional lands of the Brataualung people who form part of the Gunaikurnai Nation. The area has a large number of cultural heritage sites that provide significant information for the Gunaikurnai people of today about their history. The Bunurong and the Boon Wurrung peoples also have areas of cultural significance in this region.
- Thirty-one shipwrecks are present in the site.
- Research and education – the wildlife, marine ecosystems, geomorphological processes and various assemblages of aquatic and terrestrial vegetation within the Corner Inlet Ramsar Site provide a range of opportunities for education and interpretation.

4.4.5.2 Glenelg Estuary and Discovery Bay wetlands

The description below provides the values and baseline ecological character of the Glenelg Estuary and Discovery Bay Ramsar Site.

The Glenelg Estuary is a large estuarine system consisting of the main channel of the Glenelg River and a side lagoon called the Oxbow. The physical features of the area include a geological setting of Quaternary lacustrine, paludal, alluvial and coastal sediments on Quaternary aeolian sediments (DotEE, 2017a).

The Glenelg Estuary is a high value wetland for its ecological features. This wetland is of special geomorphological interest, being the only estuarine lagoon system in Victoria developed within a framework of dune calcarenite ridges. The Glenelg estuary contains the only remaining relatively undisturbed salt marsh community in western Victoria. Spits at river mouths such as those at Glenelg River provide valuable breeding sites for the little tern. This area is one of the few sites where little tern breed in Victoria.

There are ten wetland types within the Ramsar site generated by the interaction between geomorphology, hydrology and vegetation. Hydrology is a key driver in the characteristic of the site. Water sources for the Glenelg Estuary include groundwater, rainfall, river inflows and tidal exchange. Many of the wetlands in the area are groundwater dependent and are seasonally closed off from tidal exchange. During summer low river flow is unable to move displaced sand from low constructive waves creating a sand barrier. When the estuary refills with fresh water the barrier is breached and open to tidal exchange. This process creates a salt wedge comprising of three distinct layers within the estuary. One of the key geomorphic features in the Ramsar site is the dune slack system. Determined by the hydrology of the dune system, vegetation and breeding of aquatic species is influenced by variations in flooding of the dune system. The site also provides a variety of habitat for waterbird feeding, roosting and breeding. Many migratory shorebirds may use the area as 'staging' areas are important for the bird's survival (DELWP, 2017a). The connection between the marine, estuarine and freshwater components is significant for fish migration and reproduction. There are several fish species contributing to the value of the site with different migratory strategies, also supporting fisheries elsewhere in the catchment (DELWP, 2017a). There is one nationally listed ecological community and eight nationally and internationally listed species of conservation significance supported in the Ramsar site.

The western end of Discovery Bay Coastal Park at the Glenelg Estuary is popular for fishing, boating, walking and other activities. The Major Mitchell Trail meets the coast here: the river mouth marks the end of Major Mitchell's expedition of 1836. The Great South West Walk traverses the estuary. Aboriginal culture: several shell middens and surface scatters exist at Glenelg Estuary (DotEE, 2017a).

4.4.5.3 Lavinia

The description below provides the values and baseline ecological character of the Lavinia Ramsar Site.

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

The shifting sands of the Sea Elephant River's mouth have caused a large back-up of brackish water in the 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 Herbfeld, 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, King 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. 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.

4.4.5.4 Piccaninnie ponds karst wetlands

The description below provides the values and baseline ecological character of the Piccaninnie ponds karst wetlands Ramsar Site.

The Piccaninnie Ponds Karst Wetlands are an example of karst spring wetlands, with the largest and deepest of the springs reaching a depth of more than 110 m. The majority of the water comes from an unconfined regional aquifer and is consistently 14-15°C. The karst springs support unique macrophyte and algal associations, with macrophyte growth extending to 15 m below the surface as a result of exceptional water clarity. A number of different wetland types exist on the site, including a large area of peat fens.

There are four distinct areas of the Ramsar site. Piccaninnie Ponds (also known as Main Ponds) consists of three interconnected bodies of water - First Pond, The Chasm and Turtle Pond - rounded by an area of shrub dominated swamp. Western Wetland consists of dense closed tea-tree and paperbark shrubland over shallow dark clay on limestone soils. Eastern Wetland includes the spring-fed Hammerhead Pond. Pick Swamp, on the extreme west of the site, includes areas of fen, marshes and sedgeland as well as the spring-fed Crescent Pond on peat soils.

The system is an important remnant of an extensive system of wetlands that once occupied much of the south-east of South Australia. The major groundwater discharge points are Main Ponds, Hammerhead Pond and Crescent Pond. Water principally leaves the site via Outlet Creek and the Pick Swamp drain outlet, which connect the site to the sea. There are a number of fresh groundwater beach springs located on the site.

The geomorphic and hydrological features of the site produce a complex and biologically diverse ecosystem which supports considerable biodiversity, including a significant number of species of national and/or

international conservation value. These include the orange-bellied parrot, Australasian bittern and Yarra pygmy perch.

The site attracts 20,000 visitors annually for cave diving, snorkelling, bushwalking, educational activities and birdwatching. The site also has spiritual and cultural value. The Traditional Owners of the land, the Bunganditj (Boandik) and local Indigenous people have a strong connection with the site. Traditionally the site provided a good source of food and fresh water, and evidence of previous occupation still exists (DotEE, 2017b).

The site represents two rare wetland types; karst and fen peatlands. Karst and other subterranean systems are recognised as of global importance and represents one of the few remaining permanent freshwater areas in south east of South Australia. The biota of karst wetlands contributes to the unique element of the regional biodiversity. The site falls within a national biodiversity hotspot and supports nationally and internationally listed species of significance including the critically endangered orange-bellied parrot. The site is also important spawning grounds for species within the freshwater wetlands as well as nearby marine environments. The climate, hydrological and geomorphic components provide a unique habitat. The wetlands are continually fed by groundwater discharge. Water quality in the Main Ponds are characterised by low turbidity and high nitrogen and water clarity. The vegetation is characterised by distinct zones in the karst system while the peatland fens harbour different aquatic species. The site maintains the hydrological regime through constant groundwater discharge. The geomorphology and hydrology of the site support the unique wetlands, provide physical habitat for waterbirds and other species. There are many potential threats to the site including threats to groundwater quality, land clearance, water quality, tourism and introduced species, most of which are controlled under current management (Butcher et al, 2011a).

4.4.5.5 Port Phillip Bay (Western shoreline) and Bellarine Peninsula

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site is in the western portion of Port Phillip Bay, near the city of Geelong in Victoria. The description below provides the values and baseline ecological character of the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site.

The Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar site provides important connective habitat for migratory bird species, habitat for fauna staging and foraging, is home to indigenous cultural sites, provides use of resources, and a site for commercial and recreational activities and education initiatives. The ecological character of the Ramsar site is reliant on the management of human activities and health of environment and water ways. In Victoria, the Victorian Waterway Management Strategy (VWMS) guides the management of rivers, estuaries and wetlands. The Ramsar site Management Plan (DELWP, 2018) aligns with Actions in Water for Victoria by improving waterway health and knowledge of waterways and catchments. Since the requirement for a reduction in nitrogen to ensure the health of the Bay, Melbourne water has undertaken extensive management and monitoring which aimed to maintain the ecological character of the Ramsar Site, specifically targeting six populations: growling grass frog, migratory shorebirds, waterfowl, pied cormorant, straw-necked ibis, whiskered tern (DELWP, 2018).

The Port Phillip Bay Ramsar site consists of a number of component areas that include: parts of the shoreline, intertidal zone and adjacent wetlands of western Port Phillip Bay, extending from Altona south to Limeburners Bay; and parts of the shoreline, intertidal zone and adjacent wetlands of the Bellarine Peninsula, extending from Edwards Point to Barwon Heads and including the lower Barwon River. It is protected under the Port Phillip Bay (Western Shoreline) and Bellarine Peninsula Ramsar Site Management Plan (DELWP, 2018), which defines the key values as;

- Representativeness – it includes all eight wetlands types.
- Natural function – the interactions of physical, biological and chemical components of wetlands that enable them to perform certain natural functions and making them a vital element of the landscape.

- Flora and fauna – contains the genetic and ecological diversity of the flora and fauna of the region, with at least 332 floral species (22 state threatened species) and 304 species of fauna (29 threatened species).
- Waterbirds – provides habitat for migratory shorebirds, including some of international and national importance.
- Cultural heritage – many aboriginal sites, particularly shell middens and artefact scatters have been found at the site.
- Scenic – provide vistas of open water and marshland in a comparatively pristine condition.
- Economic – use of natural resources in agriculture, fisheries, recreation and tourism.
- Education and interpretation – offers a wide range of opportunities for education and interpretation of wildlife, marine ecosystems, geomorphological processes and various assemblages of aquatic and terrestrial vegetation.
- Recreation and tourism – provides activities such as recreational fishing, birdwatching, hunting, boating, swimming, sea kayaking and camping and activities by commercial operators.
- Scientific – site for long-term monitoring of waterbirds and waders.

4.4.5.6 Western Port

The description below provides the values and baseline ecological character of the Western Port Ramsar Site.

Western Port is approximately 60 km south-east of Melbourne, Victoria. In 1982, a large portion was specified of international importance especially as a Waterfowl Habitat (Ramsar Convention). The area consists of large shallow intertidal areas divided by deeper channels with an adjacent narrow strip of coastal land.

Western port Bay is valued for its terrestrial and marine flora and fauna, cultural heritage, recreational opportunities and science value. The area has substantial intertidal areas supported by mangroves, saltmarsh, seagrass communities and unvegetated mudflats, which are significant for its shorebird habitat. Additionally, the saltmarsh and mangroves filter pollutants, trap and process nutrients, stabilise sediments and protect the shoreline from erosion (DSE, 2003). The intertidal mudflats provide significant food source for migratory waders, making it one for the most significant areas in south-east Australia for these birds. The interaction between critical processes and components provide habitat for many waterbirds. The mangrove and saltmarsh vegetation are reported to be of regional, national and international significance because of the role in stabilising the coastal system, nutrient cycling in the bay and providing wildlife habitat. (Ross, 2000). There are three marine parks within the Ramsar sight (Yaringa, French Island and Churchill Island Marine Nation Parks). The Ramsar site is managed by DSE, Parks Victoria, the Victorian Channels Authority, Phillip Island Nature Park, Department of Defence and committees of Management under Crown Lands. There are numerous community and government projects that help monitor, protect, raise awareness and educate the community about the Ramsar site wetland (Brown and Root, 2010).

Western Port is protected under the Western Port Ramsar Site Management Plan (DELWP, 2017d), which describes the values as:

- Supports a diversity and abundance of fish and recreational fishing.
- The soft sediment and reef habitats support a diversity and abundance of marine invertebrates.
- Supports bird species, including 115 waterbird species, of which 12 are migratory waders of international significance.

- Provides important breeding habitat for waterbirds, including listed threatened species.
- Provides habitat to six species of bird and one fish species that are listed as threatened under the EPBC Act.
- Rocky reefs comprise a small area within the Ramsar site, but includes the intertidal and subtidal reefs at San Remo, which support a high diversity, threatened community and Crawfish Rock, which supports 600 species (Shapiro, 1975).
- The Western Port Ramsar Site has three Marine National Parks, one National Park and has been designated as a Biosphere Reserve under the UNESCO’s Man and the Biosphere program.
- The Ramsar site is within the traditional lands of the Boonwurrung, who maintain strong connections to the land and waters.
- The site contains the commercial Port of Hastings that services around 75 ships per year and contributes around \$67 million annually to the region’s economy.

4.4.6 Nationally Important Wetlands

The spill EMBA PMST Report (Appendix A) identified 10 marine or coastal Nationally Important Wetlands (Figure 4-6).

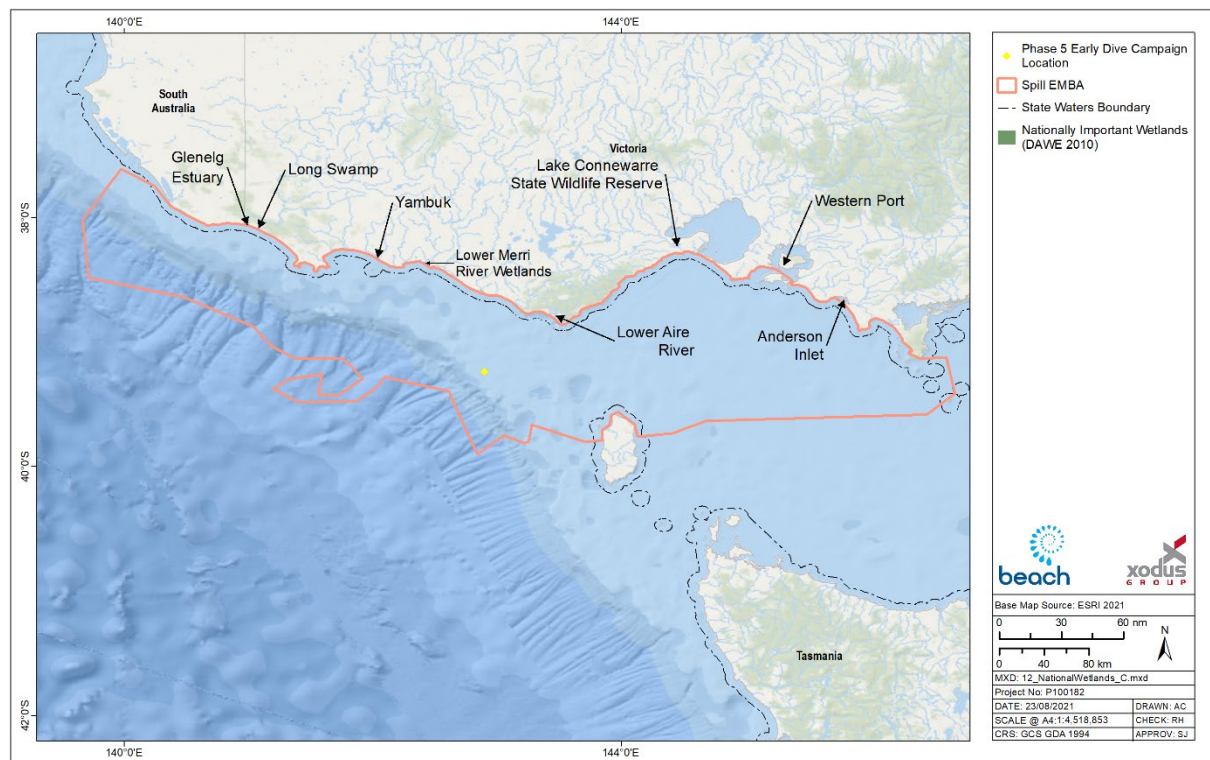


Figure 4-6: Nationally Important Wetlands within the spill EMBA

4.4.6.1 Anderson Inlet

Anderson Inlet is one of the largest estuaries on the Victorian coast. The inlet mouth is permanently open to the sea so that flushing of the estuary constantly occurs. The inlet is of high value for its fauna, including 23 waterbird species. It is popular for recreational fishing, camping, sailing, power-boating and water-skiing.

4.4.6.2 Lake Connewarre State Wildlife Reserve

The Lake Connewarre State Wildlife Reserve consists of an extensive estuarine and saltmarsh system drained by the Barwon River. It includes a large permanent freshwater lake, a deep freshwater marsh, several semi-permanent saline wetlands and an estuary.

Lake Connewarre State Game Reserve is the largest area of native vegetation remaining on the Bellarine Peninsula. The Lake Connewarre State Game Reserve consists of a wide variety of wetland habitats which support a large and diverse waterbird population and contain a significant area of natural vegetation in this part of the South East Coastal Plain.

4.4.6.3 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.

4.4.6.4 Lower Merri River Wetlands

The Lower Merri River Wetlands consist of two connected wetlands developed in a swale between calcareous dune ridges and fed by the Merri River. These wetlands are of high value for their avifauna. There are large areas of Common Reed *Phragmites australis* with Spiky Club-sedge *Schoenoplectus pungens*, saltmarsh and mudflats.

The Lower Merri River Wetlands are of high value for their geomorphology and are a well preserved example of interdunal wetlands fed by a small drainage system.

4.4.6.5 Piccaninnie Ponds

Large spring-fed limestone wetlands bounded by coastal dunes. The site comprises: First Pond, approximately 10 m deep; Turtle Pond, 6 m deep basin at the end of a wide channel; and a 90 m deep chasm which leads into a chamber known as the Cathedral.

The ponds are a unique karst feature of the South East region and are world renowned for cave diving. The wetland is the largest rift in the Gambier Embayment. The site is the only and largest remnant of coastal peat fen reserved in South Australia, and one of a few of its type reserved in Australia.

4.4.6.6 Powlett River Mouth

The Powlett River Mouth provides valuable habitat (saltmarsh vegetation) for the endangered orange-bellied parrot (*Neophema chrysogaster*).

4.4.6.7 Princetown Wetlands

These wetlands consist of swamps of varying salinity on the floodplains of the Gellibrand River and its tributary, the Serpentine (Latrobe) Creek. Wetlands types present are a deep freshwater marsh, semi-permanent saline marshes and a shallow freshwater marsh. The Princetown Wetlands have extensive beds of Common Reed *Phragmites australis* and meadows dominated by Beaded Glasswort *Sarcocornia australis* which can support large numbers of waterbirds.

A series of relict spits adjacent to the Gellibrand Estuary and a number of levee banks at various sites have State significance for their geomorphology.

4.4.6.8 Shallow Inlet Marine & 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 coastal vegetation adjoining Shallow Inlet consists of a number of distinct communities which are relatively intact. Recently described species of significance include the Prom *Sheoke Allocasuarina media* and a *Banksia* sp. of uncertain taxonomic status. Marine flora includes the seagrasses Dwarf Grass-wrack (*Zostera muelleri*) and Tasman Grass-wrack (*Heterozostera tasmanica*).

4.4.6.9 Western Port

Western Port is a large bay with extensive intertidal flats, mangroves, saltmarsh, seagrass beds, several small islands and two large islands. Refer to description in Section 4.4.5.6.

4.4.6.10 Yambuk Wetlands

The Yambuk Wetlands are a network of the estuary of the Eumeralla River and Shaw River (Lake Yambuk), associated freshwater meadows and semi-permanent saline wetlands.

The Yambuk Wetlands are high value for their flora and fauna and they act as drought refuges. The vegetation consists of extensive reed beds and narrow bands of saltmarsh. Lake Yambuk is an excellent example of an estuary with extensive overbank swamps.

4.4.7 Victorian Protected Areas – Marine

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets (DAWE), and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water).

Victoria has a representative system of 13 Marine National Parks and 11 Marine Sanctuaries established under the National Parks Act 1975 (Vic). Seven Marine National Parks and seven marine sanctuaries are located within the spill EMBA as shown in Figure 4-7.

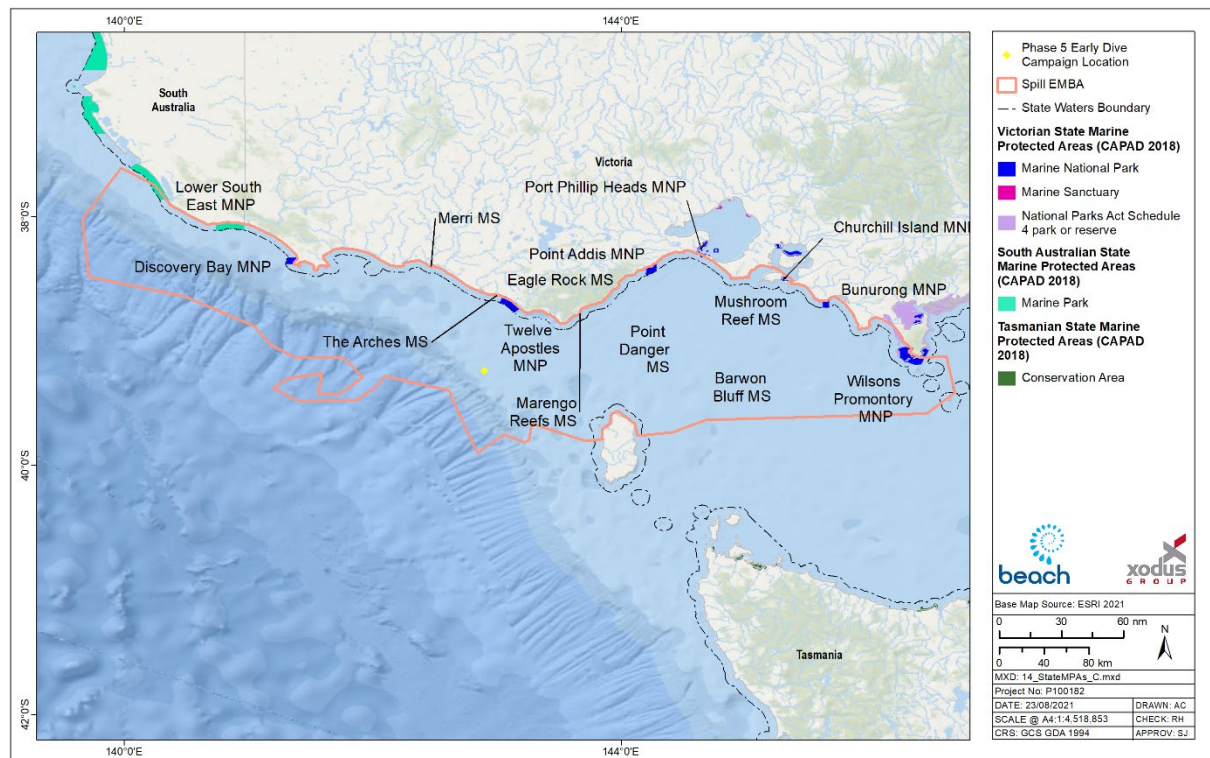


Figure 4-7: State Marine Protected Areas within the spill EMBA

4.4.7.1 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).

4.4.7.2 Churchill Island Marine National Park

Churchill Island is located south of Rhyll, on the eastern shore of Phillip Island. The park extends from Long Point to the north point of Churchill Island. Within the park are numerous marine habitats including mangroves, sheltered intertidal mudflats, seagrass beds, subtidal soft sediments and rocky intertidal shores. Churchill Island Marine National Park is part of the Western Port RAMSAR site, along with the following National Parks:

- Yaringa Marine National Park;
- French Island Marine National Park;
- Sandstone Island; and
- Elizabeth Island.

Churchill Island is an important habitat for many bird species. Migratory waders roost and feed within the Marine National Park including the bar-tailed godwit and the red-necked stint. The seagrass beds are major food sources for many commercially viable species such as king George whiting, black bream and yellow-eyed mullet (Visit Victoria, 2019a).

4.4.7.3 Discovery Bay Marine National Park

The Discovery Bay Marine National Park is situated 20 km west of Portland and covering 2,770 ha and covers part of the largest coastal basalt formation in western Victoria. In deep water (30 – 60 m) there are low reefs forms from ancient shorelines or dunes. There is a rich diversity of marine life within this park due to the cold, nutrient rich waters of the area. The deep calcarenite reefs support diverse sponge gardens whilst the shallower reefs support the brown alga *Ecklonia radiata*. The offshore waters support a diverse array of invertebrates including southern rock lobster, black-lip abalone and gorgonians. The waters also support great white sharks and blue whales during the summer breeding season. The Discovery Bay National Park is protected as part of the

Ngootyoong Gunditj Ngootyoong Mara South West Management Plan (Parks Victoria, 2015) which covers over 116,000 ha of public land and freehold Gunditjmaraland in south-western Victoria. The Plan (Parks Victoria, 2015) describes some key values of the Discovery Bay (which includes the National Park and the coastal reserve), namely:

- Recognised roosting, feeding and nesting area for birds such as the hooded plover.
- Important habitat for the orange-bellied parrot.
- Subtidal reefs with giant kelp forest communities (TEC).
- A foredune and dune complex that was formerly recognised on the National Estate.
- Surfing, boating and passive recreation.
- Tourism such as dune buggy tours.

4.4.7.4 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.

4.4.7.5 Port Phillip Heads Marine National Park

Port Phillip Heads Marine National Park is an area of 35.8 km² that is located at the southern end of Port Phillip bay. Many areas within the Port Phillip Heads Marine National Park are popular for a range of recreational activities.

The habitats that are found within the park are seagrass beds, sheltered intertidal mudflats, intertidal sandy beaches and rocky shores, subtidal soft substrate and rocky reefs. The bay has a high diversity and abundance of marine flora and fauna that provides a migratory site for wader birds (Visit Victoria, 2019b).

4.4.7.6 Twelve Apostles Marine National Park

The Twelve Apostles Marine National Park (75 km²) 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 m². 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 cited in Barton et al., 2012). 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).

4.4.7.7 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).

4.4.7.8 Marengo 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.

4.4.7.9 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.

4.4.7.10 Barwon Bluff Marine Sanctuary

Barwon Bluff Marine Sanctuary (17 ha) is located at Barwon Heads, approximately 100 km south-west of Melbourne. The Barwon Bluff Marine Sanctuary Management Plan (Parks Victoria, 2007b) identifies the environmental, cultural and social values as:

- Intertidal reef platforms with a high diversity of invertebrate fauna and flora.
- Subtidal reefs that support diverse and abundant flora, including kelps, other brown algae, and green and red algae.
- Calcarene and basalt reefs extending from The Bluff that are of regional geological significance.
- Intertidal habitats that support resident and migratory shorebirds, including threatened species.
- Subtidal habitats that support sedentary and mobile fish and are also used by migratory marine mammals.
- Marine habitats and species that are of scientific interest and valuable for marine education.
- Opportunities for underwater recreation, including visits to subtidal communities that are easily accessible from the shore.
- Outstanding coastal vistas, seascapes and underwater scenery.
- An important landmark and area for gathering fish and shellfish for the Wathaurong people.
- A strong historic and ongoing connection with marine education.
- Remnants from the Earl of Charlemont, a heritage-listed shipwreck.

4.4.7.11 Eagle Rock Marine Sanctuary

Eagle Rock Marine Sanctuary (17 ha) is about 40 km south-west of Geelong, close to Aireys Inlet. The sanctuary extends from high water mark around Split Point between Castle Rock and Sentinel Rock. It extends offshore for about 300 m and includes Eagle Rock and Table Rock. The main habitats protected by the sanctuary include intertidal and subtidal soft sediment, intertidal and subtidal reefs, and the water column. It is managed in conjunction with Point Addis Marine National Park and Point Danger Marine Sanctuary.

4.4.7.12 Merri Marine Sanctuary

The Merri Marine Sanctuary is on the Victorian south-west coast near Warrnambool, approximately 260 km west of Melbourne. Merri Reefs Marine Sanctuary (25 ha) is located at the mouth of the Merri River, west of Warrnambool Harbour. Merri Marine Sanctuary contains a mixture of habitats, including intertidal reef, sand, shallow reef and rocky overhang. These areas provide a nursery for many fish species and a habitat for many algae species, hardy invertebrates and shorebirds. Bottlenose dolphins and fur seals are regular visitors to the shore (Parks Victoria, 2007c).

The Sanctuary is protected with the Merri Marine Sanctuary Management Plan (Parks Victoria, 2007c) identifies the environmental, cultural and social values as:

- Culturally significant to indigenous communities that have a long association with the area.
- Merri River, wetlands and islands and headlands provide a variety of habitats.
- Provision of nursery for many fish species and habitat for algal species, hardy invertebrates and shorebirds.

4.4.7.13 Mushroom Reef Marine Sanctuary

The Mushroom Reef Marine Sanctuary is on the Bass Strait coast at Flinders near the western entrance to Western Port, 92 km by road south of Melbourne. The Sanctuary (80 ha) abuts the Mornington Peninsula National Parkland and extends from the high-water mark to approximately 1 km offshore. The Sanctuary is protected under the Mushroom Reef Marine Sanctuary Management Plan (Parks Victoria, 2005b) which identifies the environmental, cultural and social values as:

- Numerous subtidal pools and boulders in the intertidal area that provide a high complexity of intertidal basalt substrates and a rich variety of microhabitats.
- Subtidal reefs that support diverse and abundant flora including kelps, other brown algae, and green and red algae.
- Sandy bottoms habitats that support large beds of *Amphibolis* seagrass and patches of green algae.
- Diverse habitats that support sedentary and migratory fish species.
- A range of reef habitats that support invertebrates including gorgonian fans, seastars, anemones, ascidians, barnacles and soft corals.
- A distinctive basalt causeway that provides habitat for numerous crabs, seastars and gastropod species.
- Intertidal habitats that support resident and migratory shorebird species including threatened species.
- An important landmark and area for gathering fish and shellfish for the Boonwurrung people.
- excellent opportunities for underwater recreation activities such as diving and snorkelling among accessible subtidal reefs.

4.4.7.14 Point Danger Marine Sanctuary

Point Danger Marine Sanctuary (25 ha) is 20 km south-west of Geelong, close to the township of Torquay and nearby Jan Juc. It extends from the high-water mark at Point Danger offshore for approximately 600 m east and 400 m south, encompassing an offshore rock platform. It is managed in conjunction with Point Addis Marine National Park and Eagle Rock Marine Sanctuary.

4.4.8 Victorian Protected Areas – Terrestrial

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets (DAWE) and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water). Figure 4-8 details that there are several Victorian National Parks, Coastal Parks and Wildlife Reserves within the spill EMBA.

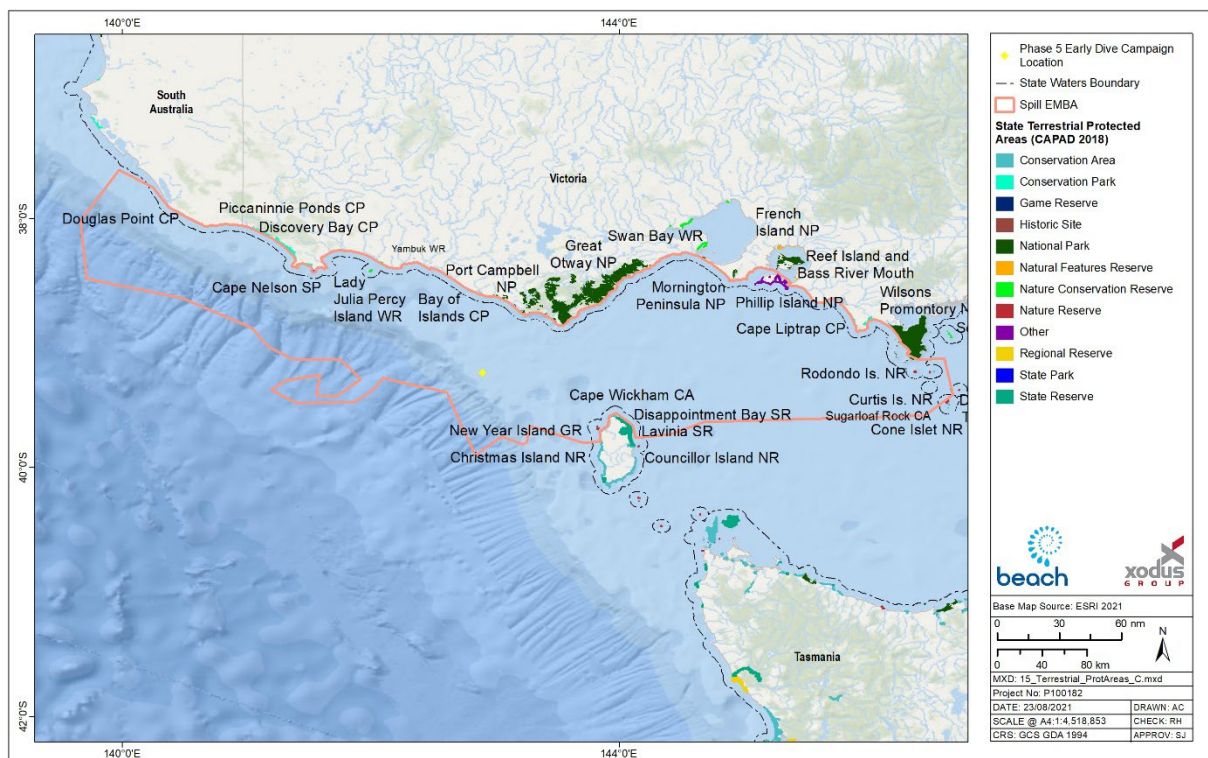


Figure 4-8: State Terrestrial Protected Areas within the spill EMBA

4.4.8.1 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.

4.4.8.2 Cape Nelson State Park

Cape Nelson State Park is near Portland on Victoria's southwest coast with an area of 243 ha. The park offers an archaeologically, ecologically and geologically rich and diverse attractions.

4.4.8.3 Discovery Bay Coastal Park

The Discovery Bay Coastal Park is a remote coastal park that protects 55 km of ocean beach. Inland, the park encompasses high coastal cliffs, sand dunes, freshwater lakes and swamps, with thriving coastal vegetation and wildlife. The park extends along the coast of Discovery Bay from Cape Nelson north-westwards to the border of South Australia, covering an area of 10,460 ha (Parks Victoria, 2015).

4.4.8.4 Douglas Point Conservation Park

Douglas Point Conservation Park is popular for recreational bush walking, bird watching, fishing, diving and surfing that is located 11 km north-west of Port MacDonnell. The park has natural and cultural values and conserves the coastal health habitat and associated endangered and vulnerable plant and animal species (DEH, 2003).

4.4.8.5 French Island National Park

The French Island National Park is located 10 km south of Tooradin, French Island Marine National Park is adjacent to the northern shoreline of French Island National Park in Western Port. Extending 15 km along the shoreline, the park encompasses approximately 2800 ha. It includes one of Victoria's most extensive areas of saltmarsh and mangrove communities and also includes mudflats of state geomorphological significance (Parks Victoria, 2019a).

4.4.8.6 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.

4.4.8.7 Lady Julia Percy Island Wildlife Reserve

Lady Julia Percy Island is off the coast of Victoria near Port Fairy. It is one of the two largest breeding sites for the Australian fur seal species in Australia (DoE, 2017a) and provides habitat to migratory seabirds. There is no management plan for Lady Julia Percy Island Wildlife Reserve.

4.4.8.8 Mornington Peninsula National Park

Mornington Peninsula National Park is situated about 70 km south of Melbourne. Mornington Peninsula National Park runs along the coast from Point Nepean, at the western tip of the Mornington Peninsula, to Bushrangers Bay, where it turns inland along the Main Creek valley, still as a narrow band, until it joins the more expansive Greens Bush section of the Park. This park protects the terrestrial environment above the low water mark of this coastline. The Park is managed under the Mornington Peninsula National Park and Arthurs Seat State Park Management Plan, which has identified the key environmental, social and cultural values as (Parks Victoria, 2013):

- Largest and most significant remaining areas of native vegetation on the Mornington Peninsula. Numerous sites and features of geomorphic significance, particularly along the coast (cliffed calcarenite coast sandy forelands and basalt shore platforms).
- Only representation in the Victorian conservation reserve system of four land systems formed within the Southern Victorian Coastal Plains and the Southern Victorian Uplands.
- Many significant native plants and vegetation communities, especially in Greens Bush and former McKellar Flora Reserve, and the most extensive remnant coastal grassy forest habitat on the Mornington Peninsula.
- Highly scenic landscape values along the ocean coast and at Port Phillip heads and the prominent landscape feature of Arthurs Seat.
- Many significant fauna species, including populations of the nationally significant hooded plover, over 30 species of State significance and many species of regional significance.
- High quality marine and intertidal habitats, with some pristine areas within Point Nepean.

- Nationally significant and fascinating historic sites at Point Nepean.
- The historic Seawinds Gardens in Arthurs Seat State Park.
- One of the highest recorded densities of Aboriginal archaeological sites along the Victorian Coast
- South Channel Fort is an important component of the historic fortification defence system of Port Phillip (and an important bird nesting and roosting site).
- Spectacular scenery and popular surf beaches associated with a wild and rugged coastline.
- Local and regional economic benefits.
- Intensively used recreational nodes, e.g. at Portsea, Sorrento, Cape Schanck and Arthurs Seat.

4.4.8.9 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.

4.4.8.10 Piccaninnie Ponds Conservation Park

The Piccaninnie Pond covers an area of 8.64 km², that has a wide diversity of fauna and flora with 60 bird species and six vegetation communities. Other vegetation found within the park includes reeds, sedge swamp, open heath and tussock grassland.

4.4.8.11 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).

4.4.8.12 Reef Island and Bass River Mouth Nature Conservation Reserve

Reef Island and Bass River Mouth Nature Conservation Reserve is situated on the eastern shores of Westernport Bay. Reef Island is accessible at low tide via a narrow spit. The day visitor area on the banks of the Bass River is ideal for fishing and bird watching. There is no management plan for this Conservation Reserve,

4.4.8.13 Swan Bay Wildlife Reserve

Swan Bay Wildlife Reserve is an internationally recognized wetland and marine ecosystem within Port Phillip Bay. Swan Bay supports diverse saltmarsh communities which form part of the habitat critical for survival of the endangered orange bellied parrot and is an important recreational and tourism resource.

4.4.8.14 Wilsons Promontory National Park

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.

4.4.8.15 Yambuk Wetlands Natural Conservation Reserve

Yambuk Wetlands Natural Conservation Reserve is located south of Lake Yambuk along the coastline with an area of 0.77 km² (Protected Planet, 2019).

4.4.9 Tasmanian Protected Areas - Marine

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets from the DAWE, and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water).

As per Figure 4-7 there are no marine Tasmanian Protected Area is within the spill EMBA.

4.4.10 Tasmanian Protected Areas – Terrestrial

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets (DAWE), and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water).

Figure 4-8 details that there are several Tasmanian National Reserves, Conservations Areas and Game Reserves within the spill EMBA.

4.4.10.1 Cape Wickham Conservation Area

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

4.4.10.2 Christmas Island Nature Reserve

Christmas Island is located off the west coast of King Island. It is designated IUCN 1a which is a strict nature reserve, which allows minimal human use (DPIPWE, 2015). It is a BIA for both breeding and foraging for the little penguin (DAWE, 2021). There is no management plan for the Christmas Island Nature Reserve.

4.4.10.3 Curtis Island Nature Reserve

Curtis Island is located in the Bass Strait between Wilsons Promontory and Tasmania. It is designated IUCN 1a which is a strict nature reserve, which allows minimal human use (DPIPWE, 2015). It has a large population of breeding seabirds and waders (Carlyon et al., 2011). It is also a recognised BIA for breeding and feeding for little penguins (DAWE, 2021). There is no management plan for the Curtis Island Nature Reserve.

4.4.10.4 Disappointment Bay State Reserve

The Disappointment Bay State Reserve is located on the north coast of King Island. It is designated IUCN II which is a national park (DPIPWE, 2015). There is no management plan for the Disappointment Bay State Reserve.

4.4.10.5 Lavinia State Reserve

Lavinia State Reserve is located on the north-east coast of King Island. The reserve contains a number of rare birds, including the endangered orange-bellied parrot (DPIPWE, 2013). It includes the Lavinia Ramsar site and two freshwater lakes. Lavinia Beach is a popular location for surfing and fishing.

4.4.10.6 New Year Island Game Reserve

New Year Island is located on the north-west coast of King Island. It is a game reserve for the muttonbird (short-tailed shearwater), with non-commercial harvesting of the species permitted during the open season.

4.4.10.7 Rodondo Island Nature Reserve

Rodondo Island is located in Bass Strait, approximately 10 km south of Wilsons Promontory. Both Australian and New Zealand fur-seal have haul-out sites on Rodondo Island (Carlyon et al, 2015). It hosts a number of breeding seabirds, with the short-tailed shearwater being the most common (Carlyon et al, 2015).

4.4.10.8 Sugarloaf Rock Conservation Area

Sugarloaf Rock is a small granite island, with an area of 1.07 ha, in south-eastern Australia. It is part of Tasmania's Curtis Group, lying in northern Bass Strait between the Furneaux Group and Wilson's Promontory in Victoria. Known breeding sites for the fairy prion and common diving-petrel along with known haul-out site for the Australian fur-seals.

4.4.11 South Australian Protected Areas - Marine

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets (DAWE), and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not

Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water).

One South Australian marine park, the Lower South East Marine Park, was identified in the spill EMBA (Figure 4-7).

The Lower South East Marine Park covers 360 km² and is divided into two sections: the area adjacent to Canunda National Park; and the area extending from Port MacDonnell Bay just west of French Point to the South Australian - Victorian border. The marine park borders Canunda National Park and partially overlays Piccaninnie Ponds Conservation Park.

The Lower South East Marine Park Management Plan 2012 (DEWNR, 2012) details the following values:

- High diversity of plants and animals, including blue whales, due to the influence of the Bonney coast upwelling, an ocean current that supplies nutrient-rich water to the area.
- Diverse range of habitats ranging from high-energy sandy beaches and freshwater springs, various reef types (shore platforms, fringing and limestone).
- Kelp forests and algal communities and is strongly influenced by natural processes such as the Bonney coast upwelling.
- Spring lakes such as Ewen Ponds and Piccaninnie Ponds (both Wetlands of National Importance) emerge from the beaches and are unusual in South Australia.
- Habitat for several threatened or potentially threatened species that require freshwater and marine environments during their lifecycle, including the pouched lamprey, short-headed lamprey and shortfinned eel.
- Feeding and resting grounds for migratory and resident shorebirds.
- Recreational activities including fishing, diving and snorkelling.
- Commercial fisheries including the Southern Zone Abalone Fishery, the Southern Zone Rock Lobster Fishery, the Marine Scalefish Fishery, the Charter Fishery and the Miscellaneous Giant Crab Fishery.
- The Buandig Aboriginal people have traditional associations with areas of the marine park.

4.4.12 South Australian Protected Areas - Terrestrial

Identification of State Parks and Reserves (marine and terrestrial) was undertaken in GIS, using the CAPAD2018_marine and CAPAD2018_terrestrial geodatasets (DAWE), and the spill EMBA boundary. Both the protected area geodatabases were filtered for those protected areas managed by State authorities (i.e. not Commonwealth reserves) and for protected areas that include land/water below high tide mark (i.e. excludes those whose management areas are only above high water).

As per Figure 4-8, there are no terrestrial South Australian Protected Areas within the spill EMBA.

4.4.13 Key Ecological Features

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

The spill EMBA PMST Report (Appendix A) identified two KEFs:

- Bonney Coast Upwelling; and
- West Tasmanian Marine Canyons

The Bonney Coast Upwelling KEF is situated ~107 km to the west of the operational area, while the West Tasmania Canyon is situated ~16 km south of the operational area.

The following KEF have not been spatially defined, and are identified as potentially occurring within the spill EMBA:

- Shelf Rocky Reefs and Hard Substrates; and
- Bass Cascade

No spatially defined KEFs were identified within the operational area (Figure 4-9).

4.4.13.1 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 4-9). 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).

4.4.13.2 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 km² 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).

4.4.13.3 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).

4.4.13.4 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).

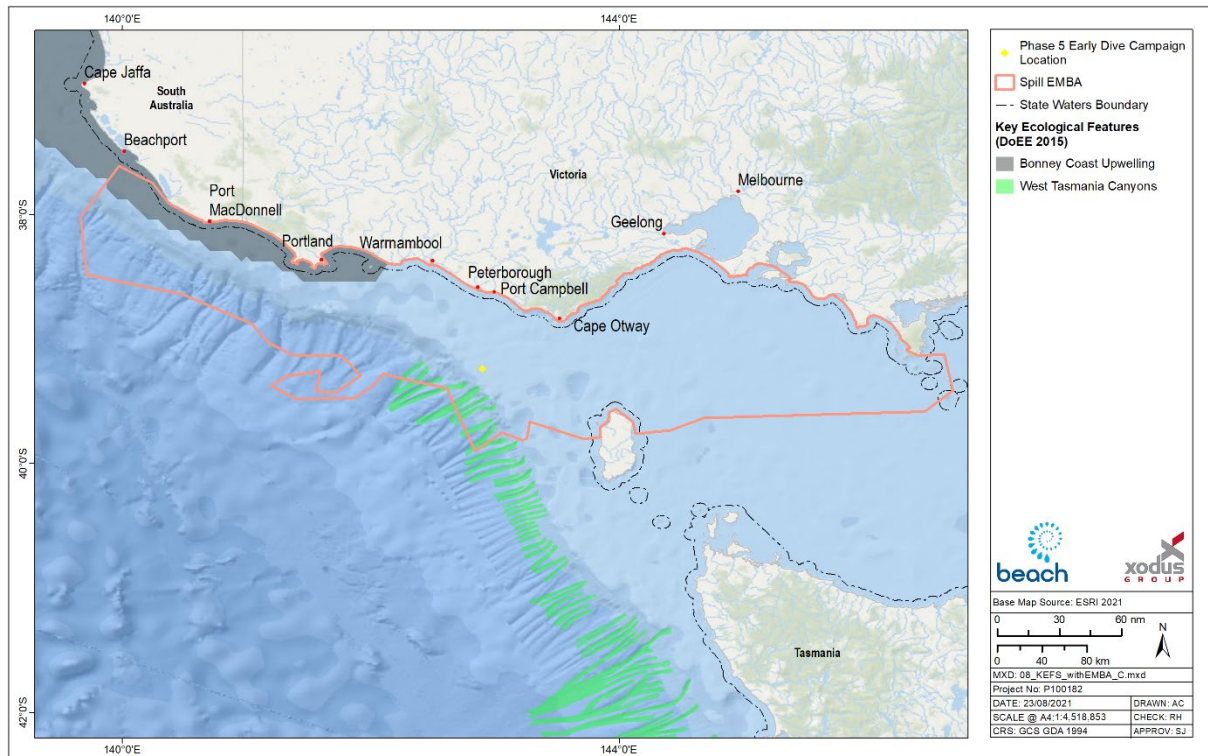


Figure 4-9: Spatially defined Key Ecological Features present within the spill EMBA

4.5 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.

4.5.1 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 4-10).

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

The shallow shelf contains 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.

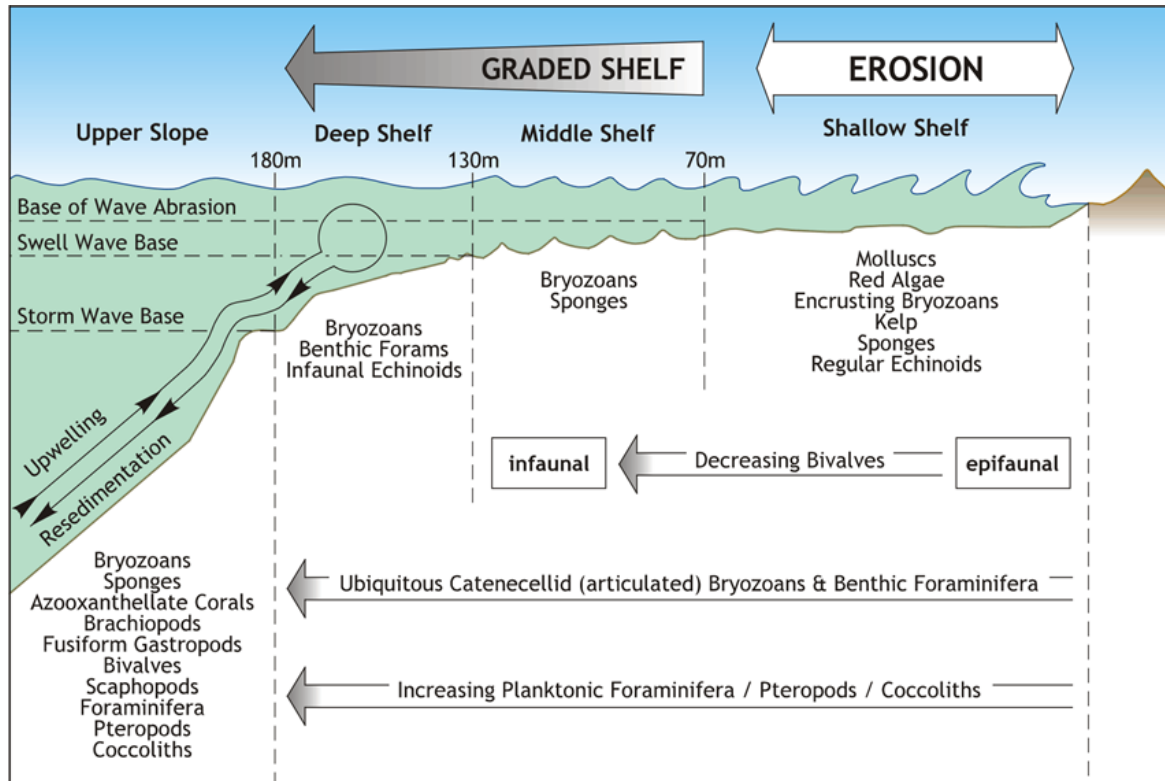


Figure 4-10: Model of the geomorphology of the Otway Shelf

4.5.2 Otway assessments and surveys - EMBA

A comprehensive assessment of the coast to continental shelf margin has been undertaken within approximately 4 km² 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 4-2 to Table 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
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		Very low density sessile; large sponge.

Depth (m)	Seabed morphology	Benthic assemblage
79	Low profile with areas of high profile limestone ridges; incomplete sand veneer	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	Coarse 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 4-11). 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.

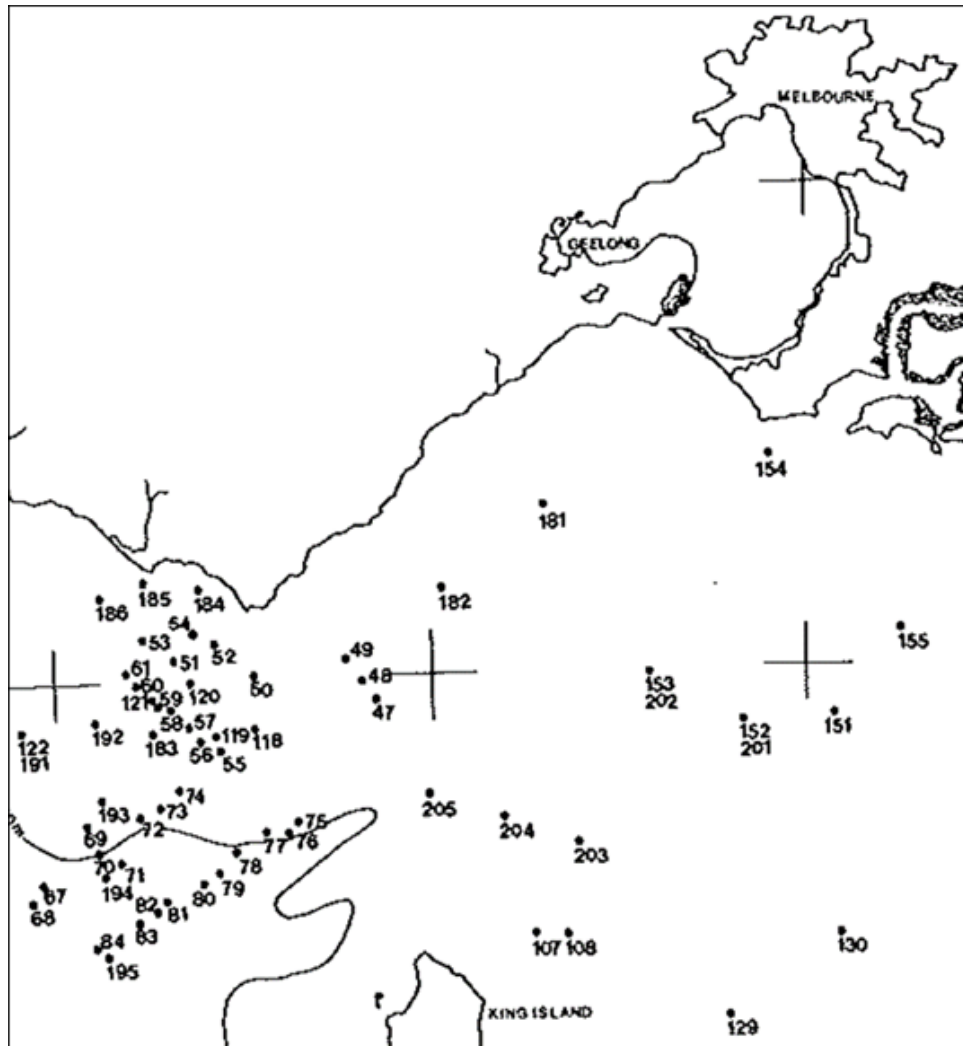


Figure 4-11: Sampling sites for the Bass Strait survey in the region of the spill EMBA (Wilson and Poore, 1987)

Table 4-7: Classification of surficial sediments sampled during the Bass Strait survey in the vicinity of the EMBA (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
61	68	Coarse sand	ND

Site No.	Depth (m)	Surficial sediments	Carbonate % by weight
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

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 4-12). BBG (2003) found that the substrate in water depths between 82 and 66 m (such as those in the operational area) 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 (such as is found in the spill EMBA), 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
3267	88	Low profile with areas of high profile limestone ridges; incomplete sand veneer.	Diverse, high density sessile: sponge, dominated and mobile species

Site No.	Depth (m)	Seabed type	Benthic Assemblage
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 fine sand	High density sessile: micro algae dominated
1668	53	Sand	None observed

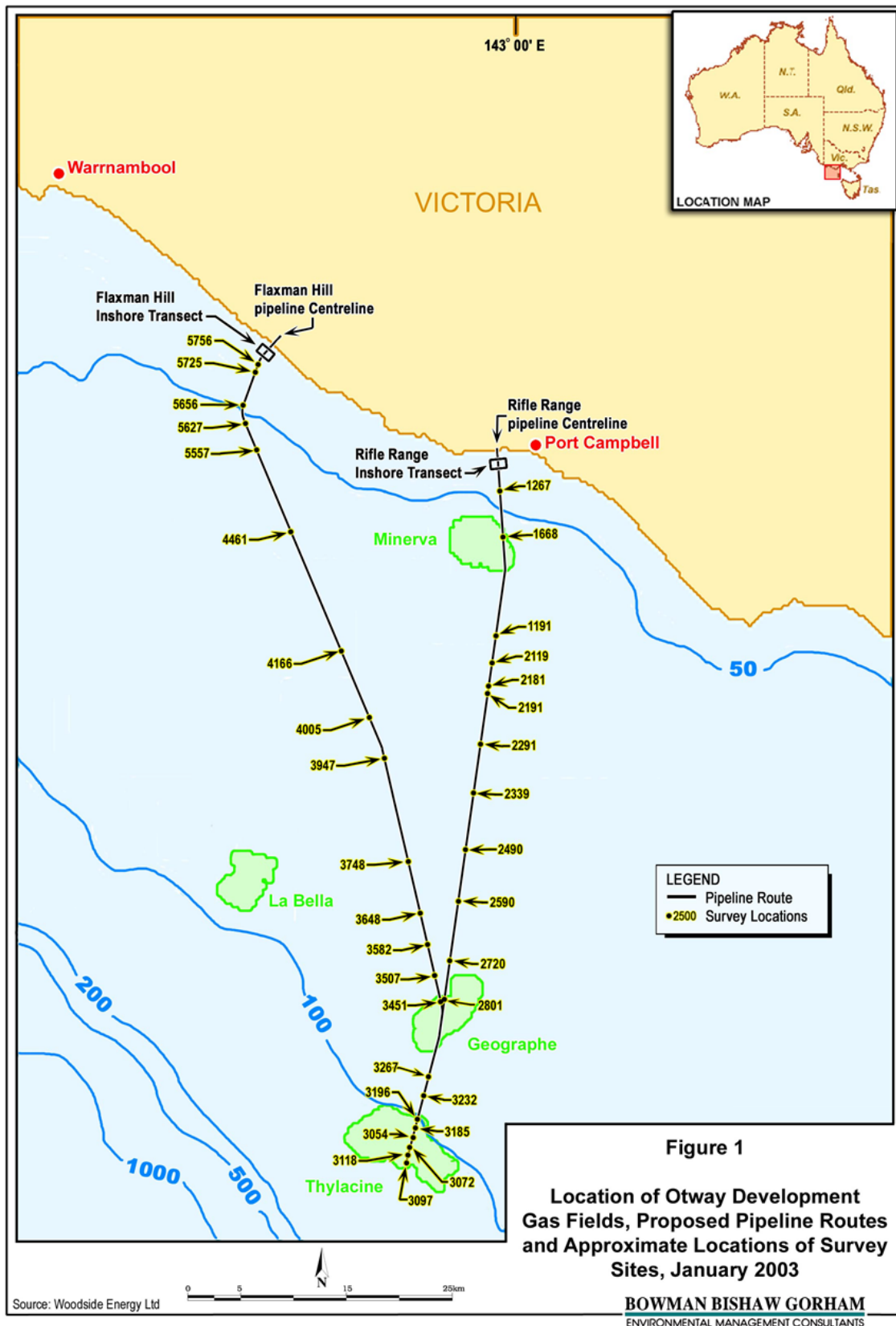


Figure 4-12: Seabed sites assessed by video survey during 2003 (BBG, 2003)

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 4-13.

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 E). 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 within the spill EMBA), while sampling at the Thylacine field is within the operational area.

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 E).

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% (Figure 4-13). Of the individual epibenthic organisms, Gastropoda sp. 2 (a cone shell) and crinoids (featherstars) were the most abundant. Further analysis of epifauna from a grab samples at Artisan (representative of the spill EMBA) 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 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 m² on average but could be found in patches of at least 0.4 m². 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 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 EMBA. In summary the seabed of the EMBA 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. Six basalt rises occur in the eastern and south-eastern section of the EMBA, the largest of which is the 'Big Reef'.

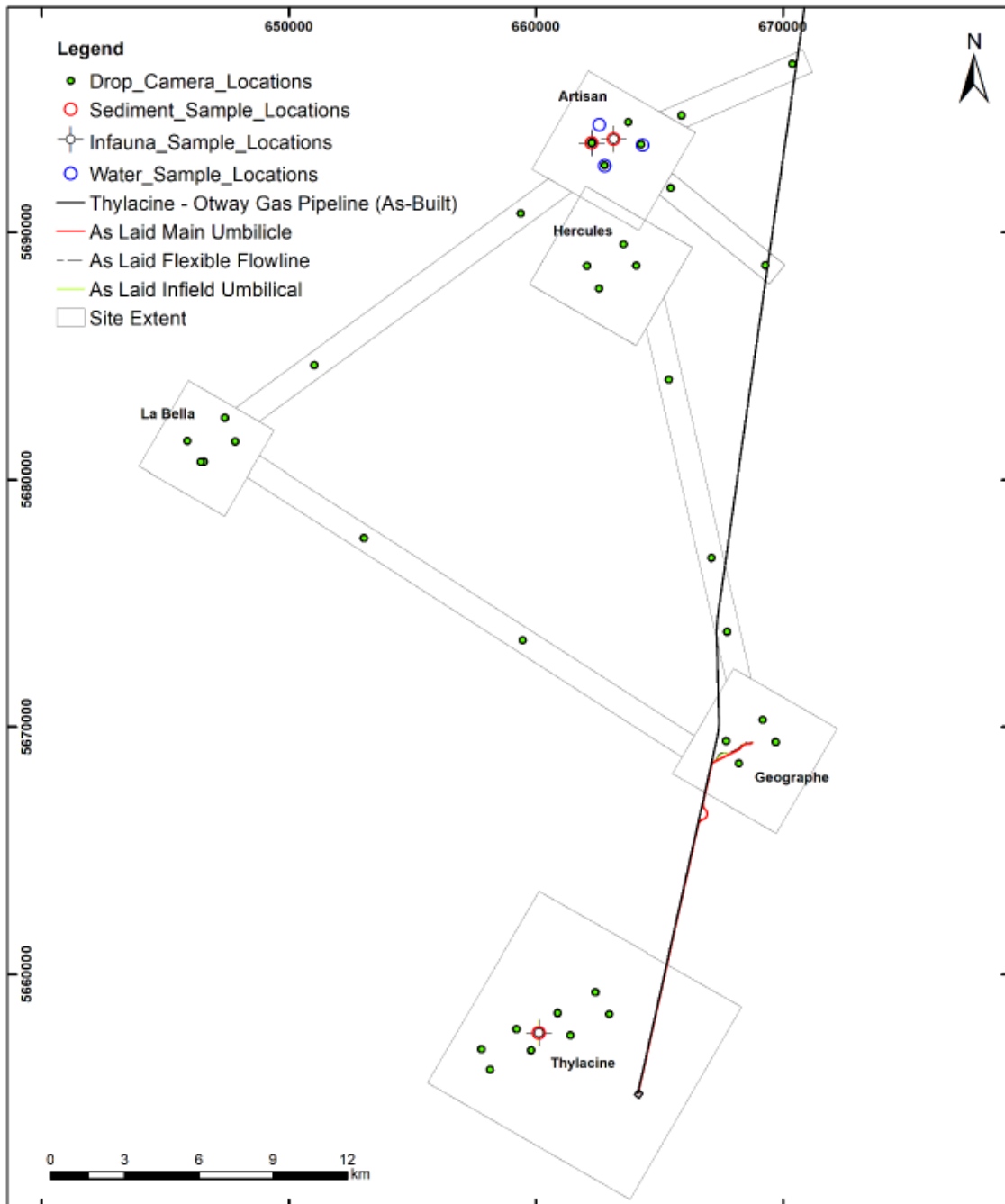


Figure 4-13: Location of the Otway Gas Development seabed site assessment

4.5.3 Otway assessments and surveys- Operational area

As detailed in Section 4.5.2, Beach commissioned a seabed site assessment for the Otway Gas Development, from November 2019 to January 2020, and in water depths ranging from 70 m to 104 m. The survey extent included the gas fields and infrastructure routes are shown in Figure 4-13.

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. Information gathered is also relevant to the Phase 5 Early Dive Installation Campaign activities 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 Thylacine gas field 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 gas field (Ramboll, 2020. Appendix E). The drop camera locations are shown in Figure 4-14. 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 comprises 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.

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.

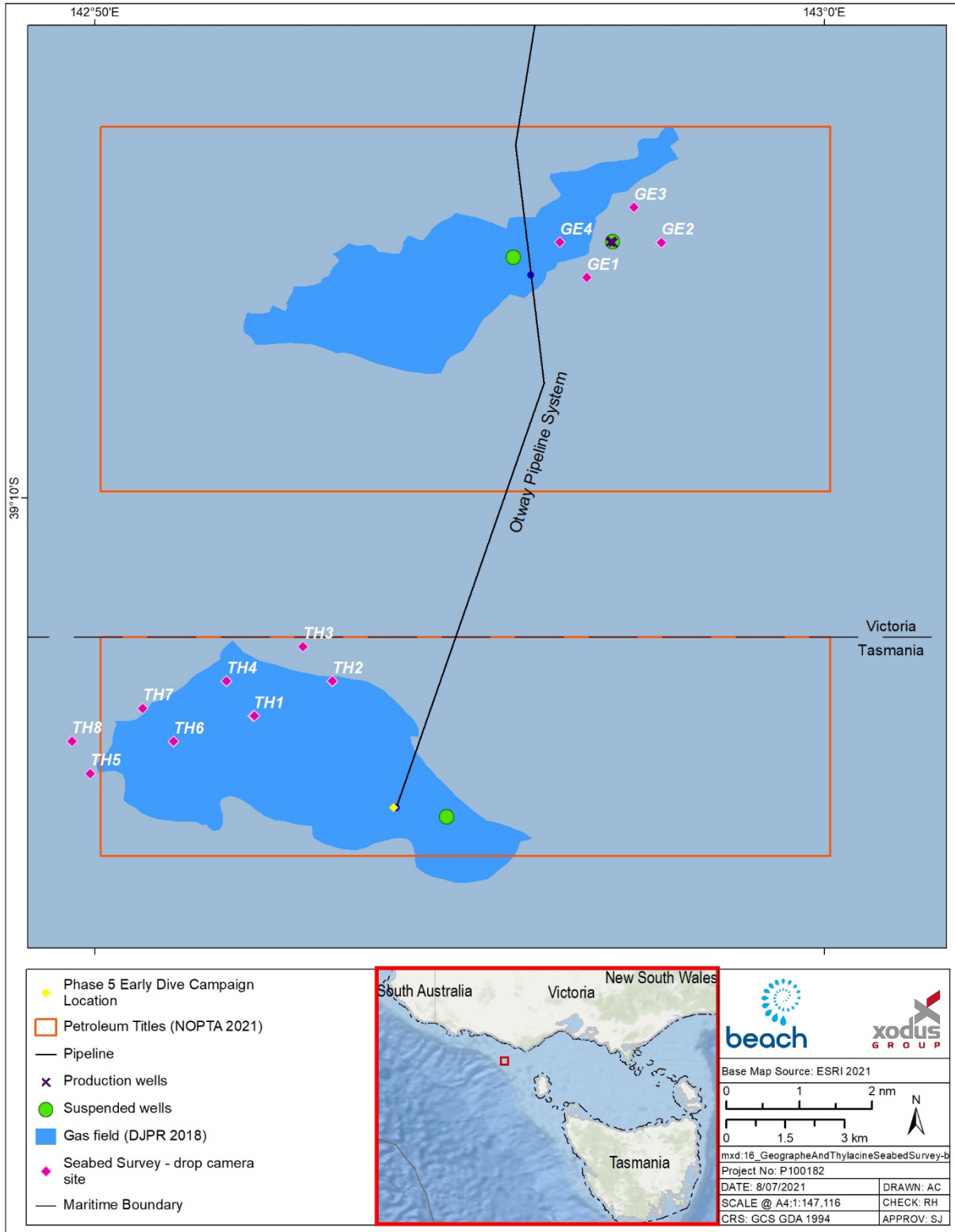


Figure 4-14: Drop camera locations within operational area



TH 1



TH 2



TH 3



TH 4



TH 5



TH 6



TH 7



TH 8

Figure 4-15: Drop camera images TH 1-8

4.5.4 Metocean conditions

4.5.4.1 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.

4.5.4.2 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 4-16).

4.5.4.3 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).

4.5.4.4 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 4-17). During winter, the South Australian current moves dense, salty warmer water eastward from the Great Australian Bight into the western margin of the Bass Strait. 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 KEF.

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.

4.5.4.5 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:

- from the westerly swell from the Great Australian Bight and Southern Ocean.
- 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.

4.5.4.6 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.

RPS Data Set Analysis
Wind Speed (knots) and Direction Rose (All Records)

Longitude = 142.88°E, Latitude = 38.89°S
 Analysis Period: 01-Jan-2008 to 31-Jan-2012

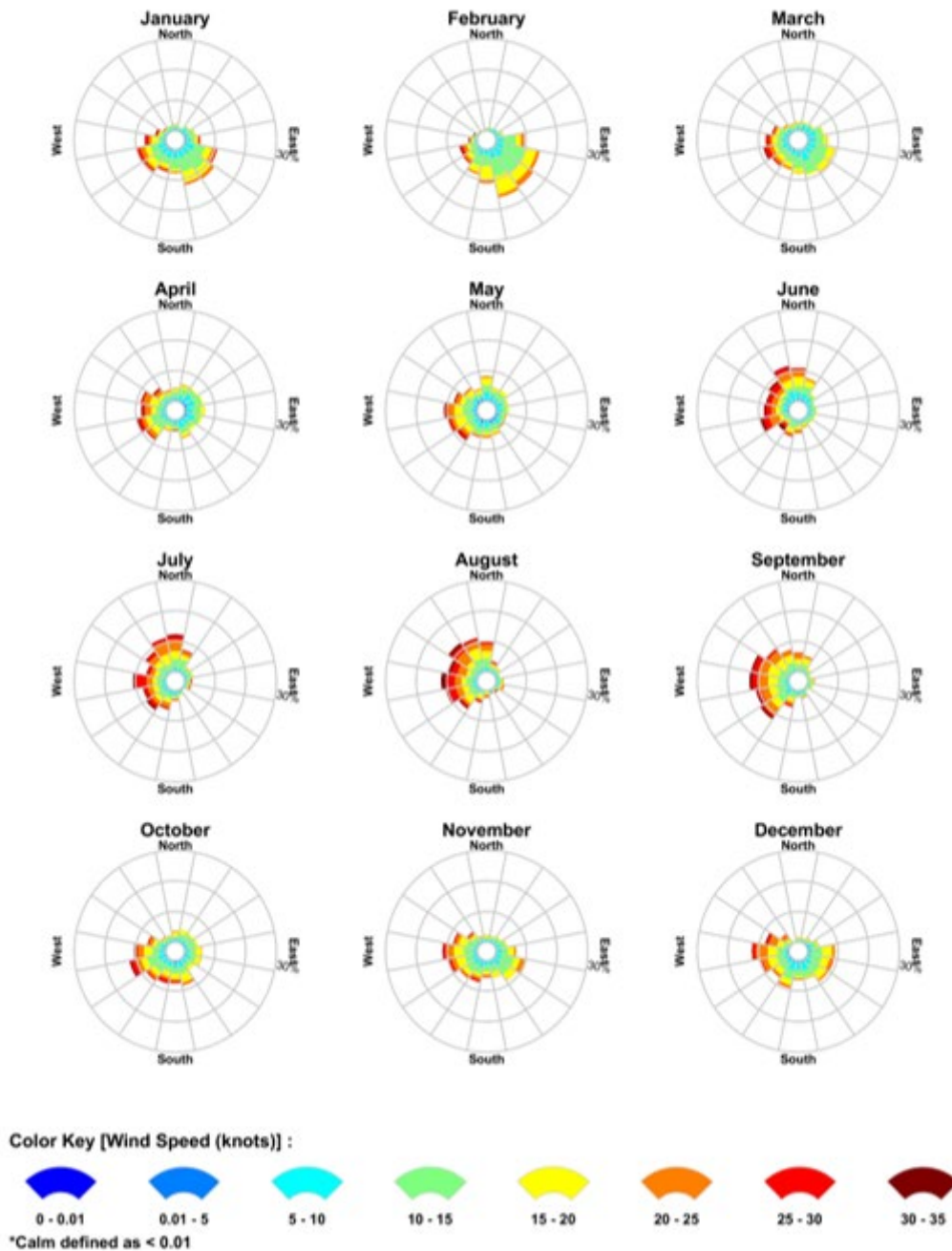


Figure 4-16: Modelled monthly wind rose distributions (RPS, 2019)

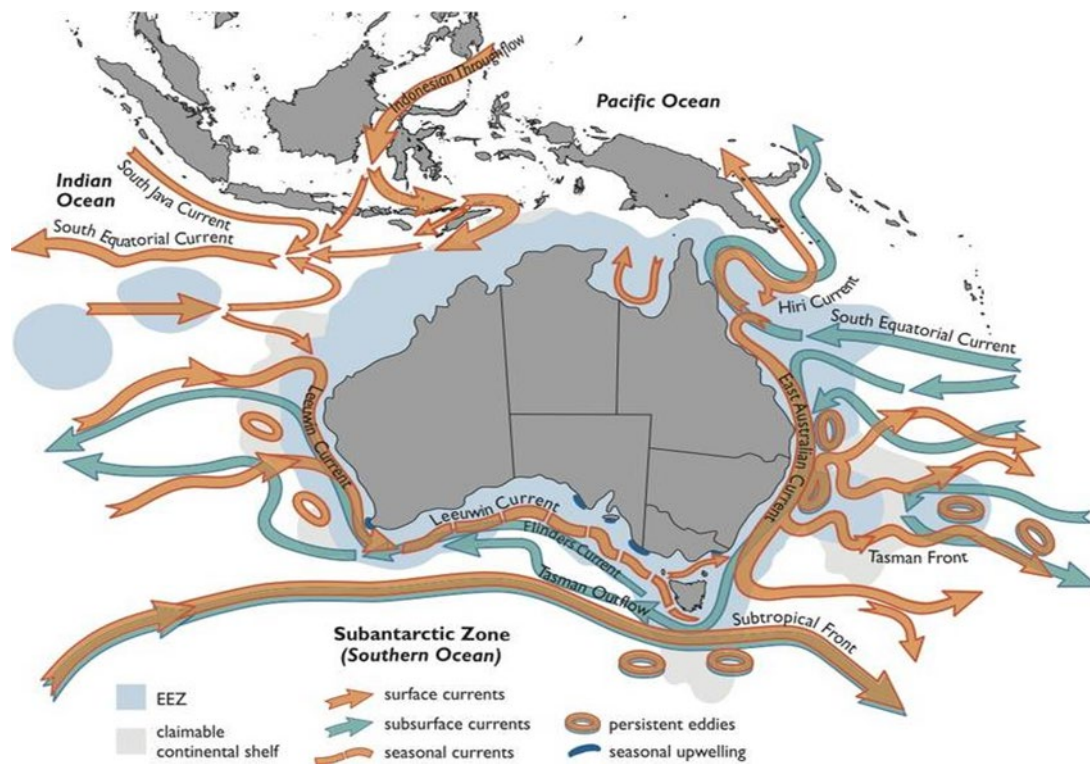


Figure 4-17: Australian ocean currents

4.5.5 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.

Between 2009 and 2016 the Integrated Marine Observing System (IMOS) has been recording 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). Biological sound sources including dolphin vocalisations were also recorded (Przeslawski et al., 2016).

Ambient sound levels in the Otway Basin have been measured as part of impact assessment activities for the petroleum industry.

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 km 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 μ Pa with shipping raising the averaged noise level above 105 dB re 1 μ Pa 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 μ Pa (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 μ Pa and maximum of 161 dB re 1 μ Pa (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 μ Pa, a mean of 118.3 dB re 1 μ Pa, a minimum of 86.6 dB re 1 μ Pa, and a maximum of 153.6 dB re 1 μ Pa. 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.

4.5.6 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 E). Water samples were collected at two of the gas fields, Artisan and Thylacine.

In-situ 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 spill EMBA 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.

4.5.7 Sediment quality

An environmental survey was undertaken from November 2019 to January 2020 for the Otway Gas Development (Ramboll, 2020. Appendix E). Sediment samples were collected at two of the gas fields, Artisan and Thylacine using a Double Van Veen grab sampler. 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 spill EMBA will be typical of the offshore marine environment of the Otway Basin.

4.5.8 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 (NO₂), ozone (O₃), sulfur dioxide (SO₂), 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 (NO₂), Ozone (O₃) and sulphur dioxide (SO₂). 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 EMBA. The Cape Grim Baseline Air Pollution Station data is likely a more reliable point of reference for air quality in the operational area and spill EMBA 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 (CO₂), methane (CH₄), nitrous oxide (N₂O) 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).

4.5.9 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 km², 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

The upwelling system is characterised by considerable variability in timing and intensity, both within and between years, and is subject to climate change. Relationships between upwelling intensity and biological production (i.e. of phytoplankton) are not linear and still poorly understood, and it is virtually impossible to predict where and when biological 'hotspots' may occur (Gill 2020).

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 Niño events tend to strengthen upwelling intensity along the south-east coast of Australia with La Niña events tending to weaken upwelling intensity. Previous studies (Middleton and Bye, 2007; Middleton et al., 2007) indicated that the El Niño 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 (*Balaenoptera borealis*) 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 (*Balaenoptera physalus*), 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) being 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 a stronger upwelling and a stronger upwelling led to increased planktonic productivity with an associate increase in blue whales.

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 Niño conditions. The remainder of the years were assessed to be neutral. The two El Niño 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 Niña 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 4-18) >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.

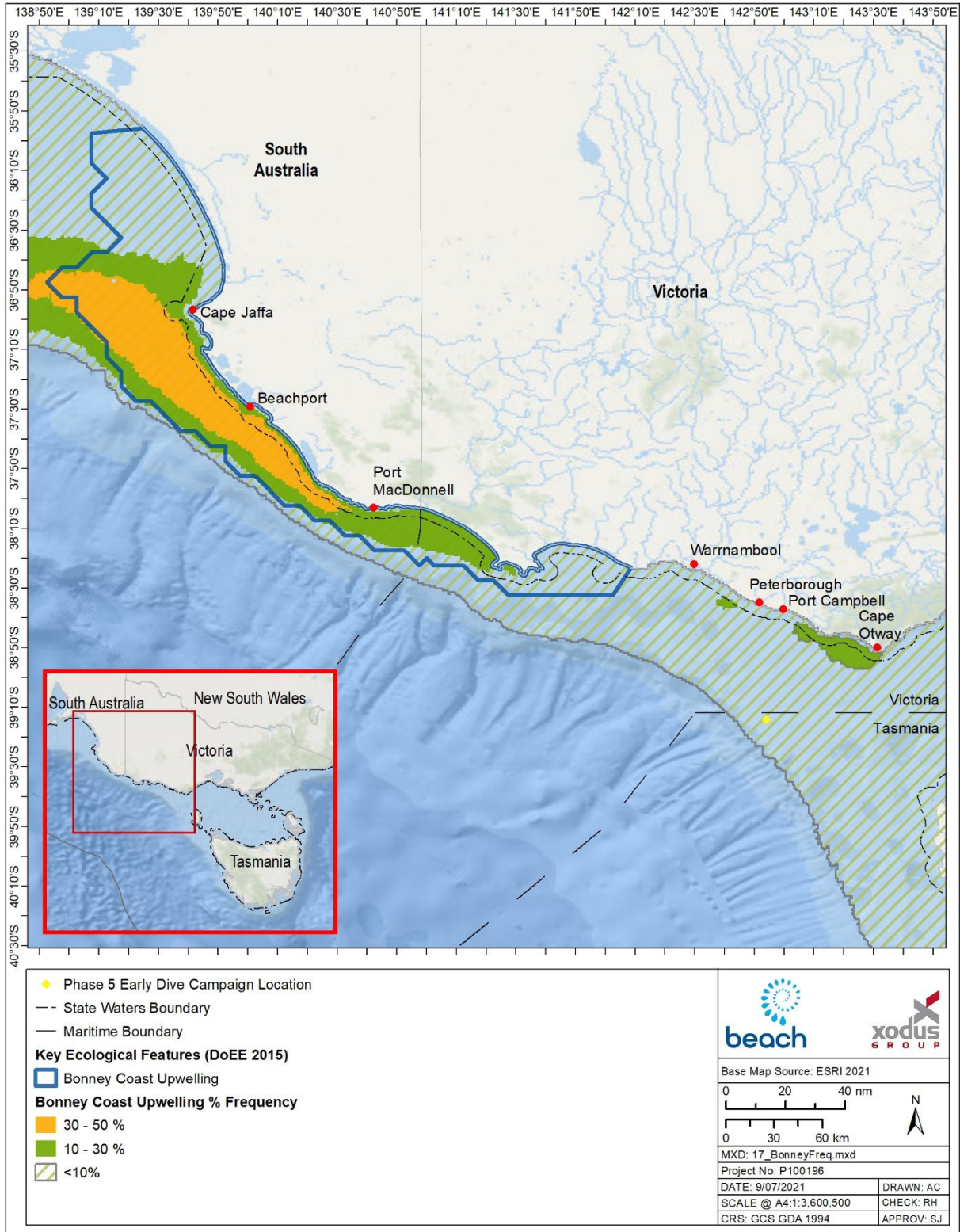


Figure 4-18: Bonney coast upwelling frequency (Source: Huang and Wang 2019; Geoscience Australia 2020).

4.6 Ecological environment

To characterise the ecological environment, a literature search and online resources and databases have been reviewed to identify and assess flora and fauna species known to be present or potentially present in the

operational area and spill EMBA. 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 provided by the DAWE.
- The DAWE 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.
- Seabed site assessment undertaken for the Otway Gas Development (Ramboll, 2020. Appendix E)
- 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.
- The National Conservation Values Atlas (Commonwealth of Australia, 2015).
- 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.

4.6.1 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 spill EMBA PMST Report (Appendix A) 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.
- Grassy eucalypt woodland of the Victorian Volcanic Plain.
- Karst springs and associated alkaline fens of the Naracoorte Coastal Plain Bioregion
- Natural damp grassland of the Victorian Coastal Plains.
- Natural temperate grassland of the Victorian Volcanic Plain.
- Seasonal herbaceous wetlands (freshwater) of the temperate lowland 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 4-19). No Threatened Ecological Communities were identified within the operational area.

4.6.1.1 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).

4.6.1.2 Giant Kelp Marine Forests of South East Australia

Giant kelp (*Macrocystis pyrifera*) is a large brown alga 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 (DSEWPoC, 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 4-19 shows that the largest extent of giant kelp marine forests are along the SA coastline with patches around the Victorian coastline.

Gillanders 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).

4.6.1.3 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 4-19 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 abundant 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.

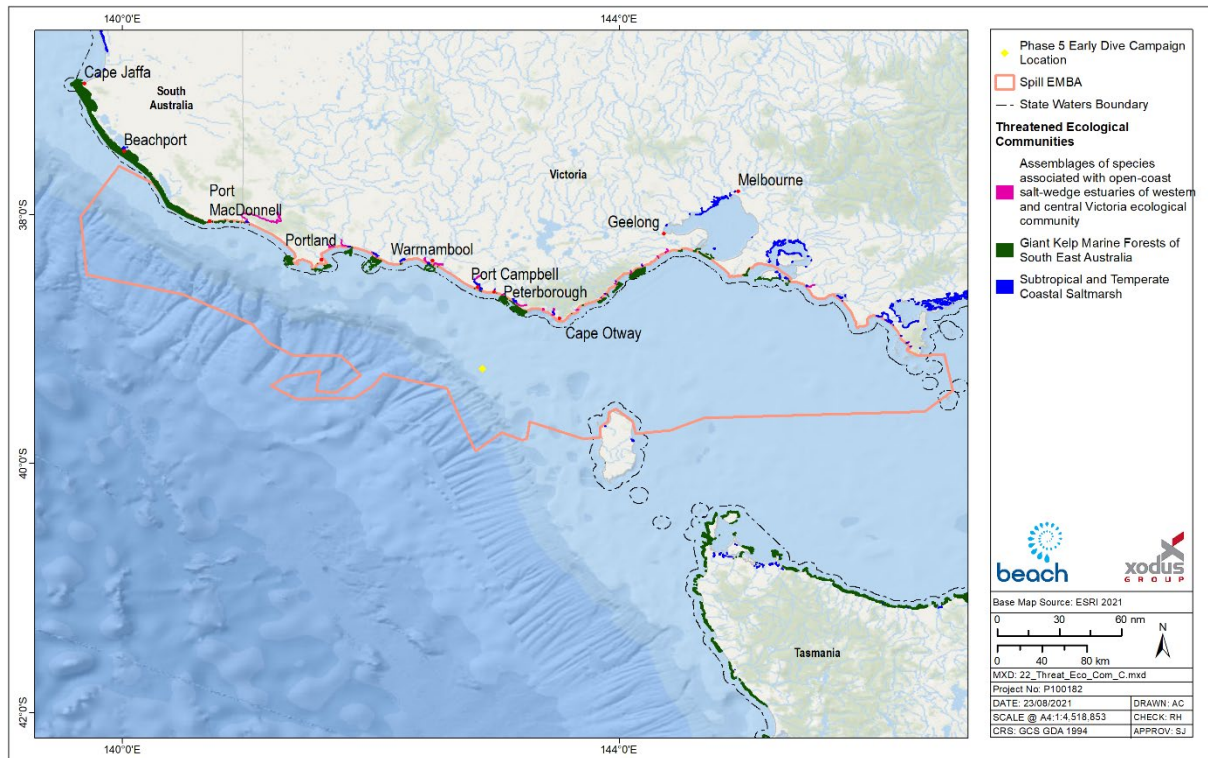


Figure 4-19: Threatened ecological communities within the spill EMBA

4.6.2 Threatened and Migratory species

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

A total of 32 Threatened species and 37 Migratory species were identified as potentially occurring within the operational area. There were also 119 marine species and 30 cetaceans identified as potentially occurring within the spill EMBA.

4.6.2.1 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; and
- Marine.

Details of listed fauna and their likely presence in the operational area or spill EMBA 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 spill EMBA 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).

4.6.2.2 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 spill EMBA. BIAs within the operational area and spill EMBA are summarised in Table 4-9 with further details in the relevant species sections.

Table 4-9: BIAs identified within the operational area and spill EMBA

Receptor	Operational area (1 km)	Spill EMBA	Type of BIA
<i>Birds</i>			
Antipodean albatross	Overlap	Overlap	Foraging
Australasian gannet	>105 km	Overlap	Foraging
	>140 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
	>120 km	Overlap	Breeding
Indian yellow-nosed albatross	Overlap	Overlap	Foraging
Little penguin	>80 km	Overlap	Foraging
	>90 km	Overlap	Breeding
Short-tailed shearwater	Overlap	Overlap	Foraging
Shy albatross	Overlap	Overlap	Foraging
Wandering albatross	Overlap	Overlap	Foraging
Wedge-tailed shearwater	Overlap	Overlap	Foraging
	>60 km	Overlap	Breeding
White-faced storm petrel	>70 km	Overlap	Foraging
	160 km	Overlap	Breeding
<i>Fish</i>			
White shark	Overlap	Overlap	Distribution
	>90 km	Overlap	Foraging
<i>Pinnipeds</i>			

Receptor	Operational area (1 km)	Spill EMBA	Type of BIA
Australian sea lion	>400 km	Overlap	Foraging
Cetaceans			
Southern right whale	>60 km	Overlap	Aggregation
	>57 km	Overlap	Migration and resting on migration
	Overlap	Overlap	Known core coastal range
	>90 km	Overlap	Connecting habitat
Blue and Pygmy blue whale	180 km	Overlap	Possible Foraging Area
	Overlap	Overlap	Foraging (annual high use area)
	>60 km	Overlap	Known Foraging Area
	Overlap	Overlap	Distribution

4.6.3 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 4-10, Boreen et al., 1993):

- Shallow shelf: consisting of exhumed limestone substrates that host encrusting mollusc, sponge, bryozoan and red algae assemblages.
- Middle shelf: a zone of swell wave shoaling and production of mega-rippled bryozoan sands.
- Deep shelf: accumulations of intensely bioturbated, fine bioclastic sands.
- 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 4.5.2 and 4.5.3, is medium to coarse carbonate sands with areas of low relief exposed limestone (Ramboll, 2020; Appendix E). Drop camera images of seabed at the Thylacine survey locations are shown in Figure 4-15. A series of basaltic rises occur in the south eastern corner of the spill EMBA.

The benthic species assemblages known or likely to be associated with these habitats are described in the following sections.

4.6.3.1 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 (*Dayatis brevicaudata*), pipi (*Plebidonax deltoids*), dumpling squid (*Euprymna tasmanica*), common stargazer (*Kathetostoma laeue*) and heart urchin (*Echinocardium cordatum*) (Parks Victoria, 2016a).

4.6.3.2 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 spill EMBA 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 spill EMBA, seagrass is present along the South Australian (SA) and Victorian coastline (Figure 4-20).

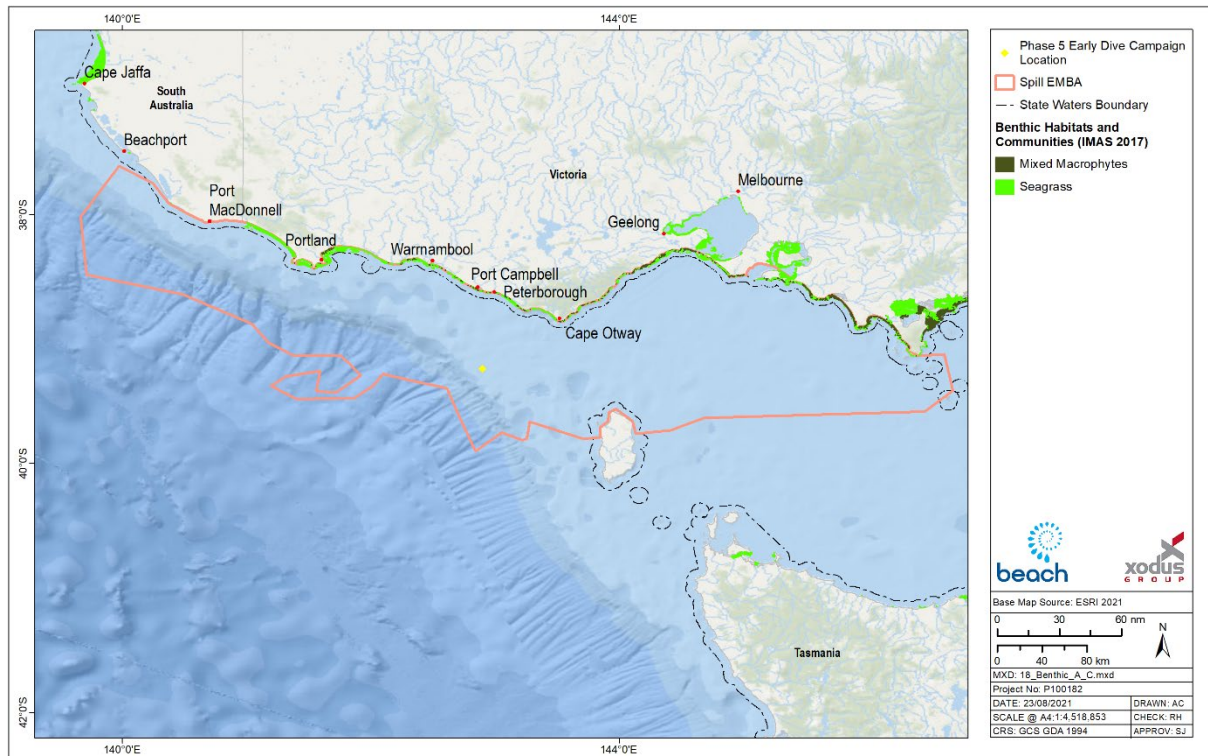


Figure 4-20: Presence of seagrass (and mixed macrophyte) habitat within the spill EMBA

4.6.3.3 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 polymeric 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 spill EMBA macroalgae is present along the South Australian (SA) and Victorian coastline from Beachport in SA to Philip Island (Figure 4-21).

4.6.3.4 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 is not listed as a dominant habitat type within the operational area and spill EMBA (IMAS, 2017), however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway. Gorgonian corals (soft corals) were identified during the seabed survey at Thylacine (Ramboll 2022; Appendix E) as

part of a patchy complex of branching epibiotic which makes up the low levels of 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).

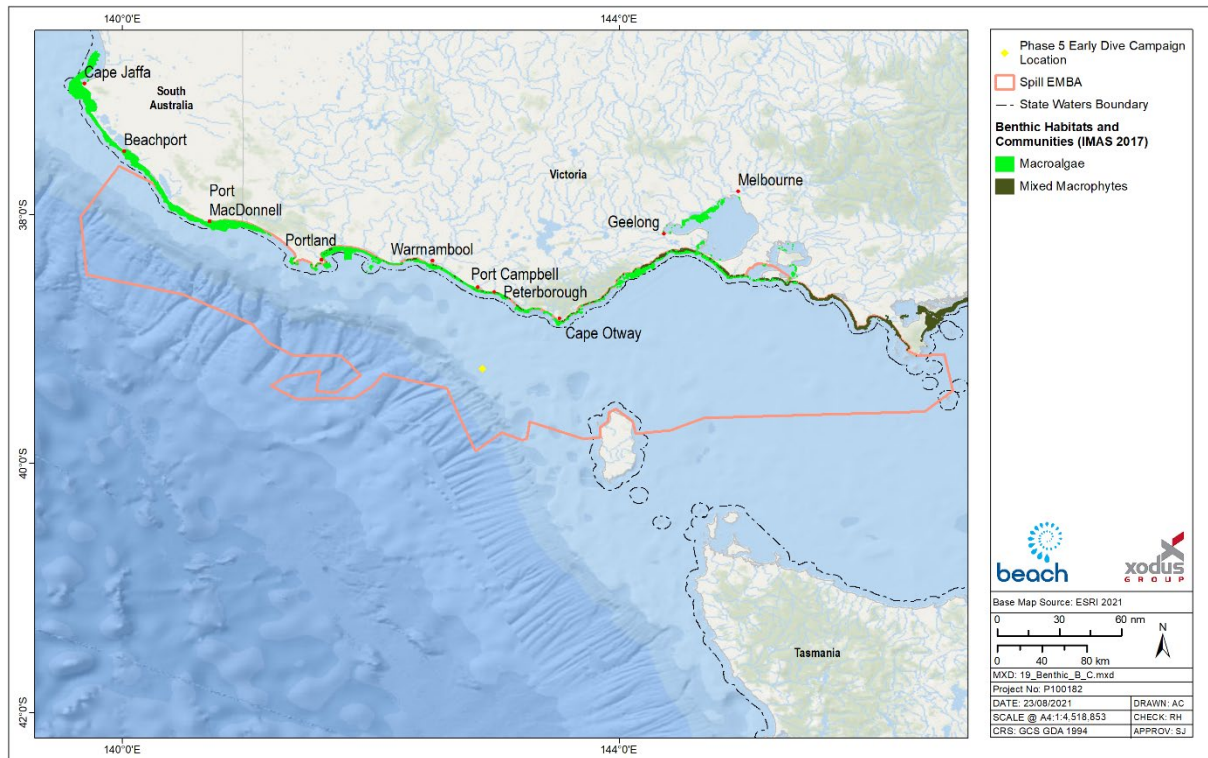


Figure 4-21: Presence of macroalgae (and mixed macrophyte) habitat within the spill EMBA

4.6.3.5 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 southern 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, encrusting and branching coralline algae, peysonellid algae, bryozoa, benthic forams, robust serpulids, 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 coarse, 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/m²), the sarconid (*Triloculina affinis*) (8.9 individuals/m²), the tanaid isopod *Apsuedes* sp. (8.3 individuals/m²) and the spionid polychaete (*Prionospio coorilla*) (4.8 individuals/m²) (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 tapirina*), gummy shark (*Mustelus antarcticus*), long-snouted flounder (*Ammotretis rostratus*), saw shark (*Pristiophorus nudipinnis*), southern sand flathead (*Platycephalus bassensis*) and southern school whiting (*Sillago bassensis*).

4.6.3.6 Basalt rises

There is no published information on the species assemblages of the basalt rises in the south east and east of the spill EMBA, other than general information on their importance as a southern rock lobster fishing area. Following the classification system of Hutchinson et al., (2010) these rises can be classified as deep reefs, defined as rocky habitat at depths greater than 20 m.

In general, deep reef biota is typified by invertebrate animals rather than algae, usually in the form of sessile, filter feeding fauna. Organisms such as sponges, octocorals, bryozoans and ascidians usually dominate rock faces on deep reefs (Hutchison et al., 2010). This is partly due to the ability of species such as sponges to survive in low light conditions that algae are unable to survive in. The most common algae present on deep reefs are encrusting coralline red algae which is able to tolerate low levels of penetrating light (Hutchison et al., 2010).

The distribution of fish fauna is governed by biologically formed habitat structure as well as by food. Fish assemblages typically begin to change at depths greater than 20 m, with the loss of the kelp- associated wrasses and leatherjackets, and the appearance of deeper water fishes such as boarfishes (family Pentacerotidae), splendid perch (*Callanthias australis*) and banded seaperch (*Hypoplectrodes nigroruber*). Schools of barber perch (*Caesioperca razor*) are replaced by the related butterfly perch (*Caesioperca lepidoptera*) (O'Hara et al., 1999). While fish present on shallow subtidal reefs include algavores, omnivores and carnivores, those on deep reefs are typically carnivorous as algae are typically not abundant at depth.

Although common on rocky reefs, sponges, hydrozoans, anthozoans, bryozoans, and ascidians are thought to be largely unpalatable to reef fish. It is therefore likely that fish at these depths are feeding on associated mobile invertebrate fauna. Edmunds et al. (2006) suggests that mobile invertebrate organisms play an ecologically significant role, providing food for carnivorous fishes on deep reefs in Port Phillip Bay, and are likely to include a variety of crustaceans and molluscs.

Information from the few specific studies of specific deep reef habitats in Bass Strait can be assessed to draw broad conclusions about the species assemblages likely to occur on the basalt rises, noting that assemblages of reef species are likely to differ based on geology, habitat structure, exposure to tidal and wave motion and nutrient availability. These studies are generally limited to one off video surveys with little or no temporal replication. More generally little is known about deep reefs in the Bass Strait, or the biology and ecology of organisms that live on them, due in part to difficulties associated with conducting observational work or manipulative experiments in situ.

Beaman et al. (2005) undertook video surveys of the New Zealand Star Bank in the eastern Bass Strait, approximately 600 km east of the operational area. This feature is comprised of granite outcrops between approximately 30 to 40 m water depth, rising from the surrounding relatively flat seabed of mainly unconsolidated quartz sands with variable amounts of shell debris.

Underwater video footage revealed a structurally complex surface of crevices and steep slopes, which is densely covered in erect large and small sponges and encrusting calcareous red algae. Encrusting red algae are usually the greatest occupier of space due to tolerance of low light conditions (< 1% of surface) found at these depths (Andrew, 1999). Mobile benthos observed were crinoids within crevices and the black sea urchin (*Centrostephanus rodgersii*) in low numbers on high slope surfaces and dense encrustations on low relief lower slopes. Underwater video showed a draughtboard shark (*Cephaloscyllium laticeps*) cruising above the crevices of high-relief granite

outcrop as well as schools of butterfly perch feeding on plankton in the water column above the bank (Andrew, 1999).

This study demonstrated a significant difference between communities that live on hard-ground granite outcrops of the New Zealand Star Bank and those which exist on soft substrate surrounding the rocky bank. These granite outcrops support a diverse sessile fauna of large and small sponges, bryozoans, hydroids and ascidians which prefer stable attachment surfaces (Underwood et al., 1991; Andrew 1999; Andrew and O'Neill, 2000). It is likely that similar species assemblages occur within the spill EMBA between the flat carbonate sands of the seabed and the basalt rises.

Edmunds et al. (2006) investigated assemblages of benthic fauna at near shore deep reefs within Central Victoria (Point Addis and Wilsons Promontory) and Port Phillip Bay. The Port Phillip Bay deep reef assemblages were dominated by sponges, occupying 70 to 90% of the rocky substratum. The Point Addis assemblage was dominated by upright sponges (arborescent, massive and flabellate growth forms), but cnidarians including hydroids were entirely absent. Wilson's Promontory had a low coverage of encrusting sponges and hydroids, with high abundances of red and brown algae and the gorgonian fan *Pteronisis* sp. The Port Phillip Heads assemblage was dominated by encrusting sponges, hydroids, ascidians and bryozoans.

In summary, the species assemblages associated with the basalt rises in the south-east and east of the spill EMBA are likely to be significantly different to the species assemblages of the surrounding flat seabed supporting carbonate sands. The depth of the basalt rises is likely to preclude significantly algal growth, with red algae likely to be most abundant. Sponges, hydrozoans, anthozoans, bryozoans, and ascidians are likely to occur though the relative abundances of these groups are not known. Targeting of the rises for rock lobster fishing indicates presence of this species in relatively high densities. The trophic effects of long term targeting of this species at these rises is not known. Site attached fishes are not likely to include kelp-associated wrasses and leatherjackets. Further statements cannot be made with sufficient confidence as site specific data for these rises are not available.

4.6.4 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 within the spill EMBA. (Figure 4-22).

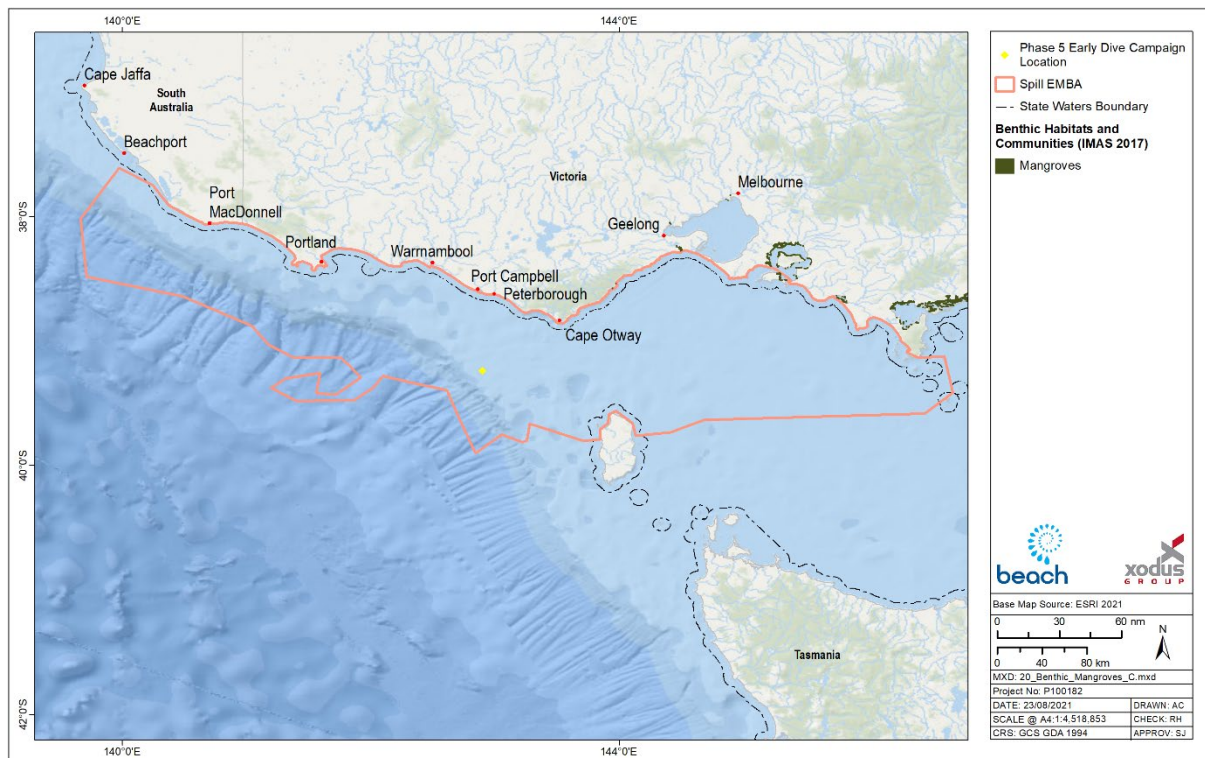


Figure 4-22: Presence of mangrove habitat within the spill EMBA.

4.6.5 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 4-23) (Boon et al., 2011).



Figure 4-23: Presence of saltmarsh habitat within the spill EMBA

4.6.6 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 spill EMBA, 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 spill EMBA 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.

4.6.7 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 habitats 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).

A microscopic examination of a qualitative sample of epibiota taken during the seabed surveys at Thylacine indicated that the complex of fauna found in the area 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 bodied invertebrates to survive and establish significant populations. (Ramboll 2020; Appendix E)

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.

4.6.8 Fish

Fish species present in the operational area or spill EMBA 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. The spill EMBA PMST report (Appendix A) identified 29 listed fish species that potentially occur in the spill EMBA. Table 4-10 details the listed fish species identified in the spill EMBA and operational area PMST reports.

The following fish species were identified in the operational area PMST Report (Appendix A.2):

- White shark;
- Shortfin mako;
- Porbeagle, mackerel shark; and
- Pipefish, seahorse, seadragons.

Table 4-10: Listed fish species identified in the PMST report

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
<i>Fish</i>						
Australian grayling	<i>Prototroctes maraena</i>	V	-	-	SHK	
<i>Sharks and rays</i>						
Porbeagle, mackerel shark	<i>Lamna nasus</i>	-	M	-	SHL	SHL
Shortfin mako	<i>Isurus oxyrinchus</i>	-	M	-	SHL	SHL
White shark	<i>Carcharodon carcharias</i>	V	M	-	FFK	SHK
<i>Pipefish, seahorse, seadragons</i>						
Australian long-snout pipefish	<i>Vanacampus poecilolaemus</i>	-	-	L	SHM	SHM
Australian smooth pipefish	<i>Lissocampus caudalis</i>	-	-	L	SHM	SHM
Bigbelly seahorse	<i>Hippocampus abdominalis</i>	-	-	L	SHM	SHM
Black pipefish	<i>Stigmatopora nigra</i>	-	-	L	SHM	SHM
Briggs' crested pipefish	<i>Histiogamphelus briggsii</i>	-	-	L	SHM	SHM
Brushtail pipefish	<i>Leptoichthys fistularius</i>	-	-	L	SHM	SHM
Bullneck Seahorse	<i>Hippocampus minotaur</i>	-	-	L	SHM	
Common seadragon	<i>Phyllopteryx taeniolatus</i>	-	-	L	SHM	SHM
Deep-bodied pipefish	<i>Kaupus costatus</i>	-	-	L	SHM	SHM
Hairy pipefish	<i>Urocampus carinirostris</i>	-	-	L	SHM	SHM
Half-banded pipefish	<i>Mitotichthys semistriatus</i>	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Javelin pipefish	<i>Lissocampus runa</i>	-	-	L	SHM	SHM
Knife-snouted pipefish	<i>Hypselognathus rostratus</i>	-	-	L	SHM	SHM
Leafy seadragon	<i>Phycodurus eques</i>	-	-	L	SHM	SHM
Mollison's pipefish	<i>Mitotichthys mollisoni</i>	-	-	L	SHM	SHM
Mother-of-pearl pipefish	<i>Vanacampus margaritifer</i>	-	-	L	SHM	SHM
Port Phillip pipefish	<i>Vanacampus phillipi</i>	-	-	L	SHM	SHM
Pug-nosed pipefish	<i>Pugnaso curtirostris</i>	-	-	L	SHM	SHM
Red pipefish	<i>Notiocampus ruber</i>	-	-	L	SHM	SHM
Rhino pipefish	<i>Histiogamphelus cristatus</i>	-	-	L	SHM	SHM
Ring-backed pipefish	<i>Stipecampus cristatus</i>	-	-	L	SHM	SHM
Robust pipehorse	<i>Solegnathus robustus</i>	-	-	L	SHM	SHM
Sawtooth pipefish	<i>Maroubra perserrata</i>	-	-	L	SHM	SHM
Short-head seahorse	<i>Hippocampus breviceps</i>	-	-	L	SHM	SHM
Spiny pipehorse,	<i>Solegnathus spinosissimus</i>	-	-	L	SHM	SHM
Spotted pipefish	<i>Stigmatopora argus</i>	-	-	L	SHM	SHM
Trawl pipefish	<i>Kimblaeus bassensis</i>	-	-	L	SHM	SHM
Tucker's pipefish	<i>Mitotichthys tuckeri</i>	-	-	L	SHM	SHM
Upside-down pipefish	<i>Heraldia nocturna</i>	-	-	L	SHM	SHM

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Listed Threatened V: Vulnerable		Likely Presence				
Listed Migratory M: Migratory		SHM: Species or species habitat may occur within area.				
Listed Marine L: Listed		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. FFK: Foraging, feeding or related behaviour 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 spill EMBA, but not present in the other smaller EMBA's or operational area.

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: southwestern Australia and eastern Australia (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 spill EMBA and operational area (Figure 4-24). 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 (outside of the spill EMBA), and they are known to forage in waters off pinniped colonies throughout the SEMR. It is likely that white sharks are present in the spill EMBA.

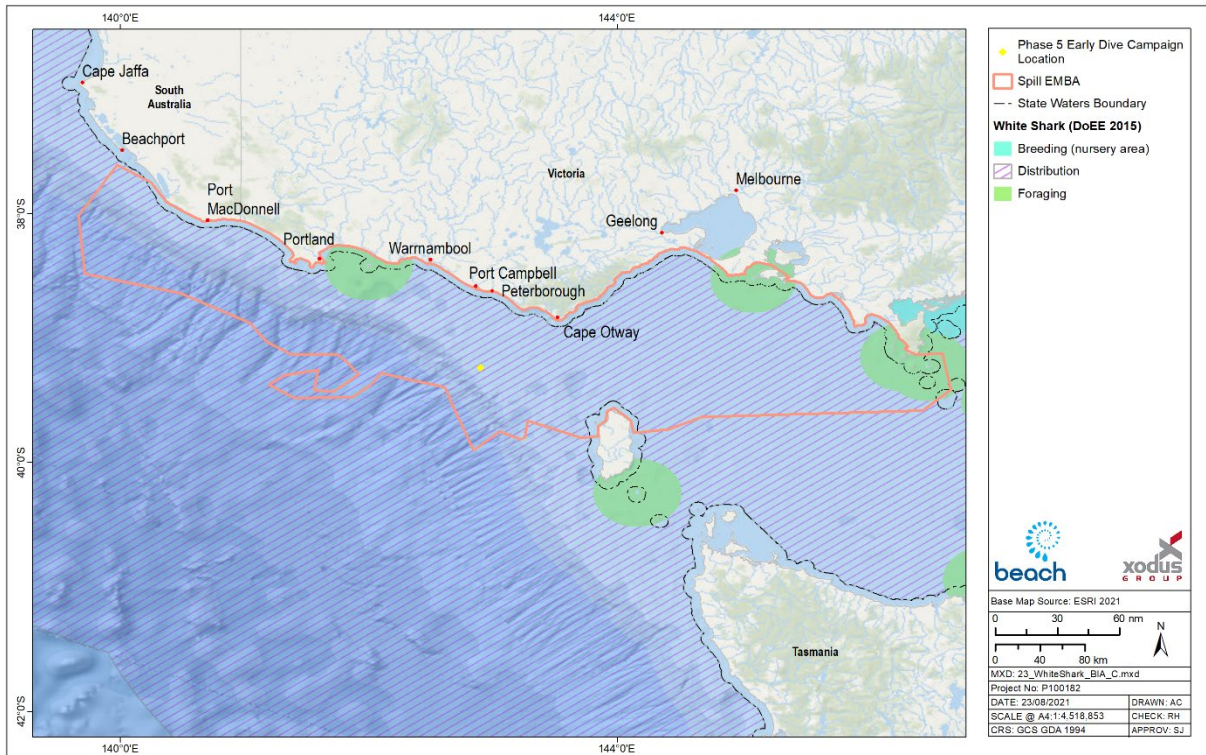


Figure 4-24: BIAs for the white shark within the spill EMBA

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 northern extent of the Bonney coast upwelling region, to be areas of highest fidelity 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 spill EMBA in low numbers.

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 spill EMBA in low numbers.

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 spill EMBA is not likely to represent critical habitat for the species.

Syngnathids

All of the marine ray-finned fish species identified in the Spill EMBA and operational area EPBC PMST Reports 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 33 species of syngnathids identified in the spill EMBA 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 species profile and threats profiles indicate that the syngnathid species listed in the spill EMBA are widely distributed throughout southern, south-eastern and south-western Australian waters. It is possible that these species will be present in the coastal area of the spill EMBA where water depths are less than 50 m, however presence in the operational area is not expected.

4.6.9 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 spill EMBA, 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 spill EMBA (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 spill EMBA are discussed in more detail.

Table 4-11: Listed bird species identified in the PMST report

* species BIA identified see Section 4.6.2.2 and Table 4-9 for information as to which species have identified BIAs within the operational area and spill EMBA

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Albatrosses						
Antipodean albatross*	<i>Diomedea antipodensis</i>	V	M	L	FL	FL
Black-browed albatross*	<i>Thalassarche melanophris</i>	V	M	L	FL	FL
Buller's albatross*	<i>Thalassarche bulleri</i>	V	M	L	FL	FL
Campbell albatross*	<i>Thalassarche impavida</i>	V	M	L	FL	FL
Chatham albatross	<i>Thalassarche eremita</i>	E	M	L	FL	
Gibson's albatross	<i>Diomedea antipodensis gibsoni</i> <i>Diomedea gibsoni</i>	V	-	L	FL	
Grey-headed albatross	<i>Thalassarche chrysostoma</i>	E	M	L	SHM	SHM
Northern buller's albatross	<i>Thalassarche bulleri platei</i>	V	-	-	FL	FL
Northern royal albatross	<i>Diomedea sanfordi</i>	E	M	L	FL	FL
Pacific albatross	<i>Thalassarche sp. nov.</i>	V	-	L	FL	FL
Salvin's albatross	<i>Thalassarche salvini</i>	V	M	L	FL	FL
Shy albatross*	<i>Thalassarche cauta</i>	E	M	L	FL	FL
Sooty albatross	<i>Phoebetrus fusca</i>	V	M	L	SHL	SHL
Southern royal albatross	<i>Diomedea epomophora</i>	V	M	L	FL	FL

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Wandering albatross*	<i>Diomedea exulans</i>	V	M	L	FL	FL
White-capped albatross	<i>Thalassarche steadi</i>	V	M	L	FL	FL
Shearwaters						
Flesh-footed shearwater	<i>Ardenna carneipes</i>	-	M	L	SHK	FL
Short-tailed shearwater*	<i>Ardenna tenuirostris</i> <i>Puffinus tenuirostris</i>	-	M	L	BK	
Sooty shearwater	<i>Ardenna grisea</i> <i>Puffinus griseus</i>	-	M	L	SHM	SHM
Petrels						
Blue petrel	<i>Halobaena caerulea</i>	V	-	L	SHM	SHM
Common diving petrel*	<i>Pelecanoides urinatrix</i>	-	-	L	BK	
Gould's petrel	<i>Pterodroma leucoptera</i>	E	-	-	SHM	SHM
Great-winged petrel	<i>Pterodroma macroptera</i>	-	-	L	FK	
Northern giant-petrel	<i>Macronectes halli</i>	V	M	L	SHM	SHM
Soft-plumaged petrel	<i>Pterodroma mollis</i>	V	-	L	FL	SHM
Southern giant-petrel	<i>Macronectes giganteus</i>	E	M	L	FL	SHM
White-bellied storm-petrel	<i>Fregetta grallaria grallaria</i>	V	-	-	BK	
White-faced storm petrel*	<i>Pelagodroma marina</i>	-	-	L	BK	
Other						
Australasian bittern	<i>Botaurus poiciloptilus</i>	E	-	-	SHK	

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Australasian gannet*	<i>Morus serrator</i>	-	-	L	BK	
Australian fairy tern	<i>Sternula nereis nereis</i>	V	-	-	SHK	FL
Australian painted-snipe	<i>Rostratula australis</i>	E	-	-	SHK	
Bar-tailed godwit	<i>Limosa lapponica</i>	-	W	L	SHK	
Black currawong	<i>Strepera fuliginosa colei</i>	V	-	-	BL	
Black-eared cuckoo	<i>Chrysococcyx osculans</i>	-	-	L	SHK	
Black-faced cormorant*	<i>Phalacrocorax fuscescens</i>	-	-	L	BK	
Black-faced monarch	<i>Monarcha melanopsis</i>	-	T	L	SHK	
Black-tailed godwit	<i>Limosa limosa</i>	-	W	L	RK	
Broad-billed sandpiper	<i>Limicola falcinellus</i>	-	W	L	RK	
Cape gannet	<i>Morus capensis</i>	-	-	L	BK	
Caspian tern	<i>Hydroprogne caspia</i> <i>Sterna caspia</i>	-	M	L	BK	
Cattle egret	<i>Bubulcus ibis</i>	-	-	L	SHM	
Common greenshank	<i>Tringa nebularia</i>	-	W	L	SHK	
Common noddy	<i>Anous stolidus</i>	-	M	L	SHL	
Common sandpiper	<i>Actitis hypoleucos</i>	-	W	L	SHK	SHM
Crested tern	<i>Thalasseus bergii</i> <i>Sterna bergii</i>	-	W	L	BK	
Curlew sandpiper	<i>Calidris ferruginea</i>	CE	W	L	SHK	SHM
Double-banded plover	<i>Charadrius bicinctus</i>	-	W	L	RK	
Eastern curlew	<i>Numenius madagacariensis</i>	CE	W	L	SHK	SHM

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Eastern hooded plover	<i>Thinornis cucullatus cucullatus</i>	V	-	L	SHK	
Fairy prion	<i>Pachyptila turtur</i>	-	-	L	SHK	SHM
Fairy prion (southern)	<i>Pachyptila turtur subantarctica</i>	V	-	-	SHK	SHK
Fairy tern	<i>Sterna nereis</i>	-	-	L	BK	
Fork-tailed swift	<i>Apus pacificus</i>	-	M	L	SHL	
Great knot	<i>Calidris tenuirostris</i>	CE	W	L	RK	
Great skua	<i>Catharacta skua</i>	-	-	L	SHM	SHM
Greater sand plover	<i>Charadrius leschenaultii</i>	V	W	L	RK	
Green rosella *King Island)	<i>Platycercus caledonicus brownie</i>	V	-	-	SHL	
Grey falcon	<i>Falco hypoleucos</i>	V	-	-	SHL	
Grey plover	<i>Pluvialis squatarola</i>	-	W	L	RK	
Grey-tailed tattler	<i>Heteroscelus brevipes</i>	-	W	-	RK	
Hooded plover	<i>Thinornis rubricollis</i>		-	L	SHK	
Hooded plover (eastern)	<i>Thinornis cucullatus cucullatus</i> <i>Thinornis rubricollis rubricollis</i>	V	-	L	SHK	
Kelp gull	<i>Larus dominicanus</i>	-	-	L	BK	
King Island brown thornbill	<i>Acanthiza pusilla archibaldi</i>	E	-	-	SHL	
King Island scrubtit	<i>Acanthornis magna greeniana</i>	CE	-	-	SHK	

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Latham's snipe	<i>Gallinago hardwickii</i>	-	W	L	SHK	
Lesser sand plover	<i>Charadrius mongolus</i>	E	W	L	RK	
Little curlew	<i>Numenius minutus</i>	-	W	L	RL	
Little penguin*	<i>Eudyptula minor</i>	-	-	L	BK	
Little tern	<i>Sternula albifrons</i>	-	M	L	BK	
Magpie Goose	<i>Anseranas semipalmata</i>	-	-	L	SHM	
Marsh sandpiper	<i>Tringa stagnatilis</i>	-	W	L	RK	
Nunivak bar-tailed godwit	<i>Limosa lapponica baueri</i>	V	-	-	SHK	
Orange-bellied parrot	<i>Neophema chrysogaster</i>	CE	-	L	MK	
Osprey	<i>Pandion haliaetus</i>	-	W	L	SHK	
Pacific golden plover	<i>Pluvialis fulva</i>	-	W	L	RK	
Pacific gull	<i>Larus pacificus</i>	-	-	L	BK	
Painted honeyeater	<i>Grantiella picta</i>	V	-	-	SHK	
Painted snipe	<i>Rostratula benghalensis (sensu lato)</i>	E	-	L	SHK	
Pectoral sandpiper	<i>Calidris melanotos</i>	-	W	L	SHK	SHM
Pied stilt	<i>Himantopus himantopus</i>	-	-	L	RK	
Pin-tailed snipe	<i>Gallinago stenura</i>	-	W	L	RL	
Plains-wanderer	<i>Pedionomus torquatus</i>	CE	-	-	SHL	
Rainbow bee-eater	<i>Merops ornatus</i>	-	-	L	SHM	
Red knot	<i>Calidris canutus</i>	E	W	L	SHK	SHM
Red-capped plover	<i>Charadrius ruficapillus</i>	-	-	L	RK	

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	-	-	L	RK	
Red-necked phalarope	<i>Phalaropus lobatus</i>	-	W	L	RK	
Red-necked stint	<i>Calidris ruficollis</i>	-	W	L	RK	
Regent honeyeater	<i>Anthochaera Phrygia</i>	CE	-	-	FL	
Ruddy turnstone	<i>Arenaria interpres</i>	-	W	L	RK	
Ruff (Reeve)	<i>Philomachus pugnax</i>	-	M	L	SHK	
Rufous fantail	<i>Rhipidura rufifrons</i>	-	T	L	SHK	
Sanderling	<i>Calidris alba</i>	-	W	L	RK	
Satin flycatcher	<i>Myiagra cyanoleuca</i>	-	T	L	BK	
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	-	W	L	RK	SHM
Silver gull	<i>Larus novaehollandiae</i>	-	-	L	BK	
Sooty tern	<i>Sterna fuscata</i>	-	-	L	BK	
South-eastern Red-tailed Black-Cockatoo	<i>Calyptorhynchus banksii graptogyne</i>	E	-	-	SHK	
Swift parrot	<i>Lathamus discolor</i>	CE	-	L	SHK	
Swinhoe's snipe	<i>Gallinago megala</i>	-	W	L	RL	
Tasmanian azure kingfisher	<i>Ceyx azureus diemenensis</i>	E	-	-	SHL	
Tasmanian wedge-tailed eagle	<i>Aquila audax fleayi</i>	E	-	-	SHL	
Terek sandpiper	<i>Xenus cinereus</i>	-	W	L	RK	
Wandering tattler	<i>Heteroscelus incana</i>	-	W	-	RK	

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed Threatened	Listed Migratory	Listed marine		
Whimbrel	<i>Numenius phaeopus</i>	-	W	L	RK	
White-bellied sea-eagle	<i>Haliaeetus leucogaster</i>	-	-	L	BK	
White-faced storm-petrel	<i>Pelagodroma marina</i>	-	-	L	BK	
White-throated needletail	<i>Hirundapus caudacutus</i>	V-	T	L	SHK	
Wood sandpiper	<i>Tringa glareola</i>	-	W	L	RK	
Yellow wagtail	<i>Motacilla flava</i>	-	T	L	SHK	
Listed Threatened		Likely Presence				
CE: Critically Endangered					SHM: Species or species habitat may occur within area.	
E: Endangered					SHL: Species or species habitat likely to occur within area.	
V: Vulnerable					SHK: Species or species habitat known to occur within area.	
Listed Migratory					FL: Foraging, feeding or related behaviour likely to occur within area.	
M: Migratory					RK: Roosting known to occur within area.	
T: Migratory Terrestrial					ML: Migratory route likely to occur in area.	
W: Migratory Wetlands					BK: Breeding known to occur within area.	
Listed Marine						
L: Listed						

^ The type of presence may vary between the different areas; e.g. an important behaviour (e.g. foraging, breeding) may be present in the spill EMBA, but not present in the other smaller EMBA's or 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. The National Recovery Plan for threatened albatross and giant petrels (DSEWPaC, 2011a). 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 threatened albatross and giant petrels (DSEWPaC, 2011a). 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 area and spill EMBA. Albatross Island, supporting a breeding population of approximately 5,000 shy albatross (*Thalassarche cauta*), is the closest breeding colony of threatened seabirds to the spill EMBA.

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 spill EMBA (Figure 4-25 and Figure 4-26). These BIAs cover either most or all the SEMR (Commonwealth of Australia, 2015). Therefore, it is likely that these will be present and forage in the EMBA.

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 area and spill EMBA. The common-diving petrel also has a breeding BIA that overlaps the spill EMBA. The white-faced storm petrel has a foraging BIA that overlaps the operational area and spill EMBA. The white-faced storm petrel also has a breeding BIA that overlaps the spill EMBA.

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). 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. Despite breeding colonies in New Zealand, the white capped and the Chatham albatross are common off the coast of south-east Australia throughout the year. 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). 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). 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, 2002; Marchant & Higgins 1990). Therefore, it is likely that these along with the Tasmanian shy albatross will be present and forage in the spill EMBA and potentially the operational area.

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). The great-winged petrel breeds in the Southern

Hemisphere between 30° and 50° south, outside of the breeding season they are widely dispersed (Birdlife International, 2019)

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 *Verella*) 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 be an uncommon visitor to the operational area or spill EMBA.

The short-tailed shearwater has foraging and breeding BIAs within the spill EMBA (Figure 4-27). 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 wedge-tailed shearwater has a foraging BIA within the operational area and spill EMBA (Figure 4-27 and Appendix A). A review of the DotEE 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 DotEE 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.

Caspian tern is the largest tern 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 nests 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. Nest 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.

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 northern 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 km² (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 spill EMBA, 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 area or spill EMBA.

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 4-28). 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 spill EMBA (Figure 4-29). However, parrots rarely land or forage out at sea.

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 spill EMBA (Figure 4-26). Their main breeding site within the spill EMBA 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).

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). A BIA, for foraging, has been established in the spill EMBA with substantial foraging sites within port Philip Bay and Port Fairy (Figure 4-25).

Other shorebirds

A number of species listed in Table 4-11 use coastal shoreline habitats such as Australian fairy tern, fairy prion, red knot, pectoral sandpiper, fork-tailed swift, sharp-tailed sandpiper, curlew sandpiper, eastern curlew, little curlew, yellow wagtail, Australasian bittern 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). This species is unlikely to be present in the operational area or spill EMBA due to the distance offshore.

Many sandpipers including the common, marsh, terek, wood 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 is a non-breeding visitor to Australia occurring at the edges of wetlands, shallow swamps, ponds and lakes (Marchant & Higgins, 1993). The wandering tattler and grey-tailed tattler migrate 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 non-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 inhabit 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 common nobby, ruddy turnstone, sanderling, red-necked stint, whimbrel, common greenshank, pied stilt, white-throated needletail, red-necked phalarope, ruff, red-necked avocet, rufous fantail and black-faced cormorant are common along Australia's coastline. The black-faced cormorant has a breeding and foraging BIA off King Island within the spill EMBA. 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 area 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 spill EMBA.

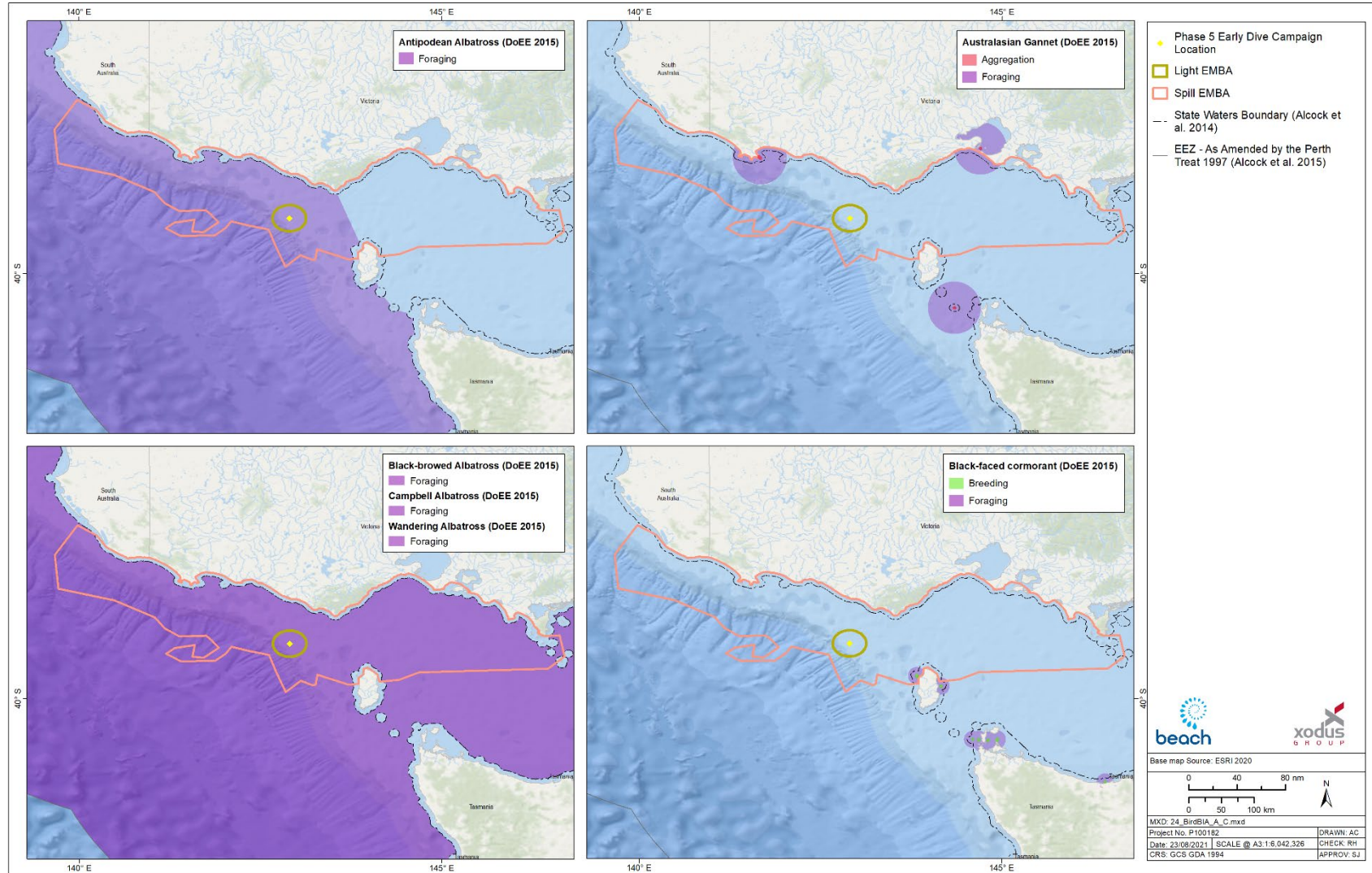


Figure 4-25: BIAs for antipodean albatross, Australasian gannet, black-browed albatross, Campbell albatross, wandering albatross and black-faced cormorant within the spill EMBA

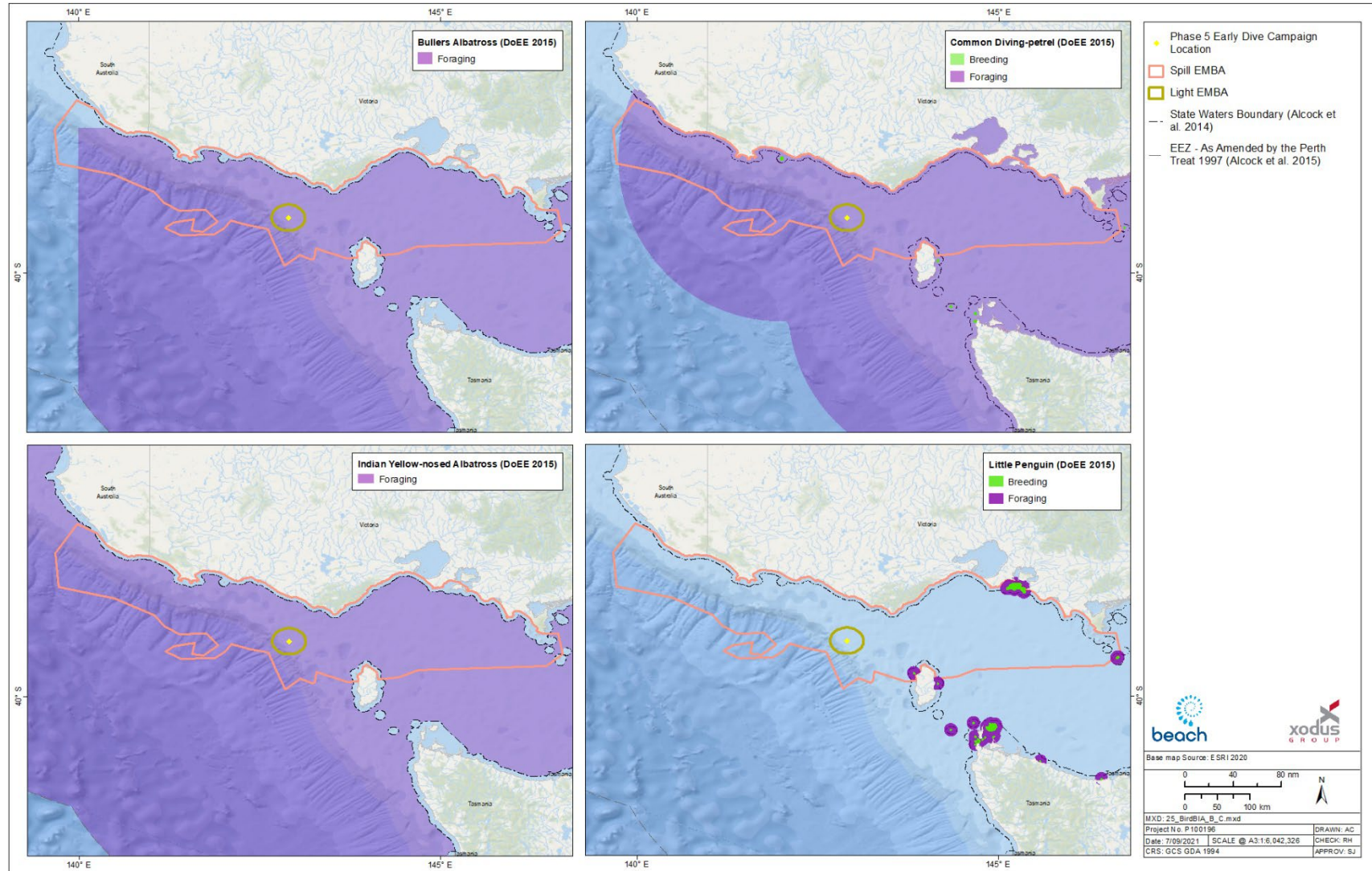


Figure 4-26: BIAs for the Buller's albatross, common diving-petrel, Indian yellow-nosed albatross and little penguin within the spill EMBA

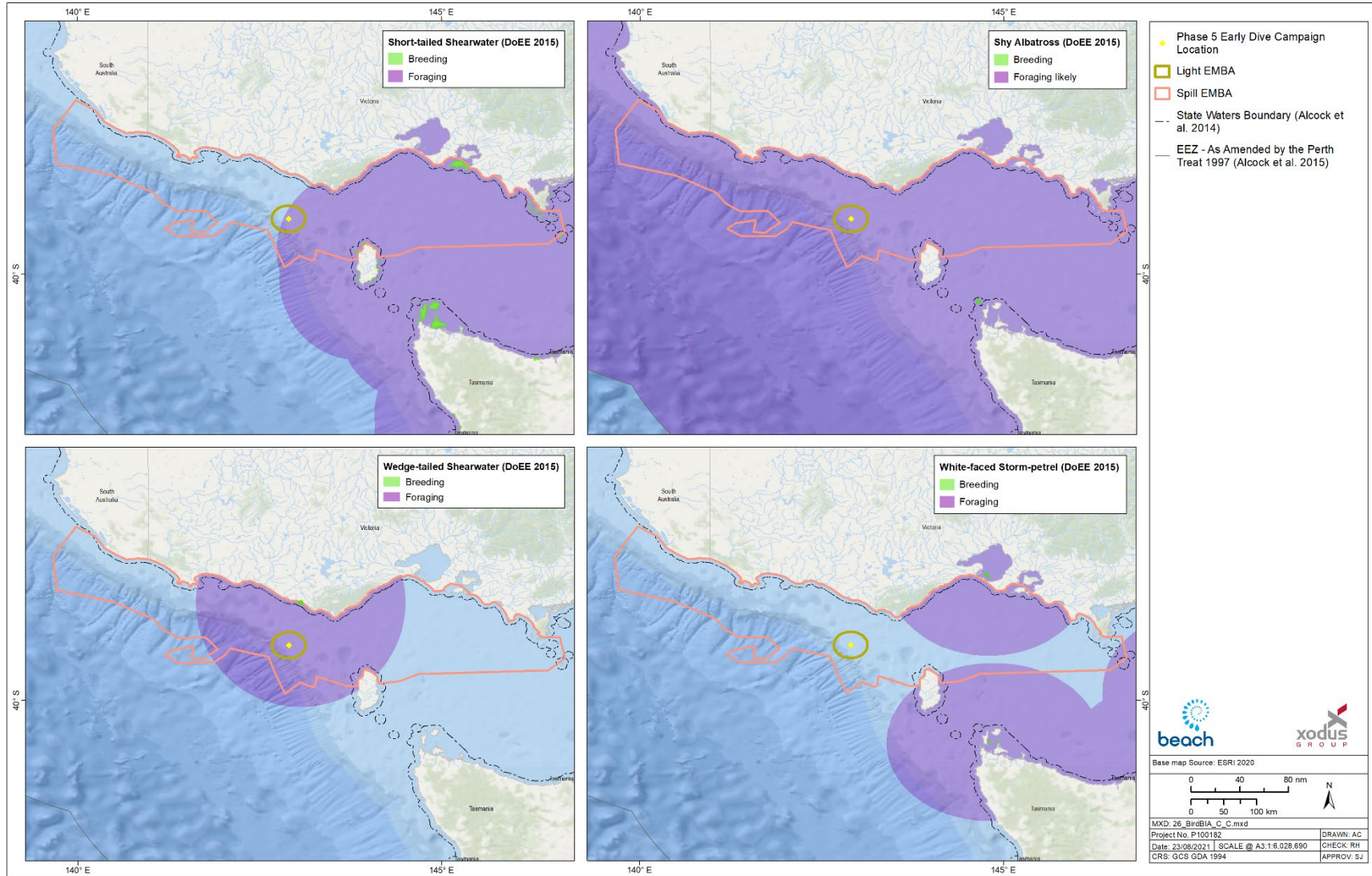


Figure 4-27: BIAs for short-tailed shearwater, shy albatross, wedge-tailed shearwater and white-faced storm petrel within the spill EMBA

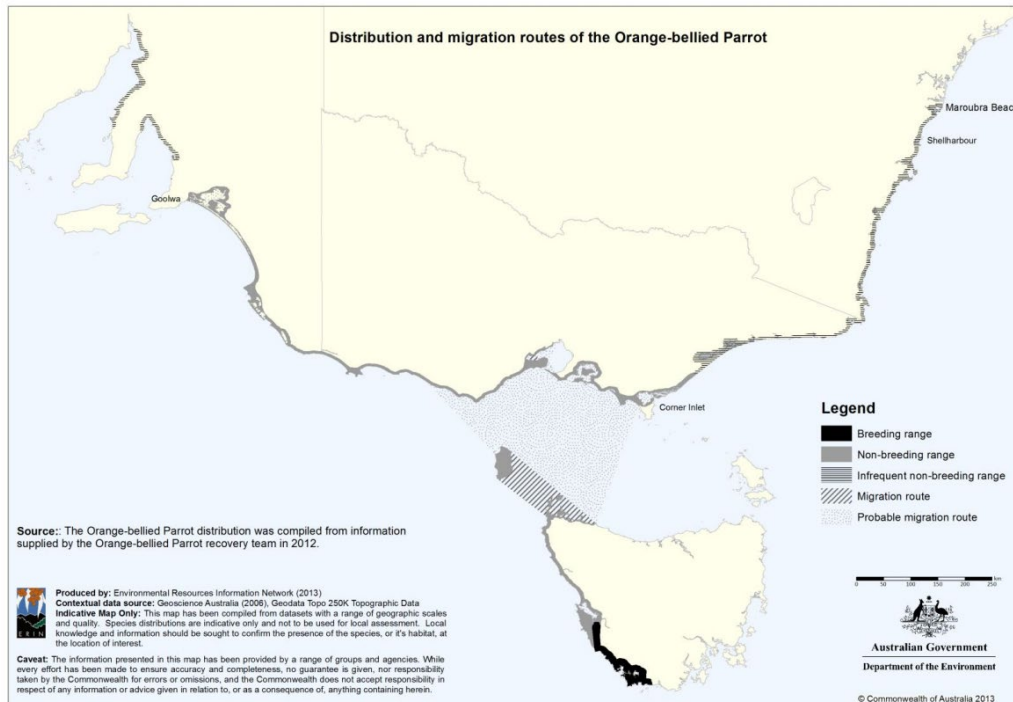


Figure 4-28: Migration routes and breeding ranges for the orange-bellied parrot (DELWP, 2016a)

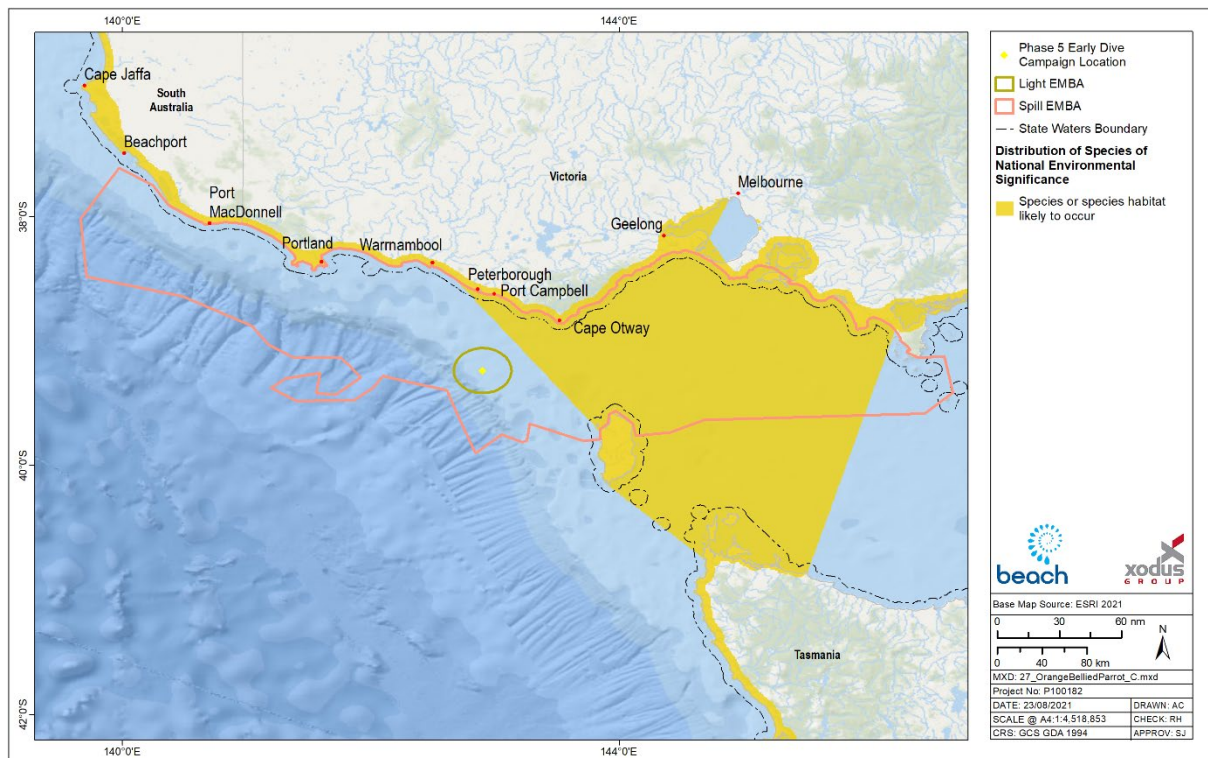


Figure 4-29: Distribution of the orange bellied parrot within the spill EMBA

4.6.10 Marine reptiles

The PMST reports for the operational area and spill EMBA 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 spill EMBA PMST report identifies that feeding is known to

occur in the spill EMBA for all species. There are no identified BIAs for these reptiles in the operational area or spill EMBA.

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 spill EMBA.

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 spill EMBA.

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 spill EMBA.

Table 4-12: Listed turtle species identified in the PMST

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed threatened	Listed migratory	Listed marine		
Green turtle	<i>Chelonia mydas</i>	V	M	L	SHM	SHM
Leatherback turtle	<i>Dermochelys coriacea</i>	E	M	L	FK	SHL
Loggerhead turtle	<i>Caretta caretta</i>	E	M	L	FK	SHL
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		SHM: Species or species habitat may occur within area				
M: Migratory						
Listed Marine						
L: Listed						

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

4.6.11 Cetaceans

The PMST reports identified several cetaceans that potentially occur in the operational area and spill EMBA (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 area or spill EMBA are discussed in more detail in the sections below.

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 below 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 whales (SRW) 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.

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 and Thylacine North-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).

The Bass Strait and the Otway Basin is considered an important migratory path for humpback, blue, SRW, 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.

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.

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

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed threatened	Listed migratory	Listed marine		
Whales						
Andrew's beaked whale	<i>Mesoplodon bowdoini</i>	-	-	L	SHM	SHM
Antarctic minke whale	<i>Balaenoptera bonaerensis</i>	-	M	L	SHL	
Arnoux's beaked whale	<i>Berardius arnuxii</i>	-	-	L	SHM	SHM
Blainville's beaked whale	<i>Mesoplodon desirostris</i>	-	-	L	SHM	SHM
Blue whale	<i>Balaenoptera musculus</i>	E	M	L	FK	FK
Bryde's whale	<i>Balaenoptera edeni</i>	-	M	L	SHM	
Curvier's beaked whale	<i>Ziphius cavirostris</i>	-	-	L	SHM	SHM
Dwarf sperm whale	<i>Kogia simus</i>	-	-	L	SHM	SHM
False killer whale	<i>Pseudorca crassidens</i>	-	-	L	SHL	SHL
Fin whale	<i>Balaenoptera physalus</i>	V	M	L	FK	FL
Gray's beaked whale	<i>Mesoplodon grayi</i>	-	-	L	SHM	
Hector's beaked whale	<i>Mesoplodon hectori</i>	-	-	L	SHM	SHM
Humpback whale	<i>Megaptera novaeangliae</i>	V	M	L	SHK	SHL
Killer whale, orca	<i>Orcinus orca</i>	-	M	L	SHL	SHL
Long-finned pilot whale	<i>Globicephala melas</i>	-	-	L	SHM	SHM
Minke whale	<i>Balaenoptera acutorostrata</i>	-	-	L	SHM	SHM
Pygmy right whale	<i>Caperea marginata</i>	-	M	L	FL	FM
Pygmy sperm whale	<i>Kogia breviceps</i>	-	-	L	SHM	SHM
Sei whale	<i>Balaenoptera borealis</i>	V	M	L	FK	FL

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (1 km)
		Listed threatened	Listed migratory	Listed marine		
Shepherd’s beaked whale	<i>Tasmacetus shepherdi</i>	-	-	L	SHM	
Short-finned pilot whale	<i>Globicephala macrorhynchus</i>	-	-	L	SHM	SHM
Southern bottlenose whale	<i>Hyperoodon planifrons</i>	-	-	L	SHM	
Southern right whale	<i>Eubalaena australis</i> <i>Balaena glacialis australis</i>	E	M	L	BK	SHK
Sperm whale	<i>Physeter macrocephalus</i>	-	M	L	SHM	SHM
Strap-toothed beaked whale	<i>Mesoplodon layardii</i>	-	-	L	SHM	SHM
True’s beaked whale	<i>Mesoplodon mirus</i>	-	-	L	SHM	SHM
Dolphins						
Bottlenose dolphin	<i>Tursiops truncates</i>	-	-	L	SHM	SHM
Common dolphin	<i>Delphinus delphis</i>	-	-	L	SHM	SHM
Dusky dolphin	<i>Lagenorhynchus obscares</i>	-	M	L	SHL	SHM
Indian ocean bottlenose dolphin	<i>Tursiops aduncus</i>	-	-	L	SHL	
Risso’s dolphin	<i>Grampus griseus</i>	-	-	L	SHM	SHM
Southern right whale dolphin	<i>Lissodelphis peronii</i>	-	-	L	SHM	SHM
Listed Threatened		Likely Presence				
E: Endangered		SHM: Species or species habitat may occur within area.				
V: Vulnerable		SHL: Species or species habitat likely to occur within area.				
Listed Migratory		SHK: Species or species habitat known to occur within area.				
M: Migratory		FK: Foraging, feeding or related behaviour known to occur within area. FL: Foraging, feeding or related behaviour likely to occur within area				
Listed Marine		FM: Foraging, feeding or related behaviour may to occur within area.				
L: Listed						

^ The type of presence may vary between the different areas; e.g. an important behaviour (e.g. foraging, breeding) may be present in the spill EMBA, 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					
<i>Eubalaena australis</i>	Southern right whale	SRW	12	52	4.2 +/- 4.2
<i>Caperea marginata</i>	Pygmy right whale		1	100	100
<i>Balaenoptera physalus</i>	Fin and like fin whale	ROR	7	8	1.1 +/- 0.4
<i>B. borealis</i>	Sei and like sei whale	ROR	12	14	1.3 +/- 0.5
<i>B. acutorostrata</i>	Dwarf minke whale	ROR	1	1	1
<i>B. bonaerensis</i>	like Antarctic minke whale	ROR	1	1	1
<i>Megaptera novaeangliae</i>	Humpback whale	ROR	10	18	1.8 +/- 1.0
Toothed whales					
<i>Physeter macrocephalus</i>	Sperm whale	ODO	34	66	1.9 +/- 2.2
<i>Mesoplodon spp.</i>	Unidentified beaked whales	ODO	1	20	20
<i>Orcinus orca</i>	Killer whale	ODO	6	21	3.5 +/- 2.8
<i>Globicephala melas</i>	Long-finned pilot	ODO	40	1,853	46.3 +/- 46.7
<i>Grampus griseus</i>	Risso's dolphin	ODO	1	40	40
<i>Lissodelphis peronii</i>	Southern right whale dolphin	ODO	1	120	120
<i>Tursiops spp.</i>	Bottlenose dolphin	DOL	4	363	90.8 +/- 140.1
	Dolphins	DOL	384	22,169	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 across months 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
Whales												
SRW	0	0	0	0	0	0	0	0	0.8	3.1	6.8	8.8
Pygmy right *	0	0	0	0	0	0	0	0	19.8	0	0	0
Fin	0	0.10	0.14	0.07	0.08	0	0	0	0	0	0	0
Sei	0	0.25	0.07	0.04	0.08	0.19	0	0.21	0	0	0	0
Minke*	0	0	0.02	0	0	0	0.12	0	0	0	0	0
Humpback	0	0.05	0.07	0	0	0	0	0.11	0.99	1.0	0	0.35
Sperm	1.7	1.2	0.23	0.53	0.08	0.13	0.75	0.85	0	0	0	0
Unidentified beaked*	0	0	0.47	0	0	0	0	0	0	0	0	0
Pilot whale	0	59.6	7.0	19.3	4.0	39.5	0	26.3	0	0	0	0
Dolphins												
Killer whale	0	0	0.19	0	0	5.0	0	6.0	0	0.68	0	0
SRW dolphin*	0	59.6	0	0	0	0	0	0	0	0	0	0
Risso's *	0	0	0	0	1.7	0	0	0	0	0	0	0
Bottlenose	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
Whales											
Blue	0	0	0	0	0	23	70	17	8	2	120
SRW	2	0	12	13	0	0	0	0	0	0	39*
Humpback	3	2	0	1	0	1	0	0	0	0	7
Sperm	2	0	0	0	4	0	0	3	1	0	10
Pilot	0	0	0	0	0	70	0	0	55	0	125
SRW	0	0	0	0	0	120	0	0	0	0	120
Dolphins											
Dolphins	13	298	0	33	54	620	80	672	1526	21	3317

*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

Observation times and locations:

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.

4.6.11.1 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 area or spill EMBA. Therefore, it is likely that they would be uncommon visitors in the spill EMBA.

4.6.11.2 Blue whale

Status

The blue whale (*Balaenoptera musculus*) is listed as an endangered species under the 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 Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015b) identifies threats and establishes actions for assisting the recovery of blue whale populations using Australian waters (Commonwealth of Australia, 2015b). The pygmy blue whale has a foraging (annual high use area) BIA within the operational area and spill EMBA (Figure 4-30).

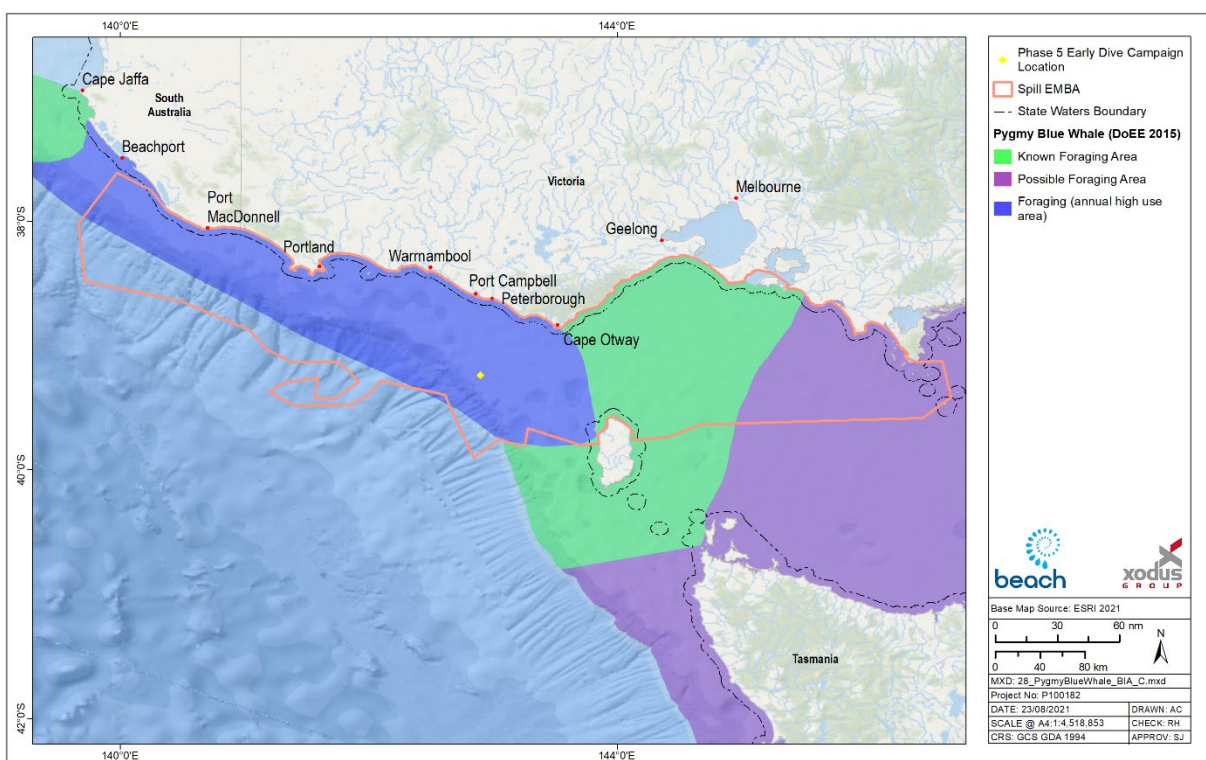


Figure 4-30: BIA for the pygmy blue whale within the spill EMBA.

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). 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.

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° South, 115–125° 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. The presence of Antarctic blue whales in the area is considered rare (Gavrilov, 2012), however acoustic detection of Antarctic blue whales indicates that they occur along the entire southern coastline of Australia (McCauley et al., 2018).

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.

Blue whales are rapid long-distance travellers, and pygmy blue whales spend the winter breeding in Indonesian waters, returning to cool temperate waters around November each year, interchanging between these waters and remoter waters of the Southern Ocean during the upwelling 'season' (Gill 2020). Pygmy blue whales have three migratory stages around Australia; the "southbound migration stage" is predominantly between October to December (sometimes into January) where whales travel from Indonesian waters down to the WA coast. The "southern Australian stage" between January and June is where whales spread across the southern Australian waters. The "northbound migration stage" is 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 (McCauley et al. 2018).

The distribution of blue whales in the Australian region is shown in Figure 4-31. 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. The Otway Offshore Project is located within a blue whale BIA – Foraging Area (annual high use area).

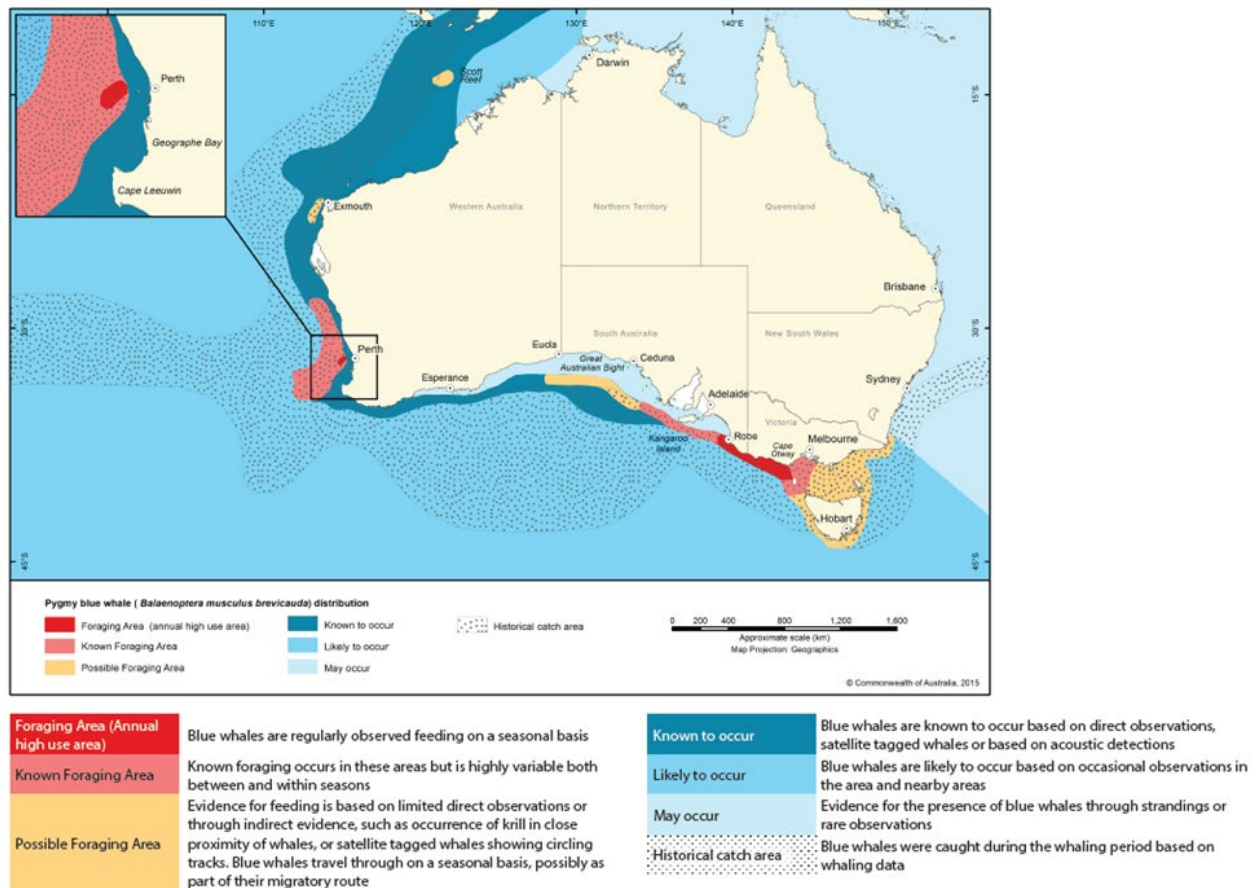


Figure 4-31: Pygmy blue whale distribution areas around Australia (Commonwealth of Australia, 2015b)

McCauley et al (2018) suggests that acoustic detection of pygmy blue whales indicate they predominantly occur west of Bass Strait. Acoustic detections of pygmy blue whales off Portland Victoria correlated with upwelling indicators in the Bonney coast upwelling in late summer to autumn (February to 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. On one occasion all three types were detected between April and June with more commonly two calls present over this period during other years.

The Otway Shelf is squarely within the productive, and to a certain extent predictable, Great Southern Australian Upwelling System. It has been shown to be an important, consistently used blue whale foraging area over many years (Gill et al. 2011)

Foraging Ecology

Krill is the key to understanding the ecology and behaviour of blue whales, yet little is known of its ecology. Krill is sensitive to temperature and migrates vertically and horizontally to maintain optimal positioning with respect to nutrients, often being found along thermal fronts and thermoclines. Krill abundance in a given season may be linked to oceanographic conditions of the previous year. Unlike most krill species, *Nyctiphanes australis* frequently swarm at or near the surface, making it easily available to foraging blue whales. However, it is often found at depth, when blue whales must dive to search for and consume it. Foraging is energetically expensive for these giant mammals, which must regularly find sufficient food to balance their enormous energy requirements (Gill 2020).

Between the months of November and April, south-east winds drive upwelling of nutrient-rich water drawn from the continental slope, onto the continental shelf. An upwelling regime known as the Great Southern Australian Upwelling System extends along the shelf from the eastern Great Australian Bight to western Tasmania. Prominent surface upwelling commonly occurs west of Portland where the shelf is narrow (the Bonney Upwelling); whereas on the broader shelf between Portland and King Island, upwelling is usually subsurface, with cooler upwelled water beneath a warmer surface layer (Gill 2020).

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 4-31). 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).

Diving behaviour of blue whales associated with feeding at depth was observed by Gill and 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; and
- 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).

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 Otway region generally coincides with the upwelling of cold water between November and April along the Bonney coast 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).

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.

Blue whales typically feed during daylight hours when krill is visible to them (Gill 2020).

The Otway Region

Aerial Surveys (2001-02 to 2006-07)

Seasonal (November to April) aerial surveys between Cape Jaffa and Cape Otway over six seasons found that the general pattern of seasonal movement of blue whales is from west to east, with whales foraging between the Great Australian Bight and Cape Nelson in November and spreading further east into the Otway Shelf between Portland and Cape Otway around December. Whales were typically widely distributed throughout Otway shelf waters from January through to April (Gill et al., 2011) (Figure 4-32 and Figure 4-33).

The sighting and effort data presented in Figure 4-32 and Figure 4-33 was used to calculate an 'encounter rate' (NB: key in upper right corner of the November, January and April figures). Dots represent blue whale sightings while squares are aerial survey effort (10 km x 10 km squares) represented as minutes flown per grid square. The data was pooled for all seasons. 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). During 2002-11, blue whales were twice more likely to be found west of Portland than to its east (Gill et al. 2011).

The spill EMBA is within the central and eastern areas and the operational area on the outer edge of the eastern area.

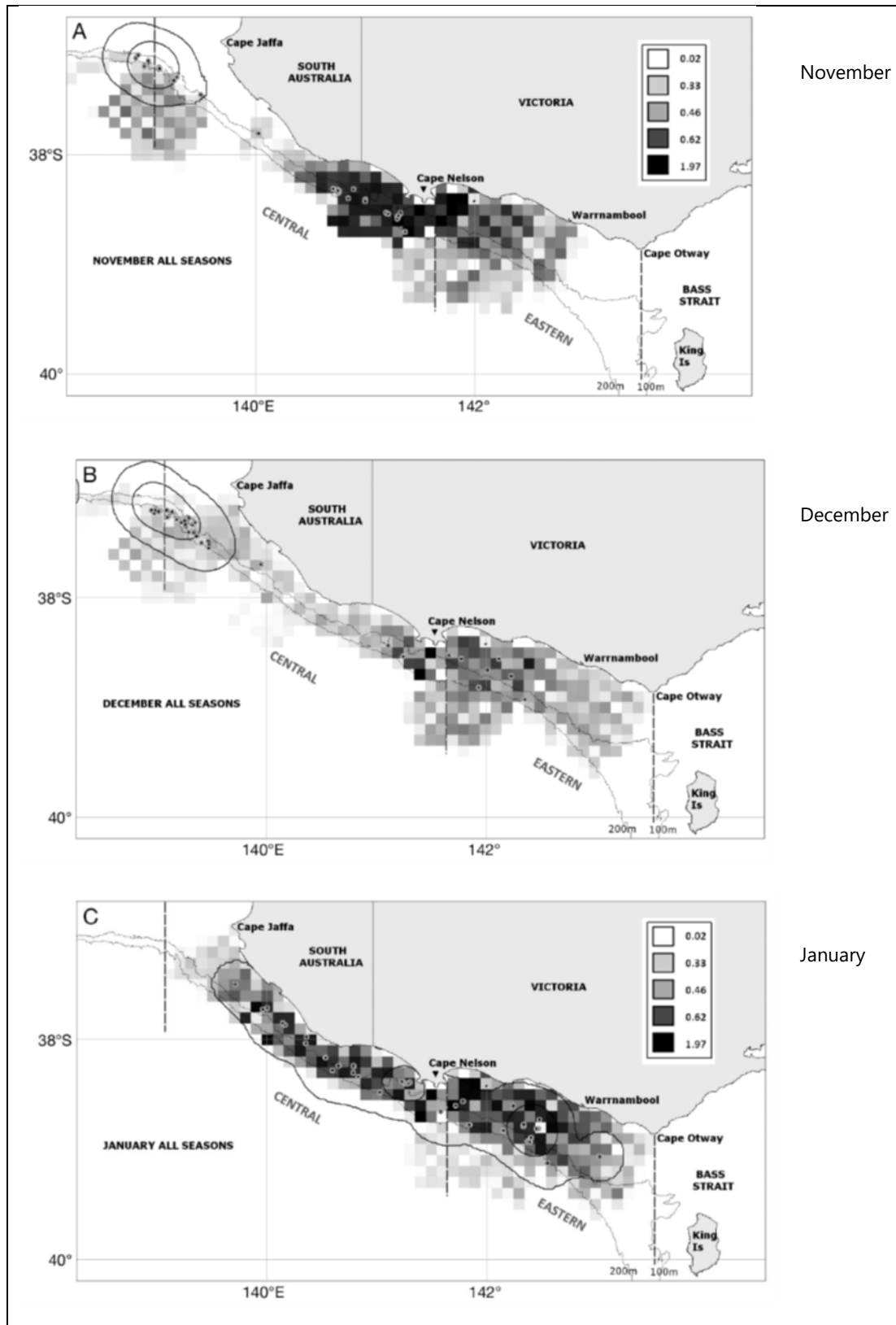


Figure 4-32: Blue whale sightings between 2001 and 2007 in the Otway Basin (Nov, Dec, Jan) (Gill et al., 2011)

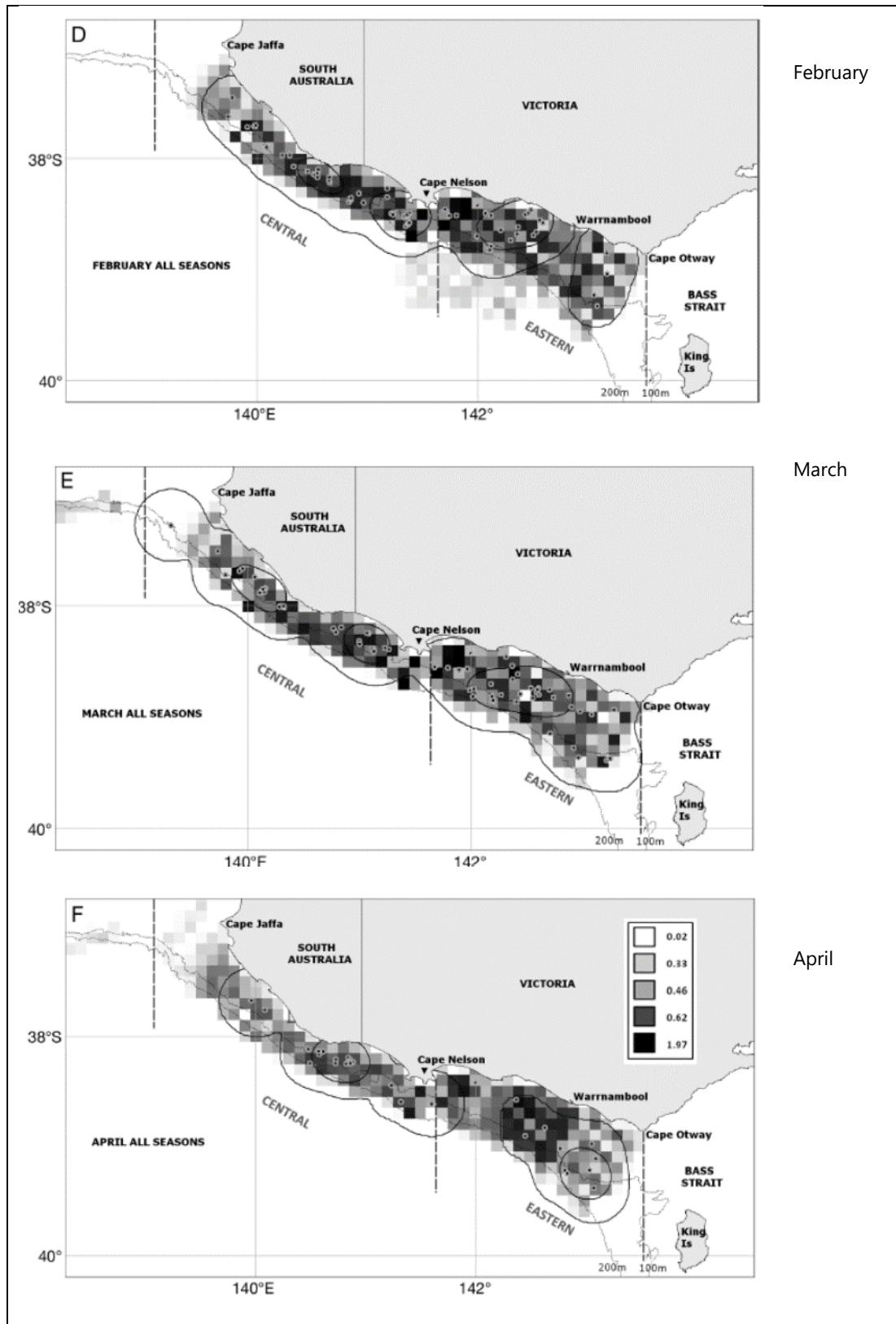


Figure 4-33: Blue whale sightings between 2001 and 2007 in the Otway Basin (Feb, Mar, Apr) (Gill et al., 2011)

Monthly blue whale encounter rates between 2001 and 2007 in the central and eastern study area (Cape Nelson to Cape Otway) are shown in Figure 4-34. The 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 (Gill et al., 2011).

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 4-32).

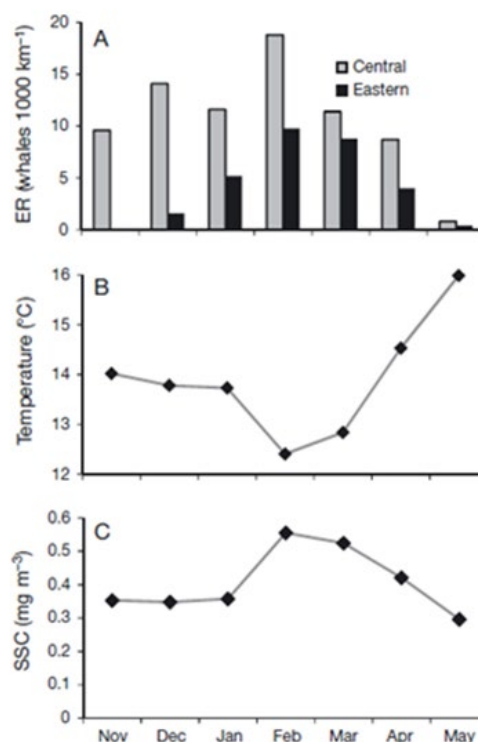


Figure 4-34: Blue whale encounter rates in the central and eastern study (Cape Nelson to Cape Otway) area by month (Gill et al., 2011)

The key findings from the 2001 – 2007 seasonal surveys were (Gill et al. 2011):

- 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 (Cape Nelson to Cape Otway) during November for any season despite significant effort.
- encounter rates in central and eastern zones peaked in February, coinciding with peak upwelling intensity and primary productivity.

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 (east of the Thylacine-A wellhead platform). 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 4-35 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 4-35 and Figure 4-36). 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).

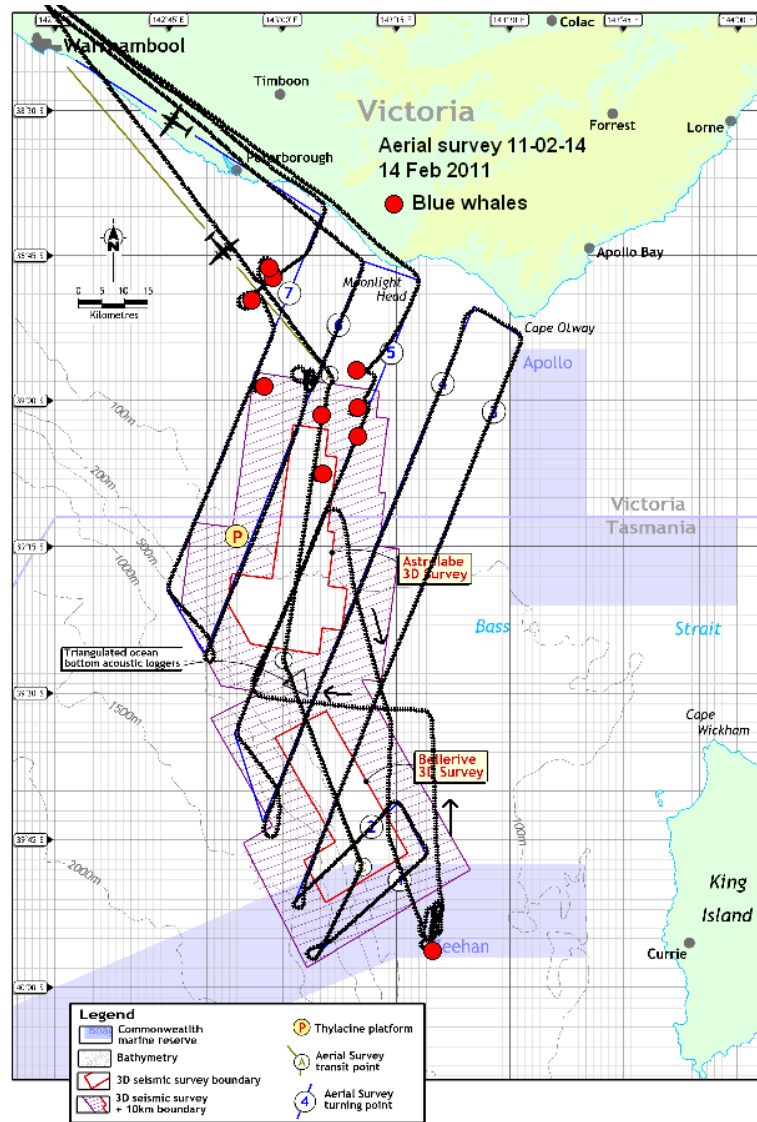


Figure 4-35: Blue whale sightings during an aerial survey for Origin Energy in February 2011 (Gill 2020).

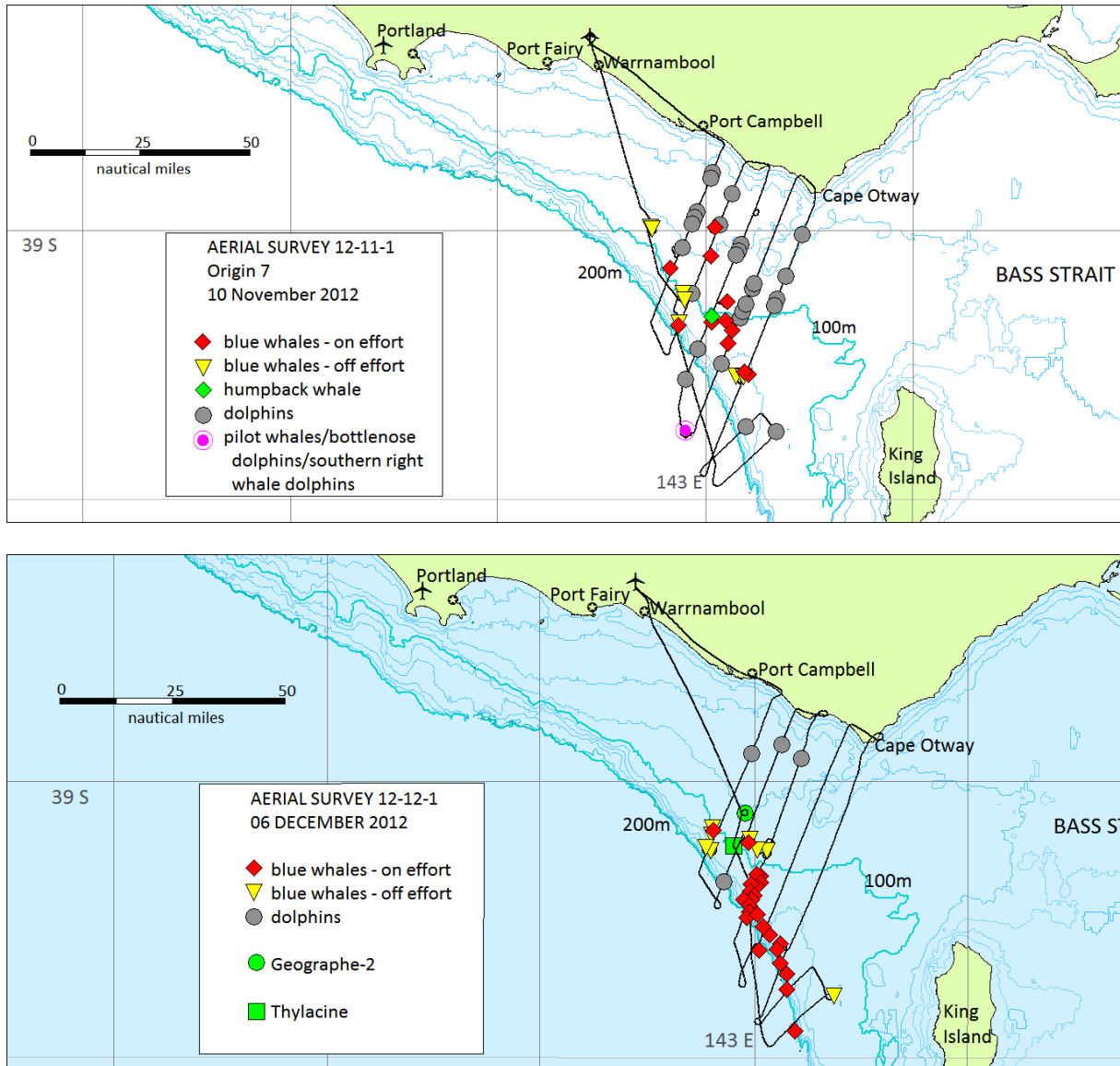


Figure 4-36: Blue whale sightings during an aerial survey for Origin Energy in November and December 2012 (Gill 2020).

Tagging Study (2015-2016)

Möller et al. (2020) analysed data from 13 pygmy blue whales tagged in the Bonney upwelling region in January 2015 with tags transmitting up to March 2016 (Figure 4-37). In summary:

- the whales' 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 .
- 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.

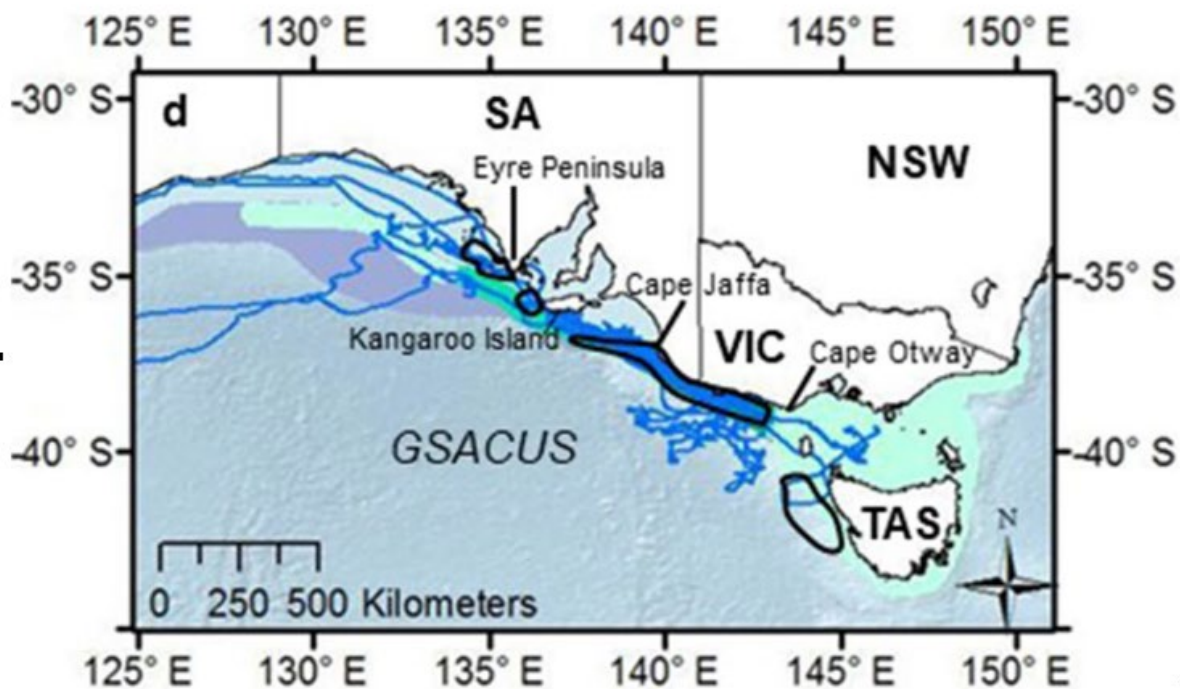


Figure 4-37: Tracks of 13 pygmy blue whales in the Great Southern Australian Coastal Upwelling System (GSACUS) (Möller et al. 2020)

Passive Acoustic Recorders (2009-2017)

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.

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).

In 2009 and 2011, pygmy blue whales arrived in November or December whereas in other years, calls were not detected until January or February (Figure 4-38). There was substantial variation in presence within a season, with some whales remaining in the Portland detection area until mid-June each year with no consistent trend other than a peak in presence somewhere over February to June.

McCauley et al. (2018) noted 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. McCauley et al. (2018) also noted that the

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

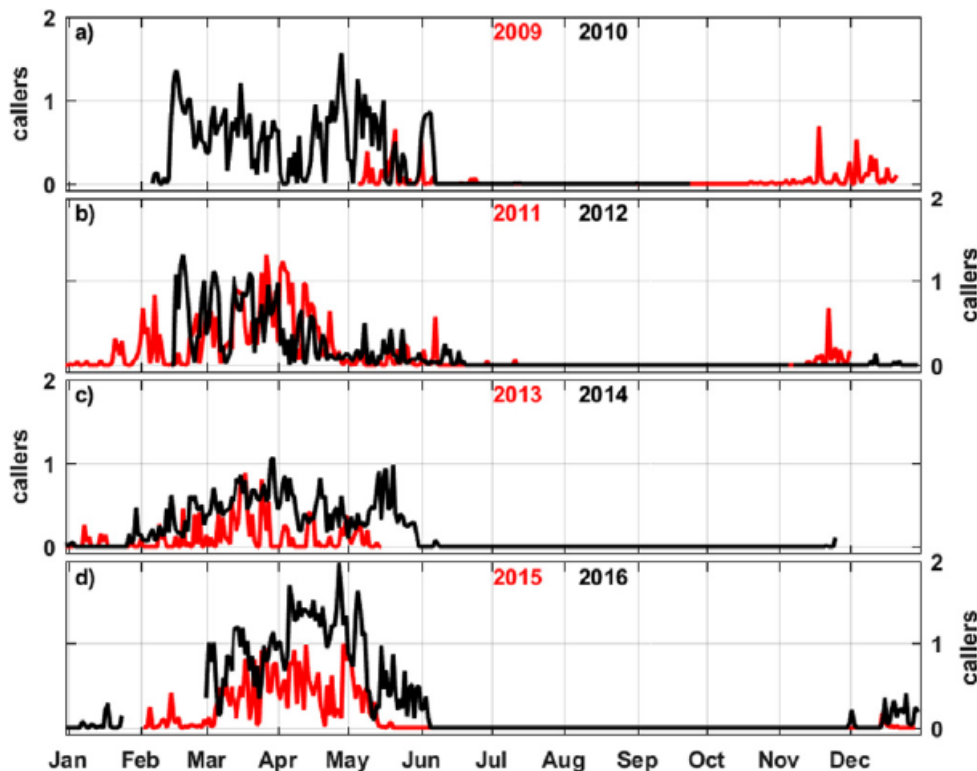


Figure 4-38: Mean number of individual pygmy blue whales calling (McCauley et al. 2018)

Beach Surveys (2019-2022)

During the Beach Otway Development Seabed Survey 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 4.5.5, 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); and
- Development drilling of the Thylacine West wells (23 January 2022 – 30 April 2022)

Drilling is currently occurring at the Thylacine North-2 well.

Drilling was undertaken by a mobile offshore drilling unit (MODU), the *Ocean Onyx*. The Blue Whale Study was engaged to undertake 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 the final blue whale was sighted 7 April.
- Blue whales and krill surface swarms were distributed throughout the area surveyed.

Throughout the drilling campaign, Marine Fauna Observers (MFOs) have been employed to ensure activities comply 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 MODU 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 4-39), 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.

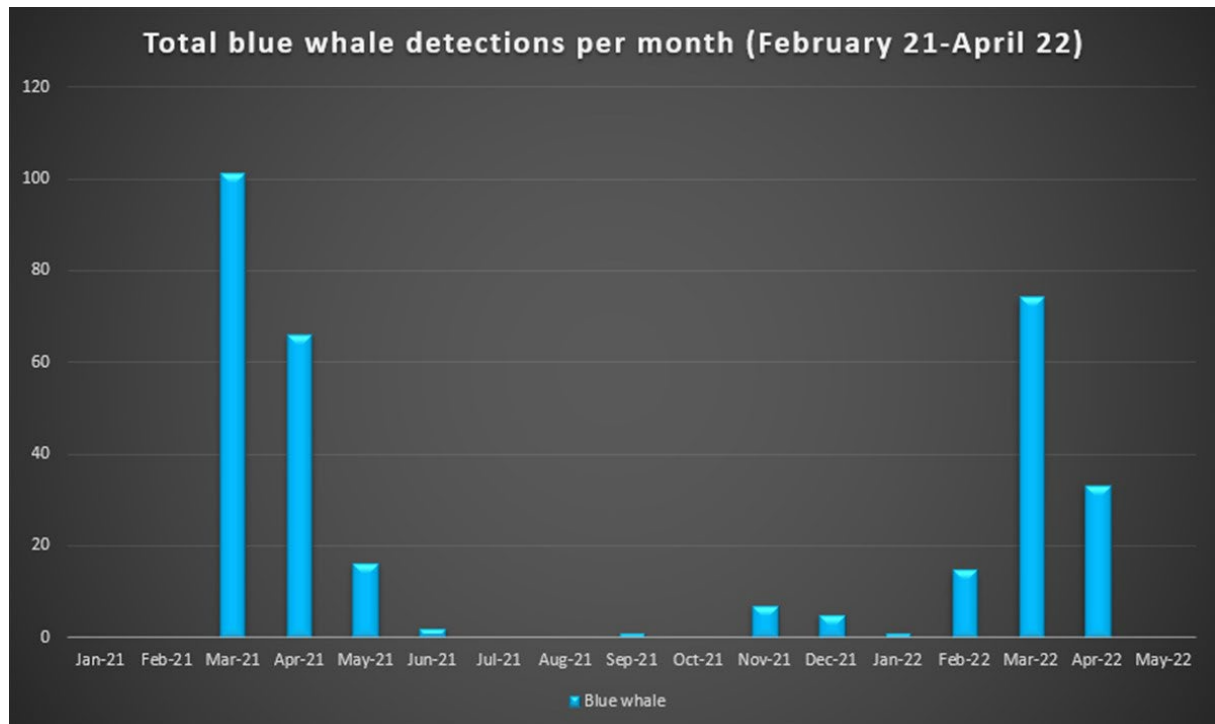


Figure 4-39: Blue whale observations during the Otway Offshore Drilling Campaign

Figure 4-40 shows all whale sightings by MFOs between 2 February 2021 and 31 March 2022 across all well locations. Figure 4-41 shows blue whale sightings within the Thylacine field between 16 November 2021 and 31 March 2022. Note that many observations were made whilst in transit.

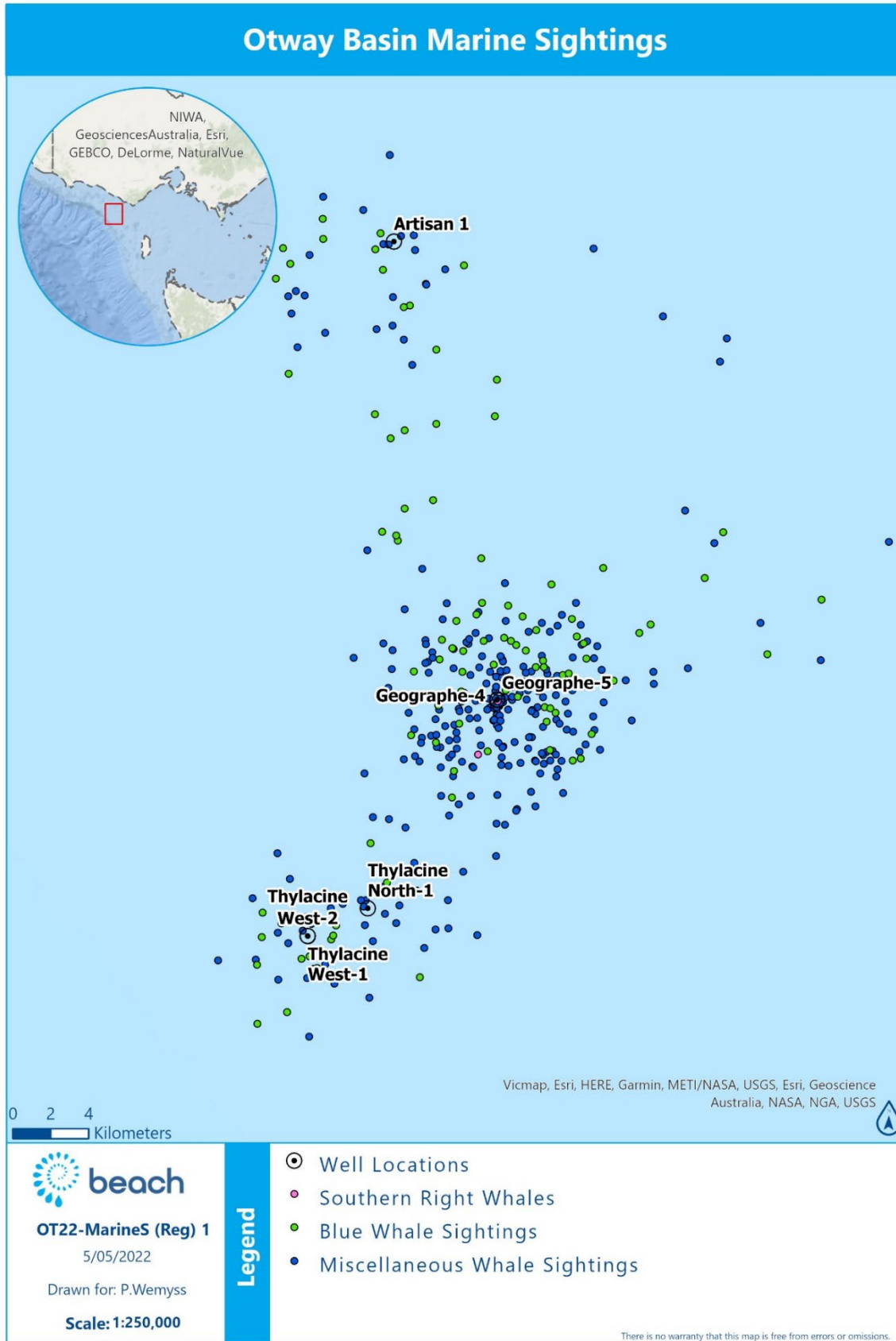


Figure 4-40: Whale sightings between 2 February 21 – 31 March 22

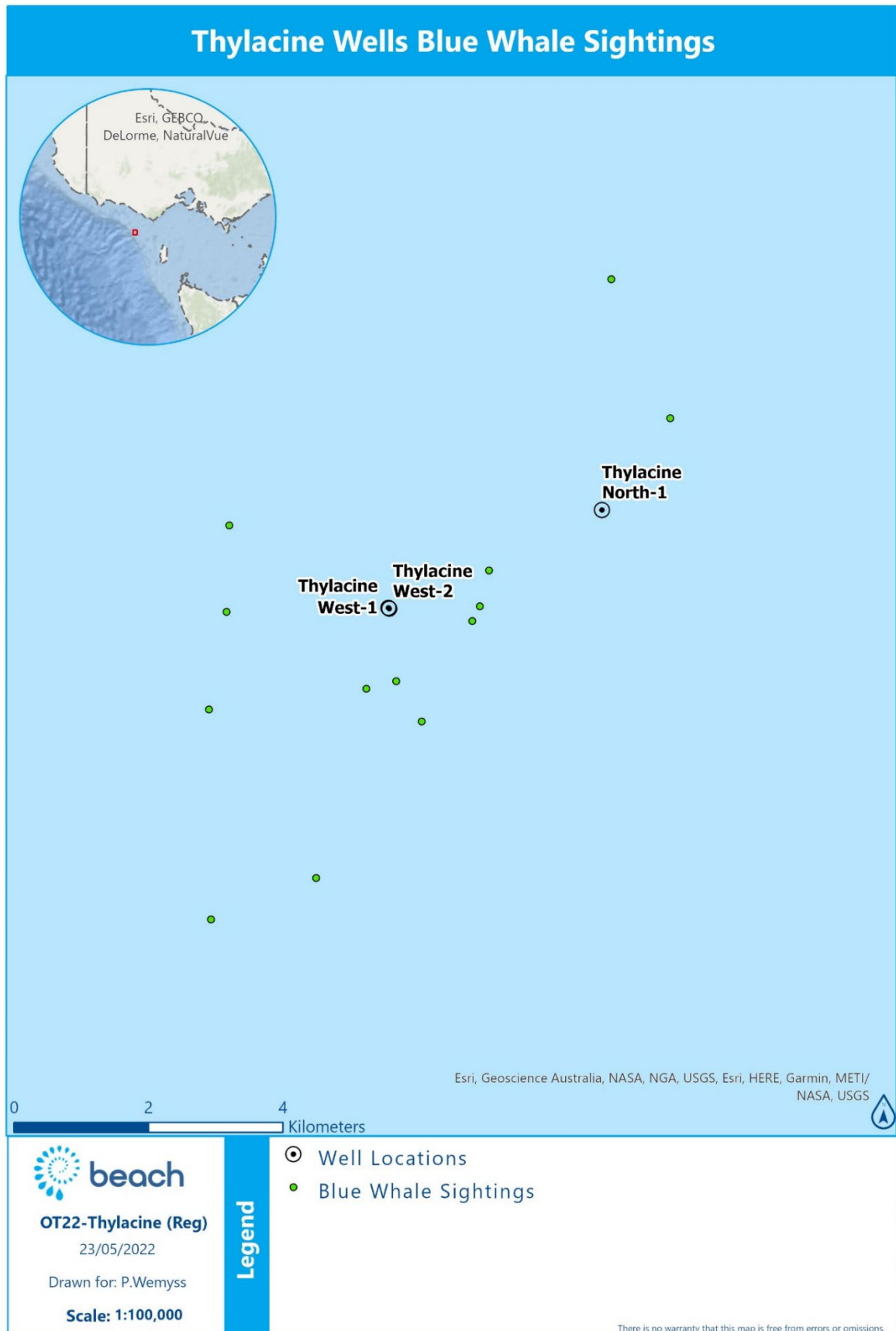


Figure 4-41: Blue whale sightings in the Thylacine field TN-1 (16 Nov 21 – 11 Jan 22); TW (23 Jan 22 – 31 Mar 22)

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/km² observed was 2.7x higher in the 0-1,500 m zone (7.8 whales/km²) than in the 1,501 to 3,000 m zone (2.9 whales/km²) (Table 4-18).

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 (km ²)	0.76	6.31	5.50	15.70				
Observed whales/km ²	7.1	4.1	4.7	2.3				
	0-1,500		1,501-3,000					
TOTAL	32		62					
Area (km ²)	7.07		21.21					
Blue whales/km ²	7.8		2.9					

It would be expected that the number of blue whales/km² 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/km² 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 4-42 shows the detection function for all data; Figure 4-43 shows the detection functions under different visibility conditions; Figure 4-44 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).

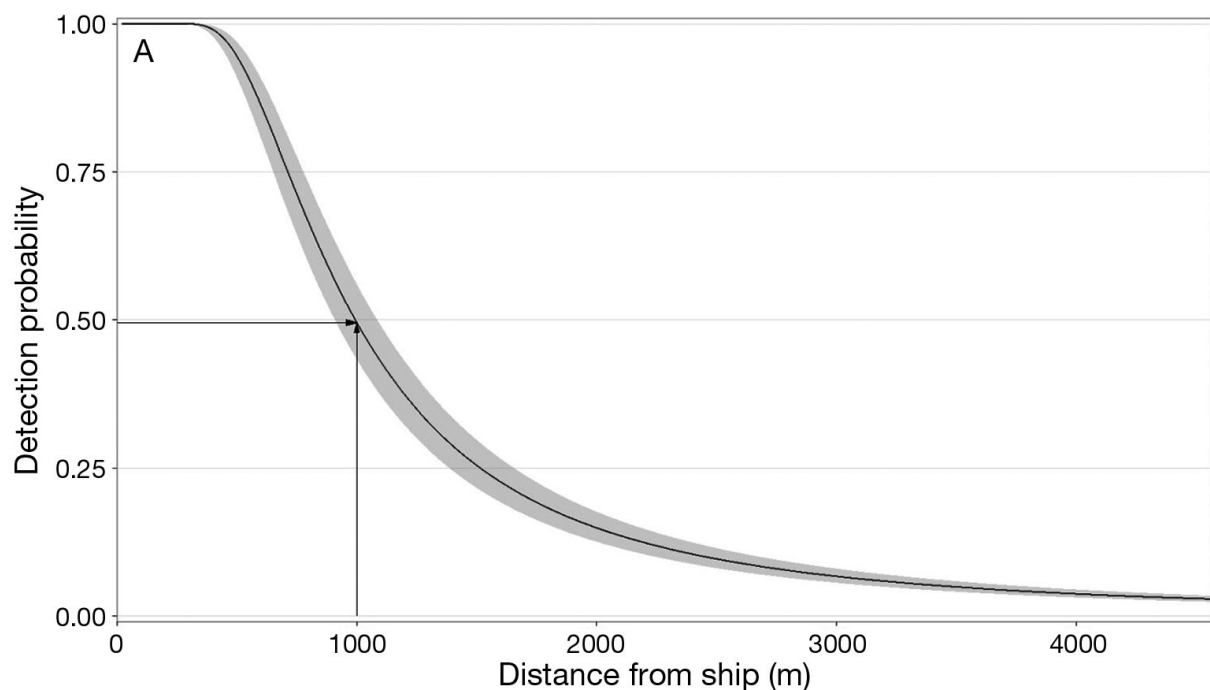


Figure 4-42: Detection probability as it varies with distance between ships and whales in and near Glacier Bay National Park from 2008 to 2015 (Williams et al. 2016)

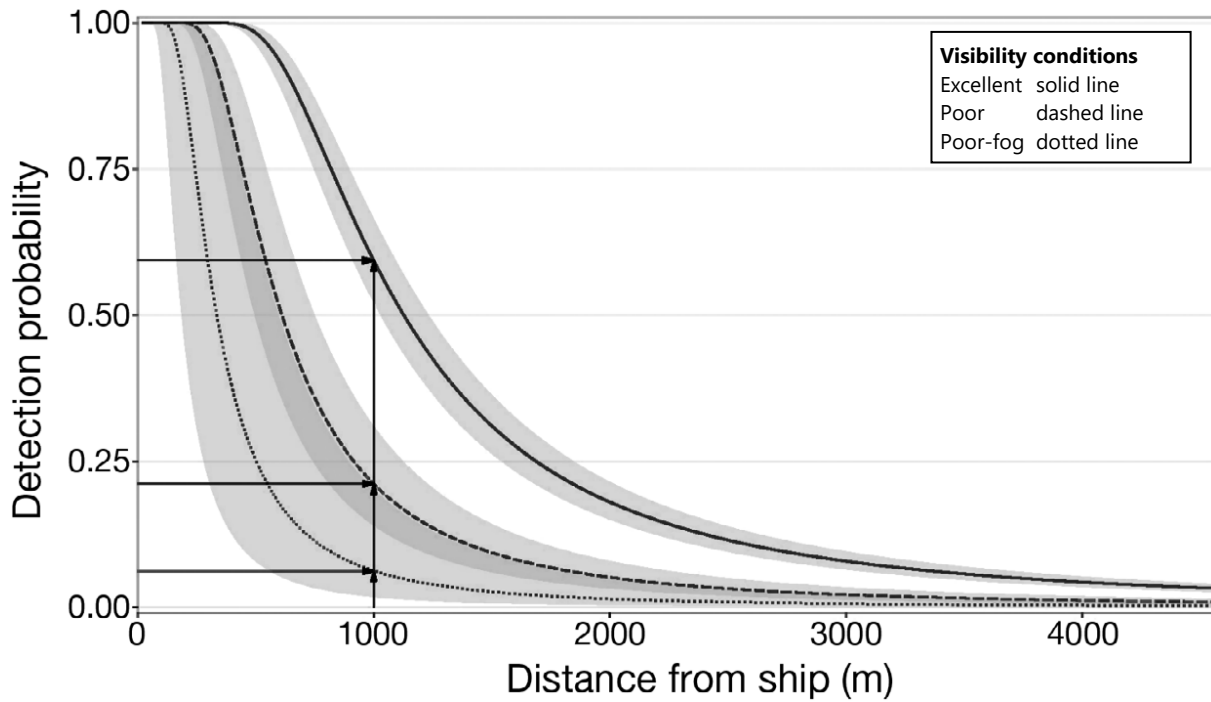


Figure 4-43: Detection probability of humpback whales under different visibility conditions as it varies with distance (Williams et al. 2016)

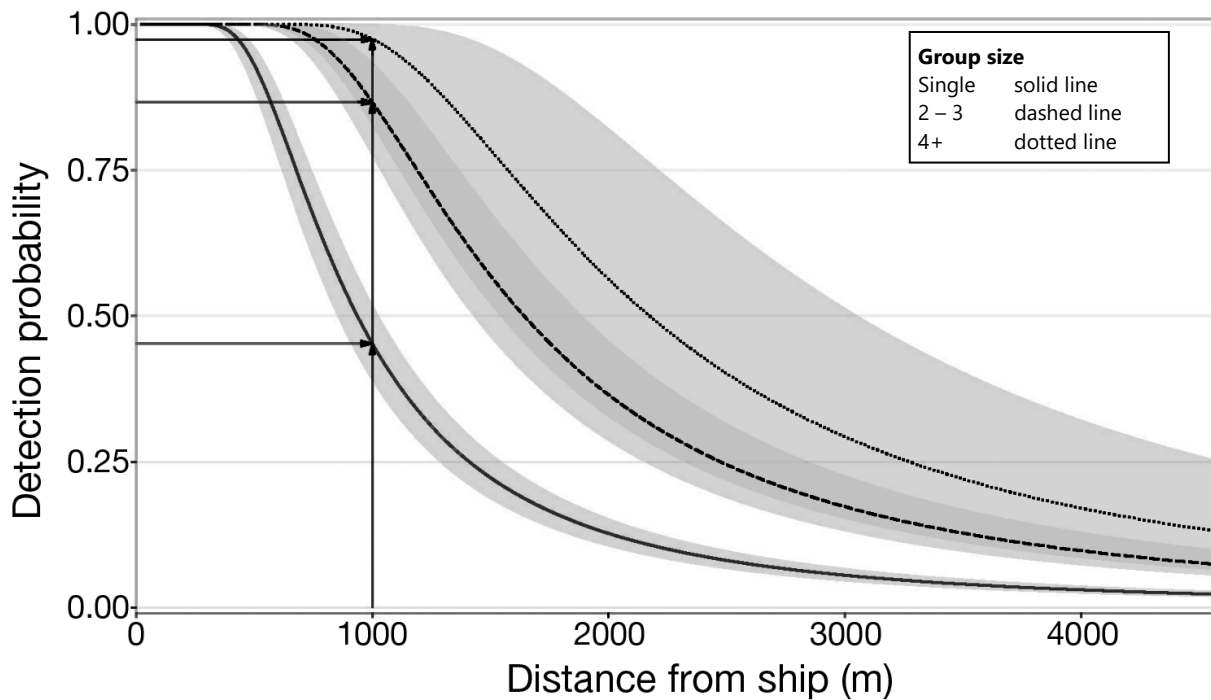


Figure 4-44: Probability of detecting whale groups of different sizes of humpback whales as it varies with distance (Williams et al. 2016)

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 MFO’s advice was the curve showing ‘4+ group size’ in Figure 4-44. Detection probabilities for this case, along with those for

'excellent visibility' conditions (Figure 4-43) and 'all' data (Figure 4-42) 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).

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 collected between 2 February 2021 and 31 March 2022

	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 4-18				
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

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 4-45. 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 MFO's 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/km² 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/km² and 22.91 blue whales/km² for the 'excellent visibility' and 'all data' scenarios, respectively.

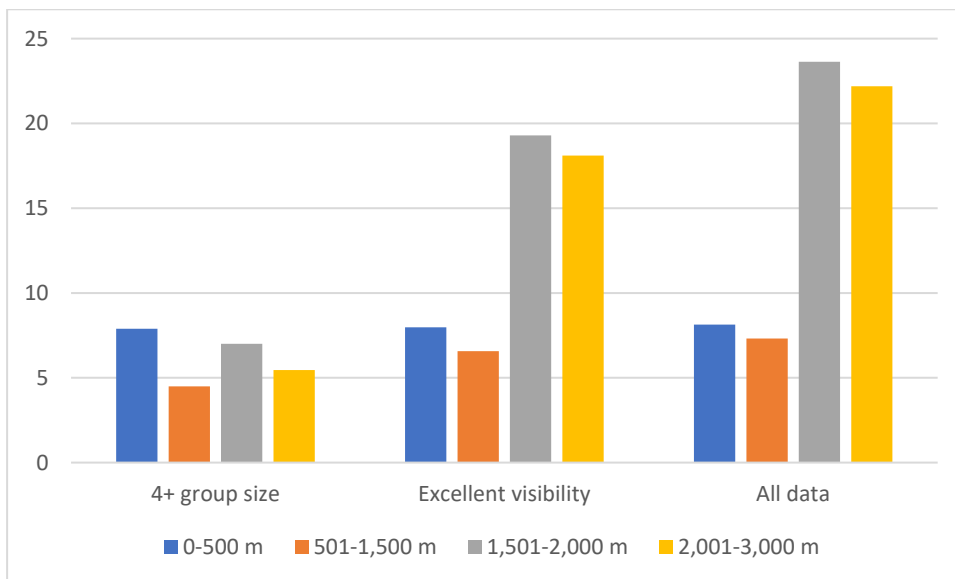


Figure 4-45: Expected density (blue whales/km²) for each management zones

4.6.11.3 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 defined 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 spill EMBA, they are likely to be uncommon visitors to the operational area and spill EMBA. No fin whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.4 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 spill EMBA, although feeding may occur opportunistically where sufficient krill density is present (Commonwealth of Australia, 2015) and anecdotal sightings of humpback whale have been made by Beach in the area. 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 activity location, 95 humpback whale detections have been 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.

4.6.11.5 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 area or spill EMBA. Therefore, it is likely that they would be uncommon visitors in the operational area or spill EMBA. No killer whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.6 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 spill EMBA. 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. It is likely that they would be uncommon visitors to the operational area or spill EMBA.

No long-finned pilot whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.7 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 (Kasamatsu, 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 spill EMBA. Therefore, it is likely that they would be uncommon visitors in the operational area or spill EMBA. During Beach's Otway drilling campaign in 2021, which includes the activity location, three minke whale detections have been made, all during May.

4.6.11.8 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 area or spill EMBA. Therefore, it is likely to be an uncommon visitor in the operational area or spill EMBA. No pygmy right whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.9 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. The sei whale is likely to be an uncommon visitor to the operational area or spill EMBA. No sei whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.10 Southern right whale

Status

The SRW (*Eubalaena australis*) is listed as endangered under the EPBC Act in Australia and as critically endangered on the Victorian Threatened Species Advisory List. Southern right whales were depleted to less than 300 individuals globally due to commercial whaling in the 19th and 20th centuries (Tormosov et al., 1998). They were protected from whaling in 1935 however, due to illegal whaling in the 1970s and because southern right whales have a slow rate of increase (7% per annum (p.a.)) 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 spill EMBA overlaps the SRW (*Eubalaena australis*) aggregation, connecting habitat and migration BIAs and current core coastal range (Figure 4-46). The operational area overlaps the known core coastal range BIA. The operational area is ~67 km from the aggregation BIA and ~90 km from the connecting habitat BIA (Figure 4-46).

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). They are distributed across thirteen primary aggregation areas along the southern coast of Australia (Figure 4-47) (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).

As a highly mobile migratory species, SRW 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 SRW 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 cited in Charlton 2017).

Aerial surveys of western Bass Strait and eastern Great Australian Bight undertaken by Gill et al., (2015) detected SRW 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 SRW 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 SRW individuals (17 breeding females) in 2013 and 39 (11 breeding females) in 2014, respectively (Watson et al., 2015).

The data presented in Table 4-17, based on observations in Beach's offshore Otway permits undertaken for most of 2021, indicates that only three SRW were observed (a single individual in each of the months of June, July and August).

Population

The Australian population of SRW 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 SRW (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).

Biologically Important Areas

Known core range: The activity area occurs within this BIA, which covers all of Bass Strait and shelf waters of the Southern Ocean.

Connecting habitat: 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) occurs 66 km north of the activity area. A portion of the King Island connecting habitat BIA is within the spill EMBA.

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, 2018). 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.

Aggregation areas: Key aggregation areas close to the activity area occur in Portland and Warrnambool in Victoria. 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). 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. No SRW 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.

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 SRW include Yokinup Bay in WA and

Fowlers Bay in SA and the Warrnambool and Portland in Victoria. Aerial surveys between Ceduna, SA and Sydney, NSW (including Tasmania) were undertaken in August of 2013 and 2014 and recorded a total of 34 SRW individuals (17 breeding females) in 2013 and 39 (11 breeding females) in 2014, respectively (Watson et al., 2015).

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 SRW 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).

Emerging aggregation areas: Such 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). A number of additional areas for SRW 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). The Port Campbell location is the closest to the activity area, located about 67 km north (measured at the 20 m bathymetry contour). Based on the abundance information for connecting habitat, SRW may be present in the Port Campbell emerging aggregation area between July and October (outside the activity window).

Calving aggregations for SRW may occur over a wide environmental range, however habitat providing a degree of protection from prevailing weather conditions is generally preferred (DSEWPac, 2012a). SRW may vary their habitat use according to local environmental conditions, optimising their distribution within aggregation areas on high energy coastlines to minimise exposure to rough sea conditions (DSEWPac, 2012a). Water depth is the most influential determinant of habitat selection at a fine-scale within aggregation areas, with whales preferring to occupy depths of less than 10 m (DSEWPac, 2012a). Therefore, it is unlikely that calving whales would remain in the activity area, given the water depth is 100 m. *Threats* 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 SRW include entanglement in fishing gear, vessel disturbance, climate variability and change, noise interference, habitat modification and overharvesting of prey.

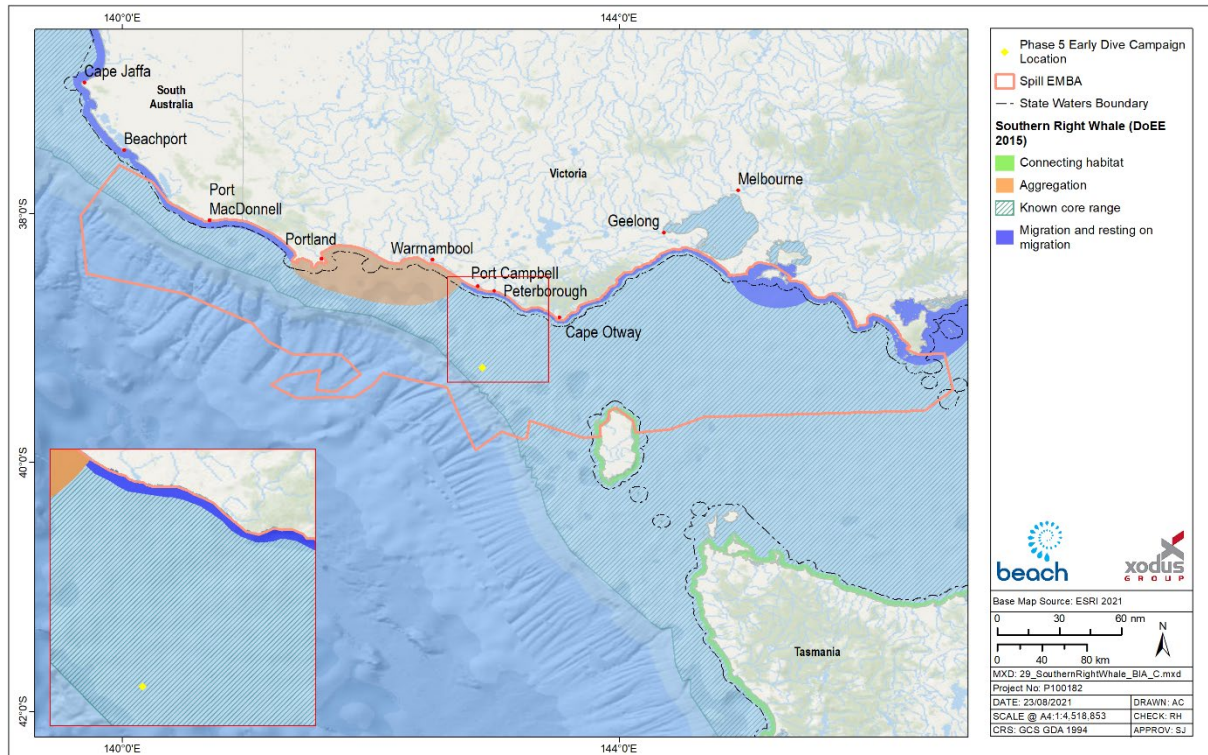


Figure 4-46: Southern right whale BIAs within the spill EMBA.

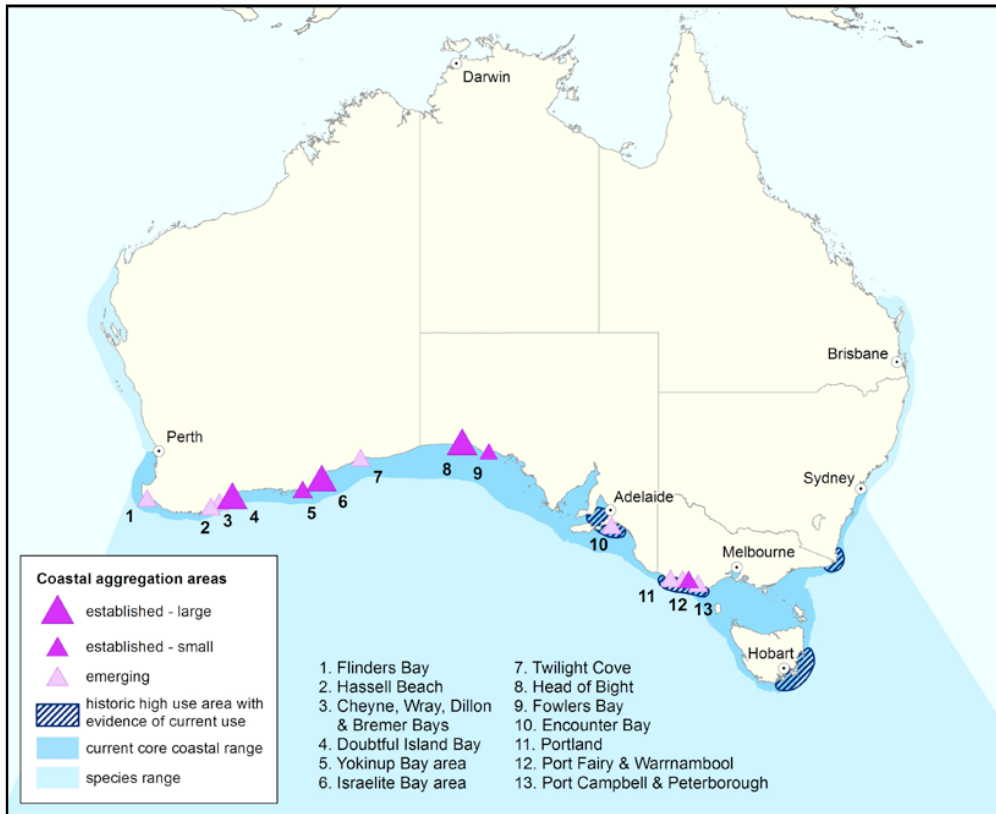


Figure 4-47: Aggregation areas for southern right whales (DSEWPaC, 2012a)

4.6.11.11 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

area or spill EMBA. No sperm whales have been detected during Beach's Otway drilling campaign, which includes the activity location.

4.6.11.12 Dolphins

Bottlenose dolphin

The bottlenose dolphin (*Tursiops truncatus*) 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 includes the activity location, 40 bottlenose dolphin detections have been made, spread across the year. However, no BIAs for this species have been identified in the operational area or spill EMBA.

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, and during Beach's Otway drilling campaign in 2021, which includes the activity location, 519 common dolphin detections have been made, spread across the year.

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 obscurus*) 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 have been detected during Beach's Otway drilling campaign, which includes the activity location.

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 have been detected during Beach’s Otway drilling campaign, which includes the activity location.

Risso’s dolphin

The Risso’s dolphin (*Grampus griseus*) is a widely distributed species found in deep waters of the continental slope 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. The Risso’s dolphin has been observed in the region, however no BIAs have been identified in the operational area or spill EMBA. Therefore, it is likely they would be uncommon visitors in the operational area or spill EMBA. No Risso’s dolphins have been detected during Beach’s Otway drilling campaign, which includes the activity location.

Southern right whale dolphin

The southern right whale dolphin (*Lissodelphis peronii*) 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 spill EMBA. No southern right whale dolphins have been detected during Beach’s Otway drilling campaign, which includes the activity location.

4.6.12 Pinnipeds

The PMST reports identified three pinnipeds that potentially occur in the operational area and spill EMBA (Appendix A). The spill EMBA overlaps a foraging BIA for the Australian sea lion.

Table 4-21: Listed pinniped species identified in the PMST search

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (500 m)
		Listed threatened	Listed migratory	Listed marine		
New Zealand fur-seal	<i>Arctocephalus forsteri</i>	-	-	L	SHM	SHM
Australian fur-seal	<i>Arctocephalus pusillus</i>	-	-	L	BK	SHM

Common name	Species name	EPBC Act status			Spill EMBA	Operational area (500 m)
		Listed threatened	Listed migratory	Listed marine		
Australian sea lion	<i>Neophoca cinerea</i>	E	-	L	SHK	
Listed Threatened E: Endangered		Likely Presence				
Listed Marine L: Listed		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				

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

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 spill EMBA 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 spill EMBA overlaps an Australian sea lion foraging BIA (Figure 4-48). 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).

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 4-49 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 spill EMBA include Seal Rocks (off King Island) and Judgement Rocks (Kent Group Islands) (Figure 4-49).

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 Wangan Inlet in Gippsland (Figure 4-50). 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 spill EMBA it is likely that Australian fur-seal would be present in the spill EMBA and operational area. During Beach’s Otway drilling campaign in 2021, which includes the activity location, 394 Australian fur seal detections have been made, spread across the year.

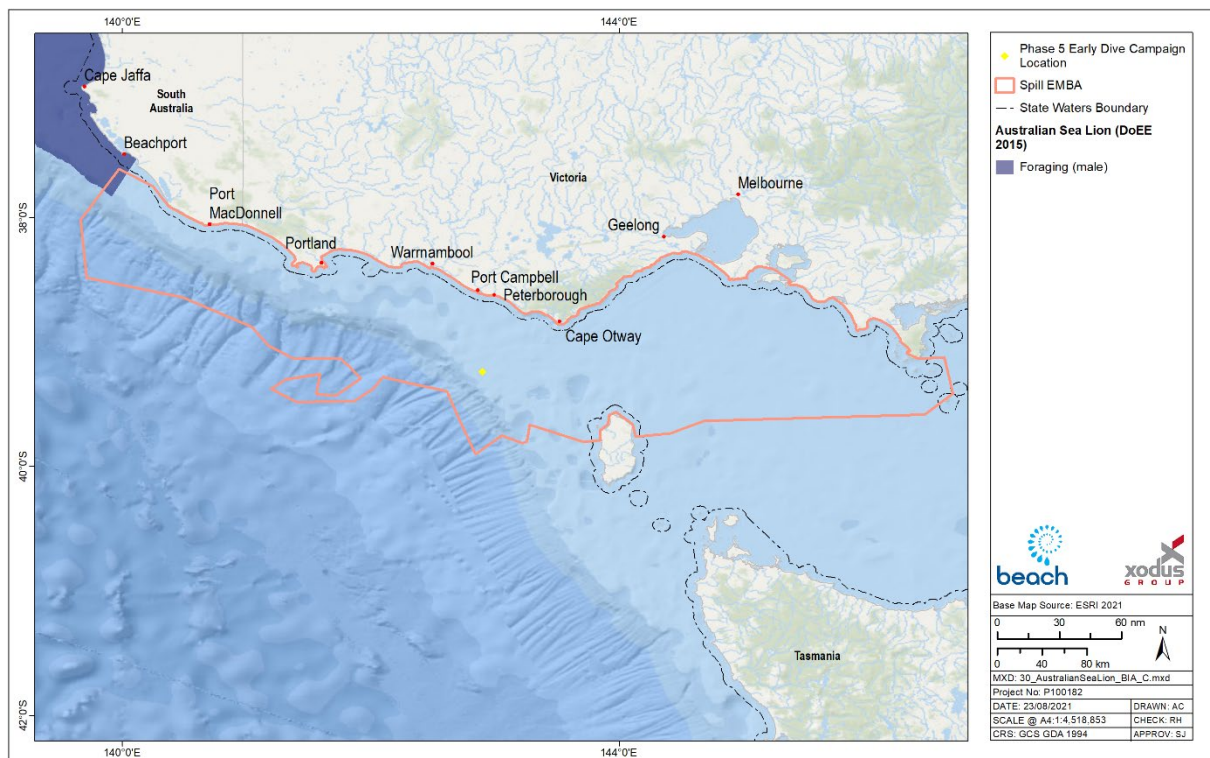


Figure 4-48: Australian sea lion foraging BIA within the spill EMBA

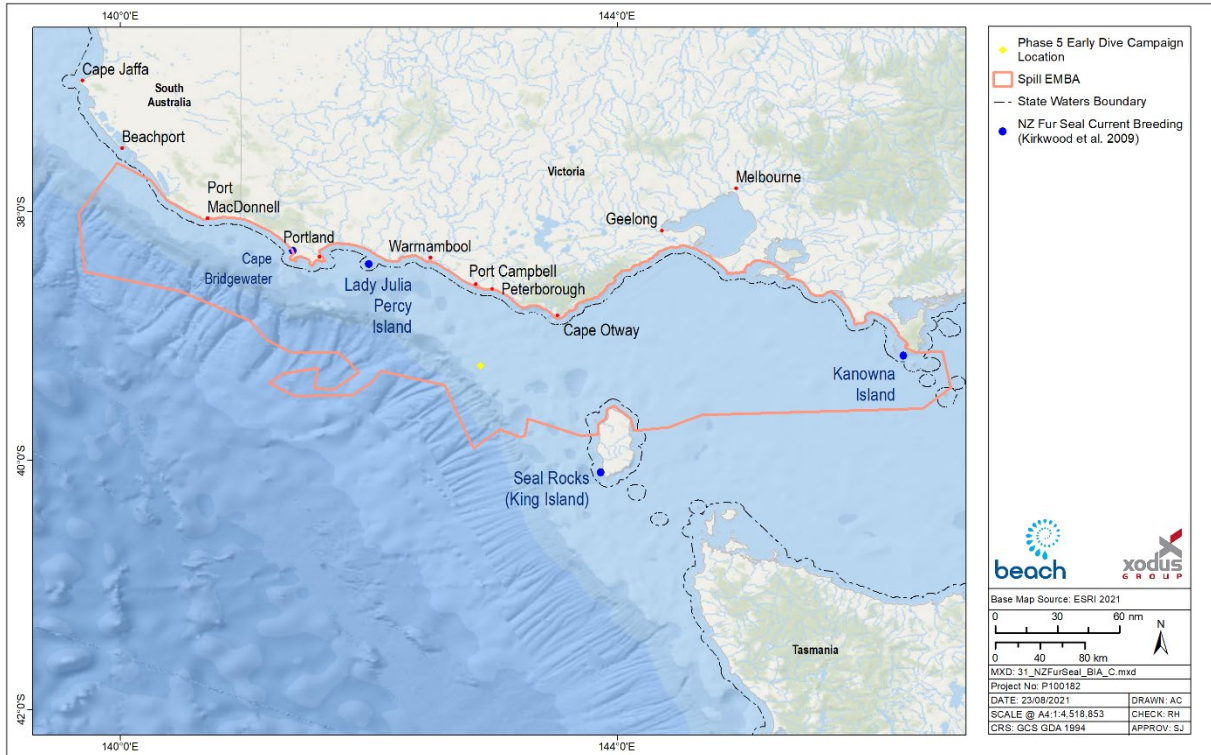


Figure 4-49: Locations of New Zealand fur-seal breeding colonies (Kirkwood et al., 2009).

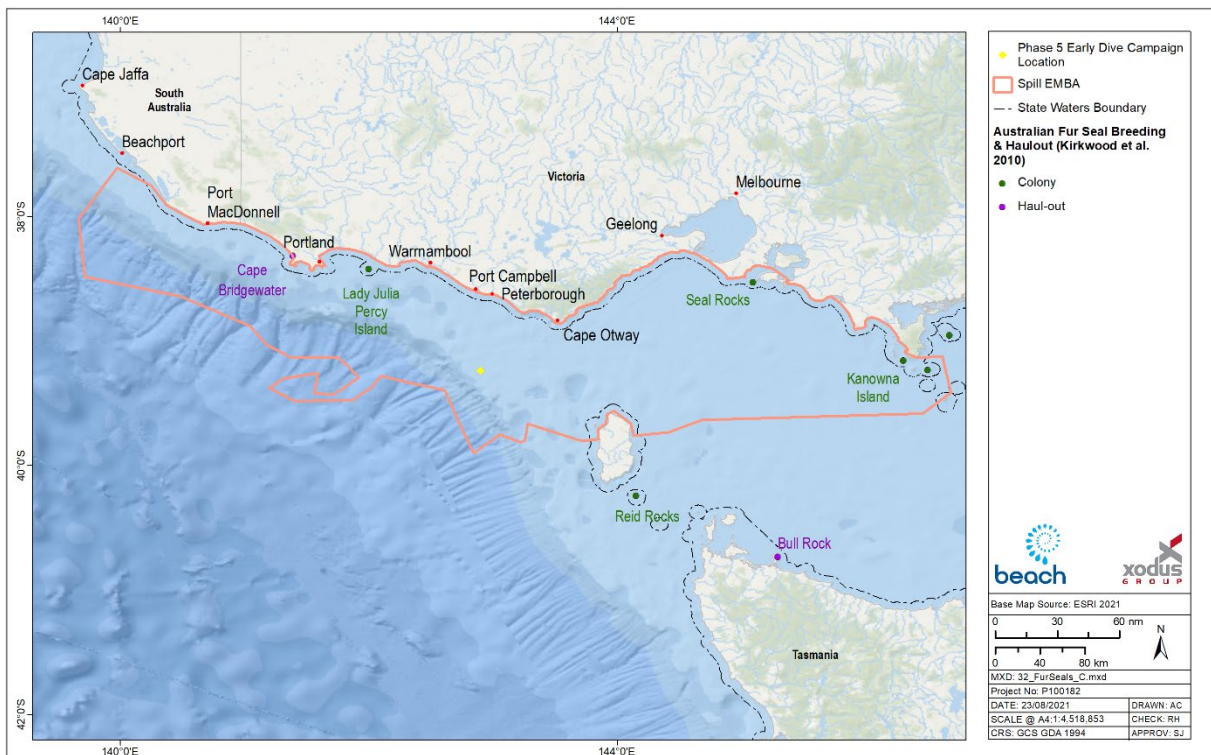


Figure 4-50: Locations of Australian fur-seal breeding colonies and haul out sites (Kirkwood et al., 2010)

4.6.13 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.

Key known pest species in the South-East Marine Region include (NOO, 2001):

- Northern pacific sea star (*Asterias amurensis*).
- Fan worms (*Sabella spallanzanii* and *Euchone* sp).
- Bivalves (*Crassostrea gigas* (Pacific oyster) *Corbulagibba* and *Theorafragilis*).
- Crabs (*Carcinus maenas* (European shore crab) and *Pyromaia tuberculata*).
- Macroalgae (*Undaria pinnatifida* (Japanese giant kelp) and *Codium fragile tormentosoides*).
- The introduced New Zealand screw shell (*Maoricolpus roseus*).

Other introduced species tend to remain confined to sheltered coastal environments rather than open waters (Hayes et al. 2005).

The Marine Pests Interactive Map (DotEE, 2019) indicates that the ports likely to be used for the survey (Warrnambool, Apollo Bay or Port Fairy) do not currently harbour any marine pests.

4.6.14 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.

4.7 Socio-economic environment

This section describes the socio-economic environment within the operational area and spill EMBA.

4.7.1 Coastal settlements

There are no coastal settlements within the operational area.

Australian's have a strong affinity to the coast, with over 80% of the population living within 50 km of the coast. The coastal settlements that lie within the EMBA and are subject to potential impact are (from west to east) Discovery Bay, Cape Nelson, Portland, Port Fairy, Warrnambool, Peterborough, Childers Cove, Bay of Islands, Port Campbell, Princetown, Moonlight Head, Cape Otway, Apollo Bay, Cape Patton, Lorne, Anglesea, Torquay, Port Phillip, Mornington Peninsula, Western Port, French Island, Kilcunda, Venus Bay, Cape Liptrap, Waratah Bay, Wilsons Promontory, Corner Inlet and Eurobodalla. All settlements are within Victoria, apart from Eurobodalla in NSW. These settlements are administered by different councils, with some of the larger councils including the Glenelg Shire Council (Portland), Moyne Shire Council (Port Fairy, Peterborough), Warrnambool City Council, Shire of Corangamite (Port Campbell, Princetown) and the Shire of Colac Otway (Apollo Bay).

The largest settlement within the spill EMBA is Mornington Peninsula, with a population just under 300,000 (Table 4-22). The Warrnambool, Peterborough, Childers Cove, Bay of Islands, Port Campbell, Princetown, Moonlight Head, Cape Otway, Apollo Bay, Cape Patton, Lorne and Anglesea settlements are along the Great Ocean Road, a National Heritage listed stretch along the Victorian coastline, with Warrnambool marking the western end. Warrnambool is another large settlement within the EMBA, with a population just under 30,000 (Table 4-22) and is a former port for the state of Victoria. The Port of Warrnambool has a breakwater and yacht club and provides shelter for commercial fishing boats. Portland and Port Fairy are the next largest centres with populations of 9,712 and 3,340, respectively (Table 4-22). Portland is Victoria's western-most commercial port and is a deep-water port with breakwaters sheltering a marina and boat ramp. Port Fairy has both harbour and fish processing facilities, but is not suitable for use by large vessels, nor is Port Campbell.

The coastal settlements within the EMBA all provide services to the commercial and recreational fishing industries in south-west Victoria and rely on fishing and tourism to contribute to their economies through income and employment. In Portland and Princetown, the largest employment industries are the agriculture, forestry and fishing industries, accounting for 59 and 28%, respectively (Table 4-22). In all but the two largest centres, accommodation and food services (which are heavily reliant on tourism) is either the first or second largest employment industry (Table 4-22).

Table 4-22: Coastal settlement population estimates and employment figures

Settlement	Population ¹	% of employment in industries relevant to potential impacts ²	
		Agriculture, forestry & fishing	Accommodation & food services
Discovery Bay	N/A	N/A	N/A
Cape Nelson	N/A	N/A	N/A
Portland	9,712	2.8	8.8
Port Fairy	3,340	6.5	12.8
Warrnambool	29,661	2.1	9.1
Peterborough	247	6.7	13.3
Childers Cove	N/A	N/A	N/A
Bay of Islands	N/A	N/A	N/A
Port Campbell	478	28.4	16.6
Princetown	241	59.3	10.5
Moonlight Head	N/A	N/A	N/A

Settlement	Population ¹	% of employment in industries relevant to potential impacts ²	
		Agriculture, forestry & fishing	Accommodation & food services
Cape Otway	15	N/A	N/A
Apollo Bay	1,598	3.6	27.9
Cape Patton	N/A	N/A	N/A
Lorne	1,114	0	0
Anglesea	2,545	0	4.8
Torquay	13,258	0	0
Port Phillip	100,872	0	0
Mornington Peninsula	289,142	0	0
Western Port	N/A	N/A	N/A
French Island	119	N/A	N/A
Kilcunda	396	0	0
Venus Bay	944	0	0
Cape Liptrap	N/A	N/A	N/A
Waratah Bay	56	N/A	N/A
Wilsons Promontory	13	N/A	N/A

¹ Data from Australian Bureau of Statistics 2016 census, available at www.censusdata.abs.gov.au

² Data from Australian Bureau of Statistics 2016 census, available at www.censusdata.abs.gov.au

4.7.2 Petroleum exploration

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.

From a review of the NOPSEMA website and engagement with other oil and gas exploration companies a summary of exploration activities that may occur within the Otway Basin are detailed in Table 4-23. There is no overlap of known seismic surveys with the operational area and the nearest survey is 17 km away (Figure 4-51). Based on the proposed survey timings, there be no temporal overlap between survey activities and early dive installation activities.

Table 4-23: Petroleum exploration potentially in close proximity to the operational area

Titleholder	Activity	Timing and Duration	Proximity to development well locations
TGS (Previously Spectrum Geo Australia Pty Ltd	Otway Deep Marine Seismic Survey	October 2020 to end February 2021 October 2021 to end February 2022 120 days	Figure 4-51 shows the Spectrum acquisition area is ~17 km from the operational area. TGS confirmed they have not committed to undertaking the survey in 2021/2022 and are looking at 2022/2023 season. (See Stakeholder Record TGS 30).

4.7.3 Petroleum production

All infrastructure within the operational area is operated by Beach. 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 spill EMBA.

Beach is undertaking or planning the following development activities over the next two years:

- Development drilling programme in the Geographe and Thylacine fields in 2021-2022. The closest well to the operational area, TN-1, is scheduled to commence in Q4 2021 and last for approximately 50 days. Based on the current drilling schedule, drilling will be completed by Q3 2022.
- Tie in of the G-4 and G-5 production wells in 2021 (within the Geographe field, Figure 4-51).
- Tie-in of the Thylacine subsea wells in 2023 (within the Thylacine field, Figure 4-51).

Based on the timing of the activity, it is possible that tie-in of the Thylacine subsea wells could overlap with the early dive installation activities. Activities covered by this EP are not expected to overlap with development drilling, however if the schedule is extended then overlap is possible.

Operation of the Otway Gas Development, including operation of the Thylacine-A wellhead platform, Geographe subsea facilities, Otway Pipeline System and IMR activities are ongoing and therefore will overlap with the early dive installation activities, although operations do not require the regular use of vessels or large scale emissions or discharges. If IMR activities are being undertaken at the same time as the early dive installation activities, they will be managed through a SIMOPS procedure. Thylacine and Geographe fields and the Otway Pipeline System are shown in Figure 4-51.

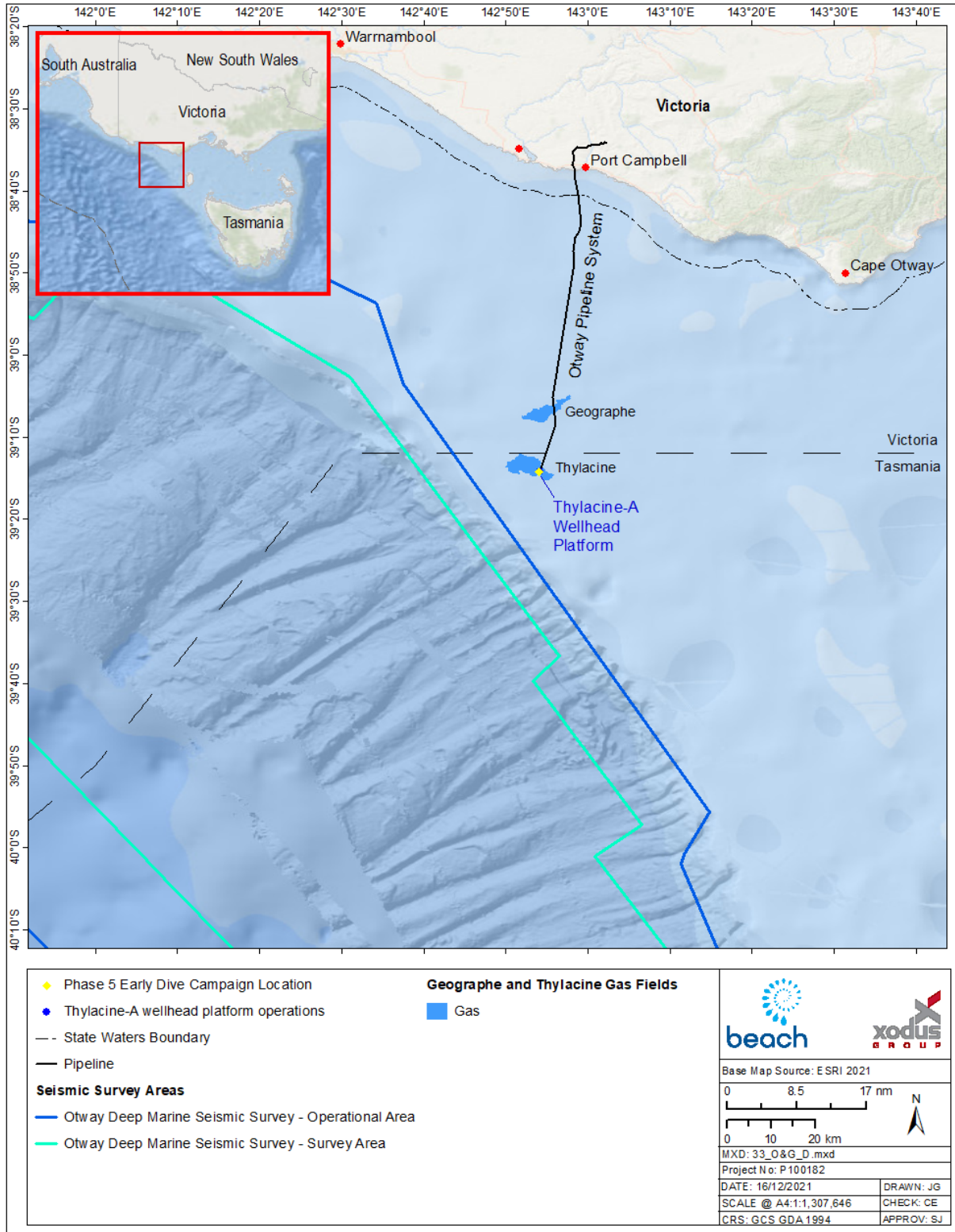


Figure 4-51: Oil and gas exploration and production

4.7.4 Shipping

The SEMR is one of the busiest shipping regions in Australia and Bass Strait is one of Australia’s busiest shipping routes (Figure 4-52). 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 (2018 – 2019 financial year) the majority of commercial shipping traffic transiting to and from Victorian ports were bulk liquid carriers (696,261), bulk gas (445,230), other cargo (3,800), container (1,057), general cargo (716), car carrier (384) and livestock (36).

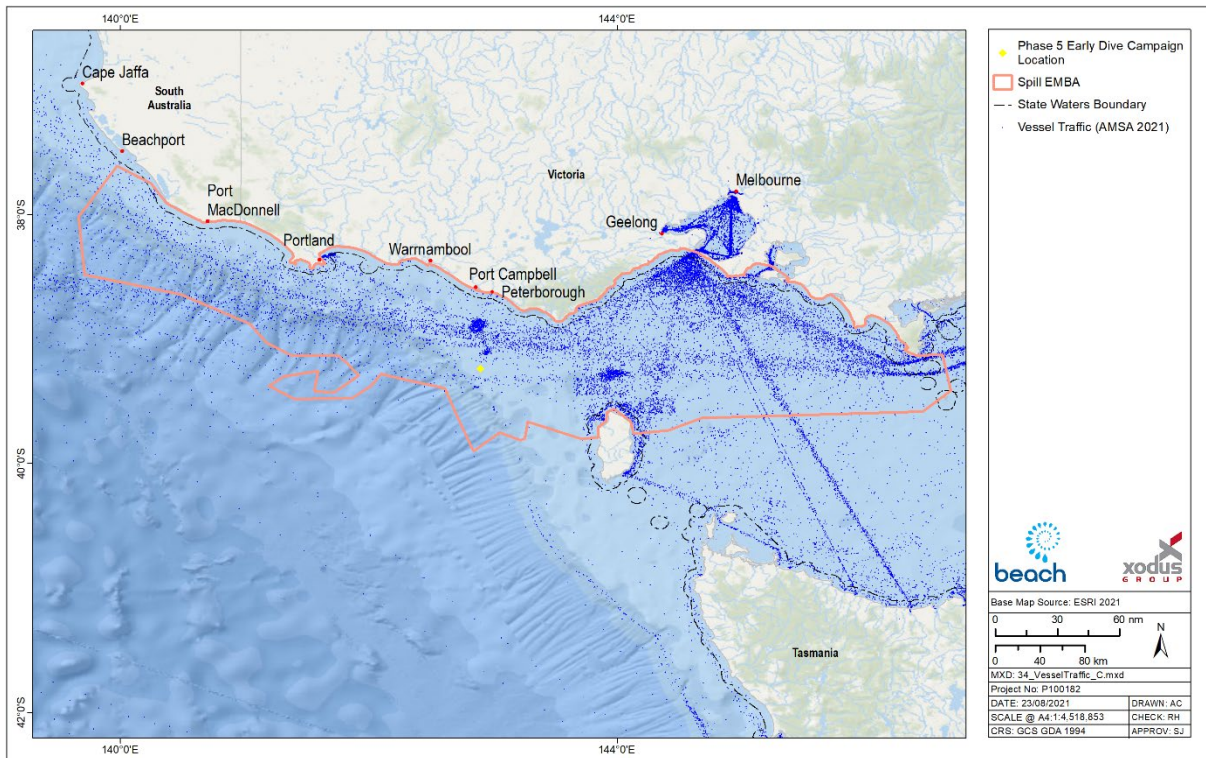


Figure 4-52: Vessel traffic within the spill EMBA and operational area

4.7.5 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.

4.7.6 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.

4.7.7 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 spill EMBA 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 EMBA. Recreational fishing for tuna has been observed by Beach in the area during Artisan-1 drilling activities, and recreational fishing vessels are regularly sighted within close proximity to the Thylacine-A wellhead platform. 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 EMBA. Pipi harvesting occurs in Venus Bay, in the eastern portion of the EMBA, but due to high levels of toxins in pipis at that location the public is currently advised that they are unsafe for human consumption.

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in Table 4-24.

Table 4-24: Recreational fisheries within the spill EMBA

Fishery	Target species	Description	Fishing activity
Rock lobster	Southern rock lobster	Recreational catch is taken by hand from coastal inshore reefs in waters less than about 20 m deep. A daily bag limit of 2 lobster applies.	Yes
Finfish	Snapper King George whiting Salmon Flathead Bream Tuna Sharks	Recreational fishing occurs along the Victorian coastline from beaches, jetties and vessels (privately owned and chartered). Artificial reefs have also been established in Port Phillip Bay and offshore from Torquay, to enhance recreational fishing opportunities.	Yes

Fishery	Target species	Description	Fishing activity
Scallops	Commercial scallops Doughboy scallops	Scallops are collected by hand by recreational fishers while diving. Most recreational catch occurs within Port Phillip Bay.	Unlikely
Abalone	Blacklip abalone Greenlip abalone	A permanent closure is in place for greenlip abalone in Port Phillip Bay, and for both green- and blacklip abalone from the intertidal to 2 m water depth in all of Victoria. The central zone (which overlaps with the EMBA) is open to recreational abalone take only on nominated days between November and April.	Yes
Squid	Gould's squid	Recreational squid fishing predominantly occurs in Port Phillip Bay and Western Port, but also in other sheltered waters such as at Portland. Fishing is generally from jetties such as at Queenscliff (Port Phillip Bay) and Flinders (Mornington Peninsula, Western Port) or from boats.	Unlikely
Pipi	Pipi	Pipi are harvested from the intertidal zone. Currently the only recreational harvest occurs in Venus Bay, although the Victorian Fisheries Authority has advised that high levels of toxins are present in pipis and advises that they are unsafe for human consumption.	Unlikely (due to toxins)

4.7.8 Commonwealth managed fisheries

A review of the Australian Fisheries Management Authority (AFMA) website identified that the following Commonwealth managed fisheries overlap the spill EMBA:

- 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 spill EMBA and SESSF and Southern Squid Jig Fishery have catch effort within the operational area based on ABARES reports data for fishing years 2013 – 2019 (Patterson et al. 2020, 2019, 2018, 2017, 2016, 2015 and Georgeson et al. 2014). The Skipjack Fishery is not currently active and management arrangements for the fishery are under review.

Information relating to the target species, fishing locations, landed catch, value and other relevant aspects of each fishery is included in Table 4-25. Detailed mapping is provided where there is overlap between recent fishing intensity and the spill EMBA (Figure 4-53 to Figure 4-56).

Engagement with AFMA was undertaken in relation to providing licensing information for any Commonwealth fishers who are active within the operational area which includes the operational area.

Table 4-25: Commonwealth managed fisheries within the spill EMBA

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Bass Strait Central Zone Scallop Fishery	Scallops	<p>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.</p> <p>Fishing effort is concentrated around King and Flinders Islands. Currently 12 active boats using towed dredges. Fishing season is 1 April to 31 December. Actual catch in 2019 was 2,931 tonnes. The major landing ports in Victoria are Apollo Bay and Queenscliff. Total fishery value in 2016 was A\$6.3 million.</p> <p>Fishing mortality: not subject to overfishing.</p> <p>Biomass: Not over fished.</p> <p>There has been fishing effort in the spill EMBA based on ABARES data for 2013 – 2019.</p> <p>There has been no fishing effort in the operational area based on ABARES data for 2013 – 2019. Figure 4-56 shows the total area fished with the highest fishing intensity occurring around King Island.</p>	No	Yes
Eastern Tuna and Billfish Fishery	Albacore tuna Bigeye tuna Yellowfin tuna Broadbill swordfish Striped marlin	<p>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 37 in 2019. Actual catch in the 2019 season was 4,341 tonnes. Total fishery value in 2019 was A\$32.1 million.</p> <p>Fishing mortality: not subject to overfishing.</p> <p>Biomass: Over fished – striped marlin. All other species not overfished.</p> <p>There has been fishing effort within the spill EMBA in 2017 based on ABARES data for 2013 – 2019.</p> <p>There has been no fishing effort in the operational area based on ABARES data for 2013 – 2019.</p>	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
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
Small Pelagic Fishery (Western sub-area)	Jack mackerel Blue mackerel Redbait Australian sardine	<p>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 16,093 tonnes in the 2019-20 season. Fishery effort generally concentrated in the near-shore Great Australian Bight to the west and south of Port Lincoln.</p> <p>Fishing mortality: not subject to overfishing.</p> <p>Biomass: Not over fished.</p> <p>There has been no fishing effort in the EMBA based on ABARES data for 2013 – 2019/2020.</p> <p>There has been no fishing effort in the operational area based on ABARES data 2013 – 2019/2020.</p>	No	No

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Southern and Eastern Scalefish and Shark Fishery (SESSF) (Commonwealth Trawl Sector and Scalefish Hook Sector)	Blue-eye trevalla Blue grenadier Blue warehou Deepwater sharks Eastern school whiting Flathead Gemfish Gulper shark Jackass morwong John dory Mirror dory Ocean jacket Ocean perch Orange roughy Smooth oreodory Pink ling Red fish Ribaldo Royal red prawn Silver trevally Silver warehou	<p>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 EMBA is within the Commonwealth Trawl Sector and Scalefish Hook Sector.</p> <p>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 13,148 tonnes in the 2019-20 season. No value is provided for 2019-20 season. In 20118-19, the fishery value was A\$49.47 million.</p> <p>Fishing mortality: some species subject to overfishing.</p> <p>Biomass: some species over fished.</p> <p>There has been fishing effort in the spill EMBA based on ABARES data for 2013 – 2019/20.</p> <p>There has been fishing effort in the operational area based on ABARES data for 2013 – 2019/20 (Figure 4-53 to Figure 4-55).</p> <p>The shark hook and trawl sectors have no fishing intensity within the operational area (Figure 4-54 and Figure 4-55), while the shark gillnet sector has high to medium fishing intensity closer to the shore but within the operational area (Figure 4-53).</p>	Yes	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Southern Bluefin Tuna Fishery (SBTF)	Southern bluefin tuna	<p>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.</p> <p>A pelagic longline and purse seine fishery that was worth \$43.41 million in 2018-19 (actual catch was 6,074 tonnes). The fishery operates year-round. Fishery effort is generally concentrated in the Great Australian Bight and off the southern NSW coast.</p> <p>Fishing mortality: not subject to overfishing.</p> <p>Biomass: Over fished.</p> <p>There has been fishing effort within the spill EMBA in 2017 based on ABARES data for 2013 – 2019.</p> <p>There has been no fishing effort in the operational area based on ABARES data for 2013 – 2019.</p>	No	Yes
Southern Squid Jig Fishery	Gould’s squid (arrow squid)	<p>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 100m at night using large lights that illuminate the waters around a boat. In 2018-19, the actual catch of 722 tonnes was worth A\$2.89 million. In 2019 there were eight active vessels in the fishery.</p> <p>Fishing mortality: not subject to overfishing.</p> <p>Biomass: Not over fished.</p> <p>There has been fishing effort in the spill EMBA based on ABARES data for 2013 – 2019.</p> <p>There has been fishing effort in the operational area based on ABARES data for 2013 – 2019. Figure 4-57 shows the total area fished with squid jig in 2019 within the operational area with the highest fishing intensity occurring on the East coast of Tasmania.</p>	Yes	Yes

Data/information sources: Australian Fisheries Management Authority (www.afma.gov.au), ABARES Fishery Status Reports 2014 to 2020.

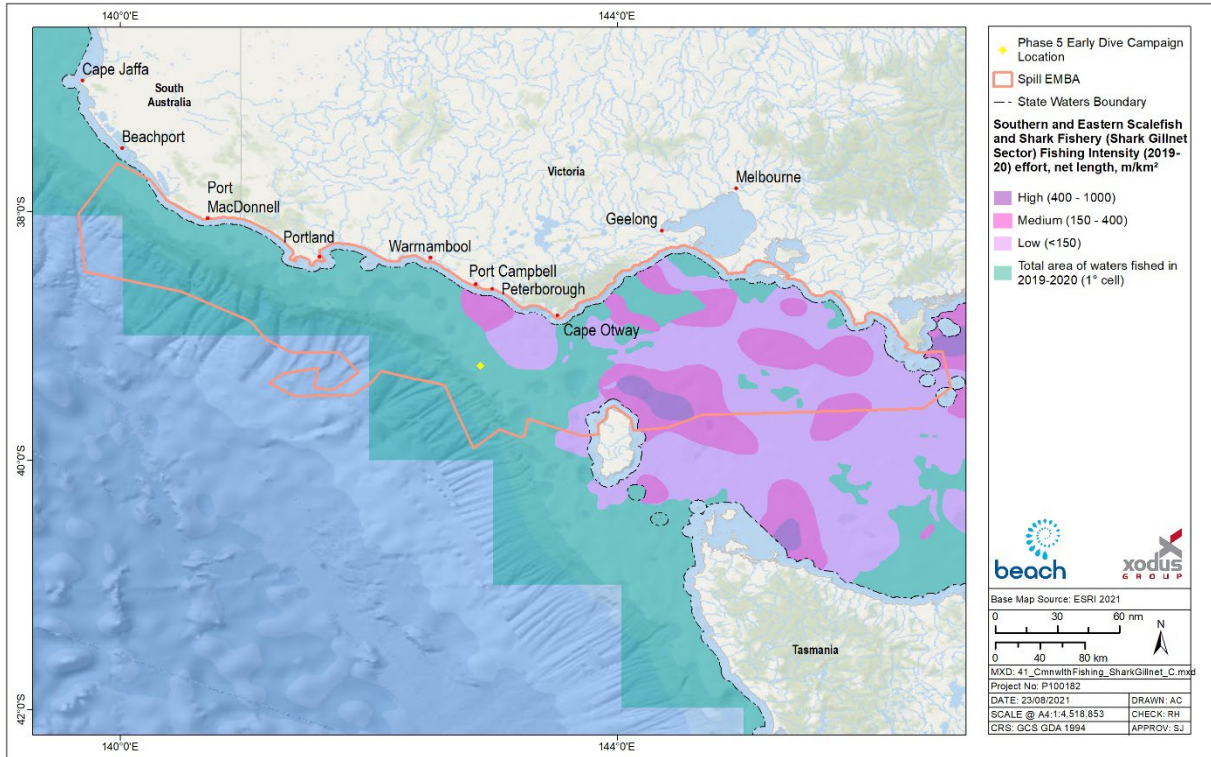


Figure 4-53: Southern and Eastern Scalefish and Shark Fishery (Shark Gillnet Sector) Fishing Intensity (effort, net length, m/km²)

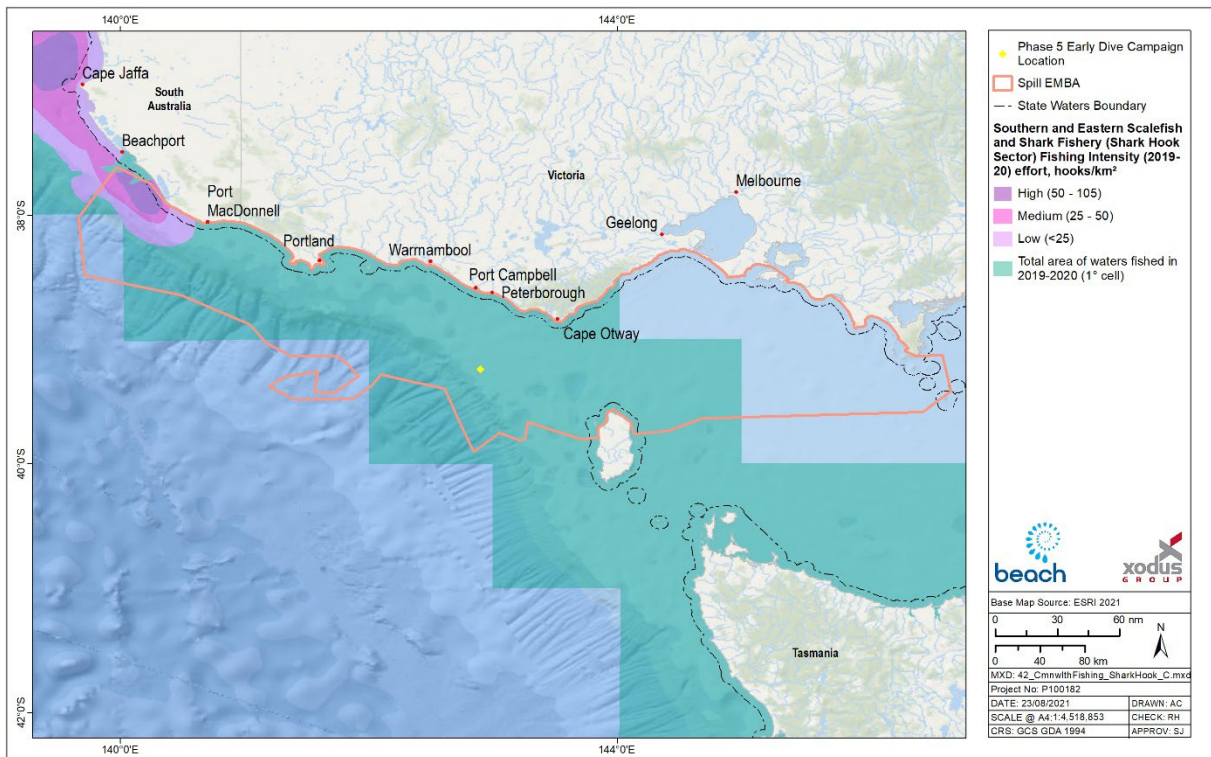


Figure 4-54: Southern and Eastern Scalefish and Shark Fishery (Shark Hook Sector) Fishing Intensity (effort, net length, m/km²)

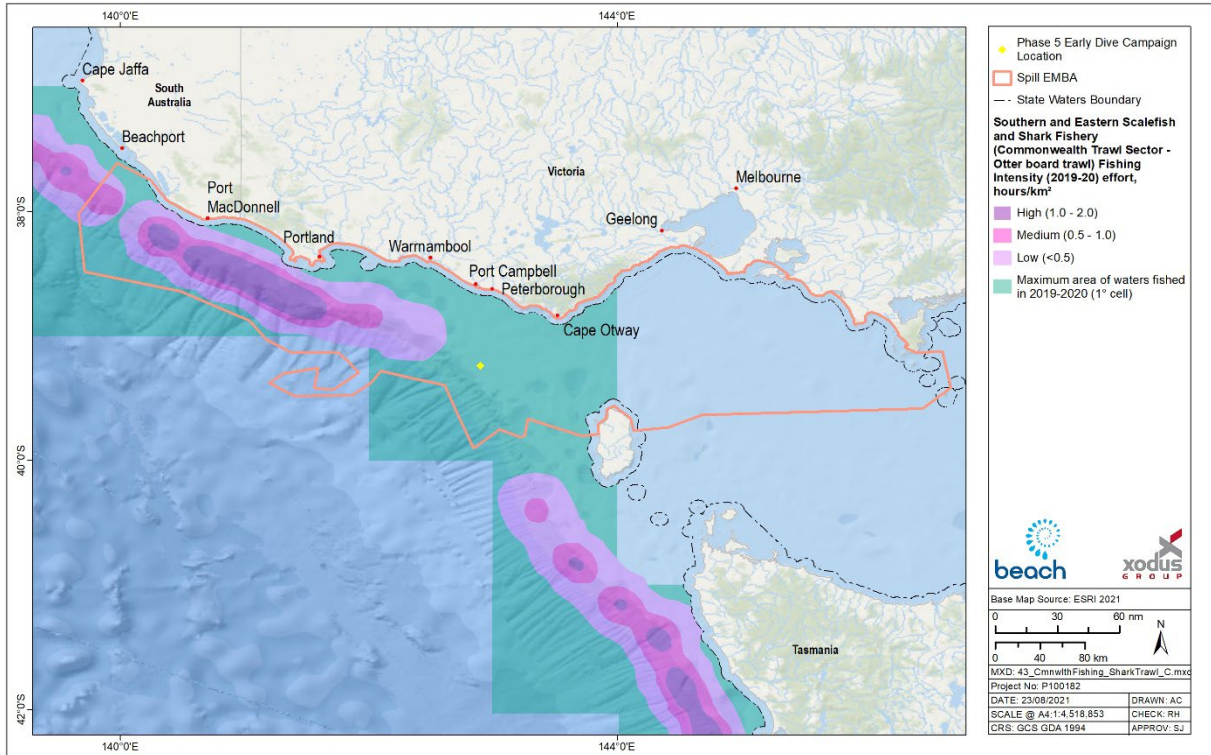


Figure 4-55: Southern and Eastern Scaleshell and Shark Fishery (Commonwealth Trawl Sector) Fishing Intensity (effort, net length, m/km²)

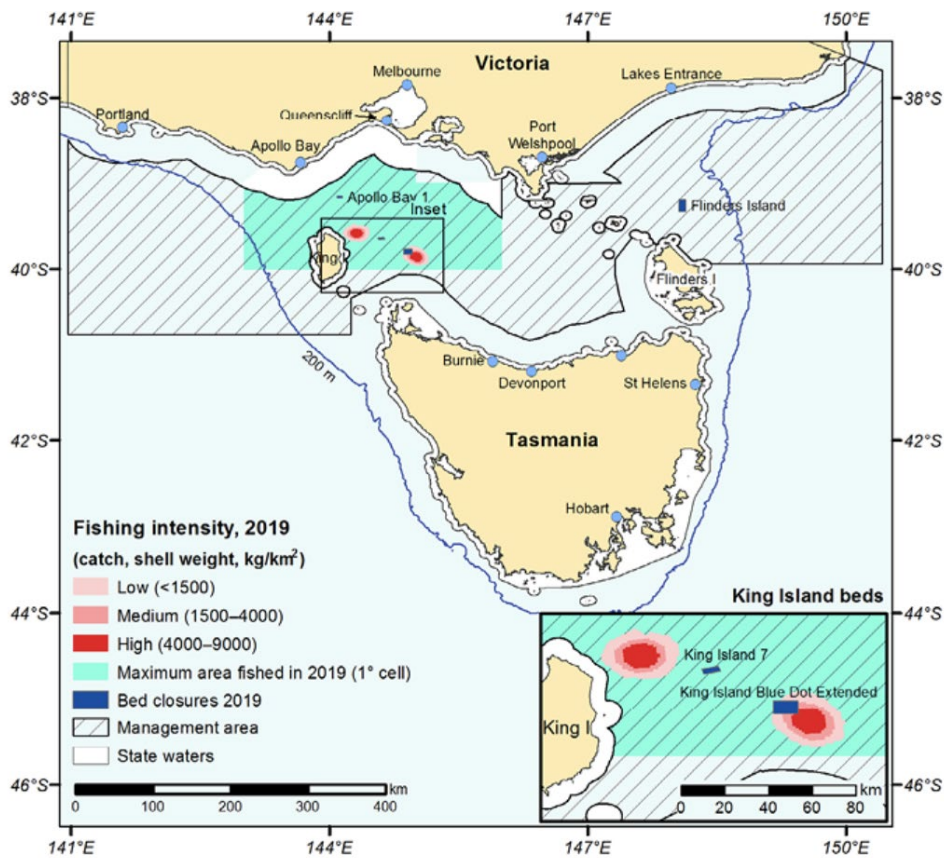


Figure 4-56: Jurisdiction of and fishing intensity of the Bass Strait Central Zone Scallop Fishery

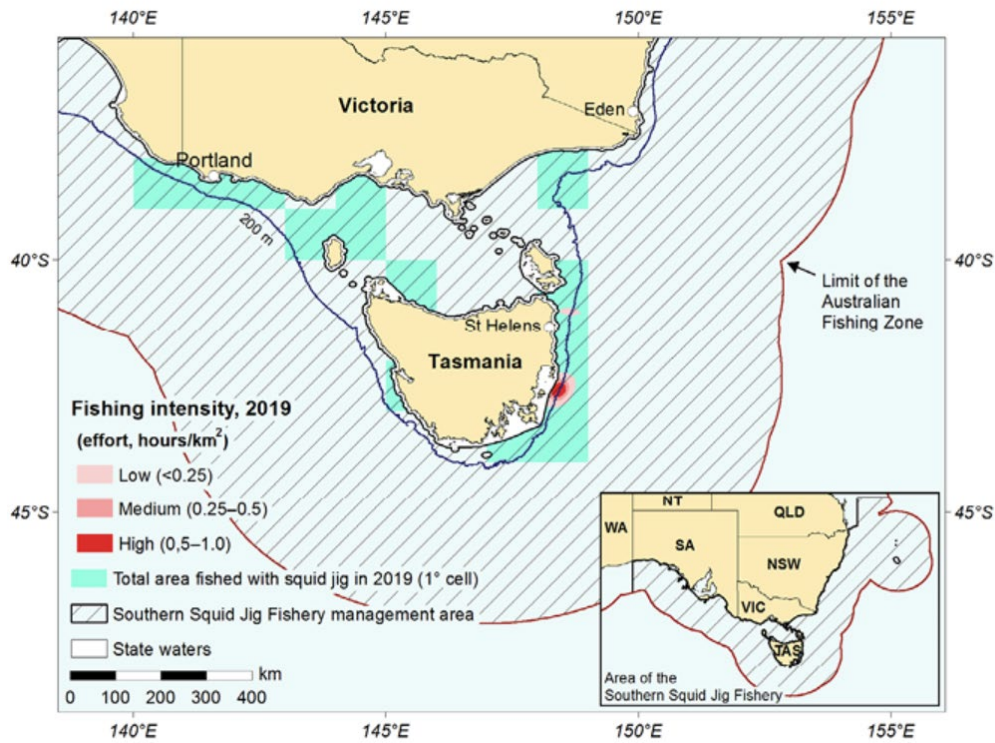


Figure 4-57: Jurisdiction of and fishing intensity of the Southern Squid Jig Fishery

4.7.9 Victorian managed fisheries

There are ten Victorian state-managed fisheries that overlap the spill EMBA:

- Abalone Fishery
- Bays and Inlet Fisheries
- Giant Crab Fishery
- Eel Fishery
- Octopus Fishery
- Pipi Fishery
- Rock Lobster Fishery
- Scallop (Ocean) Fishery
- Shark Fishery
- Snapper Fishery (Ocean fishery trawl)
- Wrasse (Ocean) Fishery

A description of these fisheries is detailed in Table 4-26.

Data was requested from VFA for the following grids. The grid numbers requested was based on where the operational area and spill EMBA lies within the grids.

- G10; G11; G12; G13
- H10; H11; H12; H13
- J10; J11; J12; J13
- K10; K11; K12; K13
- L10; L11; L12; L13
- M10; M11; M12; M13

A description of the fisheries that overlap the spill EMBA and operational area are detailed in Table 4-26 along with a description for the following fisheries that have monthly catch effort data within the operational area; fish (eel, snapper and wrasse fishers), octopus, shark, southern rock lobster and giant crab. Figure 4-58 to Figure 4-62 show the catch effort based on the maximum number of fishers in that area for each year from 2016-2020.

Table 4-26: Victorian managed fisheries in the spill EMBA

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Abalone Fishery (western zone)	Blacklip abalone Greenlip abalone	A highly valuable fishery (A\$20 million in 2014-15) 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 2017-18 season, 63.2 tonnes compared with 274.0 and 352.5 tonnes, respectively). There are 14 licences in the western zone. The water depths where abalone are fished are close to shore within the spill EMBA. 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 within the spill EMBA.	No	Yes
Eel Fishery	Eel	Target species are the short-finned eel (<i>Anguilla australis</i>) and long-finned eel (<i>A. reinhardtii</i>). Commercial fishers are only permitted to use fyke nets. Total catch for both species in 2016 was ~60 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 spill EMBA. Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-60 shows there is fishing effort within the spill EMBA and operational area. The wrasse, snapper and eel fishery have been combined in Figure 4-60. The catch data from VFA shows that the eel fishery is only present in grid G11 which is outside the operational area.	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Giant Crab Fishery	Giant crab	<p>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.</p> <p>Total landed catch in 2015-16 was 10 tonnes.</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-59 shows there is fishing effort within the spill EMBA and operational area.</p> <p>Within both the spill EMBA and operational area there is only a maximum of one giant crab fisher. The grids that show consistency with fishing data for all of the years from 2016-2020 are grids M12 and L11 which are outside of the operational area. Within the operational area L12, there has been a maximum of one giant crab fisher for August 2017, May 2018, June 2018 and December 2018.</p>	Yes	Yes
Octopus Fishery	Pale octopus Maori octopus Gloomy octopus	<p>The octopus fishery (Eastern Zone) is a new fishery harvesting mainly pale octopus (<i>Octopus pallidus</i>) in East Gippsland. The fishery may also catch maori octopus (<i>Macroctopus maorum</i>) and gloomy octopus (<i>Octopus tetricus</i>). Octopus are caught using purpose-built unbaited traps. The fishery commenced on 1st August 2020.</p> <p>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.</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-61 shows there is fishing effort within the spill EMBA and operational area.</p> <p>Most catch effort for the octopus fishery occurs along the coastline near Peterborough and Port Campbell (Figure 4-61), with presence every year from 2016-2020, however this fishery has declined in maximum number of fishers from 2016 in both grids G12 and G13. No fishing has been recorded in Grid L12 where the operational area is located.</p>	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Pipi Fishery	Pipi	<p>Main commercial harvesting area is Discovery Bay with limited activity in Venus Bay. Harvested in the high impact beach zone using traditional dip nets. Total annual catches in 2016–17 and 2017–18 were 42 tonnes each year.</p> <p>Discovery Bay and Venus Bay are within the spill EMBA</p>	No	Yes
Rock Lobster Fishery (western zone)	Southern rock lobster	<p>Victoria's second most valuable fishery with a production value of A\$24 million in 2014-15. 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.</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-58 shows there is fishing effort within the spill EMBA and operational area.</p> <p>The data shows that this fisheries presence has declined since 2016 with the maximum number of fishers close to the coastline (Figure 4-58). For grid L12 where the operational area is located there has been a maximum of one fisher in 2017 and 2019.</p>	Yes	Yes
Scallop (Ocean) Fishery	Scallops	<p>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.</p> <p>Fishing data from VFA for 2016 – 2020 did not identify scallop fishing effort within the grids provided which included the operational area. Based on the fishery location scallop fishing effort may occur within the spill EMBA.</p>	No	Yes

Fishery	Target species	Description	Fishing Effort Operational Area	Fishing Effort Spill EMBA
Shark Fishery	Gummy shark School shark Port Jackson shark Dog shark One-finned shark Broadnose shark	<p>The wrasse, inshore trawl, southern rock lobster and giant crab fisheries are able to catch gummy shark (<i>Mustelus antarcticus</i>) and school sharks (<i>Galeorhinus galeus</i>) as part of their fishery. The combined catch limit for the gummy and school shark has been increased to 5 with no more than 1 shark being a school shark. Other shark species that may be caught is the Port Jackson shark (<i>Heterodontus portusjacksoni</i>), dog shark (<i>Squalus acanthias</i>), one-finned shark (<i>Hepttranchias perlo</i>) and the broadnose shark (<i>Notorynchus cepedianus</i>).</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-62 shows there is fishing effort within the spill EMBA and operational area.</p> <p>The shark fishery has most of their recorded catch effort near the coastline. No effort has been recorded in the operational area (Grid L12).</p>	No	Yes
Snapper Fishery (western stock) (Ocean fishery trawl (inshore) licence)	Snapper	<p>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 2014-15, 147 tonnes were landed at a value of A\$1.38 million.</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-60 shows there is fishing effort within the spill EMBA and operational area.</p> <p>The wrasse, snapper and eel fishery have been combined in Figure 4-60. The catch data obtained from VFA shows that the fish fishery is mostly along the coast surrounding Port Campbell and Peterborough.</p> <p>The snapper fishery has a high presence along the Peterborough coastline from 2016-2020 (grids G11 and G12). No effort has been recorded in the operational area (Grid L12).</p>	No	Yes
Wrasse (Ocean) Fishery	Bluethroat wrasse Purple wrasse Small catches of rosy wrasse, senator wrasse and southern Maori wrasse	<p>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 catches in 2014-15 and 2015-16 were ~30 tonnes.</p> <p>Beach obtained fishing data from VFA for the years from 2016 – 2020. Figure 4-60 shows there is fishing effort within the spill EMBA and operational area.</p> <p>The wrasse, snapper and eel fishery have been combined Figure 4-60. The catch data obtained from VFA shows that the fish fishery is mostly along the coast surrounding Port Campbell and Peterborough.</p> <p>No effort has been recorded in the operational area (Grid L12).</p>	No	Yes

Data/information sources: Victorian Fisheries Authority (www.vfa.vic.gov.au), DoEE (2015), State Govt of Victoria (2015a, b)

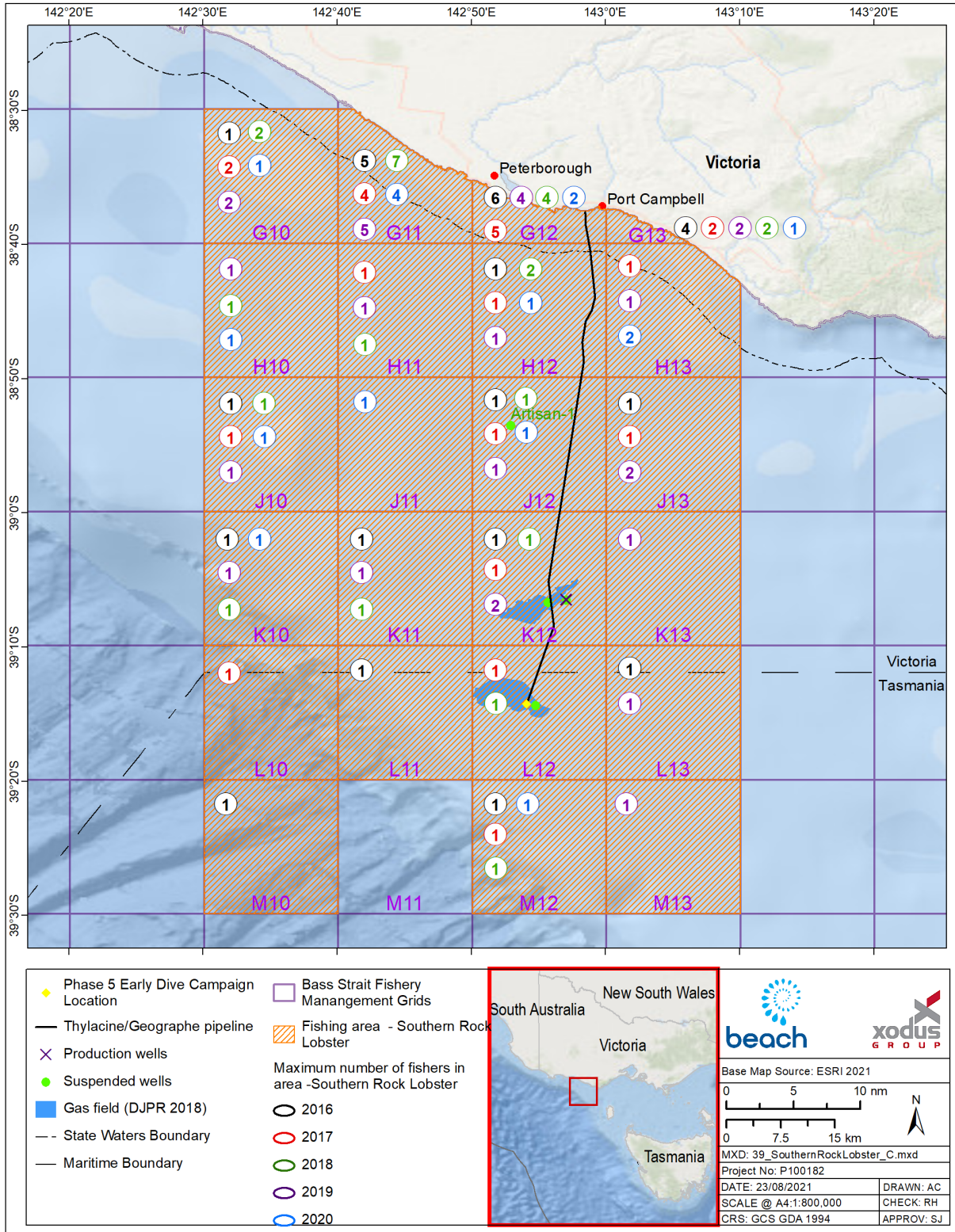


Figure 4-58: Maximum number of southern rock lobster fishers in the Otway region from 2016-2020. Data obtained from VFA, 2021.

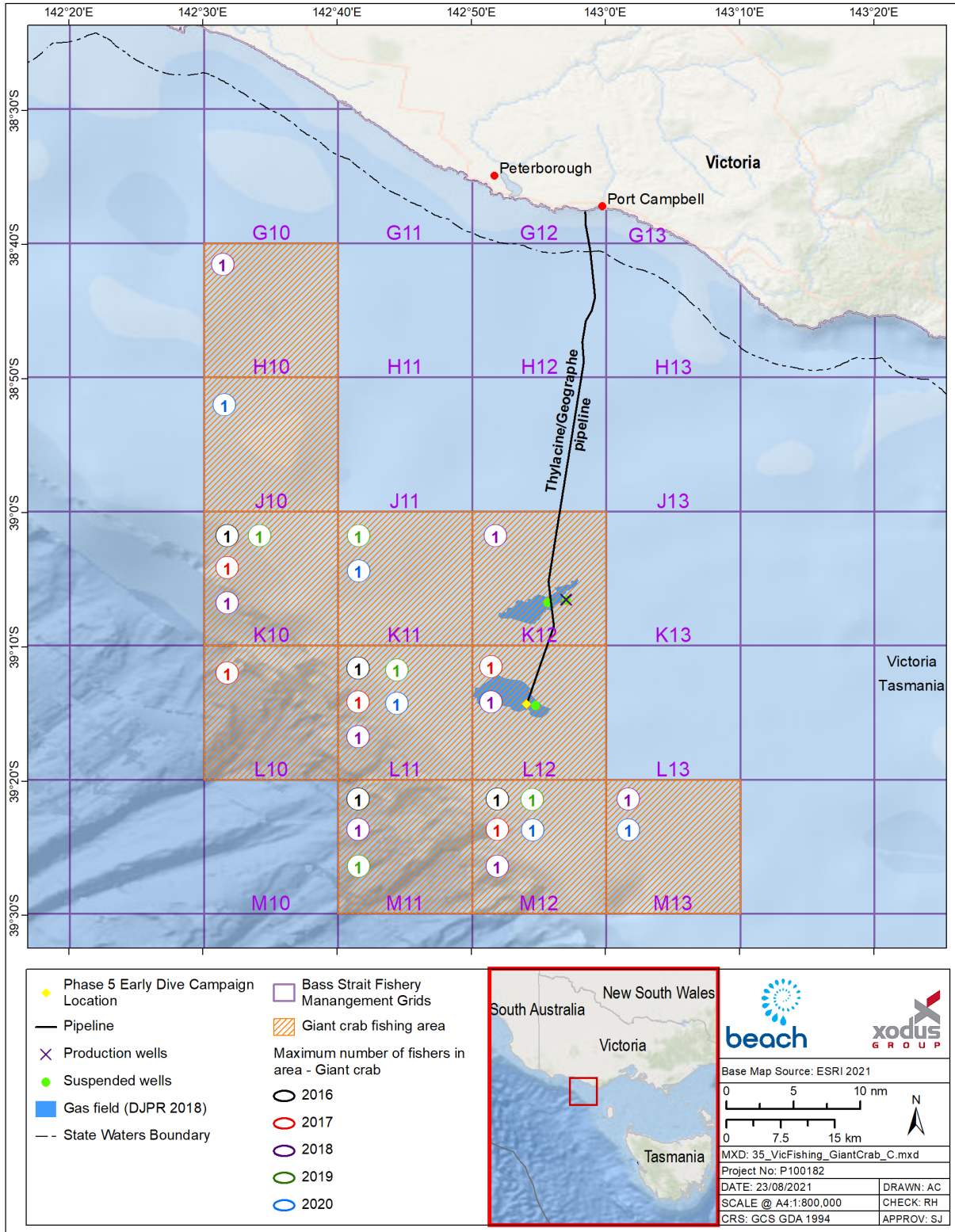


Figure 4-59: Maximum number of giant crab fishers in the Otway region from 2016-2020. Data obtained from VFA, 2021.

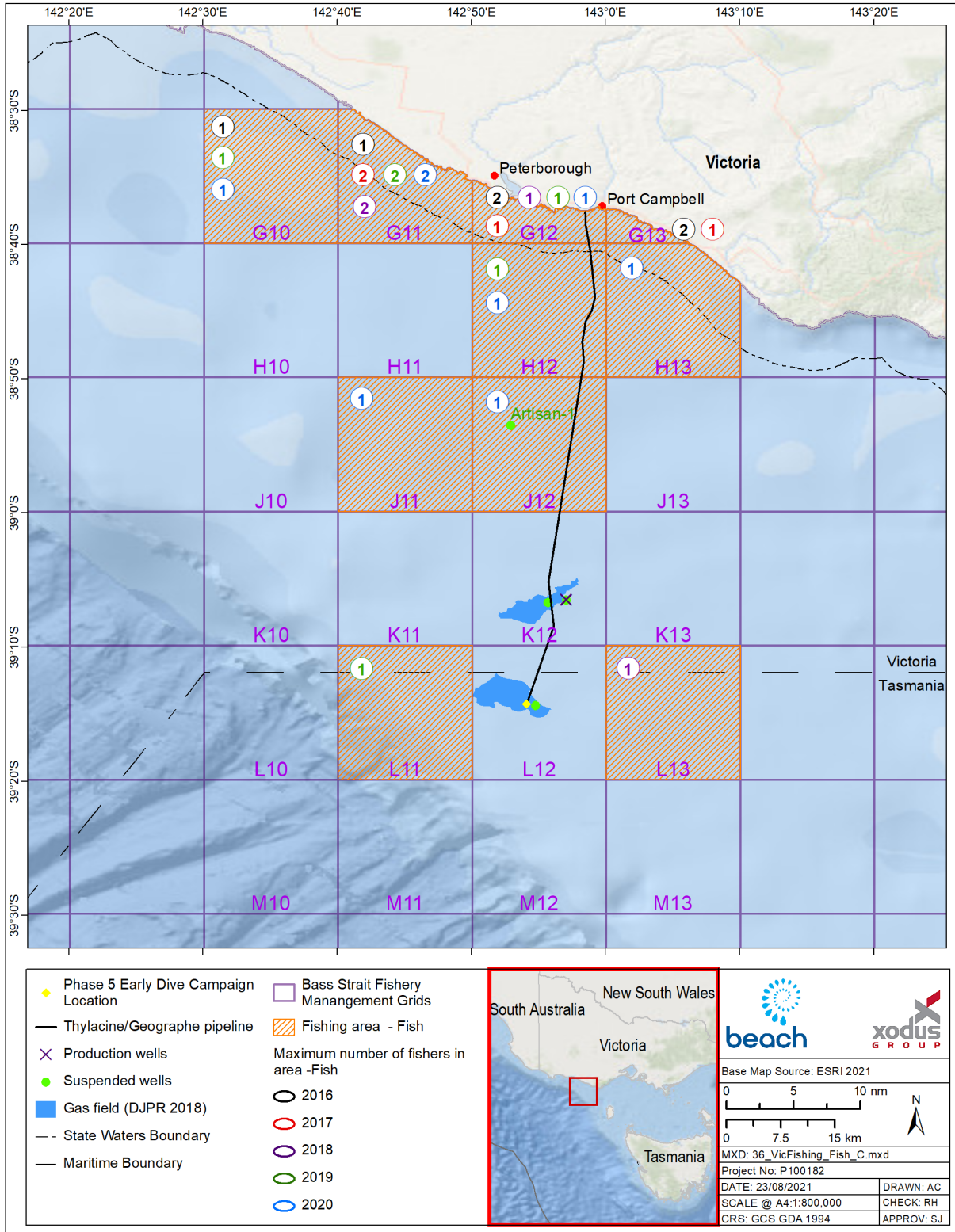


Figure 4-60: Maximum number of fish fishers (eel, snapper and wrasse fisheries) in the Otway region from 2016-2020. Data obtained from VFA, 2021.

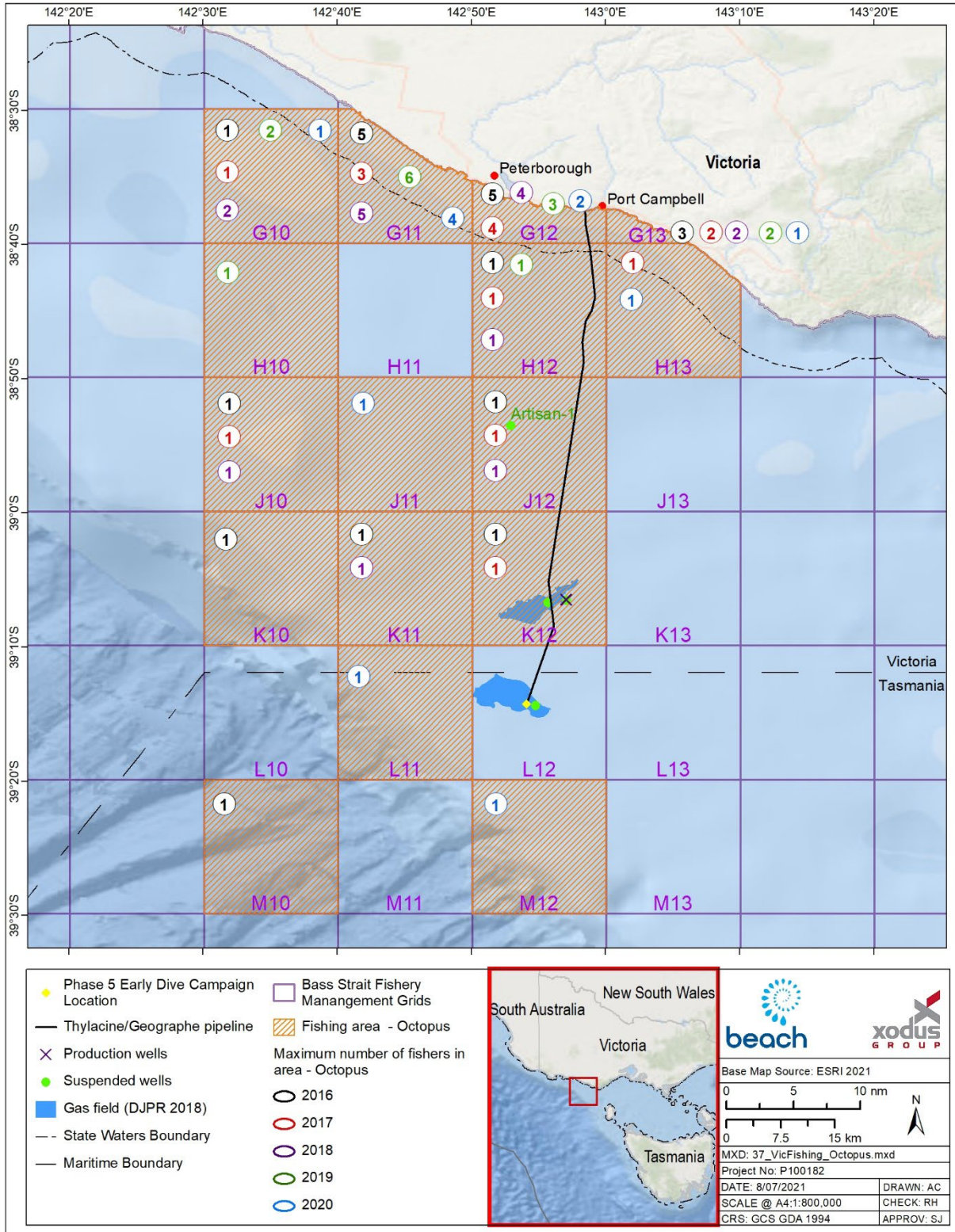


Figure 4-61: Maximum number of octopus fishers in the Otway region from 2016-2020. Data obtained from VFA, 2021.

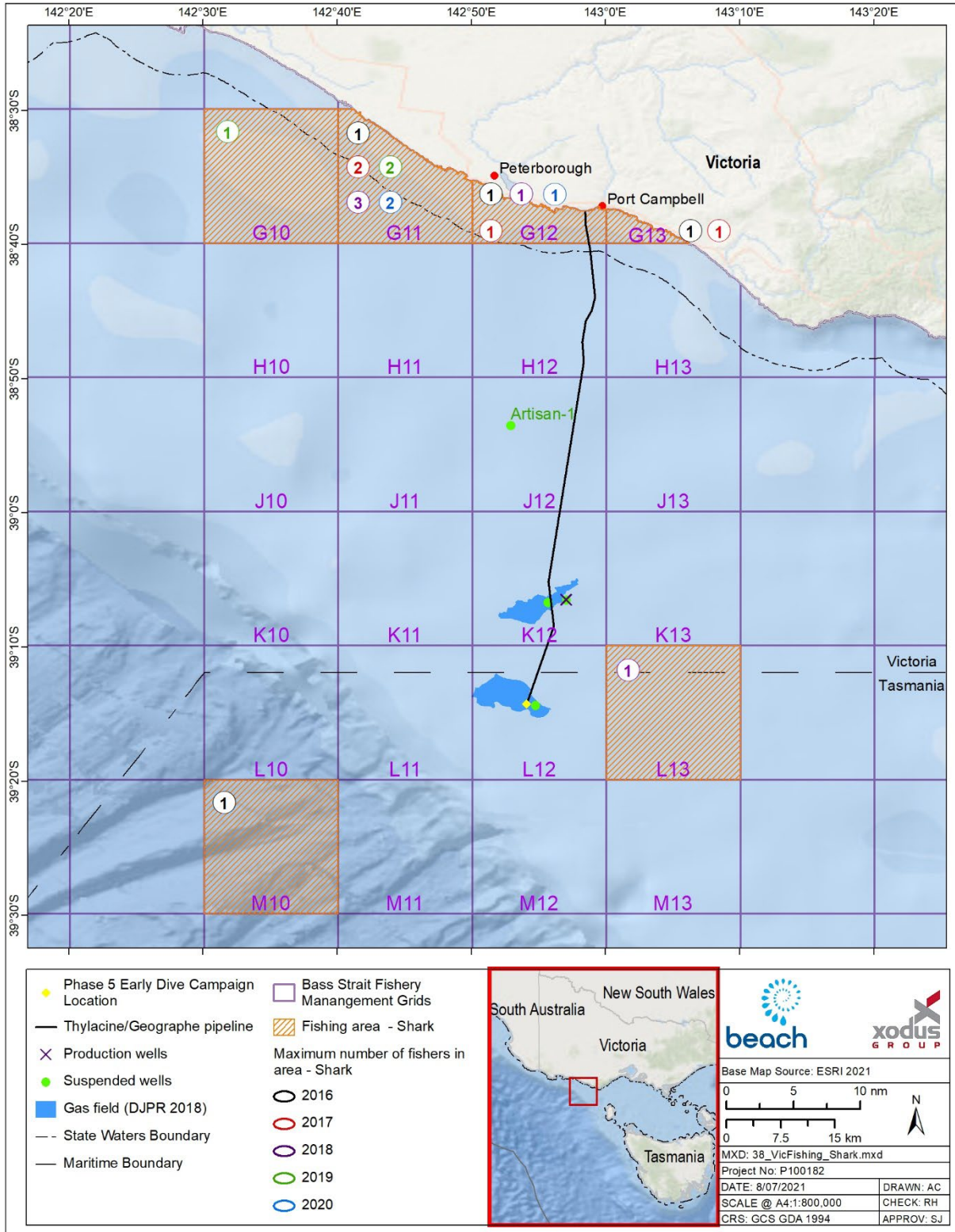


Figure 4-62: Maximum number of shark fishers in the Otway region from 2016-2020. Data obtained from VFA, 2021.

4.7.10 Tasmanian managed fisheries

No Tasmanian fisheries were identified within the operational area.

There are eight Tasmanian state managed commercial fisheries that occur within the spill EMBA:

- Abalone Fishery
- Commercial Dive Fishery
- Giant Crab Fishery
- Rock Lobster Fishery
- Scalefish Fishery
- Scallop Fishery
- Seaweed Fishery
- Shellfish Fishery

A description of these fisheries is in Table 4-27.

Historic catch assessments indicate that Commercial Dive, Scallop and Shellfish Fisheries activities are unlikely to occur in the spill EMBA, 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 spill EMBA. Giant Crab, Scalefish, Scallop and Seaweed Fisheries are also likely to be active within the spill EMBA to varying degrees.

The jurisdictional area of the Seaweed Fishery extends to the limit of Tasmanian State waters coastal waters (3 nm). The jurisdictional area for the Scallop Fishery extends from the high water mark to 20 nm from Tasmanian state waters into the Bass Strait and out to the limits of the Australian Fishing Zone (200 nm) off the rest of the state, as defined in the 1986 Offshore Constitutional Settlement (OCS) arrangements for scallop stock. The Abalone, Rock Lobster, Giant Crab, Commercial Dive, Scalefish and Shellfish Fisheries apply throughout Tasmanian State waters as defined in the 1996 OCS arrangements for invertebrates and finfish stock.

Table 4-27: Tasmanian managed fisheries in the spill EMBA

Fishery	Target species	Description	Fishing Effort Spill EMBA
Abalone Fishery (Northern and Bass Strait Zones)	Black lip (<i>Haliotis rubra</i>) and greenlip abalone (<i>H. laevigata</i>)	<p>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. Total landings were 1018.5 t for 2020, comprising 934.5 t of blacklip and 84 t of greenlip abalone.</p> <p>The spill EMBA intersects the Northern Zone (waters around King Island) and Bass Strait Zone (waters in the Northern Bass Strait Region) of the Abalone Fishery.</p>	Yes
Commercial Dive Fishery (Northern Zone)	White sea urchin (<i>Haliocidaris urethrograms</i>), black sea urchin (<i>Centrostephanus rodgersii</i>) and periwinkles (<i>Lunella undulate</i>)	<p>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 coasts of Tasmania around ports.</p> <p>The spill EMBA 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).</p>	Yes
Giant Crab Fishery	Giant crab (<i>Pseudocarcinus gigas</i>)	<p>The giant crab fishery is a comparatively small fishery with the total allowable catch for 2019-20 at 19.18 t. 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 39°12' 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 2019/20 and 2021/2022 to address the issue.</p> <p>The spill EMBA potentially overlaps the area where giant crabs are fished for on the continental slope.</p>	Yes

Fishery	Target species	Description	Fishing Effort Spill EMBA
Rock Lobster Fishery	Southern rock lobster (<i>Jasus edwardsii</i>)	<p>Southern rock lobster are the other major wild-caught Tasmanian fishery. For 2020-21 the Total Allowable Catch has declined to 990.56 t. The quota for the year remains at 1050.7 t.</p> <p>Rock lobster made up a volume of 1,047 t or 25% percent of total fisheries production in 2015/16. Production value was \$89 million or 51% of total fisheries value in 2014/15 (up 7% from 2013/14). 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. There are 209 vessels active in the fishery.</p> <p>The spill EMBA potentially overlaps the Rock Lobster Fishery.</p>	Yes
Scalefish Fishery (northwest coast)	Numerous species, but the majority of effort is on # species	<p>Complex multi-species fishery harvesting a range of scalefish, shark and cephalopod species. Fourteen different fishing methods are used. The total catch was around 270 t in 2014/15, a decline of 20 t compared to the previous season. Due to the fishery being undercaught 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 spill EMBA potentially overlaps the Scalefish Fishery.</p>	Yes
Scallop Fishery	Commercial scallop (<i>Pecten fumatus</i>)	<p>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.</p> <p>The spill EMBA does not overlap the area of effort for the Scallop Fishery.</p>	No

Fishery	Target species	Description	Fishing Effort Spill EMBA
Seaweed Fishery	Bull kelp (<i>Durvillea Pototorum</i>), Japanese kelp (<i>Undaria pinnatifida</i>)	<p>Components of this fishery include collection of cast bull kelp and harvesting of Japanese kelp, an introduced species.</p> <p>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.</p> <p>The spill EMBA potentially overlaps the Seaweed Fishery.</p>	Yes
Shellfish Fishery	Katelaysia cockles (<i>Katelaysia scalarina</i>), Venerupis clam (<i>Venerupis largillierti</i>), native oyster (<i>Ostrea angasi</i>), Pacific oyster (<i>Crassostrea gigas</i>)	<p>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 Katelaysia 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 spill EMBA), 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.</p> <p>The spill EMBA does not overlap the Shellfish Fishery.</p>	No

Data/information sources: Department of Primary Industries, Water and Environment (DPIPWE, 2021). Australian fisheries and aquaculture statistics 2014-15 (Patterson et al, 2016), Department of the Environment and Energy (DotEE, 2017c), Fish Research and Development Corporation (FRDC, 2017)

4.8 Cultural environment

4.8.1 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 spill EMBA 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 spill EMBA. Only one of these wrecks, the *SS Alert*, has a protection zone that is within the spill EMBA. There is no identified aircraft wreckage 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 gas field and infrastructure, are shown in Figure 4-13. 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.

4.8.2 Aboriginal heritage

Aboriginal 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.

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 Coastal Park are close to coastal access points that are, in some cases, now visitor access points (Parks Victoria, 2006b).

Aboriginal 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 Aboriginal peoples, leading to the relocation of people to missions on Bruny Island, Flinders Island and other sites, and finally to Oyster Cove, their numbers diminished drastically. The Aboriginal Heritage Register (AHR), lists over 13,000 sites; however, there is no searchable database to identify any sites in the operational area. It must be assumed that sites will be scattered along the coast of King Island within the spill EMBA.

4.8.3 Native title

A search of the National Native Title Tribunal (NNTT) database identifies two claims have been accepted for registration over the adjacent coastal shoreline (and terrestrial component of the spill EMBA). One 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. There is also a registered claim (2014/001) over Wilson's Promontory by the Gunaikurnai people. There are no registered claims in Tasmania.

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.

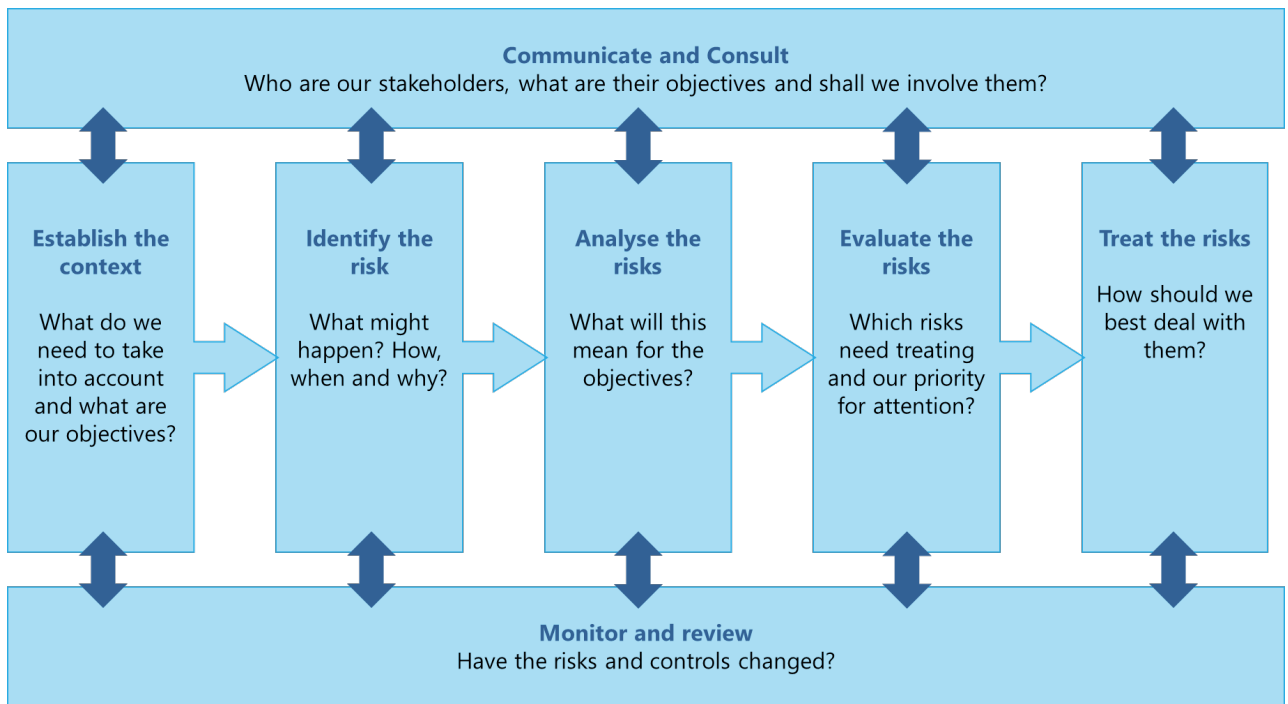


Figure 5-1: Risk assessment process

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: <ul style="list-style-type: none"> • petroleum activity means operations or works in an offshore area undertaken for the purpose of: <ol style="list-style-type: none"> 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, 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 8.

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 Section 4.1); and
- 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 EMBA, 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: EPBC Act MNES: Significant Impact Guidelines 1.1 to identify the relevant significant impact criteria. The highest category for the listed threatened species or ecological communities likely to be present within the EMBA 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); and
- 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 CATEGORY					LIKELIHOOD							
	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		
CONSEQUENCE	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	6 Catastrophic
	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	5 Critical
	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	4 Major
	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	3 Serious
	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	2 Moderate
	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	1 Minor

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; and
- 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, 2021) 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, 2021) has been applied, whereby the level of ALARP assessment is dependent upon the:

- Residual impact and risk level (high versus low); and
- 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, 2021) have been applied.

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) (derived from NOPSEMA, 2021)

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.

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; and
- Stakeholder influence.

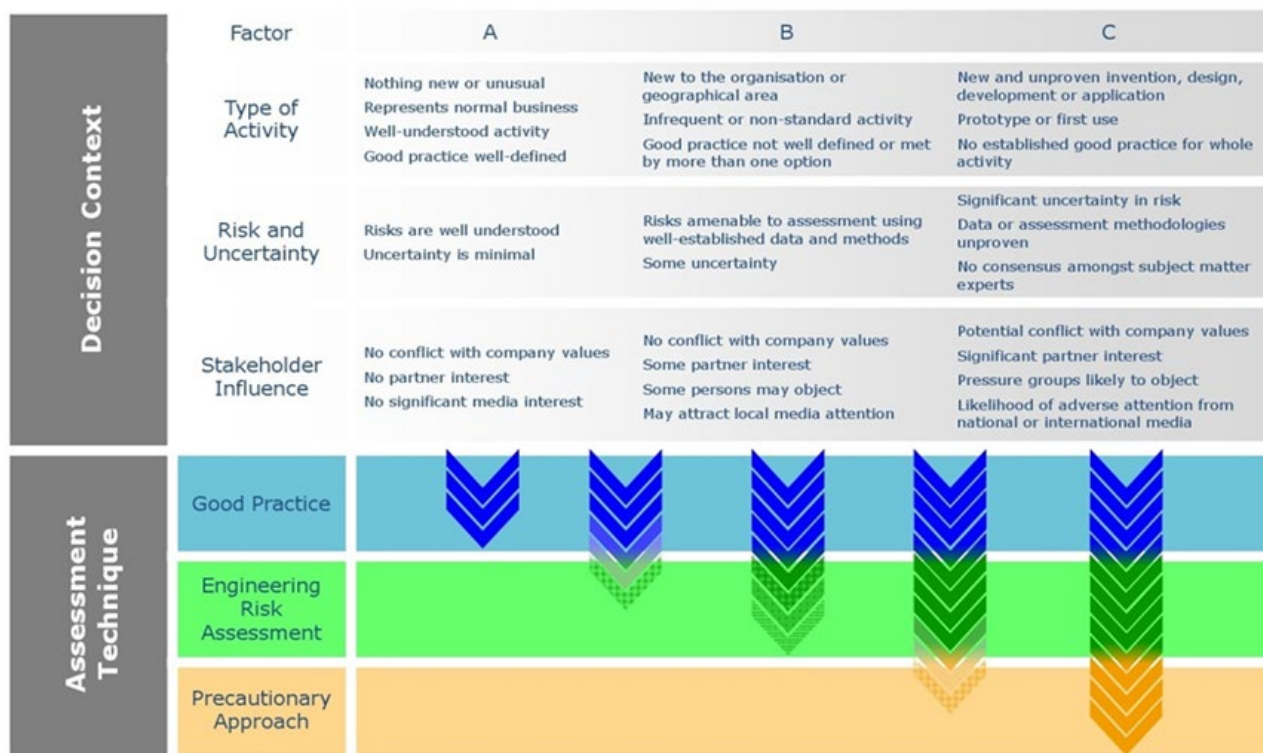


Figure 5-2: OGUK (2014) decision support framework

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; and
- 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; and
- 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; and
- 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); and
- Australian Marine Park designations (described in Section 4.4.2).

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 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.

For oil spill response options aspects associated with the use of vessels are as per vessel operations in Table 6-1. Other related impacts and risks 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 – pre-commissioning	Establishment of IMS	Disturbance to marine fauna	Unplanned Marine Discharge (Solids)	Loss of Containment
Installation of new subsea infrastructure												
Lowering of infrastructure into position				X		X						
T-DIS installation						X						
Rigid spool installation				X		X						
Pre-commissioning philosophy								X				
Support Operations												
Vessel operations		X	X	X	X		X		X	X	X	X

6.2 Light emissions

6.2.1 Hazards

During Otway Phase 5 Early Dive Installation Campaign, vessel-based activities will be undertaken 24 hours a day. Therefore, lighting is required at night for navigation and to ensure safe operations when working on the CSV. Light will also be generated by the HRV, which will be on standby outside of the Operational Area for the duration of the activity.

Light emissions from the 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 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 2020). 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 fish are discussed in the guidelines but have not been identified in the guidelines as requiring assessment and thus this is taken as impacts to them are not likely to be of a level that requires further assessment.

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.

The light EMBA is based on a 20 km boundary around the Operational Area, i.e., around the CSV. The HRV will also generate light emissions for safe operations and navigation. The HRV will be significantly smaller vessel than the CSV and will remain within 2 hour transit time of the Operational Area, therefore the light EMBA is sufficient to assess light emissions from both vessels.

Cumulative light impacts have been considered for additional lighting sources other than those expected from the activity area. Additional sources of light will be from the Thylacine-A Platform (within the operational area), and drilling or tie-in activities at the Thylacine subsea wells (if schedules overlap). The light EMBA is sufficient to assess cumulative light emissions from these sources.

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) and BIAs from the National Conservation Values Atlas. No roosting or breeding behaviours have been identified within the light EMBA.

Table 6-2: Light sensitive receptors within the light EMBA

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
	Foraging, feeding or related behaviour likely to occur within area
Northern Buller's albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging, feeding or related behaviour likely to occur within area
Northern royal albatross	Foraging, feeding or related behaviour likely to occur within area
	Foraging, feeding or related behaviour likely to occur within area
Salvin's albatross	Foraging, feeding or related behaviour likely to occur within area
	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
	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
	Foraging, feeding or related behaviour likely to occur within area
Other	
Common diving-petrel	Foraging BIA
	Foraging BIA
Short-tailed shearwater	Foraging BIA
	Foraging BIA
Wedge-tailed shearwater	Foraging BIA
	Foraging BIA

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). Three 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. Therefore, impacts to turtles from light emissions is not predicted.

Therefore, the light-sensitive receptors that may occur within the light EMBA are:

- Seabirds and migratory shorebirds.

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:

Not disrupted within, nor displaced from, important habitat; and**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. No seabird and migratory shorebird coastal habitats for nesting or roosting are within the 20 km light EMBA.

The light EMBA PMST Report (Appendix A) 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 4-25 to Figure 4-27. Light emissions are not identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). 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). 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 4-26). 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 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 4-27). 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). The light EMBA overlaps a foraging BIA within the SEMR. The foraging BIA directly intersected by the light EMBA is a buffer around Muttonbird Island, Victoria (Figure 4-27). 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.

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 21 days.

The severity (with no controls) is assessed as minor based on:

- Light will be generated by a single vessel during they activity which may take up to 21 days.
- Of the seabirds that may potentially forage within the light EMBA only the common diving-petrel was identified as foraging at night.

- There are no roosting or breeding behaviours, or BIAs identified within the light EMBA.

Cumulative impacts

There are limited available studies on the potential for cumulative impacts from illuminated offshore infrastructure and vessels on birds. Studies of light impact from offshore platforms in the North Sea have been shown to attract migrating birds, with those migrating during the night particularly affected (Verheijen, 1985). Other studies conducted in the North Sea (Marquenie et al., 2008) note that birds travelling within a 5 km radius of illuminated offshore platforms may deviate from their intended route and either circle or land on the platform. Beyond 5 km, it is thought that the strength of the light source was not sufficient to attract birds away from their preferred migration route.

The severity (with no controls) of cumulative impacts is assessed as minor based on:

- Cumulative impacts will occur for the duration of the activity only (21 days) with no long-term change to light levels.
- Of the seabirds that may potentially forage within the light EMBA only the common diving-petrel was identified as foraging at night.

6.2.5 There are no roosting or breeding behaviours, or BIAs identified within the light EMBA. Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Light emissions

ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>Impacts from light emissions are relatively well understood though there is the potential for uncertainty in relation to the level of impact.</p> <p>Activities are well practised, and there are no conflicts with company values, no partner interests and no significant media interests.</p> <p>Additional controls may be required to ensure impacts can be managed to an acceptable level.</p>
Adopted Control Measures	Source of good practice control measures
CM#2: MO 30: Prevention of collisions	<p>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.</p>
CM#1: Light Management Procedure	<p>The National Light Pollution Guidelines provide management options for mitigating the effect of light to seabirds. A review of the management options relevant to the activity is provided in the additional controls section with the following to be adopted:</p> <p>CSV will have and implement a Light Management Procedure as per the National Light Pollution Guidelines (Commonwealth of Australia, 2020). Once safety navigational lighting requirements are met (as per vessel class), the Light Management Procedure will detail additional mitigations to manage light based on the information in the Seabird Light Mitigation Toolbox and at a minimum will implement:</p> <ul style="list-style-type: none"> • Screens, blinds or window tinting on windows to contain light inside the CSV. • 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.

Additional controls assessed		
Control	Cost/Benefit Analysis	Control Implemented?
Seasonal timing	<p>The following seasonal timings were identified for the species that may be active at night within the light EMBA:</p> <ul style="list-style-type: none"> Common diving petrel: year round (NCVA, 2021). <p>Controls have been identified to ensure lighting is reduced to that for safe operations. As common diving petrel may be present all year round, no benefit is gained from adjusting the activity timing with the seasons.</p> <p>Other species are present all year round or do not forage at night thus restricting the period when activities will occur does not afford any benefit to these species.</p>	No
Implement management actions during the breeding season. Light management should be implemented during the nesting and fledgling periods.	The light EMBA is >70 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 > 70 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. 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.	The light EMBA is >70 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
Aim lights downwards and direct them away from nesting areas.	The light EMBA is >70 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 windows to contain light inside buildings has the environmental benefit of reducing light emissions from the activity.	Yes
CM#1: Light Management Procedure Reduce unnecessary outdoor, deck lighting on the CSV and permanent and floating oil and gas installations in known seabird foraging areas at sea.	Extinguishing 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.	Yes

CM#1: Light Management Procedure	As the activities will take place when birds may be foraging within the Light EMBA, 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
CSV working in seabird foraging areas during breeding season should implement a seabird management plan to prevent seabird landings on the ship, manage birds appropriately and report the interaction.		
CM#1: Light Management Procedure	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
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.		
CM#1: Light Management Procedure	A rescue program will not prevent birds grounding, but as it has proven useful to reducing mortality of seabirds it has an environmental benefit.	Yes – where appropriate
Design and implement a rescue program for grounded birds.	The program will be developed as part of the Light Management Plan (CM#1) and will include advice detailed in the International Association Antarctic Tour Operators Seabirds Landing on Ships documents and cover: <ul style="list-style-type: none"> • Handling of birds. • Releasing of birds • Reporting to DAWE in the case of protected species. 	
Consequence rating	Minor (1) with no controls, remaining 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.	

<p>Other requirements</p>	<p>Light emissions will be managed in accordance with the National Light Pollution Guidelines (Commonwealth of Australia, 2020).</p> <p>Light emissions are not identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a).</p> <p>There are no recovery plans, conservation advice or listing advice for the common diving-petrel, short-tailed shearwater or wedge-tailed shearwater.</p>
<p>Monitoring and reporting</p>	<p>Impacts associated with light emissions are for a short duration (21 days), over small area and not predicted to have long term impacts to fauna in the area. Therefore, the monitoring of light emissions is not proposed.</p>
<p>Acceptability outcome</p>	<p>Acceptable</p>

6.3 Atmospheric emissions

6.3.1 Hazards

Atmospheric emissions are generated from combustion engines used on vessels. Vessels will be powered by diesel (marine diesel oil (MDO)).

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.

6.3.3 EMBA

Predicted impacts from atmospheric emissions will be limited to the operational area. Receptors which may be affected by atmospheric emissions within the operational area include:

- Air quality
- Seabirds
- Coastal settlements

6.3.4 Consequence evaluation

The combustion of MDO can create continuous or discontinuous plumes of particulate matter (soot or black smoke) and the emission of non-GHG, such as sulphur oxides (SOX) and nitrous oxides (NOX). Inhaling this particulate matter can cause or exacerbate health impacts to humans exposed to the particulate matter, such as offshore project personnel or residents of nearby towns (e.g., respiratory illnesses such as asthma) depending on the amount of particles inhaled. Similarly, the inhalation of particulate matter may affect the respiratory systems of fauna.

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.

Diesel combustion will result in gaseous emissions of GHG such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). While these emissions add to the atmospheric GHG load, which adds to global warming potential, they are very 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 (21 days) with a consequence level of minor 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.

6.3.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Atmospheric emissions	
ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to air emissions.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#3: MO 97: Marine Pollution Prevention – Air Pollution	<p>The CSV will comply with Marine Orders – Part 97: Marine Pollution Prevention – Air Pollution (appropriate to vessel class) for emissions from combustion of fuel including:</p> <ul style="list-style-type: none"> • 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: Preventative Maintenance System	Combustion equipment shall be maintained in accordance with the preventative maintenance system (or equivalent) to ensure efficient operation.
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. Consequently, no further evaluation against the principles of ESD is required.
Internal context	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	There have been no stakeholder objections or claims regarding air emissions.

Other requirements	Air emissions are not identified as a threat in National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). Air emissions will be managed in accordance with the applicable legislative requirements.
Monitoring and reporting	Impacts associated with air emissions are over a small area and not predicted to have long term impacts to receptors in the area.
Acceptability outcome	Acceptable

6.4 Underwater Sound Emissions

6.4.1 Hazards

Underwater sound emissions will be generated by:

- Subsea positioning equipment (USBL) used during positioning of new infrastructure on the seabed;
- Cutting tools (if required) to prepare the production J-tube for connection to the new production spool; and
- Vessel operations of the CSV and HRV.

Subsea positioning equipment (USBL) will be used during installation. This equipment consists of a number of transducers and receivers positioned on the infrastructure and installation vessel hull near the sea surface.

Cutting tools, such as diamond wire cutter or disk cutter, may be used during installation.

Vessels generate continuous sound from propeller cavitation, thrusters, hydrodynamic flow around the hull, and operation of machinery and equipment.

6.4.2 Predicted environmental impacts

Underwater sound emissions will be continuous (vessel operations) and impulsive (subsea positioning equipment i.e. USBL). In all cases the sound source will be on the sea surface.

Potential impacts of underwater noise emissions from the Otway Phase 5 Early Dive Installation Campaign are:

- Behavioural changes, including displacement from foraging areas; and
- Auditory impairment, permanent threshold shift (PTS) and temporary threshold shift (TTS).

6.4.3 EMBA

The noise EMBA is the area where noise levels are predicted to be above the noise behaviour criteria. Sound modelling undertaken to determine the EMBA is described below. In summary, the largest spatial extent of impacts is predicted to be:

- Behavioural effect: 3.29 km (Scenario 31 – Table 6-3).
- TTS: 1.17 km (for high frequency cetaceans) (Scenario 31 – Table 6-3).

Specific impact thresholds for each species and / or hearing group are described in the section below.

The EPBC Protected Matters Report for the noise EMBA based on 6.5 and 1.5 km are in Appendix A.5.

Underwater sound emissions may impact biological receptors within the noise EMBA such as:

- Fish (with and without swim bladders) including commercial species such as sharks and scalefish;
- Marine reptiles; and
- Marine mammals.

6.4.4 Consequence evaluation

Vessel Operations

Underwater sound emissions will be generated by vessel dynamic position (DP) and, to a lesser extent, machinery, pumps and generators on the CSV (Erbe et al., 2013). Throughout the activity, the HRV will be on standby outside of the operational area and will be moving slowly.

Subsea Positioning Equipment

Subsea positioning systems will typically emit short pulses of medium to high frequency sound, normally within the range of 15 to 40 kHz. Typical operating energy output is between 166 and 196 dB re 1 μ Pa 1 m peak level, depending on the environmental conditions (Bai and Bai 2010).

Austin et al. (2012) calculated the distances to SPL isopleths for a comparable USBL system in open water and found the distance to 160 dB re 1 μ Pa (SPL) to be 36 m. Positioning equipment will be retrieved as soon as possible from the seabed, limiting the potential exposure. As continuous sound from vessel activities and combined activities presents the worst-case impact distances, the assessment is based on continuous sound exposure.

Cutting Tools

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. However, the sound that could be associated with the diamond wire cutting was primarily detectable above the background noise at the higher acoustic frequencies (above around 5 kHz). The background noise levels were substantially higher at lower frequencies; therefore, it is likely that the spectra of the noise peaks at lower frequencies, which has been approximated between 2.5 and 20 kHz.

6.4.4.1 Underwater sound level modelling – Continuous sound emissions

JASCO Applied Sciences (JASCO) performed a modelling study of underwater sound levels associated with the Beach Energy Otway Development (Koessler and McPherson 2021 Appendix F), 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). Modelled scenarios considered all upcoming activities undertaken by Beach, including those covered by this EP, and therefore the modelling is directly applicable to this assessment.

The underwater sound level modelling considered several locations; Artisan and Thylacine, as representative of all locations within the Otway operations. For the purposes of this EP, results from scenarios modelled at the Thylacine location will be used.

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).

Table 6-3 summarised the modelling scenarios applicable to Phase 5 Early Dive Campaign activities. As the sound pressure level (SPL) metric does not depend on the duration of the operation, these estimates are valid for both stationary (CSV) and moving (HRV) vessel activities. Note the modelling study by Koessler and McPherson (2021) (Appendix F) details results for other scenarios such as drilling that are not relevant to this EP.

Scenarios 7 and 31 are included to assess potential impacts from the Phase 5 Early Dive Campaign activities. Scenario 7 is likely to be applicable most of the time.

Table 6-3 Modelled underwater sound scenarios

#	Activity	Modelled Scenario
7	CSV installation	Vessel stationary, operating at 20% MCR. Located at Thylacine North-1 well location (close to the operational area).
31	Combined vessel operations and ROV cutting tool	Vessel stationary, operating at 40% MCR (Thylacine North-1) + Vessel stationary, operating at 40% MCR + ROV cutting tool (Geographe-4) (June)*

* ROV cutting tool modelled at the Geographe-4 location presents a worst-case distance compared to ROV cutting tool modelled at the Thylacine-A wellhead platform location and is therefore a conservative representative of the potential sound impacts during this activity.

6.4.4.2 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 6-4 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 μ Pa.

Table 6-4 details the furthest modelled distance to the NOAA (2019) exposure criteria for each scenario.

Table 6-4: Cetacean PTS, TTS and behaviour sound criteria and predicted furthest distances and areas

Hearing group	SEL24h threshold (LE,24h; dB re 1 μPa²-s)	CSV installation (Scenario 7)		Combined vessel operations and ROV cutting tool (Scenario 31)	
		Rmax (km)	Area (km²)	Rmax (km)	Area (km²)
PTS					
LF cetaceans	199	0.06	0.01	0.10	0.03
MF cetaceans	198	0.02	0.001	0.02	0.001
HF cetaceans	173	0.09	0.03	0.16	0.08
Phocid seals	201	0.02	0.001	0.02	0.002
Otariid seals	219	–	–	-	-
TTS					
LF cetaceans	179	0.60	1.04	0.95	2.39
MF cetaceans	178	0.07	0.02	0.13	0.05
HF cetaceans	153	0.84	2.02	1.17	3.55
Phocid seals	181	0.19	0.12	0.27	0.22
Otariid seals	199	0.02	0.001	0.03	0.003
Behaviour					
Marine mammals	120	2.71		3.29	

Note: a dash indicates the level was not reached within the limits of the modelling resolution (20 m).

Phocid seals

For Phocid seals the furthest distance to the PTS criteria is reached at 40 m and the furthest distance to the TTS criteria is 270 m during combined vessel operations and ROV cutting tool activities. From the PMST Reports Phocid seals were not identified within the operational area (1 km around the T-DIS location) and thus PTS and TTS are not assessed further.

The distances to the behavioural threshold ranged from 2.71 – 3.29 km. No Phocid seals were identified within the Sound Behaviour EMBA (5 km) PMST report (Appendix A.5) thus behaviour impacts are not assessed further.

Otariid seals

For Otariid seal the PTS criteria is not reached and the furthest distance to the TTS criteria is 40 m during combined drilling, platform and installation activities. The Australian and New Zealand fur seal may occur within the operational area (1 km) 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 2.71 – 3.29 km. The PMST Report (Appendix A.5 Sound Behaviour EMBA 5 km) identified that the Australian and New Zealand fur seal may occur within the Sound Behaviour EMBA (5 km). Impacts are predicted to be temporary avoidance. 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 260 m and the TTS criteria is 1.17 km. The PMST Report (Appendix A.4 Sound 24 hr TTS EMBA 1.5 km) identified that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound 24 hr TTS 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 2.71 – 3.29 km. The PMST Report (Appendix A.5 Sound Behaviour EMBA 5 km) identified that that high-frequency cetaceans such as pygmy and dwarf sperm whales may occur within the Sound Behaviour EMBA (5 km). Impacts are predicted to be temporary avoidance. 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 40 m and the TTS criteria is 160 m. The PMST Report (Appendix A.4 Sound TTS 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 2.71 – 3.29 km. The PMST Report (Appendix A.5 Sound Behaviour EMBA 5 km) identified several dolphin species, beaked and toothed whales that may occur within the Sound Behaviour EMBA (5 km). Impacts are predicted to be temporary. The consequence is assessed as Minor (1) as there are no biologically important behaviours or biologically important areas identified within the predicted ensonified area.

Low-frequency cetaceans

The furthest distance to the low-frequency cetacean PTS criteria is 100 m and the TTS criteria is 950 m. Table 6-5 details the low-frequency cetaceans that have BIAs and/or biologically important behaviours within the Sound TTS 24 hr EMBA (1.5 km) as identified from the Sound TTS 24 hr EMBA PMST Report (Appendix A.4) and Table 4-9.

The distances to the behavioural threshold ranged from 2.71 – 3.29 km. Table 6-5 details the low-frequency cetaceans that have BIAs or biologically important behaviour within the Sound Behaviour EMBA (5 km) as identified from the Sound Behaviour EMBA (5 km) PMST Report (Appendix A.5) and Table 4-9.

Table 6-5: 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 current core coastal range. Known core coastal range BIA

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 4.6.11.2, peak blue whale foraging in the operational area in recent years (2021 – 2022) has been between February and May, although they are known to occur throughout the year, with large numbers seen in the nearby area in November and December in 2012. It is expected that blue whales will be present during the period when Phase 5 Early Dive Installation Campaign activities will occur (activities could occur year-round). On the advice of Gill (2020), all blue whales are assumed to be foraging.

The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) requires 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’. The Guidance on Key Terms within the Blue Whale Conservation Management Plan (Commonwealth of Australia, 2021) defines the requirements of this action as “to ensure that any blue whale can continue to forage with a high degree of certainty in a Foraging Area, and that any blue whale is not displaced from a Foraging Area”.

The Guidance on Key Terms within the Blue Whale Conservation Management Plan (Commonwealth of Australia, 2021) suggests a whale could be displaced from a foraging area if stopped or prevented from foraging, caused to move on when foraging, or stopped or prevented from entering a foraging area. A whale is considered to be displaced from a foraging area if foraging behaviour is disrupted, regardless of whether the whale can continue to forage elsewhere within that foraging area (Commonwealth of Australia, 2021).

A precautionary approach has been taken in the assessment of possible displacement from a foraging area BIA by using conservative assumptions so as to ensure that control measures will be implemented. The severity of potential impact from the activity is assessed as moderate, and of an acceptable level because:

- 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 TTS threshold used for the assessment was for high frequency cetaceans (1.17 km) rather than the TTS for low frequency cetaceans (0.95 km), providing extra precaution for blue whales.
- For some scenarios, two time periods were modelled: June and November. In all instances the scenarios modelled during the June time period gave the furthest distances to PTS and TTS criteria and have been adopted in this assessment.
- An assessment of Beach's MFO data collected between February 2021 and March 2022 for the ongoing drilling and installation campaign was undertaken (see Beach Surveys (2019-2022) in Section 4.6.11.2). Activities included drilling and construction at the Artisan well location and activities in the Geographe and Thylacine fields. A summary of findings include:
 - Of the 127 blue whales that were observed to enter the 3,000 m management zone, 70 (55%) were observed to move towards the MODU (following first detection) and 57 (45%) were observed to move away from the MODU. This indicates that blue whales are not being displaced.
 - Published detection functions (Williams et al. 2016) and conservative assumptions were used to estimate blue whale densities in the management zones applied (0-500, 501-1,500, 1,501-2,000, 2,001-3,000, >3,000 m). If underwater noise was displacing blue whales, it would be expected less whales would be observed in the zones closest to the underwater noise. The expected densities of blue whales based on the detection function most closely matching the Lead MFOs advice indicated there was no difference in expected densities between any of the management zones (mean of 6.21 blue whales/km²).
 - The expected densities of blue whales based on the conservative detection functions showed similar results for the 0-500 and 501-1,500 m zones (means of 7.27 and 7.73 blue whales/km²). However, they showed mean expected densities of 18.70 blue whales/km² and 22.91 blue whales/km² for the 1,501-2,000 and 2,001-3,000 m zones.
 - Even if the conservative functions are used there is still no detectable difference in expected densities of blue whales in the 0-500 and 501-1,500 m zones, which conservatively means that blue whales are not displaced within 1,500 m of the noise source.
- The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) details that shipping and industrial noise are classed as a 'minor' consequence (defined as: individuals are affected but no affect at a population level).
- The Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c) 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 a continuous noise source and does not have high intensity signals, it is unlikely that they would cause injury to foraging pygmy blue whales.
- The activity will be of a short duration (21 days).
- Blue whales can occur in the underwater sound EMBA at any time of year, although in recent years (2021-2022) the peak occurrence has been between February and May. Large numbers have previously been recorded in November and December (2012). Therefore, the activity (Q4 2022 – Q2 2023) may overlap with blue whale foraging, however based on the expected start date of the activity (Q4 2022) and the short duration (21 days), the likelihood of blue whales being present or foraging in the ensonified area during the activity is low.

- The area within the low frequency cetacean TTS threshold (0.95 km) is 2.84 km², which represents 0.008% of the pygmy blue whale high density foraging BIA (35,627 km²). The area within the shutdown zone (1.5 km) is 7.07 km², which represents 0.020% of the BIA. The area within the behavioural distance (3.29 km) is 34.00 km², which represents 0.095% of the BIA.
- Adopted controls as detailed in Section 6.4.5 will prevent possible PTS, TTS and displacement impacts to pygmy blue whale that may be foraging.
- The ensonification area is ~75 km from the Bonney coast upwelling KEF, which is a known feeding aggregation area (Gill et al. 2011; McCauley et al. 2018). The ensonification area is within an area where the occurrence of an upwelling event between 2002 and 2016 was assessed as very unlikely with an upwelling frequency of <10% (Huang and Wang 2019 see Section 4.5.9 Bonney coast upwelling). Thus, blue whale foraging is likely to be opportunistic within the ensonification area.
- Aerial surveys in the Otway region (2001 – 2007) recorded mean blue whale group size of 1.3±0.6 per sighting (Gill et al., 2011), meaning that pods do not have high numbers.
- Attard et al. (2017) showed that pygmy blue whales travel widely between the two known foraging areas (Bonney coast upwelling and Perth Canyon) and that records suggest that this population of blue whales may visit diverse, widespread areas for feeding during the austral summer, including perhaps the southern Indian Ocean and sub-Antarctic region, and travel to winter breeding grounds in the Indonesian region where they may also feed.
- The Commonwealth of Australia (2021) guidance regarding the definition of ‘displaced from a foraging area’ states that 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 implementation of the control measures and EPS in Table 6-19 means that blue whale displacement from a foraging area will not occur. As such, the activity will be managed in a manner that is not inconsistent with the Conservation Management Plan for the Blue Whale (Commonwealth of Australia, 2015c), specifically Action Area A.2. See Table 6-6 for an assessment of the activity with the conservation objectives and actions of the Conservation Management Plan for the Blue Whale.

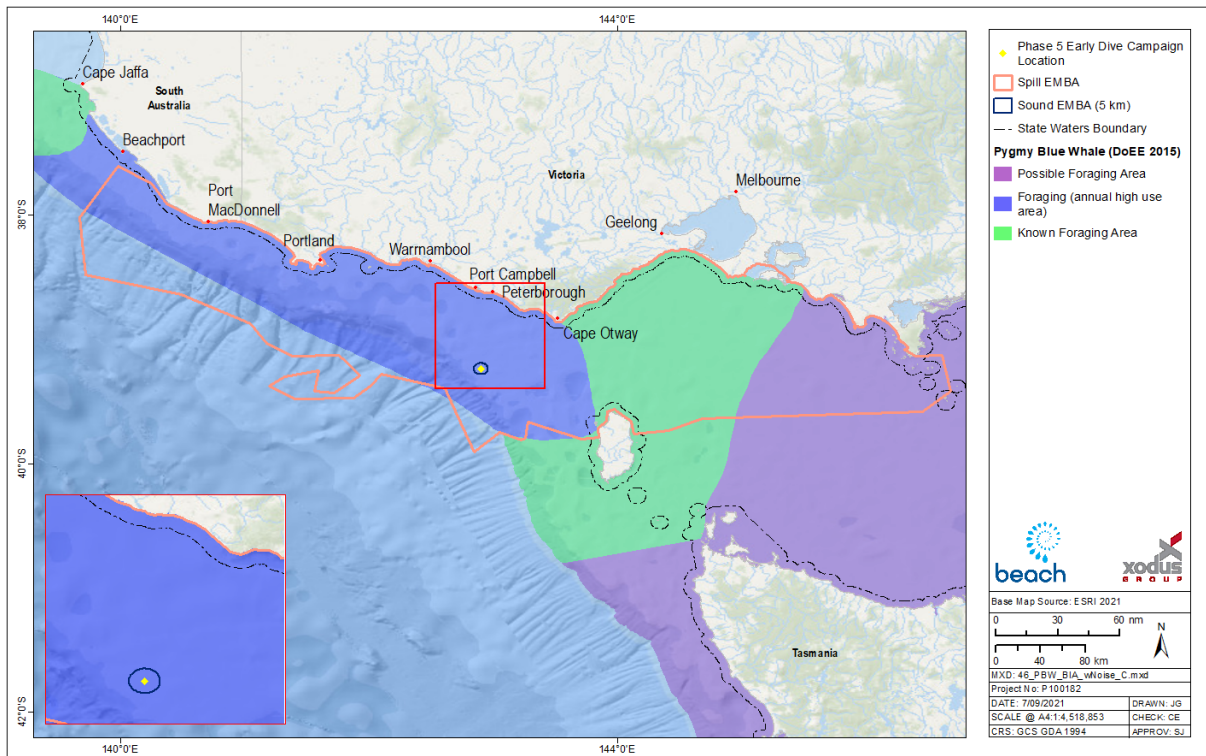


Figure 6-1: Pygmy blue whale BIAs and sound EMBA

Table 6-6: Assessment of the activity against the relevant conservation objectives, recovery targets and management actions of the Conservation Management Plan for the Blue Whale

Relevant aim / objective / action	Assessment
Relevant Interim Recovery Objective	
4. Anthropogenic threats are demonstrably minimised.	The EIA in this EP provides a comprehensive assessment to address anthropogenic noise generated by this activity on pygmy blue whale. The EPS listed in Table 6-19 address anthropogenic noise from the activity and effectively reduce its potential for impact on blue whales. The activity will be managed in a manner that is not inconsistent with this conservation objective.
Relevant Interim Objective Targets	
Target 4-1: Robust and adaptive management regimes leading to a reduction in anthropogenic threats to Australian blue whales are in place.	The EPS listed in Table 6-19 provide controls that reduce anthropogenic noise on blue whales. The activity will be managed in a manner that is not inconsistent with this conservation objective.
Target 4-2: Management decisions are supported by high quality information and high priority research projects identified in this plan are achieved or underway.	The EPS listed in Table 6-19 ensure learnings and observations from the Otway drilling campaign, and in response to new information and recommendations from the Blue Whale Study, will be considered prior to commencement of the activity to ensure continual improvement in the efficacy of control.
Relevant Actions Areas	
Action Area A.2. Assessing and addressing anthropogenic noise.	The EIA in this EP provides a comprehensive assessment of assessing and addressing anthropogenic noise generated by this activity on blue whales. The EPS listed in Table 6-19 provide controls that reduce anthropogenic

Relevant aim / objective / action	Assessment
Action 3. 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.	noise on blue whales. The activity will be managed in a manner that is not inconsistent with this conservation objective.
Action 4. EPBC Policy Statement 2.1 Interaction between offshore seismic exploration and whales is applied to all seismic surveys	The EPS listed in Table 6-19 ensure that blue whales will continue to utilise foraging BIAs without injury and are not displaced from the foraging area. Therefore, the activity will be managed in a manner such that it is not inconsistent with the relevant management action.

Southern right whales

For SRW, the following areas are within the predicted ensonified area:

- Current core coastal range is within the area where the PTS, TTS and behavioural criteria is reached (Figure 6-2a;b).
- Southern right whale emerging aggregation area is not within the area where the PTS, TTS and behavioural criteria is reached (Table 6-4, Figure 6-2b).

As detailed in Section 4.6.11, there is the potential for SRW 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.

The severity is assessed as moderate and is of an acceptable level because:

- 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.
- For some scenarios, two time periods were modelled: June and November. In all instances, the scenarios modelled during the June time period gave the furthest distances to PTS and TTS criteria and have been adopted in this assessment.
- The Conservation Management Plan for the SRW (DSEWPaC, 2012a) identifies chronic and acute industrial noise as a threat that is classed as a 'moderate' consequence (defined as population recovery stalls or reduces), while shipping noise is classed as a 'minor' consequence (defined as individuals are affected but not affect at a population level). Types of industrial noise identified as chronic and acute, such as pile driving, drilling and laying pipe, have significantly higher source volumes and durations than the modelled scenarios, which are more closely related to shipping noise.
- Though activities may occur during the period when SRW are within the core coastal area, the largest area of potential impact within the core coastal area (217,825 km²) is very small (2.39 km²), which represents 0.001% of the core coastal area for up to 21 days.
- PTS and TTS impacts are not predicted to SRW, by themselves or with calf, that may be moving through the core coastal area 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 950 m, SRW, by themselves or with calf, would move out of the ensonified area before PTS or TTS could occur.

- Avoidance behaviour may be exhibited if SRW 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 pers. comm), energetic costs would be low if avoidance behaviour took place 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.
- Low numbers of southern right whales are predicted in and around the activity area based on aerial surveys undertaken in the Otway region (2002 – 2013), which recorded 12 groups of SRW consisting of 52 individuals (Gill et al., 2015). None were observed away from the coast, which Gill et al (2015) noted is consistent with winter habitat preferences.
- It is unlikely that calving whales would remain in the activity area with water depth of 100 m, as the whales prefer to occupy depths of less than 10 m.
- PTS, TTS or behavioural criteria are not reached at the Victorian coastal migration and resting on migration BIA or SRW emerging aggregation area.
- An emerging aggregation area has been identified at Port Campbell, which has not been spatially defined. The Conservation Management Plan for the SRW (DSEWPC, 2012a) details that depth is the most influential determinant of habitat selection at a fine-scale within aggregation areas, with whales preferentially occupying water less than 10 m deep and that in coastal habitat whales are generally within 2 km of the shoreline. Charlton et al (2019) details that SRW generally occupy shallow sheltered bays within 2 km of shore and within water depths of less than 20 m. Based on a distance of 2 km from the shore, the northern-most extent of the ensonified area for marine mammal behavioural response is 62 km north of the area of potential occupancy for the Port Campbell emerging aggregation area (see Figure 6-2b). Given this distance from the ensonified area to the emerging aggregation site, impacts resulting in exclusion of SRW from the site and the potential for a reduced population recovery rate will not occur.

Anthropogenic noise will be managed such that SRW are not deterred from calving nor displaced from the emerging aggregation area. The EPS listed in Table 6-19 ensure that SRW will continue to utilise the emerging aggregation area; and movements are not deterred in and out of the migration and resting on migration area. The activity will be managed in a manner that is not inconsistent with this conservation objective of the Conservation Management Plan for the SRW (DSEWPaC, 2012a). See Table 6-7 for an assessment of the activity with the conservation objectives and actions of the Conservation Management Plan for the SRW.

- Adopted controls as detailed in Section 6.4.5 will prevent possible PTS, TTS and displacement impacts to SRW.
- The ensonified area for marine mammal behavioural response is located within the SRW core coastal range (see Figure 6-2a;b). There is the potential for SRW to be transiting through the sound EMBA during May-June and September-November as they move to and from coastal aggregation areas from their southern feeding grounds to these aggregation and migration areas. There is a partial temporal overlap with the activity timing and the latter of these migration periods. The Conservation Management Plan for the SRW

(DSEWPC, 2012a) states that where whales approach and leave the Australian coast to and from offshore areas is not well understood and that more-or-less direct approaches and departures to the coast are also likely. The furthest distance to the behaviour noise criteria of 4.85 km equates to an area of 73.9 km², which is approximately 0.03% of the SRW core coastal range (217,825 km²). Therefore, the area that may be avoided by SRW is not likely to impede access to the coastal aggregation sites due to the availability of other suitable connecting habitat and migratory pathways.

- There is little to no temporal overlap in activities undertaken by Beach in the region (refer to Section 4.7.3). This is because the Thylacine platform operations will be shut in for safety reasons for the period of this activity, the Otway drilling campaign is scheduled for completion in late Q2/early Q3 2022, the Geopraphe subsea installation and commissioning activity was completed at the end of 2021 and there are no other activities Beach is planning in the Otway Basin at the same time as this activity. The NOPSEMA website (as of 21 February 2022) indicates that there are no other activities (with EPs approved or under assessment) planned to occur in or around the activity area. Potential cumulative impacts have been assessed through modelling the worst-case cumulative modelling (JASCO modelling scenario 21; combined drilling [Otway drilling program], platform and installation activities), which considers the cumulative noise levels when all three activities are occurring simultaneously. The defined acceptable level for cumulative noise impacts on SRW is:
 - Impacts from underwater sound are not inconsistent with the Conservation Management Plan for the SRW (DSEWPaC, 2012a).
 - This includes no injury to a SRW and no deterrence of SRW from aggregating, calving/breeding, or migrating in BIAs and emerging aggregation areas.
 - Activities do not hinder the recovery of the SRW population.

The modelled level of impact indicates that the maximum distance to the behavioural threshold (of 120 dB) is 4.85 km, distance to TTS is 650 m and distance to PTS is 60 m (see Table 6-4). These distances to effect are below the defined acceptable level, as the activity is a sufficient distance from the SRW migration/resting, connecting habitat and the Port Campbell emerging aggregation area (see Figure 6-2). No injury, permanent displacement or exclusion of SRW from coastal aggregation and BIAs is predicted given the distance from the activity (see Figure 6-2b). No behavioural disturbance in the emerging SRW aggregation area or nearshore SRW BIAs is predicted since the cumulative noise modelling indicates a low level of noise (below the 120 dB behavioural threshold) will be generated from concurrent activities at the Port Campbell SRW receiver location (Koessler et al. 2021 in Appendix F).

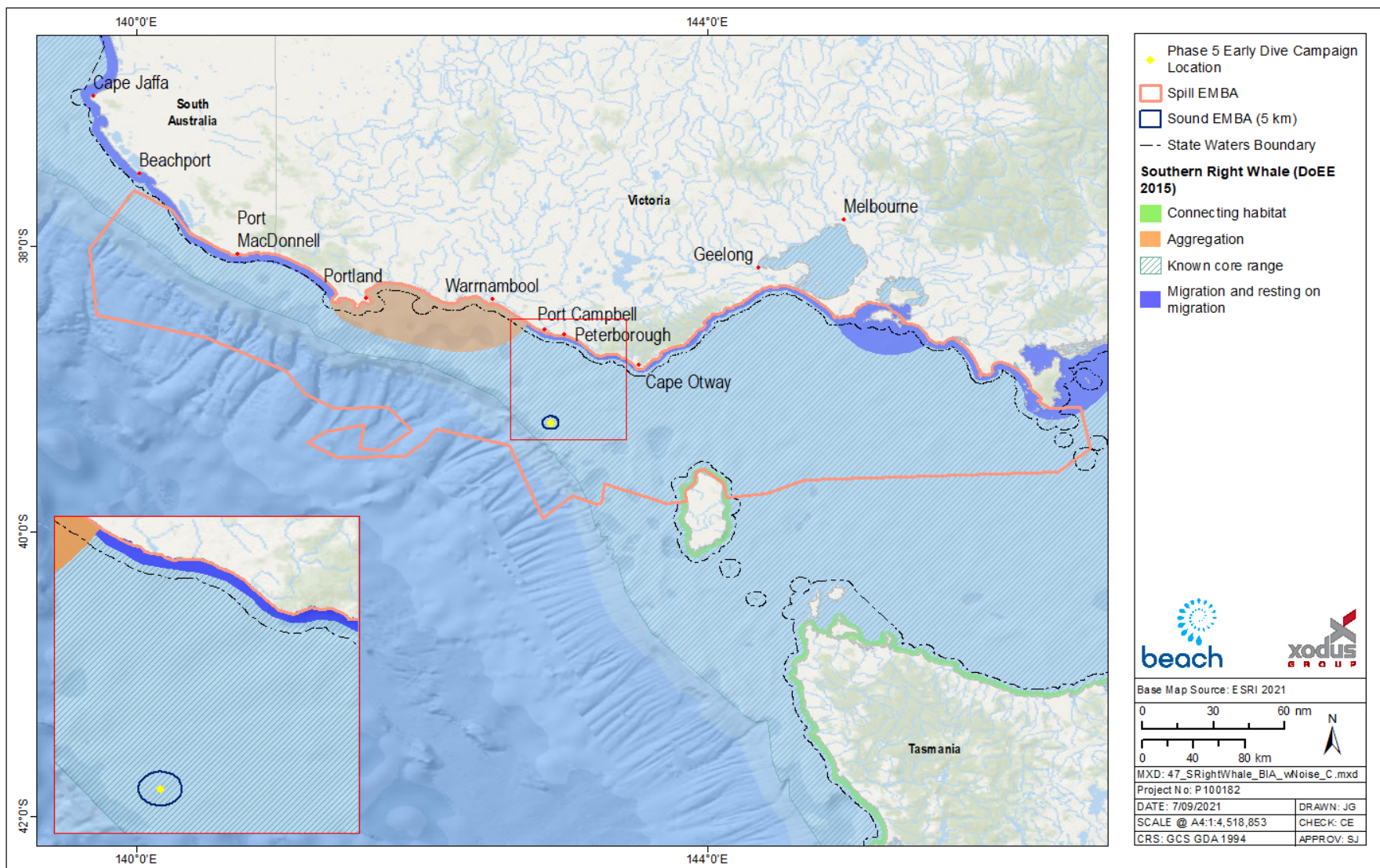


Figure 6-2a: Southern right whale BIAs, current core coastal range and sound EMBA

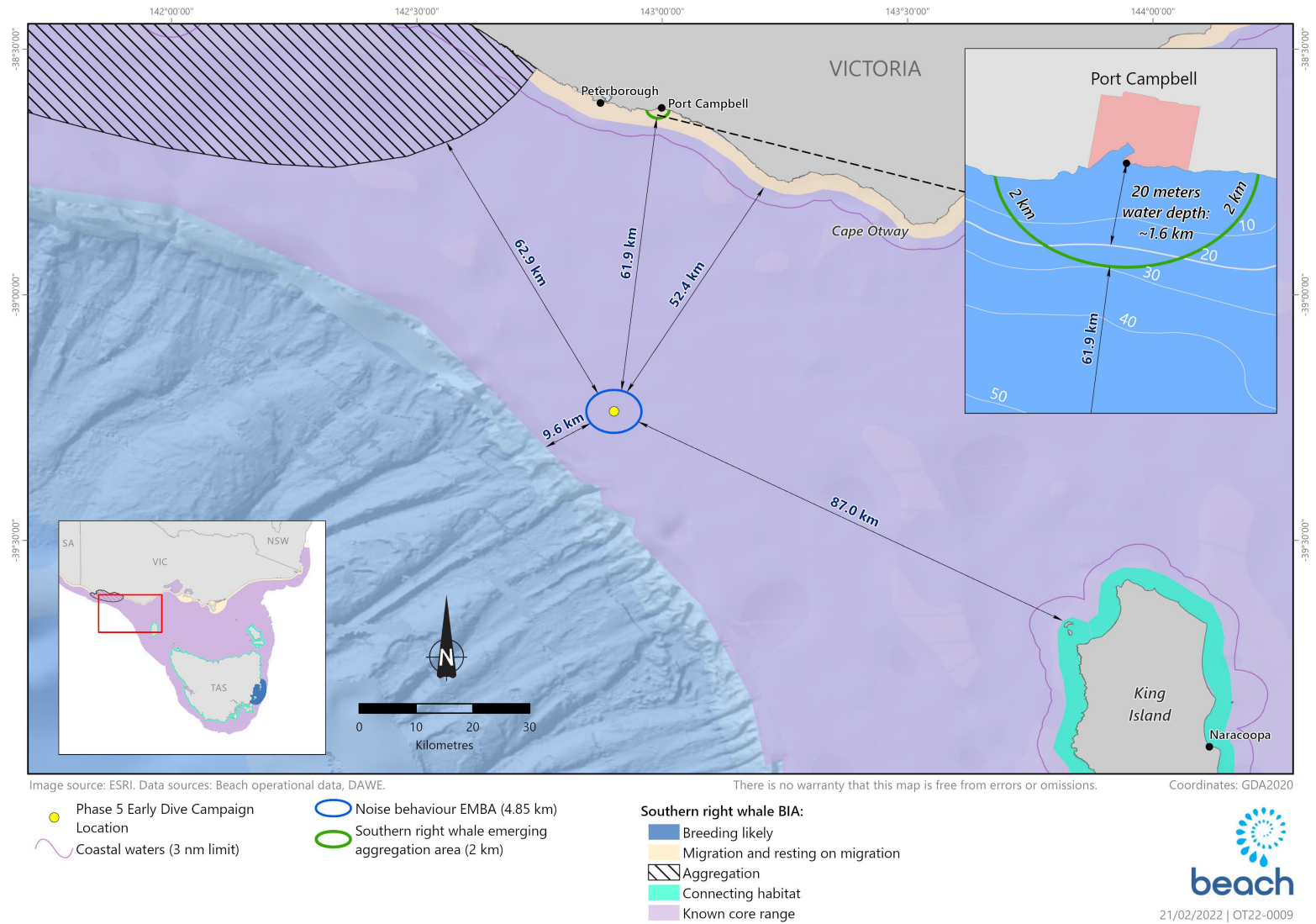


Figure 6-3b: Distance from the LFC behaviour EMBA to southern right whale BIAs and the emerging aggregation area at Port Campbell

Table 6-7: Assessment of the activity against the conservation objectives, recovery targets and management actions of the Conservation Management Plan for the Southern Right Whale

Relevant aim / objective / action	Assessment
Relevant Interim Recovery Objectives and Targets	
<i>Interim Recovery Objective 2: Demonstrate that the number of southern right whale occurring off south-east Australia (nominally the south-east Australia population) is showing signs of increase.</i>	
<p>Target 2.2: the number of whales off south-east Australia shows an apparent increase for the period 2011–2021 relative to 2005–2010:</p> <ul style="list-style-type: none"> no aggregation area identified in 2011 drops to a lower category by 2021 (categories are defined by the number of whales occupying an aggregation area each year) aggregations categorised as small established areas in 2011 are used by an equivalent or increased number of whales by 2021 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 historic high use areas not identified as aggregation areas in 2011 show signs of increased use by 2021. 	<p>The EIA and EPS listed in this EP (Table 6-19) demonstrates that anthropogenic threats are demonstrably minimised and reduced wherever possible. The activity location is located 62 km from the SRW emerging aggregation area at Port Campbell (Figure 4-46) and has been assessed not to constitute a permanent impediment to SRW travelling through the ensonified area to coastal and migration areas (noting the area of potential impact is small at only 0.03% of its known core range BIA).</p>
<p>Interim Recovery Objective 5: Anthropogenic threats are demonstrably minimised.</p>	<p>The EIA and EPS listed in this EP (Table 6-19) demonstrates that anthropogenic threats are demonstrably minimised and reduced wherever possible. Therefore, the activity will be managed in a manner such that it is not inconsistent with the relevant interim objective targets.</p>
<p>Target 5.1: robust and adaptive management regimes leading to a reduction in anthropogenically-induced southern right whale mortality in Australian waters are in place.</p>	<p>The EIA and EPS listed in this EP (Table 6-19) has been designed to avoid mortality of SRW.</p>
<p>Target 5.2: management decisions are supported by high quality information and high priority research targets identified in this plan are achieved or underway by 2021.</p>	<p>The information included in this EP regarding impacts to whales is based on detailed sound modelling that uses relevant behavioural threshold criteria and detailed assessment for SRW in the region, including the emerging aggregation area in Port Campbell.</p>
Relevant Actions Areas and Actions	
<i>Action Area A.2. Assessing and addressing anthropogenic noise.</i>	
<p>Action: Improve the understanding of what impact anthropogenic noise may have on southern right whale populations by:</p> <ol style="list-style-type: none"> Assessing anthropogenic noise in key calving areas Assessing responses of southern right whales to anthropogenic noise If necessary, developing further mitigation measures for noise impacts. 	<p>Key calving areas have been assessed with regard to anthropogenic noise generated by the activity. The nearest SRW calving area located near Warrnambool is approximately 96 km from the activity area.</p> <p>The EIA has assessed responses of SRW to anthropogenic noise.</p> <p>As per the EPS listed in Table 6-19, an MMO will be onboard the CSV throughout the activity duration as a mitigation measure for noise impacts.</p>

Relevant aim / objective / action	Assessment
Assess and address anthropogenic noise (shipping, industrial and seismic).	The EIA in this EP is consistent with this conservation objective.

Other low-frequency 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 4.6.11 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 Phase 5 Early Dive Installation Campaign activities will occur (activities could 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.

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.
- 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'.
- 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.
- 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 BIAs 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) observed feeding behaviour for sei and fin whales but noted that it is an opportunistic feeding area for these species.

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. (2015) presented revised thresholds for turtle PTS and TTS for continuous sound. Table 6-8 details the criteria and modelled distances to them (Koessler et al. 2021. Appendix F). The 24 hr PTS criteria was reached within 30 m during combined drilling, platform and installation activities. The 24 hr TTS criteria was reached within 150 m.

Table 6-8: Finneran turtle SEL24h thresholds and modelled distances

Marine Turtles	SEL24h threshold	CSV installation	Combined drilling, platform and installation activities	Combined vessel operations and ROV cutting tool
		Rmax (km)	Rmax (km)	Rmax (km)
PTS	220 dB re 1 $\mu\text{Pa}^2\text{-s}$	20 m	30 m	20 m
TTS	200 dB re 1 $\mu\text{Pa}^2\text{-s}$	80 m	80 m	150 m

Three marine turtle species may occur within the operational area (1 km) 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 80 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.

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 6-9 details the criteria and modelled distances to them (Koessler et al. 2021. Appendix F).

Table 6-9: 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)	CSV installation	Combined drilling, platform and installation activities	Combined vessel operations and ROV cutting tool
		Rmax (km)	Rmax (km)	Rmax (km)
Recoverable injury	170 dB SPL for 48 h	Not reached	Not reached	Not reached
TTS	158 dB SPL for 12 h	30 m	40 m	50 m

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 50 m of combined activities. 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. Thus, temporary avoidance may occur during 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 based on:

Environment Plan

- 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 (1 km) for commercial fish, 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 be available to be caught outside of the operational area, impacts to commercial fishing are not predicted.

6.4.5 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#23: Avoid the SRW migration season	The activity is timed to occur during the Q4 2022 (starting October) to end of Q2 2023 window (end of June), thereby avoiding the peak SRW migration season around the activity area (see 'SRW' in Section 4.6.7.6, which indicates that sightings in the region occur in June, July and August). This aligns with the Conservation Management Plan for the SRW of minimising anthropogenic threats to allow the conservation status of the SRW to improve.
CM#5: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	<p>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.</p> <p>The CSV 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.</p> <p>Helicopters will adhere to EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans in relation to distances to cetaceans.</p>
CM#6 Whale Management Procedure	There will be two competent MMOs (with recognised qualifications and experience in whale observation, distance estimation and reporting) onboard the CSV at all times during the activity to implement the Whale Management Procedure (see next row).
Marine Mammal Observers	One MMO will be on each 12-hr shift during daylight hours to implement the whale management procedures outlined here (with the second MMO available to take over the previous shift or assist the MMO on shift as required). Longer daylight hours in southern

Australia during the summer months (up to 15 hours) are greater than a 12-hr work shift, so having two competent MMOs onboard is required to ensure each shift can be reliably completed.

The MMOs will be contracted through a reputable consultancy that trains and provides MMOs on a range of projects around Australia, including many for Beach in the Otway and Bass basins in recent years.

If Otway Drilling program is undertaken concurrently to Phase 5 early dive installation activities (timing of the drilling program means this is unlikely):

MMOs on the *Ocean Onyx* support vessels will communicate with the MMO on the CSV via radio as per the Simultaneous Operations (SIMOPs) Plan. This way, information sharing can be undertaken on sightings of whales in the region and give advanced warning that a whale may be heading in the direction of the CSV if spotted from the drilling campaign (or vice versa). This will allow for advanced notice of a possible shutdown.

CM#6 Whale Management Procedure

This Whale Management Procedure details the controls to prevent possible PTS, TTS and displacement impacts to foraging blue whale and SRW that may be present in the core coastal area and migration and resting on migration BIA. The procedure assumes that once an activity is underway, whales within the pre-activity survey zone are not displaced and that only PTS and TTS need to be managed.

Pre-start survey

Prior to an activity commencing, a pre-activity survey will be undertaken of the observation zone for the activity (5 km around the activity location).

The observation zone is precautionary based on the distance to the conservatively modelled behaviour criteria for cumulative sound impacts (3.29 km) and has been rounded up to take into account accuracy of estimation of distance at sea.

On advice from the Blue Whale Study, a conservative precautionary approach will be adopted whereby it is assumed that all whales present on the Otway shelf are conducting biologically important behaviours (e.g., foraging). All whales will also include SRW 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 observation zone; or
- Whales are observed leaving the observation 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 CSV has a bridge height above sea level of ~24 m, MMO viewing distance will be able to cover the observation zone especially as the vessel will be moving during the pre-survey.

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 4.6.11.

Shutdown zones

Once the activity has commenced, observations will be undertaken from the highest practicable position on the CSV (most likely the bridge) within the activity shutdown zone (1.5 km). Once CSV operations are underway, it is assumed that if whales are sighted within the observation zone (5 km) then they are not being displaced from the area. Therefore, it is considered that only the extent of the potential zone for TTS and PTS impacts (i.e., 1.5 km from the CSV) need to be managed once operations have begun. As

such, no shutdown of the CSV is necessary if a whale is observed to be more than 1.5 km away from the CSV.

The shutdown zone is based on the distance to the modelled TTS criteria for high frequency cetaceans (1.17 km) and has been rounded up to 1.5 km to provide a precautionary approach. This is particularly precautionary for blue whales which have a TTS of 950 m.

If a whale is sighted within the shutdown zone, the CSV will continue operations until the earliest point is reached at which operations can be safely suspended (i.e., the 'safe point'). On suspension of operations, the vessel will adopt the most favourable heading in order to reduce propulsion noise and then increase separation to whales if safe to do so.

The activity can recommence once:

- No whales are observed for 30 min within the activity shutdown zone; or
- Whales are observed leaving the activity shutdown zone.

Night-time and low visibility

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 observation zone (5 km radius) in the 3 hours prior to sunset (using sunset times provided the Bureau of Meteorology).

The 'no more than three whales' criterion is acceptable for blue whales because it indicates the krill stock at the location has been diminished. Additionally, blue whales typically feed during daylight hours when krill is visible to them (Gill 2020). More than three whales may indicate a large krill supply and that more whales could be expected. Three SRW would be an indication that there is an increased likelihood of a SRW within the shutdown zone during the period that observations cannot be undertaken.

CM#4: Preventative Maintenance System	Power generation and propulsion systems on the CSV will be operated in accordance with manufacturer's instructions and ongoing maintenance to ensure efficient operation.
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Additional controls assessed		
Control	Cost/Benefit Analysis	Control Implemented?
Conduct the activity outside the peak blue whale foraging season	<p>Pygmy blue whales are potentially in the foraging BIA within the Otway shelf waters at any time of the year, although most likely from November through to June. The peak numbers in the Otway area in recent years (2021-2022) have been between February and May, with highest numbers in March and April.</p> <p>Conducting the activity outside of the peak blue whale foraging period will minimise the likelihood of encountering high numbers of blue whales. However, the period outside spring and summer results in the activity taking longer to complete, due to (typically) poorer sea states, when the CSV cannot operate.</p> <p>Although the intent is to commence and complete the activity outside the peak blue whale foraging period, committing to this is not possible because weather or technical delays may mean that the activity extends into the January to March period. The high cost of potential delays (in the millions of</p>	No

	<p>dollars) associated with this control measure is not commensurate with the low residual consequence rating for cetaceans.</p> <p>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.</p>	
Anchoring of the CSV	<p>This is not feasible at the site of installation activities as anchoring may damage existing subsea infrastructure. In addition, minor adjustments to the vessel position are required throughout the installation of subsea infrastructure. The vessel must also be able to react to an errant vessel, man overboard or other safety issues. Thus, anchoring of the CSV is not a feasible option while installing equipment.</p> <p>However, in the event of a whale-instigated shutdown, the vessel would shutdown the DP, where safe to do so, and move to a safe location away from subsea infrastructure.</p>	No
Passive acoustic monitoring (PAM)	<p>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, SRW) 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.</p>	No
Monitoring upwelling events pre-mobilisation – sea surface temperature and chlorophyll-a	<p>Scientific research demonstrates that blue whales aggregate to feed on krill at upwelling locations along the Bonney coast and west Tasmania canyons. Remote sensing shows decreased sea surface temperature (SST) and increased chlorophyll-a levels when upwelling reaches the surface. However, there is a lag between changes in SST and increased primary production leading to krill swarms, and then the presence of feeding whales. This lag has been identified in some studies on upwelling-krill-blue whale foraging presence as between 1 to 4 months. As such, monitoring SST and chlorophyll-a does not provide a robust prediction of blue whale feeding activity in the activity area.</p>	No
Satellite imagery	<p>A number of satellite types exist, however the most suitable for monitoring whales is Digital Globe's WorldView3 Satellite which uses 30 cm resolution. This is recommended by a study by Cubaynes et al (2018) due to the better resolution that is needed to confidently identify objects such as whales (e.g., characteristic features such as flippers and flukes that are not easily detected on lower resolution images (e.g., 50 cm), and which are essential for identifying an object such as a whale, and for differentiating between species (e.g., pygmy blue whale vs another large baleen whale)). Several factors make the use of satellite imagery to monitor for whale presence unviable, as below:</p> <ul style="list-style-type: none"> • Uncertainty as to whether satellite image quality will be sufficient to identify whales. • There will be a lag between when the satellite images are being taken and when Beach will receive them. Additional time will then be required 	No

	<p>to analyse the images. This delay makes satellite imagery unsuitable for making a decision to mobilise or to begin operations.</p> <ul style="list-style-type: none"> Whales need to be at or above the sea surface to be able identifiable – therefore submerged whales, even if just below the surface, will be missed. <p>Given these factors, this technology is unreliable for the purpose of whale behaviour identification, thus no environmental benefit is achievable regardless of the cost.</p>	
Drone surveys	<p>Drones have been considered as a method of increasing the observation distance of MMOs and monitoring the PTS, TTS and observation zones. Drone surveys have been carried out for cetaceans mainly in the nearshore marine environment via beach operations. To date it is not known if drone surveys have been effectively used as a real-time monitoring method. Drone effectiveness offshore is limited due to the following:</p> <ul style="list-style-type: none"> Physical range of drones is only approximately 4-5 km. Drone operations are sensitive to wind, particularly gusting winds, which would limit the use of this equipment. Technical support and operators required. <p>Given an MMO will be present on the CSV, the extra observation distance afforded through the use of drones provides negligible observation benefit. The additional cost, safety issues and operational limitations outweigh the negligible environmental benefit.</p>	No
Infra-red systems	<p>Infra-red (IR) systems could enhance the ability of MMOs to visually detect the presence of foraging or potentially foraging whales.</p> <p>Infra-red systems are not available as a real-time monitoring tool for operations and have the following limitations:</p> <ul style="list-style-type: none"> Poor performance of the system in sea states greater than Beaufort Sea State 4 (due to the inability to adequately stabilise the camera) (Verfuss et al., 2018). Conditions such as fog, drizzle and rain limit detections that can be made using IR (Verfuss et al., 2018). Detection range for large baleen whales is 1 to 3 km. <p>Given an MMO will be present on the CSV, the use of IR technology provides negligible observation benefit. The additional cost, safety issues and operational limitations outweigh the negligible environmental benefit.</p>	No
Dedicated MMO monitoring vessel	<p>An additional dedicated vessel for MMO monitoring is not considered to represent an ALARP solution as monitoring activities can effectively be carried out by an MMO situated on the CSV because the extent of the observation zone (5 km) and shutdown zone (1.5 km) can be easily monitored from the bridge of the CSV. MMOs contracted to the Otway drilling campaign state that the viewing distance from a support vessel bridge is 7 km.</p>	No

	<p>Additional vessels may increase the risk of vessel strike with cetaceans, increase underwater sound impacts and other vessel-related impacts and risks. The cost to implement this control measure is disproportionate to marginal environmental benefit and may actually contribute to increased environmental risk.</p>	
Undertake aerial observations for cetaceans prior to and during the activity	<p>Flights in small aircraft over open water introduce significant safety risks, and there is no guarantee that whales will be spotted. Previous spotter flights undertaken in the Otway have identified that the ability to detect cetaceans can be severely limited during:</p> <ul style="list-style-type: none"> • Choppy sea states, when white caps make it extremely difficult to spot tell-signs of whale presence, • Calm conditions, when glare from the water can significantly reduce the ability to detect any features on the sea surface, and • Mists and fogs, which can severely reduce visibility. <p>The speed and turning time of the aircraft make positive identification of potential sightings very challenging. Spotter flights are also unable to detect cetaceans that are not active on the ocean surface.</p> <p>Undertaking aerial spotter flights has a low likelihood of success and involves taking a high safety risk. This, combined with the high costs of spotter flights, means the risks and costs associated with this control are disproportionately high when considering the low residual impact consequence for cetaceans.</p> <p>Aerial flights will be undertaken as part of the Otway Offshore Drilling Campaign. Information from these flights will be provided to the MMO onboard the CSV.</p>	No
Consequence rating	Moderate (2)	
Likelihood of occurrence	NA	
Residual risk	Low	
Acceptability assessment		
To meet the principles of ESD	<p>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.</p> <p>A precautionary approach was undertaken in the assessment for blue whales as the activity will occur within a high annual use foraging area BIA.</p>	
Internal context	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>	
External context	There have been no stakeholder objections or claims regarding noise emissions.	
Other requirements	Sound emissions will be managed in accordance with legislative requirements.	

	<p>Sound emissions will:</p> <ul style="list-style-type: none"> • 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). • Not impact the recovery of the white shark as per the Recovery Plan for the White Shark (DSEWPaC, 2013a). <p>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:</p> <ul style="list-style-type: none"> • Assessing the effect of anthropogenic noise on blue whale behaviour. Section 6.4 assesses the effects of anthropogenic noise from the activity on blue whale behaviour. • 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. The review of Beach’s MFO data in Section 4.6.11.2 uses a precautionary approach to show that blue whales are likely not being displaced. Section 6.4 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. <p>Actions from the Conservation Management Plan for the SRW (DSEWPAC, 2012a) applicable to the activity in relation to assessing and addressing anthropogenic noise have been addressed as per:</p> <ul style="list-style-type: none"> • Assessing the effect of anthropogenic noise on SRW behaviour. Section 6.4 assesses the effects of anthropogenic noise from the activity on SRW behaviour. • Anthropogenic noise in BIAs will be managed such that any SRW continues to utilise the area without injury and is not displaced from a foraging area. Section 6.4 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 SRW from BIAs (known core range or migration and resting on migration).
<p>Monitoring and reporting</p>	<p>Cetacean sightings will be recorded using the DAWE sighting sheets as detailed in Section 7.12.6.</p>
<p>Acceptability outcome</p>	<p>Acceptable</p>

6.5 Physical presence

6.5.1 Hazards

Physical presence of the Otway Phase 5 Early Dive Installation Campaign includes:

- 500 m safety exclusion zone around the CSV when undertaking installation activities.

Once installed, infrastructure will be managed under the Otway Operations EP, which considered impacts related to physical presence of the infrastructure.

6.5.2 Predicted environmental impacts

The physical presence of the CSV operating within the operational area can result in the displacement of other marine users.

6.5.3 EMBA

Predicted impacts from the physical presence of vessel activities will be limited to the operational area (1 km).

Other marine user identified to occur within the operational area are:

- Recreation and tourism
- Commercial shipping
- Petroleum activities
- Commercial fishing

6.5.4 Consequence evaluation

6.5.4.1 Recreation and tourism

Recreation and tourism could be affected by restricted access to an area (i.e. due to the presence of the safety zone), 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 operational area is offshore (~70 km) and the absence of emergent features within the operational area.

6.5.4.2 Commercial shipping

The operational area is located within an area of major shipping traffic (Section 4.7.4) however, 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.

Vessel 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 operational area. The severity is assessed as minor based on the area of impact is small, duration is short (21 days) and the exclusion is required for safe operations of the vessel.

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6.5.4.3 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 safety exclusion zone for the duration of the activity (21 days). Displacement of other petroleum activities is therefore not predicted.

6.5.4.4 Commercial fishing

The Commonwealth SESSF and Southern Squid Jig Fishery have catch effort within the operational area based on ABARES reports 2014 – 2020 (Patterson et al. 2018, 2017, 2016, 2015 and Georgeson et al. 2014). The Skipjack Fishery is not currently active and management arrangements for the fishery are under review.

AFMA detailed that there are currently no active vessels in Commonwealth fisheries within the operational area.

Based on Victorian Fishing Association data from 2016 to 2020 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 4.7.9.

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 8).

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 Phase 5 Early Dive Installation Campaign.

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 Phase 5 Early Dive Installation Campaign activities.

The extent of displacement is the 500 m safety exclusion zone for the duration of the activity (21 days). The severity is assessed as minor based on:

- Small area of displacement (0.79 km²) within the safety exclusion zone
- Short duration (21 days)
- No trawl or gill net fishing occurs in the operational area.

- Limited fishing has been identified within the operational area.

6.5.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Physical Presence

ALARP decision context and justification	ALARP Decision Context: Type A
	<p>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.</p> <p>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 area.</p> <p>No objections or claims were raised from fishers from consultation undertaken for the development of this EP.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#7: Ongoing consultation	Consultation will continue with relevant stakeholders as detailed in Section 8.8
CM#8: Beach Fair Ocean Access Procedure	Beach's Fair Ocean Access Procedure (Appendix D) is being 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#2: 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#9: 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.
Consequence rating	Minor (1)

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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	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	The merits of claims or objections raised by a relevant stakeholder have been adequately assessed and additional controls adopted where appropriate.
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

6.6 Benthic disturbance

6.6.1 Hazards

Benthic disturbance can occur as a result of activities which interact with the seabed, including (footprints in brackets):

- Placement of positioning equipment on the seabed (< 5 m²).
- Temporary wet-parking of infrastructure and equipment on the seabed (up to ~150 m²).
- Installation of the T-DIS (47 m²) and rigid spools (~70 m²), including the pipe handling frame (~6 m² per frame).
- Spool span rectification via jetting
- Installation of stabilisation mattresses and dropped object frames (198 m²) and grout bag / cement bags.

The footprint of all activities will be within the operational area.

Vessel anchoring will not occur during the activity.

6.6.2 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.

6.6.3 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.

6.6.4 Consequence evaluation

As detailed in Section 4.5.2 and 4.5.3 a seabed site assessment was undertaken over the Otway Development gas fields and proposed infrastructure corridors. This included the Thylacine field. In relation to benthic habitat within the Thylacine field and broader area the following was identified:

- The seabed topography is dominated by exposed rock on the seabed.
- Small patches of very thin transgressive coarse sand are present across the survey area.
- The seabed showed a scattered sessile biota on a sandy seafloor.
- No rocky reefs or outcrops were identified.
- The sandy substrates described for Thylacine gas field 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 m² on average but could be found in patches of at least 0.4 m².

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- 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 bodied invertebrates to survive and establish significant populations.
- The epibiota on the seabed in the vicinity of the Thylacine field 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 Shelf Rocky Reefs and Hard Substrates KEF is not spatially defined and may occur within the operational area. No threatened ecological communities or habitats critical to the survival of the species were identified within the operational area. 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 a hard substrate within the operational area but did not identify rocky reefs (Ramboll, 2020, Appendix E). 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 4.4.13). 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 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. This is supported by the seabed site assessment (Ramboll, 2020, Appendix E), that identified that the epibiota on the seabed in the vicinity of the Thylacine gas field 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.

The total disturbance footprint from the Phase 5 Early Dive Installation Campaign is expected to be ~400 m², which in the context of T/L2 and the marine bioregion occupies a very small area of the seabed. The activity may result in the mortality of sessile fauna within this very small footprint and potentially the mortality of benthic infauna associated with the habitat. However, it is considered that potentially impacted benthic habitats and associated biota are well represented in the region. Therefore, any disturbance and loss of habitat will represent a very small fraction of the widespread available habitat and abundance of benthic fauna in the region. Following removal of the temporarily positioned equipment and pipe handling frames, the soft sediments will be left disturbed. However, benthic habitats will remain viable and are expected to recolonise through the recruitment of new colonists from planktonic larvae in adjacent undisturbed areas. In addition, the installation of the subsea infrastructure will generate hard substrate in an area of otherwise relatively featureless seabed. This will act as an anchoring point for some benthic organisms and contribute to a localised increase in biodiversity following the activity.

Displacement of sediments may occur during subsea equipment deployment and installation, and during jetting for span rectification. This will result in temporary, localised plumes of suspended sediment and subsequent deposition of sediment, potentially resulting in smothering of marine benthic habitat and benthic communities in the immediate vicinity. Given the limited amount of subsea equipment to be installed, the displacement of sediments and creation of silt plumes in the water column are not expected to significantly impact benthic communities in the activity area because they are likely to be dispersed by oceanic currents.

The extent of the area of impact is predicted to be small for a duration of up to months to years while the disturbed area recolonises. The severity is assessed as minor 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 area).

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- Though the operational area 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 area 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 area.

6.6.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Benthic disturbance

ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to benthic disturbance.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#10: As-left survey	An ROV survey will be undertaken at the completion of the activity to confirm temporary equipment, including any temporarily 'wet parked' equipment and infrastructure, has been removed from the activity area and the location of subsea infrastructure is recorded.
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.

Environment Plan

Internal context	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	<p>There have been no stakeholder objections or claims regarding benthic disturbance.</p>
Other requirements	<p>No other requirements were identified in relation to benthic disturbance.</p>
Monitoring and reporting	<p>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.</p>
Acceptability outcome	<p>Acceptable</p>

6.7 Planned marine discharges – Vessels

6.7.1 Hazards

The 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.

6.7.2 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.

6.7.3 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.

6.7.4 Consequence evaluation

6.7.4.1 Planned marine discharges

The consequence evaluation considers the potential cumulative impacts from:

- Planned marine discharges of waste waters and putrescible wastes from the CSV 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, such as if early dive installation campaign activities (this EP) overlap with drilling activities at Thylacine North-1. However, the small additional volume that one 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 all wastewater discharges will dissipate within the operational area (1 km).

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.

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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 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 current core coastal 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 Phase 5 Early Dive Campaign activities is the Bonney coast upwelling KEF. Figure 4-18 shows that the Bonney coast upwelling KEF is ~ 75 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 impacts are not predicted.

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The extent of impact, including any cumulative impacts, is predicted to be 500 m from a vessel. The severity is assessed as minor 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.
- The 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.
- The 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.
- The operational area overlap with the southern right whale current core coastal 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.

6.7.4.2 Putrescible waste

The operational area where the vessel would discharge putrescible waste overlaps foraging BIAs for several albatross species, common diving-petrel, and short-tailed and wedged-tailed shearwater (Figure 4-25, Figure 4-26 and Figure 4-27). 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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a); 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 based on:

Environment Plan

- 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.
- The 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.

6.7.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Planned marine discharges – vessels	
ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to planned marine discharges</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#11: 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: Preventative Maintenance System	Equipment to treat marine discharges such as bilge water, slops from deck drainage, sewage and food waste are operated in accordance with the preventative maintenance system (or equivalent) 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	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	There have been no stakeholder objections or claims regarding planned marine discharges.

<p>Other requirements</p>	<p>Planned marine discharge will be managed in accordance with legislative requirements.</p> <p>Planned marine discharges will not:</p> <ul style="list-style-type: none"> • 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 (<i>Carcharodon carcharias</i>) (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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • 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, fin whale or humpback whales, covered by conservation advice.
<p>Monitoring and reporting</p>	<p>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.</p>
<p>Acceptability outcome</p>	<p>Acceptable</p>

6.8 Planned marine discharges – pre-commissioning

6.8.1 Hazards

During the activity, pre-commissioning discharges will include small volumes (< 1m³) of inhibited seawater and MEG released during:

- MEG manifold isolation verification
- Spool installation (including discharges from production riser)
- T-DIS installation

The base plan is to pressure test within a closed-system; however, it is possible that flushing will be required. In this case, a total of 11 m³ of flushing fluid (MEG and inhibited seawater) would be discharged to sea, likely from the T-DIS location.

In the event that the MEG riser has to be depressurised, approximately 100 m³ of MEG would be discharged at the base of the Thylacine MEG riser for system testing, flushing and contingency purposes. 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.

6.8.2 Predicted environmental impacts

Planned discharges of pre-commissioning fluid can result in changes in water quality which can lead to toxic effects to marine fauna.

6.8.3 EMBA

Predicted impacts from planned marine discharges of pre-commissioning fluid will be limited to the operational area. Receptors potentially affected include water quality and marine fauna.

6.8.4 Consequence evaluation

MEG has a low toxicity, is readily biodegradable and is rated as posing little or no risk to the environment (PLONOR) and 'E' (non-CHARM) in the OCNS rankings. The fluid proposed for use in the HFL function test (MacDermid Oceanic 443) is a water-based fluid that is ranked "D" in the OCNS ranking and has a substitution ("SUB") warning, indicating that alternative products should be used where possible. The substitution warning is triggered by a non-biodegradable fluorescent leak tracer dye at <150ppm in the whole product. The dye is non-toxic and does not have a potential to bioaccumulate.

The consequence of the subsea discharges to the physical and biological environment are expected to have minor consequences because of the:

- Low toxicity of the products to be discharged;
- Low volumes associated with the discharges (likely discreet discharges of <1 m³);
- Temporary nature of the discharges;
- High dilution and dispersal factor in open waters; and
- Absence of sensitive habitats in the activity area.

Control, ALARP and acceptability assessment: Planned marine discharges – pre-commissioning

ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to marine discharges of hydraulic control fluids or other operational discharges.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#12: 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.
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	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
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.

Environment Plan

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

6.9 Establishment of invasive marine species

6.9.1 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.

6.9.2 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.

6.9.3 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.

6.9.4 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.

Environment Plan

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 located in deep waters (greater than 70 m).

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 activities, no impacts to Australian Marine Parks are predicted.

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 activity is geographically isolated from other subsea or surface infrastructure which might be suitable for colonisation.
- The offshore location of the activity 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.
- Areas of higher value or sensitivity are located away from the operational area with Twelve Apostles Marine National Park on the Victorian coast over 70 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 activity (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 6.9.5 Beach has demonstrated that the acceptability criteria is met and therefore, the residual risk is considered low.

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).

AFMA have confirmed there is no fishing effort for Commonwealth fisheries within the operational area. There is some fishing effort from the Rock Lobster Fishery,

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.

6.9.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Establishment of invasive marine pests

ALARP decision context and justification	<p>ALARP Decision Context: Type B</p> <p>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.</p> <p>The Victorian DJPR have expressed interest in the management of IMS in Victorian State waters.</p>
Adopted Control Measures	Source of good practice control measures
<p>CM#13: Beach IMS Management Plan</p>	<p>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.</p> <p>The Beach Domestic IMS Biofouling Risk Assessment Process:</p> <ul style="list-style-type: none"> 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; and

- 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	<p>A specialised installation vessel is required to undertake the activity.</p> <p>Using a vessel that is 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.</p> <p>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.</p>	Not selected

Consequence rating	Serious (3)
Likelihood of occurrence	Remote (1)
Residual risk	Low

Acceptability assessment

To meet the principles of ESD	<p>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:</p> <p>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.</p> <p>No impacts to MNES are predicted.</p> <p>The implementation of controls makes it a remote likelihood that IMS will be introduced from the activity resulting in a low residual risk.</p> <p>It is not considered that there is significant scientific uncertainty associated with this aspect. Therefore, the precautionary principle has not been applied.</p>
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Internal context	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	<p>There have been no stakeholder objections or claims regarding the introduction or establishment of invasive marine pests in relation to the activity.</p>
Other requirements	<p>The impact will be managed in accordance with legislation requirements and guidance, including:</p> <ul style="list-style-type: none"> • 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) with gives effect to the Biosecurity Act 2015; 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 <p>There are no EPBC management plans (management plans, recovery plans or conservation advice) which relate specifically to IMS introduction and establishment as a threat.</p> <p>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 makes it unlikely that IMS will be introduced from the activity and spread to nearby AMPs.</p>
Monitoring and reporting	<p>Impacts as a result of the introduction of marine invasive species will be monitored and reported in accordance with the Section 7.10.</p>
Acceptability outcome	<p>Acceptable</p>

6.10 Disturbance to marine fauna

6.10.1 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.

Disturbance from sound emissions is assessed in Section 6.4.

6.10.2 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.

6.10.3 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.

6.10.4 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; and
- 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.

Three 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.

Five 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 current core coastal range 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 and Conservation Advice for the sei whale, fin whale and 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. Pygmy blue whales are likely to be foraging within the BIA (November to June) which overlaps the period of the activity (March – July). 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.

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. During the activity the CSV will predominantly be holding position and is unlikely to be moving at speeds or over distances which could result in collision with marine fauna.

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 remote based on:

- Within the operational area the CSV will be slow moving to stationary.
- The short duration of the activity (21 days).
- 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.
- If an incident occurred, it would be restricted to individual fauna.

6.10.5 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
	<p>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.</p> <p>No objections or claims were raised by stakeholders in relation to air emissions.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#5: 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# 14: Vessel speed restrictions	The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017(Commonwealth of Australia, 2017a) identifies that speed is a concern when considering collision risk and the outcome and that slower moving vessels provide greater opportunity for both fauna and vessel to avoid collision. Large, high-speed vessels, in particular, have become a major concern as they are capable of travelling at speeds of up to 35 to 40 knots, which correlates to an increase in collisions (Weinrich 2004; Ritter 2010 cited in Commonwealth of Australia, 2017a). The National Strategy for Reducing Vessel Strike on Cetaceans and other Marine Megafauna 2017(Commonwealth of Australia, 2017a) does not make any recommendations in relation to a

maximum vessel speed, but case studies within the strategy have implemented a 10 knot speed limit in sensitive areas. Furthermore, the strategy details, according to Laist et al. (2001), 89 % of incidences where the whale was severely hurt or killed occurred at vessel travelling speeds greater than 14 knots and were most serious in large vessels (> 80 m).

Based on this information vessel speeds within the operational area will be restricted to 10 knots.

Consequence rating	Moderate (2)
Likelihood of occurrence	Remote (1)
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: <ul style="list-style-type: none"> • 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 (<i>Carcharodon carcharias</i>) (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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPac, 2011a). • 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.

	<ul style="list-style-type: none"> • 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, fin whale or humpback whales, covered by conservation advice. <p>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:</p> <ul style="list-style-type: none"> • 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 7.12 • 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 6.10 details the impact assessment and mitigation measures (controls) to be implemented to ensure impacts are of an acceptable level and ALARP.
Monitoring and reporting	Disturbance to protected marine fauna area required to be reported as detailed in Section 7.12.
Acceptability outcome	Acceptable

6.11 Unplanned marine discharges - solids

6.11.1 Hazards

Solids which may be accidentally discharged include:

- Waste maybe accidentally blown overboard off the vessel.

6.11.2 Predicated environmental impacts

Solids accidentally released to the marine environment may lead to injury or death to individual marine fauna through ingestion or entanglement.

6.11.3 EMBA

Impacts resulting from the risk of unplanned marine discharge (solids) will be limited to the operational area.

6.11.4 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 accidentally 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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a).

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.

Three species of pinniped (or species habitat) may occur within the operational area; the New Zealand fur-seal, the Australian fur-seal and the Australian sea lion. A foraging BIA for the Australian sea lion is present within the EMBA.

Five 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 a foraging BIA for the pygmy blue whale and the current core coastal range 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, fin whale and humpback whale do not identify marine debris as threat.

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 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.

6.11.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Unplanned marine discharges - Solids

ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to unplanned marine discharge of solids.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#15: MO 95: Marine Pollution Prevention – Garbage	<p>Marine Order Part 95 (Marine pollution prevention — garbage gives effect to MARPOL Annex V.</p> <p>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.</p>
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	<p>The proposed management of the risk is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>

External context	There have been no stakeholder objections or claims regarding marine fauna injury or death from unplanned discharge of solids
Other requirements	<p>Waste on board the CSV will be managed in accordance with legislative requirements.</p> <p>Marine fauna injury or death from unplanned discharge of solids if occurred will not:</p> <ul style="list-style-type: none"> • 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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • 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, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Unplanned discharge of solids is required to be reported as per Section 7.12.6.
Acceptability outcome	Acceptable

6.12 Loss of Containment – Minor Release of Hazardous Substances

6.12.1 Hazards

Several loss of containment scenarios of minor releases of hazardous substances have been identified as credible during Phase 5 Early Dive Campaign. These are described in Table 6-10.

There is no refuelling of the vessel within the operational area.

Table 6-10 Credible Loss of Containment (hazardous substances) scenarios

Scenario	Description
Loss of Containment – hazardous substances stored on the vessel	Routine operation of CSV includes handling, use and transfer of chemicals with the following were identified as potentially leading to a loss of containment event: <ul style="list-style-type: none"> • Use, handling and transfer of 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	Loss of MEG could occur due to: <ul style="list-style-type: none"> • Failure in infrastructure system as a result of equipment damage, dropped object or human error. • Loss of containment during flushing activities

6.12.2 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

6.12.3 EMBA

Impacts resulting from the risk of a loss of containment of hazardous substances will be limited to the operational area.

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6.12.4 Consequence evaluation

An evaluation of the types of minor spill events was completed to determine 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 m³. Loss of containment of MEG could result in a maximum release of the flushing volume ~11 m³.

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.

6.12.5 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Loss of Containment – hazardous substances

ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>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.</p> <p>No objections or claims were raised by stakeholders in relation to minor spills during the activity.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#16: 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.
CM#18: Crane handling and transfer procedure	The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.
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	<p>The proposed management of the risk is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	<p>There have been no stakeholder objections or claims regarding loss of containment (hazardous substances).</p>
Other requirements	<p>Loss of containment (hazardous substances) will be managed in accordance with legislative requirements.</p> <p>Loss of containment (hazardous substances) will not:</p> <ul style="list-style-type: none"> • 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 (<i>Carcharodon carcharias</i>) (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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • 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, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	<p>Loss of containment (hazardous substances) are required to be reported as per Section 7.10.</p>
Acceptability outcome	<p>Acceptable</p>

6.13 Loss of Containment – damage to existing subsea infrastructure

6.13.1 Hazards

There is the potential for damage to existing subsea petroleum infrastructure from the accidental loss of an object from the CSV during the activity. For this activity, dropped objects may include ROV baskets, production spools, flying lead deployment frames and any unsecured equipment (e.g., tools and hardware) that may be accidentally dropped overboard during crane lifting and hoisting operations.

No planned lifts or crane operations will be undertaken directly over the production export pipeline and MEG pipeline, which are located to the west of the Thylacine-A wellhead platform.

6.13.2 Predicted environmental impacts

The predicted environmental impacts of a dropped objects on existing subsea petroleum infrastructure 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 dropped objects on existing subsea petroleum infrastructure will be limited to the operational area.

6.13.4 Consequence evaluation

In the event of a dropped object to the marine environment, potential environmental effects would be limited to localised physical impacts on benthic habitats and communities. If the dropped object is recovered, this impact will be temporary in nature. If the object cannot be recovered, then the impact may be longer.

There is no risk of a well blowout within the activity area because there are no wells within the operational area. As such, a catastrophic loss of hydrocarbons will not occur.

No planned lifting or crane activities will occur directly over the production export pipeline or MEG line. These pipelines are also entirely covered in stabilisation mattresses, which act as protection from dropped objects. There is therefore no risk of an uncontrolled release from the pipeline or MEG line.

The potential consequence of a damage to existing infrastructure 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.

Control, ALARP and acceptability assessment: damage to existing infrastructure	
ALARP decision context and justification	<p>ALARP Decision Context: Type A</p> <p>The risk of damage to existing infrastructure 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.</p> <p>No objections or claims were raised by stakeholders in relation to damage to existing infrastructure during the activity.</p> <p>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.</p>
Adopted Control Measures	Source of good industry practice control measures
CM#18: Crane handling and transfer procedure	The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects.
Consequence rating	Minor (1)
Likelihood of occurrence	Unlikely (3)
Residual risk	Low
Acceptability assessment	
To meet the principles of ESD	The risk of damage to existing infrastructure 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	<p>The proposed management of the risk is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the Implementation Strategy (Section 7).</p>
External context	There have been no stakeholder objections or claims regarding damage to existing infrastructure.
Other requirements	<p>Damage to existing infrastructure will be managed in accordance with legislative requirements.</p> <p>Damage to existing infrastructure will not:</p>

	<ul style="list-style-type: none"> • 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 (<i>Carcharodon carcharias</i>) (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 Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPaC, 2011a). • 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, fin whale or humpback whales, covered by conservation advice.
Monitoring and reporting	Any loss of containment (hazardous substances) resulting from damage to existing infrastructure are required to be reported as per Section 7.10.
Acceptability outcome	Acceptable

6.14 Loss of Containment - diesel

6.14.1 Hazards

MDO is used in offshore vessels. A collision between a Beach contracted vessel (i.e. the CSV) and third-party vessel has the potential to result in a spill of fuel. The following events have the potential to result in a spill of fuel:

- A collision between the CSV and third-party vessel.

A collision with the CSV is assessed to be the worst-case release when compared to a collision with the HRV, due to the significantly larger vessel size and the stationary nature of the CSV during operations.

No refuelling will occur during Phase 5 Early Dive Installation Campaign.

A vessel collision typically occurs as a result of:

- Mechanical failure/loss of DP
- Navigational error, or
- Foundering due to weather.

Grounding is not considered credible due to the water depths typically being greater than 10 m and absence of submerged features in the operational area.

6.14.1.1 Characteristics of diesel oils

Diesel oils are generally considered to be low viscosity, non-persistent oils, which are readily degraded by naturally occurring microbes.

Diesel oils are considered to have a higher aquatic toxicity in comparison to many other crude oils due to the types of hydrocarbon present and their bioavailability. They also have a high potential to bio-accumulate in organisms.

Marine diesel is a medium-grade oil (classified as a Group II oil) used in the maritime industry. It has a low density, a low pour point and a low dynamic viscosity (Table 6-11), indicating that this oil will spread quickly when spilled at sea and thin out to low thicknesses, increasing the rate of evaporation.

Due to its chemical composition, approximately 40% will generally evaporate within the first day, with the remaining volatiles evaporating over 3-4 days depending upon the prevailing conditions. Diesel shows a strong tendency to entrain into the upper water column in the presence of moderate winds and breaking waves (> 12 knots) but floats to the surface when conditions are calm, which delays the evaporation process. Table 6-12 shows the boiling point ranges for the diesel used in the spill modelling.

Table 6-11: Physical characteristics of marine diesel oil

Parameter	Characteristics
Density (kg/m ³)	829 at 15oC
API	37.6
Dynamic viscosity (cP)	4.0 at 25oC
Pour point (°C)	-14
Oil category	Group II
Oil persistence classification	Light-persistent oil

Table 6-12: Boiling point ranges of marine diesel oil

Characteristic	Volatiles (%)	Semi-volatiles (%)	Low volatiles (%)	Residual (%)
Boiling point (°C)	<180	180 – 265	265 – 380	>380
Marine diesel oil	6.0	34.6	54.4	5
	Non-Persistent			Persistent

On release to the marine environment, diesel would evaporate and decay and be distributed over time into various components. Of these components, surface hydrocarbons, entrained hydrocarbons (non-dissolved oil droplets that are physically entrained by wave action) and dissolved aromatics (principally the aromatic hydrocarbons) have the most significant impact on the marine environment. These are discussed in further detail below.

6.14.2 Quantitative hydrocarbon spill modelling

Beach commissioned RPS Australia West Pty Ltd (RPS) to conduct quantitative spill modelling (Appendix A) for a credible, yet hypothetical, worst-case hydrocarbon release scenario.

Scenario 1: a 300 m³ surface release of marine diesel oil (MDO) over 6 hours.

This scenario represents a loss of inventory from the largest fuel tank on the CSV 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 spill modelling was undertaken at the Artisan-1 well location. To develop the diesel spill EMBA the low threshold boundary for the vessel spill modelling at the Artisan-1 well location was duplicated and repositioned over the Phase 5 Early Dive Installation Campaign location.

6.14.2.1 Hydrocarbon exposure thresholds

In the event of an oil pollution 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 presented in Table 6-13 are considered appropriate to:

- Predict potential hydrocarbon contact at conservative (low exposure) concentrations and inform the description of the environment (Section 3), inform the EPBC Protected Matters Search (Appendix A) and identify the AMP, Marine National Parks MNP, Marine Parks (MP), and Ramsar wetlands that may require monitoring in the event of a worst-case discharge based upon conservative (low exposure) in-water thresholds;
- Inform the oil spill impact and risk evaluation; and
- Inform oil spill response planning based upon potentially actionable concentrations of hydrocarbons (see OPEP) and potential monitoring requirements (see Section 7.9.4 and OSMP).

Table 6-13: Hydrocarbon exposure thresholds

Exposure type	Exposure threshold		
	Low exposure	Moderate exposure	High exposure
Surface	0.5 g/m ²	10 g/m ²	25 g/m ²
Shoreline	10 g/m ²	100 g/m ²	1,000 g/m ²
Entrained*	10 ppb	100 ppb	1,000 ppb
Dissolved*	6 ppb	50 ppb	400 ppb

* In-water (entrained & dissolved) hydrocarbon thresholds are based upon an instantaneous (1 hr) hydrocarbon exposure

Beach also applies a time-based exposure (ppb.hrs) for in-water hydrocarbons to evaluate the potential consequences associated with hydrocarbon contact at various concentrations, considering potential exposure pathways for various receptor types. Time-based exposure is not used to inform the outer geographical extent of potential hydrocarbon contact to various receptors.

The quantitative spill modelling assessment was completed for two distinct periods, defined by the unique prevailing wind and general current conditions; summer (November–April) and winter (May–October).

The spill modelling was performed using an advanced three-dimensional trajectory and fates model, Spill Impact Mapping Analysis 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.

The modelling study was carried out in several stages. Firstly, a five-year current dataset (2008–2012) that includes the combined influence of ocean currents from the HYCOM model and tidal currents from the HYDROMAP model was developed. Secondly, high-resolution local winds from the Climate Forecast System Reanalysis model 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 oils.

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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 spill simulations per season for each scenario initiated at random start times, using the same release information (spill volume, duration and composition of the oil). This ensured that each simulation was subject to different wind and current conditions and, in turn, movement and weathering of the oil.

6.14.3 Extent of potential hydrocarbon exposure

The extent of possible exposure to hydrocarbons is based upon a hypothetical worst-case 300 m³ surface release of MDO over 6 hours at the Artisan-1 well location with results derived from the Artisan-1 Exploration Well Oil Spill Modelling, RPS 2019 (Appendix B). The extent of potential hydrocarbon exposure at moderate thresholds (including 48-hour time-based in-water dissolved and entrained) for a marine diesel spill scenario is presented in Figure 6-4.

Potential extent of hydrocarbon exposure to Australian Marine Parks

Whilst Apollo AMP could potentially be exposed to moderate (instantaneous) thresholds of entrained hydrocarbons (up to 7% summer and 16% winter), spill modelling indicates there is no potential for Apollo AMP to be impacted by moderate or high time-based in-water exposure thresholds.

No AMPs are predicted to be exposed to high (instantaneous or time-based) thresholds of dissolved or entrained hydrocarbons.

Potential extent of hydrocarbon exposure to surface waters

During summer conditions, moderate (10 g/m²) exposure to surface hydrocarbons were predicted to travel a maximum distance of 12 km from the release location. During winter, moderate exposure of surface hydrocarbons extended to a maximum distance of 10 km from the release location.

None of the receptors identified within the modelling report were exposed at or above the moderate or high (>25 g/m²) thresholds. However, spill modelling indicates potential summer and winter exposure to surface waters up to a maximum of 6 km from the release location of 48% and 41% probability respectively.

Potential extent of hydrocarbon exposure to shorelines

No shoreline contact above the minimum threshold (> 10 g/m²) was predicted for any of the seasons modelled.

Potential extent of in-water dissolved hydrocarbon exposure

The averaged dissolved hydrocarbon concentrations over 48 hours was highest within open ocean surrounding the release location registered 8 ppb and 9 ppb during summer and winter conditions, respectively based upon a 1% probability of exposure in open waters surrounding the release location. No identified receptors were exposed at or above the low 48-hour time-based dissolved hydrocarbon exposure threshold.

Based on the 1-hour (instantaneous) exposure window, the greatest predicted dissolved hydrocarbon concentration was 76 ppb during summer and 59 ppb during winter. Open waters surrounding the release location recorded a probability of 2% and 3% during the summer and winter conditions, respectively, based on the moderate instantaneous threshold. There was no predicted exposure to identified receptors at either moderate or high instantaneous thresholds.

Potential extent of in-water entrained hydrocarbon exposure

At the depths of 0-10 m, the maximum entrained hydrocarbon exposure (over a 48-hour window) during summer and winter conditions was 2,182 ppb and 792 ppb, respectively. While there is potential (1-2% probability) of low

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(10 ppb) exposure (over a 48-hour window) in open waters surrounding the release location, none of the identified receptors were exposed at or above the moderate (10-100 ppb) or high (>1,000 ppb) thresholds.

Within the 0-10 m depth layer, the maximum entrained hydrocarbon exposure (over 1 hour) for the open waters surrounding the release location was 5,933 ppb and 5,046 ppb, during summer and winter conditions, respectively. For identified receptors, the probability of exposure to entrained hydrocarbons at or above the moderate threshold (100-1,000 ppb) ranged from 1% (Cape Patton sub-Local Government Area (sub-LGA)) to 8% (within Victorian State Waters) during summer conditions and 1% (Twelve Apostles MNP) to 16% (Apollo AMP) during winter conditions. No receptors were exposed at or above the high threshold (>1,000 ppb).

6.14.4 Predicted environmental impacts

The known and potential environmental impacts of a diesel 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

6.14.5 Consequence evaluation

The potential environmental impacts to receptors within the EMBA are discussed in Table 6-14 to Table 6-17.

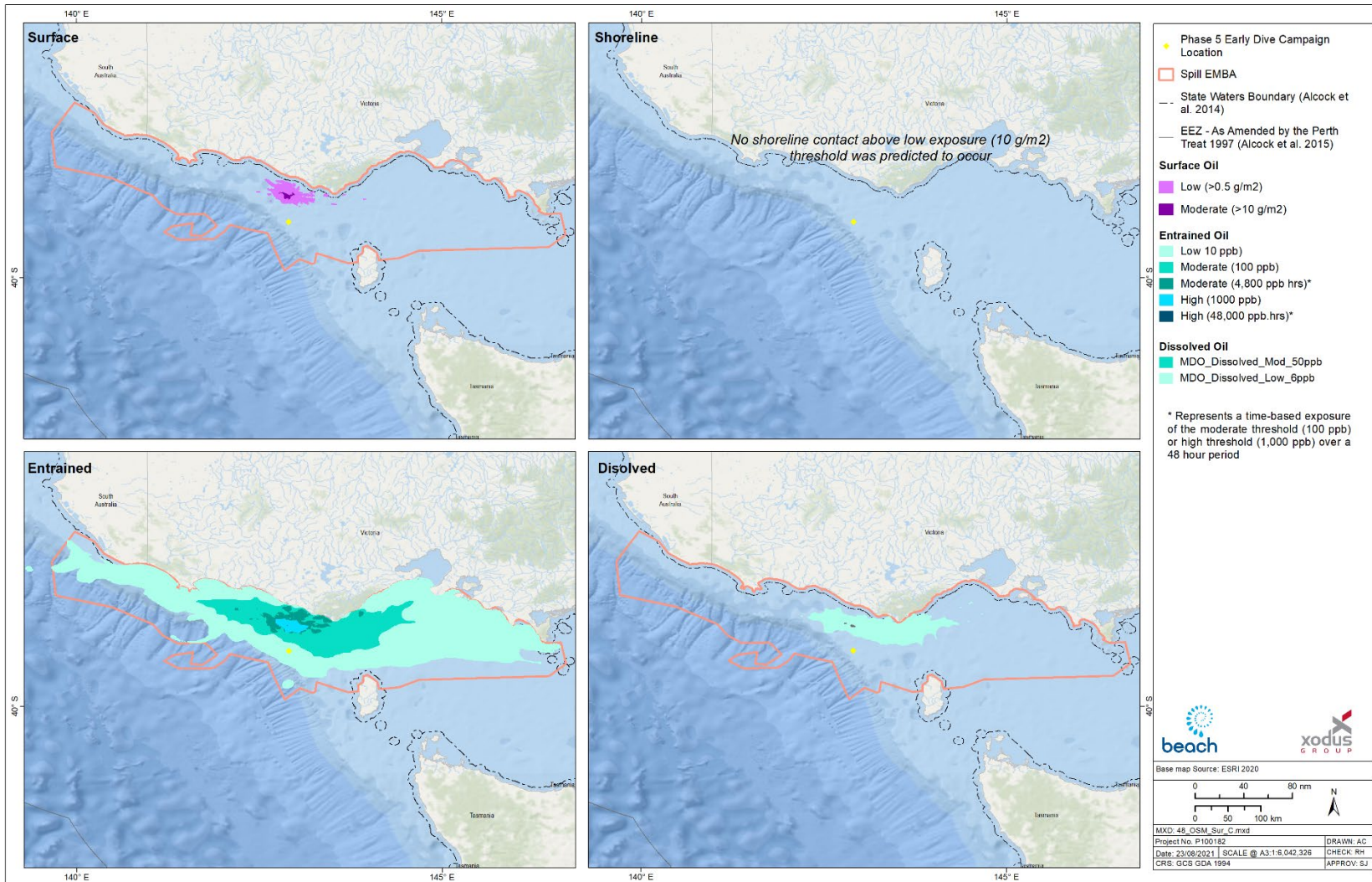


Figure 6-4: Environment potentially exposed to hydrocarbons from a hypothetical 300 m³ diesel spill at Artisan-1 over 6 hours

Table 6-14: Consequence evaluation to ecological receptors within the EMBA – 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 12 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 and short-tailed are present in the area Figure 4-26 and Figure 4-27) predicted to be above threshold. Foraging and breeding BIAs for little penguins are within the EMBA (Figure 4-26), however are well beyond the predicted area of surface exposure at >10 g/m ² , 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 >10g/m ² .	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 concentrations >10 g/m ² out to 12 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. Refer to management advice and evaluation of acceptability in Section 6.14.6.
	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 4.6.10).	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.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>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 EMBA. Sea surface oil > 10 g/m² (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.</p> <p>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</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>
Pinnipeds (seals and sea lions)	<p>Change in fauna behaviour</p> <p>Injury / mortality to fauna</p>	<p>The Australian and New Zealand fur-seals may occur within the area predicted to be exposed to surface hydrocarbons > 10 g/m². No BIAs, breeding colonies or haul outs areas are within the area of exposure (Section 4.6.12).</p> <p>There is a foraging BIA for the Australian sea-lion but it is outside of the predicted area of surface exposure at > 10 g/m².</p>	<p>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.</p> <p>The number of seals that may be exposed to surface diesel at > 10 g/m² 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/m² (Section 4.6.12). Sea surface oil > 10 g/m² (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.</p>	

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>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</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>
Cetaceans (whales)	<p>Change in fauna behaviour</p> <p>Injury / mortality to fauna</p>	<p>Several threatened, migratory and/or listed marine species have the potential to be within the area predicted to be exposed to surface hydrocarbons of > 10 g/m². Surface exposure of > 10 g/m² is expected to extend out 12 km from the release location i.e., a relatively small areas compared to the overall distribution area of cetaceans.</p> <p>BIA for foraging for pygmy blue whales and distribution for southern right whale are within the area predicted to be exposed to surface hydrocarbons > 10 g/m² (Section 4.6.11).</p>	<p>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.</p> <p>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/m² (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 (12 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 current core coastal range for southern right whales, the risk of displacement to whales is considered low.</p> <p>There is potential for interaction with southern right whales given the activity window overlaps with the northern migration period of May-June, and the peak breeding (July-August) (Section 4.6.11).</p> <p>The activity timing overlaps with the blue whale season for migration and foraging in the operational area and EMBA. Visual and acoustic surveys suggest that blue whales are present in the Otway region between November to June, peaking in February and March (Section</p>	

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>4.6.11). There is no population estimate for blue whales globally or in Australia and they are EPBC listed as endangered and migratory. Blue whales are highly mobile and widespread across the world's oceans. Aerial surveys in the Otway region recorded mean Blue whale group size of 1.3±0.6 per sighting with cow-calf pairs observed in 2.5% of the sightings (Gill et al. 2011). However, acknowledging there is scientific uncertainty with specific whale numbers within the vicinity of the Phase 5 Early Dive Campaign location, and given activities may occur during upwelling events, it is expected that foraging whales would be present in the area. As such in the event of a spill potential hydrocarbon exposure could possibly affect aggregations of blue or other foraging whale species.</p> <p>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.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>
Cetaceans (dolphins)	Change in fauna behaviour Injury / mortality to fauna	There may be dolphins in the area predicted to be exposed to surface oil (> 10 g/m2 - 12 km from the release location). However, there are no BIAs or habitat critical to the survival of the species (Section 4.6.11).	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.

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>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.</p> <p>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.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>

Table 6-15: Consequence evaluation to socio-economic receptors within the EMBA – sea surface

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Human systems	Recreation and tourism (including recreational fisheries)	<p>Change in aesthetic value</p> <p>Changes to the functions, interests or activities of other users</p>	<p>Marine pollution can result in impacts to marine-based tourism from reduced visual aesthetic. The modelling predicts (visible surface rainbow sheen) surface sheens (0.5 g/m²) may occur up to 93 km from the release location. This oil may be visible as a rainbow sheen on the sea surface during calm conditions.</p>	<p>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.</p> <p>Refer also to:</p> <ul style="list-style-type: none"> • Cetaceans (whales) <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
	Industry (shipping)	Displacement of other marine users	Shipping occurs within the area predicted to be exposed to surface hydrocarbons > 10 g/m2 (12 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.
	Industry (oil and gas)	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/m2 (12 km from the release location).	No impact as there are no non-Beach oil and gas platforms located within the area predicted to be exposed to surface hydrocarbons.

Table 6-16: Consequence evaluation to physical and ecological receptors within the EMBA – in water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Habitat	Algae	Change in habitat	Macroalgae communities may be within the overall area potentially exposed to moderate levels of in-water entrained hydrocarbons. 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 4.6.3.3). Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO residue.	<p>Smothering, fouling and asphyxiation are some of the physical effects that have been documented from oil contamination in marine plants (Blumer 1971; Cintron et al. 1981). The effect of hydrocarbons however is largely dependent on the degree of direct exposure, and the presence of morphological features (e.g. a mucilage layer and/or fine ‘hairs’) will directly influence the amount of hydrocarbon that will adhere to the algae. Generally, the effects of oil on macroalgae, such as kelp and many other species which dominate hard substrata in shallow waters is small due to their mucilaginous coating that resists oil absorption.</p> <p>Hydrocarbons may contact the intertidal shores as the tide ebbs, but it would be expected that this would be flushed with each flood tide. Natural flushing is more likely to reduce impacts in exposed areas of shoreline.</p> <p>Consequently, the potential consequence to algae are considered to be Minor, as they could be expected to result in localised low-level impacts.</p>
	Soft Coral	<p>Change in water quality</p> <p>Change in habitat</p>	<p>Corals do not occur as a dominant habitat type within the EMBA, however their presence has been recorded around areas such as Wilsons Promontory National Park and Cape Otway (Section 4.6.3.4).</p> <p>In-water exposure (entrained) is only predicted to occur within intertidal or shallow nearshore waters. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the hydrocarbon.</p>	<p>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).</p> <p>However, given the lack of coral reef formations, no predicted dissolved in-water hydrocarbon exposure 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 smothering of isolated corals.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>Hydrocarbons may contact the intertidal shores as the tide ebbs, but it would be expected that this would be flushed with each flood tide. Natural flushing is more likely to reduce impacts in exposed areas of shoreline.</p> <p>Consequently, the potential consequence to corals are considered to be Minor, as they could be expected to result in localised low-level impacts.</p>
	Seagrass	Change in habitat	<p>In-water exposure (entrained) is only predicted to occur within the surface layers with the potential to contain seagrasses. Note that the greater wave action and water column mixing within the nearshore environment will also result in rapid weathering of the MDO.</p> <p>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) (Section 4.6.3.2). Exposure in nearshore and intertidal areas is predicted to only be at moderate thresholds (e.g. instantaneous exposure > 100 ppb for entrained hydrocarbons only).</p>	<p>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).</p> <p>Given the restricted range of exposure (shallow nearshore and intertidal waters only), no predicted dissolved in-water hydrocarbon exposure and the predicted moderate concentrations of entrained hydrocarbons expected to be in these waters, any impact to seagrass is not expected to result in long-term or irreversible damage.</p> <p>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.</p>
Marine fauna	Plankton	Injury/Mortality to fauna	<p>Plankton are likely to be exposed to entrained 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.</p>	<p>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.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				<p>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 4.6.6). 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.</p> <p>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.</p>
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).	<p>Impact by direct contact of in-water hydrocarbons to benthic species in the deeper areas of potential exposure are not expected. Species located in shallow nearshore or intertidal waters may be exposed to in-water hydrocarbons.</p> <p>Several commercial fisheries for marine invertebrates are within the area predicted to be exposed to moderate levels of entrained in-water hydrocarbons.</p>	<p>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.</p> <p>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.</p> <p>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.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Fish	Injury/Mortality to fauna	<p>Injury/Mortality to fauna</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>There is a known distribution and foraging BIA for the white shark in the EMBA, however, it is not expected that this species spends a large amount of time close to the surface where thresholds may be highest.</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>
Pinnipeds (seals and sea lions)	<p>Injury/Mortality to fauna</p> <p>Change in fauna behaviour</p>	<p>The PMST report identified three pinnipeds that potentially occur in the EMBA (Australian sea lion, Australian and New Zealand fur-seal) (Section 4.6.12). There are no identified BIAs for seals within the EMBA. Known breeding colonies for Australian fur-seals are on islands off the coast; Kanowna Island, Rag Island, West</p>	<p>Exposure to moderate effect levels of hydrocarbons 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, their 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 by moderate in-water hydrocarbon thresholds), the potential consequence to pinnipeds are considered to be Moderate, as</p>	

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			<p>Moncoeur Island, Lady Julia Percy Island and Seal Rocks (Vic). Cape Bridgewater is also a known haul out site. Seal Rocks on King Island is also a New Zealand fur-seal breeding colony.</p> <p>A foraging BIA for the Australian sea-lion is located west and north-west of Beachport within the EMBA. This BIA overlaps both South Australian State waters and the Bonney Coast Upwelling KEF, therefore the predicted hydrocarbon exposure to these areas is likely to also contact with the foraging BIA. There is no predicted exposure to the Bonney Coast Upwelling KEF at the low (48-hour) threshold exposure. A maximum entrained hydrocarbon exposure for a 1-hour window is predicted to be 98 ppb with a 22% probability of low instantaneous exposure to the KEF.</p> <p>There is no predicted dissolved exposure to South Australian State waters and the maximum time entrained hydrocarbon exposure for a 48-hour window is 31 ppb and 26 ppb for a 1-hour window based upon a 2% probability of contact.</p> <p>Known breeding colonies of Australian fur-seals are unlikely to be exposed to moderate in-water exposure thresholds, and the foraging BIA for the Australian Sea-lion is not within the predicted area of moderate in-water exposure.</p> <p>Given the mobility of pinnipeds, there may be small numbers of seals and sea-lions in the areas</p>	<p>they could be expected to result in localised minor short-term impacts to species of recognised conservation value.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			<p>predicted to be temporarily exposed to moderate concentrations of in-water hydrocarbons in the water column, noting that in-water exposure (dissolved or entrained) is only predicted to occur within the upper layers of the water column.</p>	
Cetaceans (whales and dolphins)	<p>Injury/Mortality to fauna</p> <p>Change in fauna behaviour</p>	<p>Several threatened, migratory and/or listed marine cetacean species have the potential to be migrating, resting or foraging within an area predicted to be exposed to in-water hydrocarbons.</p> <p>Known BIAs are present for foraging for pygmy blue whales and distribution for southern right whale in area exposed to moderate in-water thresholds, i.e. >50 ppb for dissolved and >100 ppb for entrained.</p>	<p>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.</p> <p>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.</p> <p>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 current core coastal range for southern right whales.</p> <p>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.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>	

Table 6-17: Consequence evaluation to socio-economic receptors within the EMBA – in water

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
Human system	Commercial and recreational fisheries	Change in ecosystem dynamics	In-water exposure to entrained diesel may result in a reduction in commercially targeted marine species, resulting in impacts to commercial fishing and aquaculture.	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. Refer to management advice and evaluation of acceptability in Section 6.14.6
		Changes to the functions, interests or activities of other users	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 EMBA and overlap the spatial extent of the water column hydrocarbon predictions (Section 4.7.8, Section 4.7.9 and Section 4.7.10).	
	Recreation and tourism	Change in ecosystem dynamics Changes to the functions, interests or activities of other users Change in aesthetic value	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	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: <ul style="list-style-type: none"> • Fish • Birds • Pinnipeds • Cetaceans (whales and dolphins) • Marine invertebrates

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
		Change in water quality	<p>coastline is via a 7 to 8-day walking track from Apollo Bay ending at the Twelve Apostles.</p> <p>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 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.</p>	<ul style="list-style-type: none"> Recreational fisheries <p>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, impacts would be localised and for a short duration (21 days).</p> <p>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.</p> <p>Refer to management advice and evaluation of acceptability in Section 6.14.6</p>
Natural system	State Marine Protected Areas	<p>Change in ecosystem dynamics</p> <p>Change in aesthetic value</p> <p>Change in water quality</p>	<p>State marine protected areas (e.g. Twelve Apostles Marine Park) occur within the area predicted to be exposed to in-water hydrocarbons at the instantaneous screening level of 100 ppb (entrained).</p> <p>Conservation values for these areas include high marine fauna and flora diversity, including fish and</p>	<p>Refer to:</p> <ul style="list-style-type: none"> Marine invertebrates Macroalgae <p>The consequence to conservation values within the Twelve Apostles Marine Park is assessed as localised and short term and ranked as Moderate.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			invertebrate assemblages and benthic coverage (sponges, macroalgae).	Refer to management advice and evaluation of acceptability in Section 6.14.6.
	Australian Marine Parks	Change in ecosystem dynamics Change in aesthetic value Change in water quality	Stochastic modelling indicates in-water hydrocarbons at the instantaneous screening level of 100 ppb (entrained) may extend to within the boundaries of the Apollo Marine Park (Section 4.4.2). Conservation values for Apollo Marine Park include foraging habitat for seabirds, dolphins, seals and white sharks, and blue whales migrate through Bass Strait. A reduction in water quality will lead to a breach in management objectives for AMPs.	Refer to: <ul style="list-style-type: none">• Seabirds• Cetaceans and pinnipeds• Fish• Plankton The concentration at which the water column within Apollo Marine Park may be exposed is within the moderate thresholds for entrained hydrocarbons. Given the nature of the exposure to foraging habitats, and transient nature of migrating and foraging marine fauna, the consequence is ranked as Moderate. Refer to management advice and evaluation of acceptability in Section 6.14.6.
Conservation Values and sensitivities	Key Ecological Features	Change in water quality Injury / mortality to fauna Change in fauna behaviour. Change in ecosystem dynamics.	The KEFs that overlap the spill EMBA are described in Section 4.4.13, however, the Bonney Coast Upwelling is the only KEF predicted to be exposed to in-water hydrocarbons from a potential MDO spill. MDO is classified as a light persistent oil, has a low specific gravity (and will therefore tend to remain afloat) and has a high proportion (~95%) of volatile components and only a small (5%) residual component. Due to this	Stochastic modelling indicates potential low-level and very short-term hydrocarbon exposure to the Bonney Coast Upwelling KEF resulting in a low-level reduction in water quality. This contact is predicted to be below the conservative environmental impact threshold for pelagic species i.e. moderate thresholds (refer Section 6.14.2) At the low instantaneous entrained exposure thresholds predicted, there is potential for chronic-level exposure to juvenile fish, larvae and planktonic organisms that might be entrained (or otherwise moving) within the entrained plumes (see Appendix B). Given the seasonal upwelling event supports regionally high productivity and high species diversity along the Bonney coast

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			<p>volatility most of this oil will evaporate from the water surface; depending on wind conditions the proportion of evaporated oil may vary between approximately 40% within the first day, with the remaining volatiles evaporating over 3-4 days depending upon the prevailing conditions. Under moderate winds, oil will begin to entrain into the water column. Entrained oil can persist for extended periods of time, however if it re-floats it is subject to evaporation and is also subject to dissolution and natural degradation within the water column.</p> <p>There is no predicted surface or dissolved hydrocarbon exposure to any KEF from an MDO spill.</p> <p>The maximum time-entrained hydrocarbon exposure for a 48-hour window is predicted to be 125 ppb at the Bonney Coast Upwelling KEF with no predicted low (48-hour) threshold exposure.</p> <p>The maximum entrained hydrocarbon exposure for a 1-hour window is predicted to be 98 ppb at the Bonney Coast Upwelling KEF with a 22%</p>	<p>extending between Cape Jaffa, South Australia and Portland, Victoria. (DoE, 2015a) and the potential exposure is limited to low threshold contact to the eastern boundary of the Bonney Coast Upwelling KEF, some localised short-term impairment of ecosystem functioning during an upwelling event could occur.</p> <p>Consequently, the consequence of short-term effects including a potential regional decline in water quality during the upwelling season associated with the Bonney Coast KEF are considered to be Moderate, as they could be expected to result in localised short-term impacts to an area of recognised conservation value.</p> <p>Given the details above, Refer to management advice and evaluation of acceptability in Section 6.14.6.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
			probability of low instantaneous exposure.	
	Wetlands	Change in water quality Change in ecosystem dynamics	<p>Marine waters adjacent to the Port Phillip Bay and Bellarine Peninsula Ramsar site may be exposed to maximum time-entrained (for a 48-hour window) of 7 ppb with no exposure at low thresholds, and a maximum instantaneous exposure of 10 ppb with a 1% probability of exposure at low thresholds.</p> <p>No other Wetlands of International importance identified within the EMBA are predicted to be exposed to hydrocarbons from an MDO spill at any threshold.</p> <p>Nationally important wetlands, with a coastal interface, also occur within the EMBA and may be exposed to in-water hydrocarbons above low thresholds.</p>	<p>There is predicted low probabilities of low-level in-water hydrocarbon contact with marine waters adjacent to some wetlands (including both internationally important (Ramsar) and national important sites). Specifically, there is potential for a temporary decline in water quality that may impact on the ecological character of the following Ramsar sites: Port Phillip Bay (Western shoreline) and Bellarine Peninsula.</p> <p>Wetland habitat can be of particular importance for some species of birds, fish and invertebrates. As such, in addition to direct impacts on wetland vegetation communities, oil that reaches wetlands may also affect these fauna utilising wetlands during their life cycle.</p> <p>Refer to other to receptor evaluations for in-water hydrocarbons, including:</p> <ul style="list-style-type: none"> • Seagrass • Fish • Marine invertebrates <p>At the predicted low exposure levels for dissolved and entrained in-water contact there is unlikely to be lethal ecological impacts on any of the values (receptors) that contribute to the ecological character of wetlands, however, a conservative consequence of Moderate has been applied given the cultural significance and International and National Importance of the wetlands (Ramsar-listed wetlands) and there may be localised minor short-term impacts to some of these receptors in closer proximity to the release location where they may be exposed to moderate in-water hydrocarbon thresholds.</p>

Receptor Group	Receptor Type	Impact	Exposure Evaluation	Consequence Evaluation
				Refer to management advice and evaluation of acceptability in Section 6.14.6

6.14.6 Control measures, ALARP and acceptability assessment

Control, ALARP and acceptability assessment: Loss of Containment - diesel

<p>ALARP decision context and justification</p>	<p>ALARP Decision Context: Type B</p> <p>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.</p> <p>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.</p>
<p>Adopted Control Measures</p> <p>CM#7: Ongoing consultation</p>	<p>Source of good practice control measures</p> <p>Under the <i>Navigation Act 2012</i>, 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.</p> <p>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 8.8 (Ongoing Stakeholder Consultation).</p> <p>Under the <i>OPGGs Act 2006</i> 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.</p>
<p>CM#17: SMPEP or SOPEP (appropriate to class)</p>	<p>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:</p> <ul style="list-style-type: none"> • response equipment available to control a spill event; • review cycle to ensure that the SMPEP/SOPEP is kept up to date; and • testing requirements, including the frequency and nature of these tests. • in the event of a spill, the SMPEP/SOPEP details: <ul style="list-style-type: none"> • reporting requirements and a list of authorities to be contacted; • activities to be undertaken to control the discharge of hydrocarbon; and • procedures for coordinating with local officials. <p>Specifically, the SMPEP/SOPEP contains procedures to stop or reduce the flow of hydrocarbons to be considered in the event of tank rupture.</p>

CM#19: 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#2: 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#20: 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#9: 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#21: NOPSEMA and DJPR accepted OPEP	<p>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.</p> <p>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.</p>
CM#22: NOPSEMA accepted OSMP	<p>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:</p> <ul style="list-style-type: none"> operational monitoring to inform response planning; and 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?
Eliminate or substitute the use of diesel.	Equipment	<p>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.</p> <p>There are other options for power generation, such as LNG or electrically powered vessels, which eliminate the need for fuel oil such as MDO to be stored and used. However, there are currently no vessels with the specifications required to undertake this scope of work which offer this option.</p>	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	<ul style="list-style-type: none"> • Vessel activities undertaken during Phase 5 Early Dive Installation Campaign 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. No AMPs are predicted to be exposed to surface, high (instantaneous) thresholds for entrained hydrocarbons or moderate or high thresholds for dissolved hydrocarbons. Only the Apollo AMP is predicted to be exposed to moderate (instantaneous) thresholds of entrained hydrocarbons (up to 7% summer and 16% winter). Impacts to Apollo AMP major conservation values for fauna (blue, fin, sei and humpback whales, black-browed and shy albatross, Australasian gannet, short-tailed shearwater, and crested tern) are assessed as short-term and recoverable based on the majority of the exposure being to moderate level of dissolved hydrocarbons for a short period of time. Impacts to Apollo 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 – 30 m of the water column which does not intersect with these values. • The following Conservation Advices / Recovery Plans identify pollution as a key threat: <ul style="list-style-type: none"> ○ Conservation Advice <i>Balaenoptera borealis</i> (sei whale) (TSSC 2015g) ○ Conservation Advice <i>Balaenoptera physalus</i> (fin whale) (TSSC 2015f) ○ Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution) ○ Conservation Advice <i>Calidris ferruginea</i> (curlew sandpiper) (DoE, 2015f) identified as Habitat degradation/ modification (oil pollution) ○ National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC 2011a) ○ Conservation Advice for <i>Sterna nereis nereis</i> (fairy tern) (DSEWPC, 2011c) • The following Conservation Advices / Recovery Plans identify habitats degradation/modification as threat, which may be consequence of accidental release of hydrocarbon:

	<ul style="list-style-type: none"> ○ Conservation Advice Calidris canutus (red knot) (TSSC 2016d) ○ Conservation Advice Limosa lapponica baueri (bar-tailed godwit (western Alaskan)) (TSSC 2016a) ○ Conservation Advice for Numenius madagascariensis (eastern curlew) (DoE 201e) ● These Conservation Advices and Recovery Plan identify the following conservation actions: <ul style="list-style-type: none"> ○ 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 spill EMBA. 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	<p>Loss of containment resulting in a diesel spill is required to be reported as per Section 7.10.</p> <p>Impacts as a result of a loss of containment resulting in a diesel spill will be monitored and reported in accordance with the OSMP.</p>
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.

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 6-18 provides an assessment of the available oil spill response options, their suitability to the potential spill scenarios and their recommended adoption for the identified events.

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; and
- 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 6-18.

Table 6-18: 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 and vessel	MDO	<p>Effective - MDO rapidly spreads to thin layers on surface waters.</p> <p>Monitoring used to inform both response planning and monitoring requirements.</p> <p>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.</p> <p>Scientific monitoring implemented to inform extent of impact and remediation requirements.</p> <p>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.</p>	Yes	<p>Actionable on-water hydrocarbon thresholds limited to immediate vicinity of well site.</p> <p>Up to 8 km of coastline subject to moderate oiling.</p> <p>1 x plane & observer required and/or</p> <p>1 x vessel & observer and / or 5 x vessels and OSMP study teams</p> <p>Remote oil spill trajectory modelling (OSTM)</p>	<p>As detailed in OPEP:</p> <ul style="list-style-type: none"> 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 <p>Implement response as per OPEP and under direction of the State Control Agency (if in State waters)</p> <p>Capability in place and sufficient to implement timely response.</p>
Source Control	Right stricken vessel Transfer MDO to secure tank	MDO	<p>Effective – primary response strategy for all spills in accordance with vessel SMPEP/SOPEP.</p> <p>For MDO source control in Commonwealth waters, AMSA is the Control Agency and has access to NatPlan resources, therefore no further controls are considered.</p> <p>For MDO source control in Victorian state waters, Department of Jobs, Precincts and Regions (DJPR) is the Control Agency. Upon establishment of incident control by DJPR, Beach shall continue to provide planning and resources as required by the EMT Leader. Beach will make available to DJPR an Emergency Management Liaison Officer (EMLO) who can mobilise to the incident control centre. Equipment within the respective port region will be utilised as per the Maritime Emergencies (NSR) Plan through Vic DJPR Emergency Management Branch (EMB)</p> <p>In the event of a cross-jurisdictional response (i.e. where a response is required in State and Commonwealth waters), Beach and DJPR will establish a Joint Strategic Coordination Committee (as per the DJPR guidance) to facilitate effective co-ordination between DJPR and AMSA.</p>	Yes	Contract vessels	<p>Vessel contract in place</p> <p>Capability available at request of AMSA as Control Agency</p>
Offshore Containment and Recovery	Booms and skimmers	MDO	<p>Not feasible. MDO spreads rapidly to less than 10 g/m² 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.</p> <p>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.</p>	N/A	N/A	N/A
Protection and Deflection	Booms and skimmer	MDO	<p>Potentially feasible. 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. There may be insufficient mobilisation time to capture residues prior to hydrocarbons reaching the shore. In addition, corralling of surface hydrocarbons close to shore may not be effective for MDO depending on sea surface conditions. However, 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.</p>		<p>Response personnel</p> <p>Booms & skimmers</p> <p>Waste facilities</p>	<p>As detailed in OPEP:</p> <ul style="list-style-type: none"> 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 <p>Tactical Response Plans developed for:</p> <ul style="list-style-type: none"> Aire River; Princetown; Port Campbell Bay; and Curdies Inlet

Response Option	Response Description	Hydrocarbon Type	Feasibility, Effectiveness & ALARP Analysis	Net Environmental Benefit	Capability Needs Analysis (See OPEP and OSMP for details)	Capability Assessment
Shoreline Clean-up	The active removal and/or treatment of oiled sand and debris	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.	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.	Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response As detailed in OPEP: <ul style="list-style-type: none"> 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: <ul style="list-style-type: none"> Aire River; Princetown; Port Campbell Bay; and Curdies Inlet Implement response as per OPEP and under direction of the State Control Agency Capability in place and sufficient to implement timely response
Oiled Wildlife Response (OWR)	Capture, cleaning and rehabilitation of oiled wildlife.	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.	Yes	Personnel Equipment Triage and waste facilities	As detailed in OPEP: <ul style="list-style-type: none"> Core Group responders and equipment available via AMOSC NRT and NRST available via Control Agency request under NatPlan. DELWP are the State agency responsible for responding to wildlife affected by a marine pollution emergency in Victorian waters. DELWP’s response to oiled wildlife is undertaken in accordance with the Victorian Wildlife Response Plan for Marine Pollution Emergencies. The Tasmanian Oiled Wildlife Response Plan (WildPlan) is administered by the Resource Management and Conservation Division of the DPIPWE. If an incident occurs in Commonwealth waters which affects wildlife, AMSA may request support from DELWP or DPIPWE to assess and lead a response if required. Both DELWP & DPIPWE 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	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).	No	N/A	N/A

6.15.3 Oil Spill Response activities

6.15.3.1 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

6.15.3.2 Consequence 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.

Shoreline clean-up or protection actions could affect significant stretches of coastline, with prolonged effects on areas and populations located with increased response effort (such as tourism sites). The presence of accumulated hydrocarbons on shorelines as well as the presence of clean-up operations will necessitate the implementation of exclusion zones (e.g. beach closures). The exclusion of local residents and tourists from coastal areas has the potential to impact local tourism businesses and local settlements. As exclusion zones may be in place for the entire duration of the spill and beyond to account for clean-up periods once the spill has been contained, impacts to tourism and local residents may last for extended periods of time.

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. There is a potential to affect the internationally significant Ramsar wetlands at localised locations. Shoreline clean up and protection will endeavour to prevent impact to the ecological characteristics of Ramsar sites.

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).

6.15.4 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 activity is located in close proximity to shore (70 km), and mobilisation of in-field monitoring, or	No

		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 3 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#21: 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	<p>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.</p> <p>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.</p> <p>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.</p> <p>Proposed response activities are consistent with industry practice.</p> <p>No impact to KEFS, Ramsar Wetlands, BIAs or state marine protected areas are expected during spill response.</p>
Internal context	<p>The proposed management of the impact is aligned with the Beach Environment Policy.</p> <p>Activities will be undertaken in accordance with the SCCP including relief well plan, OPEP, Tactical Response Plans and OSMP.</p>
External context	<p>No stakeholder concerns have been raised with regards to impacts of the spill response activities on relevant persons.</p> <p>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.</p>
Other requirements	<p>Response has been developed in accordance with:</p> <ul style="list-style-type: none"> • 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) • The following Conservation Advices / Recovery Plans identify pollution as a key threat: <ul style="list-style-type: none"> ○ Conservation Advice <i>Balaenoptera borealis</i> (sei whale) (TSSC 2015g) ○ Conservation Advice <i>Balaenoptera physalus</i> (fin whale) (TSSC 2015f) ○ Recovery Plan for Marine Turtles in Australia (Commonwealth of Australia, 2017b), identified as acute chemical discharge (oil pollution) ○ Conservation Advice <i>Calidris ferruginea</i> (curlew sandpiper) (DoE, 2015f) identified as habitat degradation/ modification (oil pollution) ○ National Recovery Plan for Threatened Albatrosses and Giant Petrels 2011-2016 (DSEWPC 2011a)

	<ul style="list-style-type: none"> ○ Conservation Advice for <i>Sterna nereis nereis</i> (fairy tern) (DSEWPC, 2011c) • The following Conservation Advices / Recovery Plans identify habitats degradation/modification as threat, which may be consequence of accidental release of hydrocarbon: <ul style="list-style-type: none"> ○ Conservation Advice <i>Calidris canutus</i> (red knot) (TSSC 2016d) ○ Conservation Advice <i>Limosa lapponica baueri</i> (bar-tailed godwit (western Alaskan) (TSSC 2016a) ○ Conservation Advice for <i>Numenius madagascariensis</i> (eastern curlew) (DoE 2015e) • These Conservation Advices and Recovery Plans identify the following conservation actions: <ul style="list-style-type: none"> ○ minimise chemical and terrestrial discharge. ○ 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. ○ ensure appropriate oil-spill contingency plans are in place for the subspecies' breeding sites which are vulnerable to oil spills. ○ implement measures to reduce adverse impacts of habitat degradation and/or modification; or ○ no explicit relevant management actions; oil pollution is recognised as a threat. <p>In regard to oil spill response, activities associated with Phase 5 Early Dive Installation Campaign 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.</p>
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 are provided in Table 6-19.

Table 6-19: Environmental performance outcomes, standards and measurement criteria

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
<p>EPO1: No death or injury to fauna, including listed threatened or migratory species, from the activity.</p> <p>EPO2: Noise emissions in BIAs will be managed such that any whale, including blue whales, continues to utilise the area without injury, and is not displaced from a foraging area.</p> <p>EPO3: Biologically important behaviours within a BIA or outside a BIA can continue while the activity is being undertaken.</p> <p>EPO4: No substantial reduction of air quality within local airshed caused by atmospheric emissions produced during the activity.</p>	CM#1: Light Management Procedure	<ul style="list-style-type: none"> CSV will have a Lighting Management Procedure (or equivalent) to minimise light spill by: <ul style="list-style-type: none"> 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. 	Lighting Management Procedure (or equivalent) Vessel inspection	Vessel Master
	CM#2: MO 30: Prevention of collisions	<ul style="list-style-type: none"> CSV shall meet the navigation equipment, watchkeeping, radar and lighting requirements of AMSA MO 30. 	Vessel inspection	Vessel Master
	CM#3: MO 97: Marine Pollution Prevention – Air Pollution	<ul style="list-style-type: none"> 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]). CSV 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: Preventative Maintenance System	<ul style="list-style-type: none"> Power generation and propulsion systems on the CSV will be operated in accordance with preventative maintenance system (or equivalent) to ensure efficient operation. 	PMS records Vessel inspection	Vessel Master
	CM#5: EPBC Regulations 2000 – Part 8 Division 8.1 interacting with cetaceans	<ul style="list-style-type: none"> Vessel operators shall adhere to the distances and vessel management practices of EPBC Regulations (Part 8) and report vessel interactions with dolphins specifically: <ol style="list-style-type: none"> Do not approach a dolphin. Maintain a distance of 150 m from a dolphin. 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: <ol style="list-style-type: none"> Do not approach a whale. Maintain a distance of 300 m from a whale. If a whale approaches the vessel try to maintain the separation distances without changing direction or moving into the path of the animal. 	Project induction DAWE cetacean sighting sheets	Vessel Master

CM#6 Whale Management Procedure

- There will be two competent MMOs (with recognised qualifications and experience in whale observation, distance estimation and reporting) onboard the CSV at all times during the activity to implement the Whale Management Procedure (see next row).
- One MMO will be on each 12-hr shift during daylight hours to implement the whale management procedures outlined here (with the second MMO available to take over the previous shift or assist the MMO on shift as required). Longer daylight hours in southern Australia during the summer months (up to 15 hours) are greater than a 12-hr work shift, so having two competent MMOs onboard is required to ensure each shift can be reliably completed.
- The MMOs will be contracted through a reputable consultancy that trains and provides MMOs on a range of projects around Australia, including many for Beach in the Otway region in recent years.
- If Otway Drilling program is undertaken concurrently to Phase 5 early dive installation activities (timing of the drilling program makes this unlikely):
 - MMOs on the *Ocean Onyx* support vessels will communicate with the MMO/s on the CSV via radio as per the Simultaneous Operations (SIMOPs) Plan. This way, information sharing can be undertaken on sightings of whales in the region and give advanced warning that a whale may be heading in the direction of the CSV if spotted from the drilling campaign (or vice versa). This will allow for advanced notice of a possible shutdown.
- As part of the activity induction all vessel crew will be inducted into cetacean management and the importance of reporting whale sightings to the MMO immediately.
- Prior to an activity commencing an observation survey will be undertaken of the observation survey zone for the activity (5 km) for 30 min prior to the activity commencing. If a whale is sighted within the observation zone the activity will not commence until:
 - No whales are observed for 30 min within the observation zone; or
 - Whales are observed leaving the observation zone.
- Once the activity has commenced observations will be undertaken within the activity shutdown zone (1.5 km)
- Once the activity has commenced, observations will be undertaken from the highest practicable position on the CSV (most likely the bridge) within the activity shutdown zone (1.5 km). Once CSV operations are underway, it is assumed that if whales are sighted within the observation zone (5 km) then they are not being displaced from the area. Therefore, it is considered that only the extent of the potential zone for TTS and PTS impacts (i.e., 1.5 km from the CSV) need to be managed once operations have begun. As such, no shutdown of the CSV is necessary if a whale is observed to be more than 1.5 km away from the CSV.
-
- On advice from the MMO that a whale has been sighted within the shutdown zone (1.5 km), the CSV will continue operations until the earliest point is reached at which operations can be safely suspended (i.e., the 'safe point'). On suspension of operations, the vessel will adopt the most favourable heading in order to reduce propulsion noise and then increase separation to whales if safe to do so.
- The CSV will not re-continue installation activities in the activity area until such time as:
 - No whales are observed for 30 minutes within the shutdown zone; or
 - Whales are observed leaving the shutdown zone.
- The MMO on the CSV will remain in communications with the MMOs on the nearby drilling support vessels (as per the SIMOPS Plan) so that all MMOs can communicate the presence of whales in the area. For the CSV, this provides advanced notice of the possible entry of a whale into the shutdown zone and the possible need to reach a safe point of operations.

Daily report
MMO report
Review of whale data

Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
		<ul style="list-style-type: none"> 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 observation zone (5 km radius) in the 3 hours prior to sunset (using sunset times provided the Bureau of Meteorology). 		
		<ul style="list-style-type: none"> Any learnings and observations from the Otway drilling campaign, and in response to new information and recommendations from the Blue Whale Study, will be considered prior to the commencement of the activity to ensure continual improvement in the efficacy of control measures and that the activity does not have unacceptable impacts to blue whales. 	Updated Otway Drilling Whale Management Procedure.	Project Manager
	CM#23: Conduct the activity outside the peak SRW migration season	<ul style="list-style-type: none"> The activity is timed to occur during the Q4 2022 (starting October) to end of Q2 2023 window (end of June), thereby avoiding the peak SRW migration season around the activity area (see 'SRW' in Section 4.6.7.6, which indicates that sightings in the region occur in June, July and August). This aligns with the Conservation Management Plan for the SRW of minimising anthropogenic threats to allow the conservation status of the SRW to improve. 	Daily operations reports	Project Manager
	CM#14: Vessel speed restrictions	<ul style="list-style-type: none"> Vessel speeds within the operational area will be restricted to 10 knots. 	Project induction Vessel log	Vessel Master
EPO5: No impact to water quality or sediment quality at a distance > 500 m from planned activities from planned marine discharges.	CM#10: As-left survey	<ul style="list-style-type: none"> An ROV survey will be undertaken at the completion of the activity to confirm temporary equipment has been removed from the activity area and the location of subsea infrastructure is recorded. 	ROV survey footage	Project Manager
EPO6: Seabed and associated biota disturbance will be within the operational area.	CM#11: <i>Protection of the Sea (Prevention of Pollution from Ships) Act 1983</i> and Marine Order 96 (Marine pollution prevention — sewage) 2018 giving effect to MARPOL Annex IV.	<ul style="list-style-type: none"> 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: Preventative Maintenance System	<ul style="list-style-type: none"> Equipment used to treat planned discharges shall be maintained in accordance with manufacturer's specification as detailed within the preventative maintenance system. 	PMS records Vessel inspection	Vessel Master
	CM#12: Beach Chemical Management Plan	<ul style="list-style-type: none"> 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
EPO7: 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#7: Ongoing consultation	<ul style="list-style-type: none"> Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 8 (Stakeholder Consultation). 	Notification records Communication records	Project Manager
	CM#8: Beach Fair Ocean Access Procedure	<ul style="list-style-type: none"> 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
EPO8: No introduction of a known or potential invasive marine species	CM#13: Beach IMS Management Plan	<p>A pre-qualification is undertaken for the CSV against Beach's IMS Management Plan ((IMSMP) S4000AH719916) as per Section 8.22 of this EP to:</p> <ul style="list-style-type: none"> 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 CSV 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; and prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area). 	Vessel contractor pre-qualification audit report verifies the vessel meets the requirements outlined in the IMSMP.	Project Manager
EPO9: No unplanned discharge of waste to the marine environment.	CM#15: MO 95: Marine Pollution Prevention – Garbage	<ul style="list-style-type: none"> Waste with potential to be windblown shall be stored in covered containers. 	Vessel inspection Garbage record book Incident report	Vessel Master

Environmental performance outcome	Control measure #	Environmental performance standard	Measurement criteria	Responsible person
EPO10: No spills of chemicals or hydrocarbons to the marine environment.	CM#16: Spill containment	<ul style="list-style-type: none"> 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#17: SMPEP or SOPEP (appropriate to class)	CSV shall have a SMPEP (or equivalent appropriate to class) which is: <ul style="list-style-type: none"> 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#18: Crane handling and transfer procedure	<ul style="list-style-type: none"> The crane handling and transfer procedure is in place and implemented by crane operators (and others, such as dogmen) to prevent dropped objects. The crane operators are trained to be competent in the handling and transfer procedure to prevent dropped objects. 	Vessel inspection.	Vessel Master
	CM#7: Ongoing consultation	<ul style="list-style-type: none"> Notifications for any on-water activities and ongoing consultations shall be undertaken as per Section 8 (Stakeholder Consultation). 	Notification records Communication records	Project Manager
	CM#19: MO 21: Safety and emergency arrangements	<ul style="list-style-type: none"> CSV shall meet the safety measures and emergency procedures of the AMSA MO 21. 	Vessel inspection	Vessel Master
	CM#2: MO 30: Prevention of collisions	<ul style="list-style-type: none"> CSV shall meet the navigation equipment, watchkeeping, radar and lighting requirements of AMSA MO 30. 	Vessel inspection	Vessel Master
	CM#20: MO 31: SOLAS and non-SOLAS certification	<ul style="list-style-type: none"> CSV will meet survey, maintenance and certification of regulated Australian vessels as per AMSA MO 31. 	Vessel certification	Vessel Master
	CM#9: MO 27: Safety of navigation and radio equipment	<ul style="list-style-type: none"> CSV shall meet the safety of navigation and radio equipment requirements of AMSA MO 27. 	Vessel inspection	Vessel Master
	CM#21: NOPSEMA accepted Oil Pollution Emergency Plan (OPEP)	<ul style="list-style-type: none"> Emergency spill response capability is maintained in accordance with the OPEP 	Outcomes of internal audits and tests demonstrate preparedness	Senior Crisis, Emergency & Security Advisor
		<ul style="list-style-type: none"> Implement spill response in accordance with relevant EPOs and EPSs in the accepted OPEP. 	EMT log	Beach EMT
CM#22: NOPSEMA accepted Operational and Scientific Monitoring Plan (OSMP)	<ul style="list-style-type: none"> 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	

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; and
- 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); and
- 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

Element	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



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.

The roles responsibilities for the implementation, management and review of this EP are detailed in Table 7-2.

Responsibility in the event of an oil pollution emergency is dependent on the response category level. For a Level 1 (or vessel) spill, the Vessel Master has the immediate responsibility. Roles and responsibilities for an oil pollution emergency response are clearly described in the OPEP.

Table 7-2: Roles and responsibilities

Role	Responsibilities
Chief Executive Officer	Ensure: <ul style="list-style-type: none"> Beach has the appropriate organisation in place to be compliant with regulatory and other requirements and this EP. OEMS continues to meet the evolving needs of the organisation.
Beach Otway Project Manager	Ensure: <ul style="list-style-type: none"> Compliance with 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. 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 for the activity are tested as per Section 12.2 of the OPEP. Audits and inspections are undertaken in accordance with Section 7.12.2.
Beach Principal Environment Advisor	Ensures: <ul style="list-style-type: none"> Environmental and regulatory requirements are communicated to those who have specific responsibilities pertaining to the implementation of this EP or OPEP. The environmental component of the activity induction is prepared and presented. Environmental incidents are reported and managed as per Section 7.10. The monthly and end-of-activity EP environmental performance report are prepared and submitted.

Role	Responsibilities
	<ul style="list-style-type: none"> 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. That audits and inspections are undertaken as detailed in Section 7.12 and any actions from non-conformances or improvement suggestions tracked. Reviews and revisions to the EP are made as per the requirements in Section 7.12.
Beach Community Relations Manager	<ul style="list-style-type: none"> Undertake stakeholder consultation for the activity. Record and report to the Activity Manager and Environment Advisor any objections or claims raised by relevant stakeholders. Maintain a stakeholder consultation log.
Vessel Master	<p>Ensure:</p> <ul style="list-style-type: none"> Vessel operations are carried out in accordance with regulatory requirements and this EP. Vessel adheres to the distances and vessel management practices for whales and dolphins as per the EPBC Regulations (Part 8). Environmental incidents are reported to the Otway Operations Manager 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	<ul style="list-style-type: none"> 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 legislation applicable to the activity. The acceptability discussion for each aspect is assessed in Chapter 6 and specifically details the legislation 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 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.
- noise controls to be implemented to ensure impacts and risks are ALARP and of an acceptable level and the importance of reporting whale sightings to the vessel MMO immediately.

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 Vessel Master and Beach Offshore Representative are jointly responsible for keeping the vessel crew informed about HSE issues, acting as a focal point for personnel to raise issues and concerns and consulting and involving all personnel in the following.

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; and
- 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 7.12.2 details how the contractors will be assessed to ensure they have the capabilities and competencies to implement the control measures identified in Section 6.16.

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 7.12.3, 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 triggered through a change in risk or controls, the revision process shall be managed in accordance with the MoC process outlined in Section 7.8.1.

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 7-3. 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.

Emergency Response Plan

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 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.

The Bridging ERP will be supported by the Beach EMP. The 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.

Where a third-party contractor (TPC) company is required to work under its own HSE management system while on the construction vessel, the Bridging ERP will detail the clear reporting lines between the TPC representatives and Beach personnel.

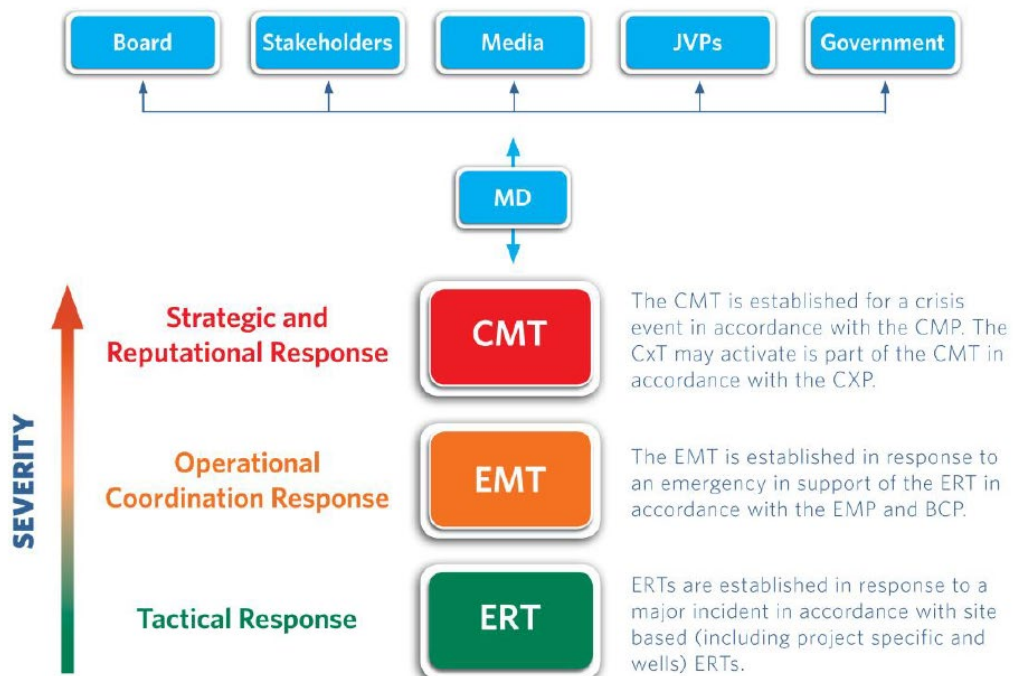


Figure 7-3: Beach Crisis and Emergency Management Framework

Prior to commencing the activity, office and vessel-based personnel will participate in an activity-specific desktop emergency response exercise to test the emergency response arrangements. The outcomes of the test will be

documented to assess the effectiveness of the exercise against its objectives and to record any lessons and actions, and the outcomes will be communicated to participants. Actions will be recorded and tracked to completion. This emergency response exercise may be combined with a test of spill response arrangements (see Section 7.4).

Table 7-3: Responsibilities of the Beach Crisis and Emergency Management Teams

Team	Base	Responsibilities
CMT	Adelaide head office	<ul style="list-style-type: none"> 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. Activate the Crisis Management Team (CMT) if required.
EMT	Adelaide, Melbourne	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> Respond to the emergency in accordance with the site-specific ERP.

7.9.3 Oil Pollution Emergency Plan

Oil spill response arrangements associated with Phase 5 Early Dive Installation Campaign are detailed within the Offshore Victoria – Otway Basin Oil Pollution Emergency Plan (OPEP) (CDN/ID S4100AH717907).

The COVID-19 pandemic has 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 Phase 5 Early Dive Installation Campaign, the environmental risk profile has been reviewed with respect to the commitments in EPs and the Otway Offshore OPEP.

Section 7.12.2 Audits and Assessments and the Otway Offshore OPEP Section 12 On-Going Preparedness and Exercises detail the processes that Beach will complete to ensure that oil spill response requirements can be met during project activities.

7.9.4 Operational and Scientific Monitoring Plan

Operational and scientific monitoring arrangement associated with Phase 5 Early Dive Installation Campaign are detailed within the Offshore Victoria Operational and Scientific Monitoring Plan (OSMP) (CDN/ID S4100AH717908) and Phase 5 Early Dive Installation Campaign OSMP Addendum (CDN/ID S4111AF725810).

Table 7-4 details particular values and sensitivities that may require monitoring in the event of a worst-case discharge, using Artisan-1 well location as a proxy indicator for the activity location and based upon conservative (low exposure) in-water thresholds, specifically: AMP, MNP, Marine Park (MP) and RAMSAR wetlands. There was shoreline contact at low exposure thresholds predicted for condensate release, but no intersection with RAMSAR wetlands; there was no shoreline contact predicted for the diesel release. Surface exposure was typically restricted to the immediate vicinity of the release location, however a low probability (1%) of exposure to the Apollo MP was predicted for the diesel release, and a low probability (3%) of exposure to the Twelve Apostles Marine National Park was predicted for the condensate release. These identified values and sensitivities are not exhaustive, as other receptors may also require monitoring in the event of a Level 2 or Level 3 hydrocarbon spill but provide an indication of the potential extent of hydrocarbon contact to formally managed areas.

7.9.5 Testing of spill response arrangements

Section 12.2 of the OPEP details the oil spill response testing arrangements.

Table 7-4: Environment potentially exposure to low in-water thresholds – diesel release from Artisan-1 well location

Receptor type	Receptor name	Summer				Winter			
		Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)	Probability (%) of instantaneous dissolved >6ppb	Maximum instantaneous dissolved hydrocarbon exposure (ppb)	Probability (%) of instantaneous entrained >10ppb	Maximum instantaneous entrained (ppb)
AMP	Apollo	3	22	25	406	5	24	54	501
	Beagle	-	-	-	-	-	-	2	11
MNP	Discovery Bay	-	-	3	25	-	-	-	-
	Point Addis	-	-	-	-	-	-	2	17
	Port Philip Heads	-	-	-	-	-	-	4	19
	Twelve Apostles	-	-	26	278	-	-	15	283
	Wilson's Promontory	-	-	-	-	-	-	3	16
MP	Lower South East	-	-	2	22	-	-	-	-
RAMSAR	Port Philip Bay and Bellarine Peninsula	-	-	-	-	-	-	1	10

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 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 CMO Incident Management System.

Notification and reporting requirements for environmental incidents to external agencies are provided in Table 7-5.

Table 7-5: 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: <ul style="list-style-type: none"> 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 a repeat of similar incidents occurring. Regulation 26B of the OPGGS(E)R requires a recordable incident report to	Before the 15 th day of the following calendar month	<ul style="list-style-type: none"> NOPSEMA – submissions@nopsema.gov.au 	Offshore Project Manager

Requirement	Timing	Contact	Responsible Person
<p>be submitted if there is a recordable incident, thus nil reports are not required.</p>			
<p>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:</p> <ul style="list-style-type: none"> • pipeline or well loss of containment. • vessel collision resulting in a loss of containment or otherwise. • introduction of marine pests to the operational area 			
<p><i>Verbal notification</i> The notification must contain:</p> <ul style="list-style-type: none"> • 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. 	<p>Within two hours of becoming aware of incident</p>	<ul style="list-style-type: none"> • NOPSEMA – 1300 674 472 • NOPSEMA – submissions@nopsema.gov.au • DJPR – marine.pollution@ecodev.vic.gov.au (0409 858 715) • NOPTA – reporting@nopta.gov.au 	<p>Offshore Project Manager</p>
<p><i>Written notification</i> 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:</p> <ul style="list-style-type: none"> • 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. 	<p>Within 3 days of notification of incident</p>	<ul style="list-style-type: none"> • NOPSEMA – submissions@nopsema.gov.au 	<p>Offshore Project Manager</p>

Requirement	Timing	Contact	Responsible Person
Written incident reports to be submitted to NOPTA and DJPR (for incidents in Commonwealth waters).	Within 7 days of written report submission to NOPSEMA	<ul style="list-style-type: none"> DJPR – marine.pollution@ecodev.vic.gov.au NOPTA – reporting@nopta.gov.au 	Offshore Project Manager
<p>Vessel spill to marine environment</p> <p>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.</p> <p>Reporting info: http://www.amsa.gov.au/forms-and-publications/AMSA1522.pdf.</p>	Verbal notification ASAP	<p>Immediate notification by the Vessel Master to AMSA.</p> <p>Follow-up with Marine Pollution Report (POLREP).</p> <ul style="list-style-type: none"> Ph: 1800 641 792 Email: rccaus@amsa.gov.au AMSA POLREP: https://amsa-forms.nogginoca.com/public/ 	Vessel Master
AMP – in the event an AMP may be exposed to hydrocarbons	Verbal notification ASAP	<ul style="list-style-type: none"> Marine Park Compliance Duty Officer – 0419 293 465 <p>Notification must be provided to the Director of National Parks and include:</p> <ul style="list-style-type: none"> titleholder details; time and location of the incident (including name of marine park likely to be affected); proposed response arrangement; confirmation of providing access to relevant monitoring and evaluation reports when available; and contact details for the response coordinator. 	EMT Lead (or delegate)
Vessel strike with cetacean	Within 72 hours	<ul style="list-style-type: none"> DAWE – online National Ship Strike Database https://data.marinemammals.gov.au/report/shipstrike 	Vessel Master
	ASAP for cetacean injury assistance	<ul style="list-style-type: none"> Department of Environment, Land, Water and Planning (Whale and Dolphin Emergency Hotline) – 1300 136 017 Seals, Penguins or Marine Turtles 136 186 (Mon-Fri 8am to 6pm) or AGL Marine Response Unit 1300 245 678. 	Vessel Master / Environment Advisor
Injury to or death of EPBC Act-listed species	Within seven days	<ul style="list-style-type: none"> DAWE – 1800 803 772 EPBC.Permits@environment.gov.au 	Environment Advisor

Requirement	Timing	Contact	Responsible Person
Suspected or confirmed Invasive Marine Species introduction	Verbal notification ASAP	<ul style="list-style-type: none"> Department of Environment, Land, Water and Planning – 136 186 	Environment Advisor
Identification of any historic shipwrecks, aircraft or relics	Written notification within 1 week	<ul style="list-style-type: none"> written notification via the notification of discovery of an historic shipwreck or relic online submission form. 	Offshore Project 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 HSEMS standard. Three process identified as controls in Section 6 are described below.

7.11.2 Whale Management Procedure

A daily cetacean strategy meeting involving the MMO, Beach Offshore Representative and the vessel operator will be held at the start and/or end of each day shift. The meeting will review cetacean observations from the previous 24 hours and discuss implications for the following day’s operations. In accordance with Part A of EPBC Policy Statement 2.1, the cetacean sighting data report will be submitted to DAWE within three months of the activity completion.

The controls outlined in Section 6.4.5 are summarised in a flowchart presented in Figure 7-4. This flowchart will be provided to the MMO in order to implement these measures throughout the activity.

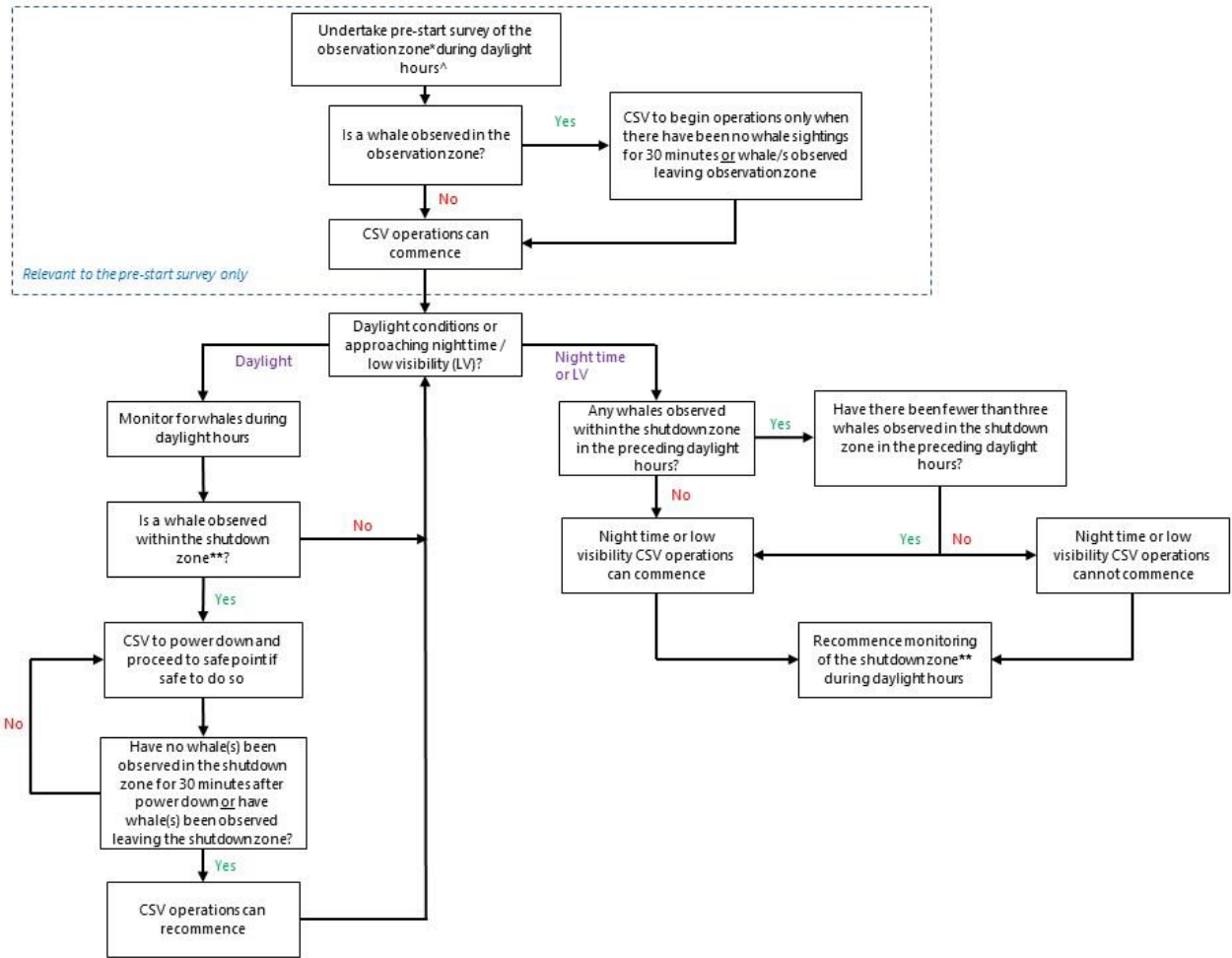


Figure 7-4 whale management procedure

7.11.3 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.

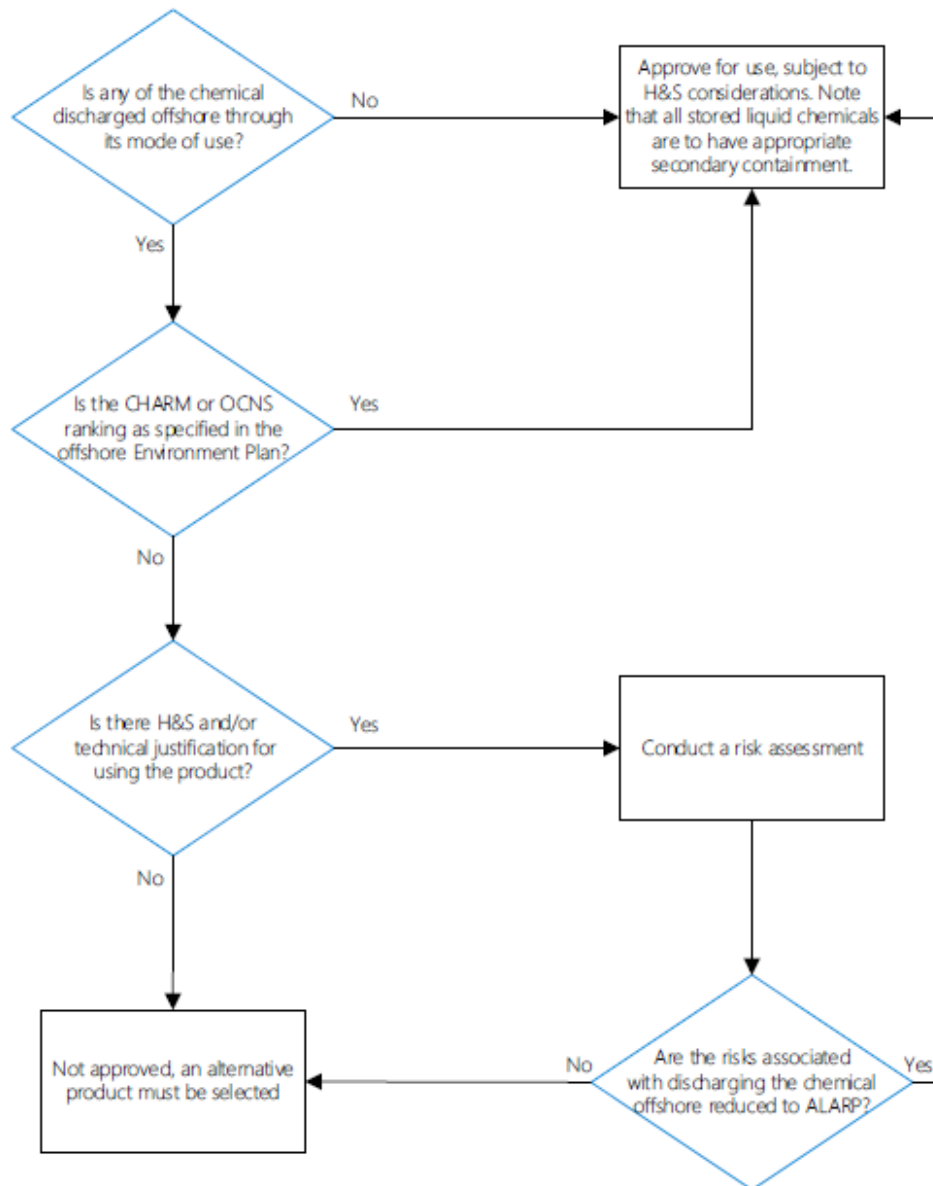


Figure 7-5: Beach offshore chemical environmental risk assessment process summary

7.11.4 Beach Energy Domestic IMS Biofouling Risk Assessment Process

Scope

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.

This domestic IMS biofouling risk assessment process does not include an evaluation of potential risks associated with ballast water exchange given all 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 area;
- Identify the potential IMS risk profile of vessels prior to deployment within the operational area;
- Identify potential deficiencies of IMS controls prior to entering the operational area;
- Identify additional controls to manage IMS risk; and
- Prevent the translocation and potential establishment of IMS into non-affected environments (either to or from the operational area).

Screening Assessment

Prior to the initial mobilisation of the vessels to the operational 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 vessel 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; 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 vessel may be deployed into the operational 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 vessel must be deemed low-risk prior to mobilisation into the operational area.

Basis of Detailed IMS Biofouling Risk Assessment

The basis by which an independent IMS expert evaluates the risk profile of a vessel includes:

- The age, type and condition of the vessel;
- Previous cleaning and inspection undertaken and the outcomes of previous inspections;
- Assessment of internal niches with potential to harbour IMS;
- The vessel history since previous inspection;
- The origin of the vessel 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; and
- Where appropriate, undertake in-water inspections.

7.11.5 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 11.2 – 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.

7.12.2 Audits and Inspections

Environmental performance will be reviewed in several ways to ensure:

- EPSs to achieve the EPOs are being implemented and reviewed.
- potential non-compliances and opportunities for continuous improvement are identified.
- environmental monitoring and reporting requirements have been met.

A pre-mobilisation audit will be undertaken at least two weeks prior to commencement of vessel operations, of the EPOs and EPSs in this EP and the requirements detailed in the implementation strategy. The audit will inform the annual performance report submitted to the relevant regulator as per Section 7.12.5.

For offshore activities undertaken by the vessel the following will be undertaken:

- premobilisation inspection of each vessel (desktop or site) to confirm the requirements of the EP will be met.

Non-compliances and opportunities for improvements identified via audits, inspections or other means are communicated to the appropriate supervisor and/or manager to report and action in a timely manner. Tracking of non-compliances and audit actions will be undertaken using Beach's incident management system which includes assigning a responsible person for ensuring the action is addressed and closed out.

7.12.3 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); and
 - ongoing Stakeholder communications.

Where the EP is revised the changes are to be logged in the EP Revision Change Register in Appendix C. Any revisions to the EP are to be assessed against the criteria for submission of a revised EP to NOPSEMA as detailed in Table 7-6 and Management of Change as per Section 7.8.1 shall be evaluated.

7.12.4 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 7-6.

Table 7-6: 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.

7.12.5 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.

7.12.6 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 7-7 details the types of emissions and discharges that shall be recorded including the monitoring method and frequency of reporting.

Table 7-7: Emissions and discharges monitoring requirements

Emission / Discharge	Monitoring parameter	Recording method	Reporting frequency	Responsibility
Pre-commissioning fluid	Chemical name Volume discharged	Daily report	Monthly	Offshore Project Manager
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

Emission / Discharge	Monitoring parameter	Recording method	Reporting frequency	Responsibility
Putrescible food	Volume discharged	Garbage record book	As required	Vessel Operator

8 Stakeholder Consultation

Stakeholder consultation was undertaken in line with current NOPSEMA guidelines on consultation requirements under the OPGGS(E)R.

Beach is committed to open, on-going and effective engagement with the communities in which it operates and providing information that is clear, relevant and easily understandable. Beach welcomes feedback and is continuously endeavouring to learn from experience in order to manage our risks.

8.1 Regulatory requirements

Section 280 of the OPGGS Act states that 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.

In relation to the content of an EP, more specific requirements are defined in the OPGGS (E) Regulation 11(A). This regulation requires that the Titleholder consult with 'relevant persons' in the preparation of an EP. A relevant person is defined as:

- a) each Department or agency of the Commonwealth to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;
- b) each Department or agency of a State or the Northern Territory to which the activities to be carried out under the environment plan, or the revision of the environment plan, may be relevant;
- c) the Department of the responsible State Minister, or the responsible Northern Territory Minister;
- d) a person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the environment plan, or the revision of the environment plan;
- e) any other person or organisation that the titleholder considers relevant.

Regulation 9(8) of the OPGGS(E)R requires 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.

Regulation 9AB of the OPGGS(E)R requires the Regulator must publish (the EP) on the Regulator's website.

Regulation 14(9) of the OPGGS(E)R also defines a requirement for ongoing consultation to be incorporated into the Implementation Strategy. In addition, Regulation 16(b) of the OPGGS(E)R requires that the EP contain a summary and full text of this consultation. It should be noted that the full text is not made publicly available for privacy reasons.

8.2 Stakeholder consultation objectives

The objectives of Beach's stakeholder consultation in preparation of the EP were to:

- identify all relevant persons for stakeholder consultation.
- engage with stakeholders and the community in an open, transparent, timely and responsive manner.
- minimise community and stakeholders concern where practicable.
- build and maintain trust with stakeholders and the local community.

- demonstrate that stakeholders have been consulted in line with the requirements of the relevant regulations.

The objectives were achieved by:

- identifying stakeholders whose functions, interests or activities may be affected by the activity.
- confirming, through consultation, 'relevant persons' (stakeholders) and engaging them at the earliest opportunity.
- providing sufficient information to allow relevant persons to make an informed assessment of the possible consequences of the activity on their functions, interests or activities.
- ensuring relevant persons are informed about the process for consultation and their feedback is considered in the development of the EP.
- ensuring that issues raised by relevant persons are adequately assessed, and where requested or relevant, responses to feedback are communicated back to them.
- providing a copy of this EP to NOPSEMA for publication on the NOPSEMA website as per regulation 11B of the OPGGS(E)R.
- ensuring that relevant person sensitive information is not made publicly available.

8.3 Consultation approach

The approach Beach has undertaken for consultation for the entire Beach Otway Offshore Project, including this EP is:

- identify stakeholders that may be potentially affect by the activities by reviewing its stakeholder database and consulting with existing stakeholders to identify other relevant stakeholders. Beach, previously as Lattice Energy, has operated in the area since the early 2000s, and has built an extensive database of stakeholders from ongoing engagement in relation to the current Operating assets and in executing the Otway Offshore Project including the Otway Offshore Drilling program and subsea connections.
- determine the possible consequences of the activities on each stakeholders' functions, interests or activities from previous knowledge, reviewing any public statements by the stakeholder as to how they want to be engaged by oil and gas companies and/or consulting with stakeholders.
- provide sufficient information, based on possible consequences and the way they would like to be consulted, for the stakeholder to be able to make an informed assessment of the possible consequences of the activity on their functions, interests or activities.
- allow a reasonable period of time for the stakeholder to review and respond to any information provided, typically two to four weeks.
- provide further information requested by the stakeholder or that became available during the consultation period and allowed a reasonable time for the stakeholder to review and respond. Depending on the information provided this was between one to four weeks.
- ensure relevant stakeholders were informed about the consultation process and how their feedback, questions and concerns were considered in the EP.

8.4 Fair Ocean Access Procedure

The Fair Ocean Access Procedure was developed by Beach after consultation with stakeholders in particular SETFIA and BSSIA, the stakeholder records can be found in the Prion 3D Marine Seismic Survey EP.

The procedure supersedes Beach's Commercial Fisher Operating Protocol. The Fair Ocean Access Procedure Information Sheet can be found in Appendix D.

8.5 Stakeholder identification

Relevant stakeholders were identified by reviewing:

- social receptors identified in the existing environment section.
- existing stakeholders within Beach's stakeholder register.
- reviewing consultation record for previous Otway Basin activities undertaken by Beach and Lattice.
- Commonwealth and State fisheries jurisdictions and fishing effort in the region.
- the Australian Government Guidance Offshore Petroleum and Greenhouse Gas Activities: Consultation with Australian Government agencies with responsibilities in the Commonwealth Marine Area.

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 and then Lattice and now Beach.

Lattice also undertook three marine seismic surveys between 2014 and early 2017 and had regular and detailed engagement with both fishing industry associations and individual fishers over this period. In 2017 Lattice commenced consultation in relation to the Otway Development Phase 4 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 Phase 4. Consequently, Beach consider that they have effectively identified relevant stakeholders and have a good understanding of issues and areas of concern within the Otway Development area. Table 8-1 details the relevant stakeholders identified and groups them by the categories listed under OPGGS(E) Regulation 11A. It should be noted that no fishing effort by Tasmanian fisheries was identified within the operational area.

8.6 Provision of information

The OPGGS(E)R require titleholders to 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.

To determine the type of information to provide to a stakeholder an Information Category was developed and is detailed in Table 8-2.

8.7 Summary of stakeholder consultation

Table 8-4 provides a summary of the stakeholder consultation undertaken as part of the development of the EP. The summary provides details of the information sent to stakeholders and any response received. It also details the assessment undertaken of any objection or claims. 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 detail in section 5 and controls applied where appropriate to ensure impacts and risks are managed to ALARP and an acceptable level.

Where an objection or claim was raised by a stakeholder, 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 or if not substantiated why.

On 28th June 2021 an email containing the Otway Offshore Project 2021-2023 Program, the Otway Offshore Project 2021-2023 Summary Information Sheet's along with the Drilling Locations and Timings of the Otway Offshore Project was sent to the stakeholders identified in Table 8-1. The information sheet is provided in Appendix G. Table 8-4 provides any stakeholder responses received during the consultation and details any objections and claims made.

Along with consultation completed on 28th June 2021, consultation has been ongoing since 2019 for the Otway Offshore Project and will continue on as required via one-on-one communications, mail outs and provision of information on the Beach website. Emails sent to stakeholders in early 2019, including Commonwealth and State government departments and commercial fisheries associations, specifically included subsea infrastructure installation as one of the activities to be undertaken during the Otway development activities.

Table 8-4 provides any stakeholder responses received during the consultation and details any objections and claims made.

Table 8-1: Relevant stakeholders for the activity (refer to Table 8-2 for information category definition)

Stakeholder	Relevance	Information category
<i>Department or agency of the Commonwealth to which the activities to be carried out under the EP may be relevant</i>		
Australian Fisheries Management Authority (AFMA)	Australian Government agency 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.	1
Australian Hydrological Office (AHO)	Australian Government agency responsible for issuing notices to mariners.	2
AMSA Joint Rescue Coordination Centre (JRCC)	Australian Government agency responsible for maritime safety, adherence to advice, protocols, regulations. Issue radio-navigation warnings.	1
Parks Australia – Director of National Parks	Australian Government agency responsible for MNES and Australian Marine Parks	1
Department of Agriculture, Water and Environment-Biosecurity	Australian Government agency responsible for preventing, responding and recovering pests and diseases that threatened the economy and environment.	1
<i>Each Department or agency of a State or the Northern Territory to which the activities to be carried out under the EP may be relevant</i>		
Victorian Fishery Authority	Activity is within a Victorian fishery area or will impact or potentially impact a Victorian fishery area or resource.	1

Stakeholder	Relevance	Information category
<i>The Department of the Responsible State or Northern Territory Minister</i>		
Tasmanian DPIPWE EPA Tasmania	Regulatory body for oil and gas activities in Tasmanian waters. Required to be notified of reportable incidents. Commencement and cessation notifications are only required for drilling and seismic surveys.	2
DJPR - 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.	2
DJPR – Marine Pollution	Regulatory body ensuring Victoria is adequately prepared for and effectively responds to a marine pollution incident in State coastal waters up to three nautical miles offshore.	2
<i>A person or organisation whose functions, interests or activities may be affected by the activities to be carried out under the EP</i>		
Australian Southern Bluefin Tuna Industry (SBTF) Association	Peak body representing Southern Bluefin Tuna companies in Australia. The SBTF overlaps the operational area.	1
Blue Whale Study	Primary research into the ecology of endangered pygmy blue whales in south-east Australia. The operational area BIAs for the pygmy blue whale.	1
Commonwealth Fisheries Association (CFA)	Peak association representing commercial fishing in Commonwealth fisheries. Industry Association for the following Commonwealth fisheries that have catch effort within the operational area: <ul style="list-style-type: none"> • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook and Shark Gillnet Sectors). • Southern Squid Jig Fishery. 	1
Department of Defence (DoD)	After reviewing the DoD's website it was noted that in the Bass Strait and Otway regions there could possibly be unexploded Ordnance (UXO) in the Otway region.	1
Port Campbell Professional Fisherman's Association	Association representing Port Campbell fishers, primarily rock lobster around Port Campbell and Peterborough. Engagement via SIV. s	1
Portland Professional Fishermen's Association	Association representing Portland fishermen.	1
South East Trawl Fishing Industry Association (SETFIA)	SETFIA represents businesses with a commercial interest in the SETF and the East Coast Deepwater Trawl Sector. SETFIA represent the following fisheries that have catch effort within the operational area: <ul style="list-style-type: none"> • SESSF (Commonwealth South East Trawl Sector, Scalefish Hook Sector and the Shark Hook, Shark Gillnet Sectors and small pelagic fishery). 	1
Seafood Industries Victoria (SIV)	Peak body representing professional fishing, seafood processors and exporters in Victoria. SIV primary contact for State fishers.	1
Southern Rock Lobster Limited	Associations representing state-based commercial rock lobster fishers. Associations are represented by one consultancy and are therefore grouped.	1

Stakeholder	Relevance	Information category
South Australian Rock Lobster Advisory Council Inc. South Eastern Professional Fishermen's Association Inc. Tasmanian Rock Lobster Fishermen's Association		
Victorian Fisheries Authority	Independent statutory authority established to effectively manage Victoria's fisheries resources.	1
Victorian Rock Lobster Association (VRLA)	VRLA represents Victorian rock lobster licence holders. Engagement via SIV as VRLA no longer functions as a separate association and now operates as a committee of SIV.	1
<i>Any other person or organisation that the titleholder considers relevant</i>		
Abalone Victoria Central Zone	Represent the views and interests of its members and to ensure appropriate governance of member resources. No impact to stakeholders' functions, interests or activities due to the distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Alcatel Submarine Networks	They installed the sub-sea fibre optic cable south of Yolla Platform within the Bass Strait. No impact to stakeholders' functions, interests or activities. However, Beach maintain engagement in relation to activities within the Otway area.	3
Australian Petroleum Production and Exploration Association (APPEA)	APPEA is the voice of the oil and gas industry on the issues that matter, working collaboratively with industry and the community.	3
ConocoPhillips	Operator with current permit areas within the EMBA. No impact to stakeholders' functions, interests or activities. However, Beach maintain engagement in relation to activities within the Otway area.	3
Cooper Energy	Operator with current permit areas within the EMBA. No impact to stakeholders' functions, interests or activities. However, Beach maintain engagement in relation to activities within the Otway area.	3
Corangamite Shire Council	The Otway Gas Plant is within the Corangamite Shire. The activity does not overlap shoreline receptors. However, Beach maintain engagement in relation to activities within the Otway area.	3
Crab and Shark Fisher	This stakeholder has acknowledged concern in the past during consultation. Beach maintain engagement in relation to activities within the Otway area.	3
Deakin University – School of Life and Environmental Sciences	Beach provide information as have ongoing engagement in relation to marine studies within their operating areas. No impact to stakeholders' functions, interests or activities.	3

Stakeholder	Relevance	Information category
Department of Agriculture and Water Resources	Ensuring Australia's agriculture, fisheries, food and forestry industries remain competitive, profitable and sustainable. No impact to stakeholders' functions, interests or activities. Beach maintain engagement in relation to activities within the Otway area.	3
Fishwell Consulting	Provide expert research advice and consulting services to encourage and promote sustainable fishing practices to the commercial fishing industry within Australia. Beach provide information as have ongoing engagement in relation to marine studies within their operating areas. No impact to stakeholders' functions, interests or activities.	3
Institute for Marine and Antarctic Studies (IMAS) - University of Tasmania	No impact to stakeholders' functions, interests or activities. Beach provide information as have ongoing engagement in relation to seismic survey impacts to commercial fisheries.	3
Lochard Energy	Owns and operates the Iona Gas Plant and the associated facilities located near Port Campbell in the state of Victoria. Offshore activities do not impact on the stakeholder's activities, interests or functions. Beach send information on offshore activities to stakeholder for their information only.	3
Ocean Racing Club of Victoria	Club which conducts regular offshore racing including the Melbourne to Hobart and the Melbourne to Launceston yacht races. However, no impact to stakeholders' functions, interests or activities due to distance offshore.	3
Otway Gas Plant Community Reference Group	Community Reference Group established for the Otway Gas Plant. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Peterborough Residents Association Port Campbell Community Group Port Campbell Progress Group Port Campbell Visitor Centre	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintain engagement in relation to activities within the Otway area.	3
Port Campbell Surf Life Saving Club Port Campbell Board Riders Association	No impact to stakeholders' functions, interests or activities, because of the distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Schlumberger	Schlumberger have no planned activities within the Otway region, therefore there will be no impact to stakeholders' functions, interests or activities. However, Beach maintain engagement in relation to activities within the Otway area.	3
SCUBA Divers Federation of Victoria	No impact to stakeholders' functions, interests or activities, because of the distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3

Stakeholder	Relevance	Information category
Surf Rider Association	Registered not for profit sea-roots organisation dedicated to the protection of Australia's waves and beaches through conservation, activism, research and education. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Tasmanian Abalone Council Limited	Peak industry body representing divers, processors and quota holders and represents the views and needs of all stakeholders and allied interests alike. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3
Tasmanian Seafood Industry Council (TSIC)	The TSIC is the 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. However, Beach maintain engagement in relation to activities within the Otway area.	3
TGS	Proposing to undertake the Otway Deep three-dimensional (3D) marine seismic survey (MSS) in the Commonwealth waters of the Otway Basin, which is outside of the operational area. No impact to stakeholders' functions, interests or activities. However, Beach maintain engagement in relation to activities within the Otway area.	3
Timboon Action Group	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintain engagement in relation to activities within the Otway area.	
Tuna Australia - ETBF Industry Association	Represents statutory fishing right owners, holders, fish processors and sellers, and associate members of the Eastern and Western tuna and billfish fisheries of Australia. The operational area does not overlap any Eastern and Western tuna and billfish fishery areas. However, Beach maintain engagement in relation to activities within the Otway area.	3
Twelve Apostles Tourism and Business Group	No impact to stakeholders' functions, interests or activities, because offshore activities do not have an impact. However, Beach maintain engagement in relation to activities within the Otway area.	3
Victorian Scallop Fishermen's Association	Represents the interests of scallop fishermen operating within Australia's south east waters. No impact to stakeholders' functions, interests or activities due to distance offshore. However, Beach maintain engagement in relation to activities within the Otway area.	3

Table 8-2: Information category to determine information provided stakeholder

Information Category	Description	Information Type
1	Organisations or individuals whose functions, interests or activities may be impacted by the activity. Relevant government agencies Representative body for fishers who provide information to their members.	Information Sheet and/or provision of information as per organisations consultation guidance Provision of further information where required Meeting or phone call where required

Information Category	Description	Information Type
2	Organisation who receive activity commencement and cessation notices.	Commencement and cessation notices.
3	Organisations or individuals whose functions, interests or activities will not be impacted by the activity but are kept up to date with Beach’s activities in the Otway area.	Information Sheet

8.8 Ongoing stakeholder consultation

Beach will continue to consult with stakeholders to 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 Gas Development project via one-on-one communications, mail outs and provision of information on the Beach website.

Any objections or claims raised from ongoing consultation will be managed as per Section 8.8.2 Management of Objections and Claims.

Records of ongoing stakeholder engagement will be maintained as per Section 8.8.2 Records Management.

8.8.1 Ongoing Identification of Relevant Persons

New or changes to relevant persons will be identified through ongoing consultation with stakeholders including peak industry bodies and the environment plan review process detailed in Section 7.12.3. Should new relevant persons be 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 8.8.2.

8.8.2 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 it will be assessed as per the risk assessment process detail in Section 5 and controls applied where appropriate to manage impacts and risks to ALARP and an acceptable level. Stakeholders 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 as per Section 7.12.3 and 7.12.4. This will also be communicated to the stakeholder.

Table 8-3: Ongoing stakeholder consultation requirements

Stakeholder	Ongoing stakeholder requirement	Timing
Relevant stakeholders	Ongoing engagement including: <ul style="list-style-type: none"> stakeholder communication of information and addressing queries and concerns via email, phone or meeting; and updates to Beach website. 	As required

Stakeholder	Ongoing stakeholder requirement	Timing
Relevant stakeholders listed in Table 8-2 under category 1	<p>Stakeholder notification of activity commencement.</p> <p>Notification to include:</p> <ul style="list-style-type: none"> • 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; and • Beach contact details. <p>Note: coordinates to be provided as degrees and decimal minutes referenced to the WGS 84 datum.</p>	2 weeks prior to activity commencing
AHO	<p>Vessel Contractor to issue notification of activity for publication of notice to mariners.</p> <p>Information provided should detail:</p> <ul style="list-style-type: none"> • type of activity; • geographical coordinates of the well location; • 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; and • Beach and vessel Contractor contact details. <p>Update AHO of progress, changes to the intended operations including if activity start or finish date changes.</p>	4 weeks prior to activity commencing
AMSA - JRCC	<p>Vessel Contractor to issue notification of activity for promulgation of radio navigation warnings.</p> <p>Information provided should detail:</p> <ul style="list-style-type: none"> • type of activity; • area of operation: geographical coordinates of the well location; • 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; and • Beach and vessel Contractor contact person. <p>Update AMSA JRCC of progress, changes to the intended operations including if activity start or finish date changes.</p>	48 – 24 hrs prior to activity commencing
NOPSEMA	Regulatory notification of start of activity.	10 days prior to activity commencing

Stakeholder	Ongoing stakeholder requirement	Timing
Relevant stakeholders who have requested vessel location information.	SMS or email messaging undertaken where requested by stakeholder.	During activity
NOPSEMA	Regulatory notification of cessation of activity.	Within 10 days of activity completion

Table 8-4: Summary of stakeholder consultation records and Beach assessment of objections and claims

Stakeholder name	Date	Record #	Description	Assessment of objection or claim
Australian Hydrographic Office (AHO)	28/06/2021	AHO 09	AHO responded to Beach's email. It was an acknowledgement that the AHO had received and registered Beach's correspondence.	No concerns raised.
Australian Maritime Safety Authority	06/08/2021	AMSA 06	AMSA notified Beach that they need to ensure AMSA-JRCC will be contacted by the vessel master via the contact AMSA JRCC provided 24-48 hours prior to moving and Beach will notify the AHO no later than 4 weeks before operations will commence.	Table 7-6 updated to include notifications to AMSA JRCC 24-48 hours prior to operations and no later than 4-weeks notification to AHO before operations commence.
Department of Agriculture, Water and Environment (DAWE) - Biosecurity	28/06/2021	DAWE-Bio 03	DAWE Biosecurity emailed Beach a receipt of confirmation they have received the email.	No concerns raised.
Director of National Parks	02/07/2021	DNP 09	Director of National Parks acknowledged that they had received Beach's correspondence	No concerns raised.
Petuna Sealord Deepwater Fishing	29/06/2021	PSDF 15	Petuna Sealord Deepwater Fishing notified Beach of a new primary contact to use.	Beach have updated their internal stakeholder systems with the new contact details.
South East Trawl Fishing Industry Association (SETFIA)	06/08/2021	SETFIA_117	Beach asked SETFIA to confirm timing for notification to SETFIA for activities such as well inspections and the Otway basin activities including drill rig moves and installation of subsea infrastructure. SETFIA replied for smaller jobs (non-seismic) pipelines etc 1 or 2 weeks, with a follow up at 1-3 days.	SETFIA's 2 week requirement aligns with the notification timing for stakeholders in Table 8-3.
Seafood Industry Victoria	28/06/2021	SIV 82	SIV notified Beach that they will distribute the information provided to them to their website.	No concerns raised.
Victorian Fisheries Association	18/03/2021	VFA_79	Beach emailed VFA notifying them that Beach are currently reviewing their exploration and development planning and therefore their stakeholder assessments. As such, Beach requested the latest fishing activity data in the area of their operations, given Beach's last data request was in 2019, for which Beach received data from 2014 – 2018. Beach requested for an up-to-date report of monthly catch by species from the last 5 years (Jan 2016- Nov 2020) for the following fishing blocks: <ul style="list-style-type: none"> • G10; G11; G12; G13 • H10; H11; H12; H13 • J10; J11; J12; J13 • K10; K11; K12; K13 • L10; L11; L12; L13 • M10; M11; M12; M13 	Data was obtained for January 2016 - November 2020. Based on the updated fishery data Section 4.7.9 was updated.

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Appendix A EPBC Act Protected Matters Search Reports

A.1: Spill EMBA

A.2: Operational Area – 1 km

A.3: Light EMBA – 20 km

A.4: Noise 24 hr EMBA– 1.5 km

A.5: Noise Behaviour EMBA– 5 km

Appendix B RPS APASA Artisan-1 Spill Model Report

Appendix C EP Revision Change Register

Any changes to the EP should be assessed against the OPGGS(E)R revision submission criteria detailed in Table 7-6.

Date	EP Revision	Section Revised	Changes	MOC No.	EP Submission Required

Appendix D Fair Ocean Access Information Sheet

Fair Ocean Access

Minimising fishing impacts from offshore operations



Information Sheet | May 2021



Introduction

Licensed 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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Appendix E Environmental Survey – Otway Basin

Appendix F Acoustic Modelling Report

Appendix G Stakeholder Consultation Sensitive Information